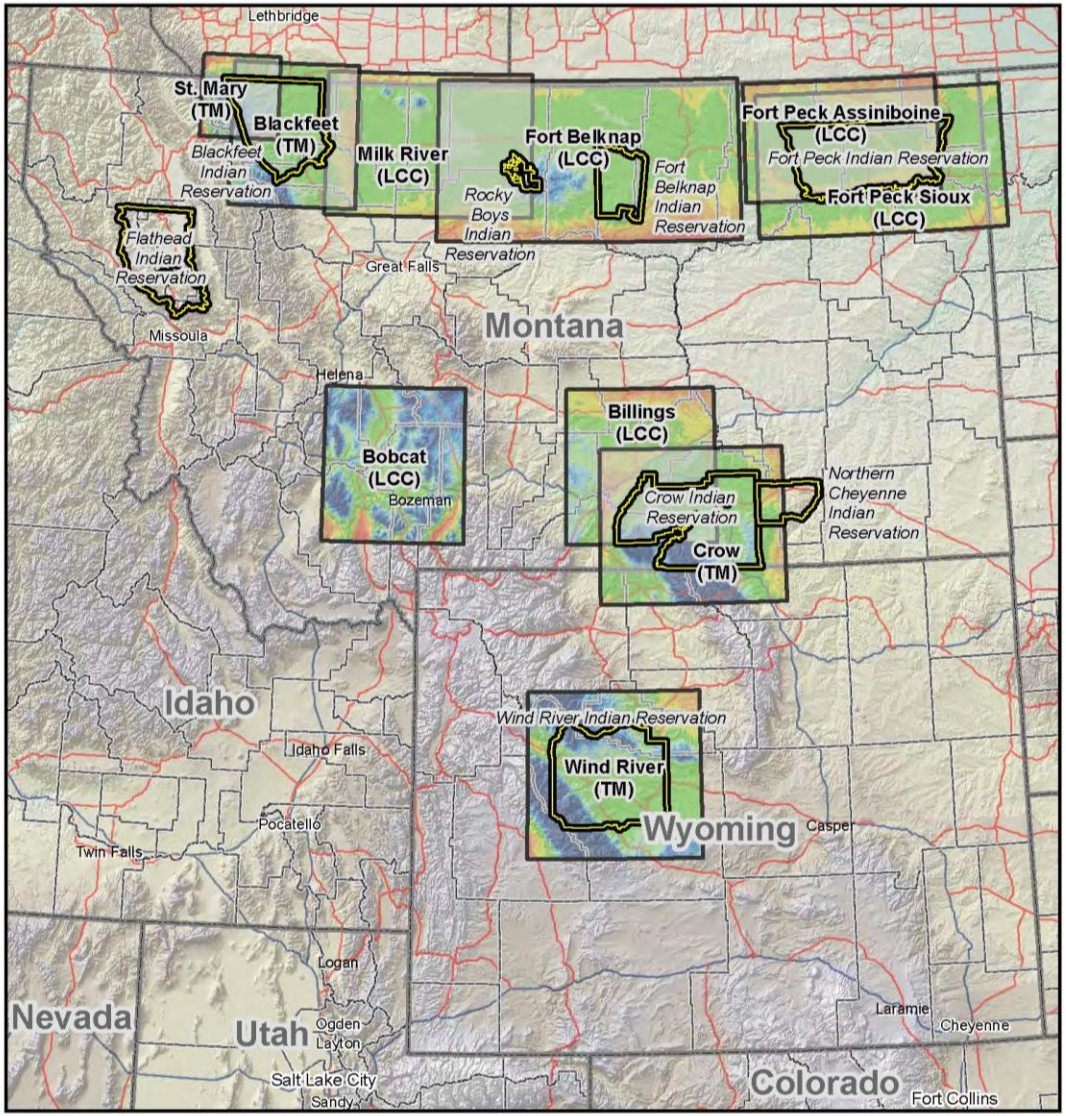
On the Road: Transportation Programs Driving Regional Tribal Mapping Project

John Healy, Director, Fort Belknap Transportation
Amy Darlinton, NECI
Stephanie Rodriguez, GISP, NECI
Dawn Chandler, Tribal Surveyor, Fort Belknap Transportation Department

Overview

- Introductions
- Tribal Mapping Project Overview
- GIS development and RIFDS
- Practical applications
- Questions

Rocky Mountain Tribal Mapping Project

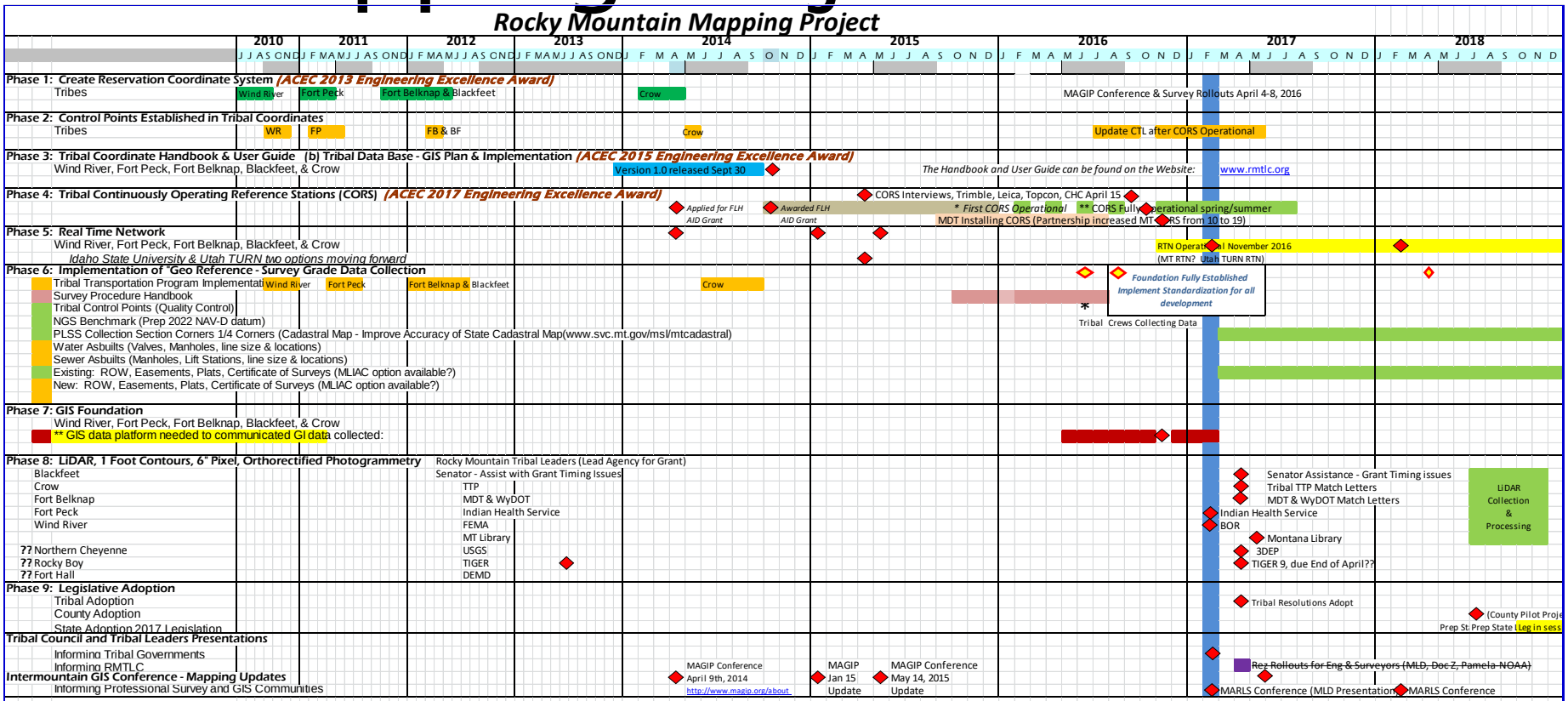


Rocky Mountain Tribal Transportation Association

The Survey Grade Accuracy World Meets GIS and LiDAR (A Planning and Design Tool)

- Survey grade accuracy in GIS system
- Coordinates and associates all surveying, engineering, and GIS projects onto one simple mathematical base
- DOTs, Land Departments, Irrigation, Tribal Housing, DNR, Forestry, Utilities and all others involved with development and mapping will be able to put all data onto one common survey grade base map.
- ACEC 2013, 2015, and 2017 Engineering Excellence Honor Award to the Blackfeet Nation, Crow Nation, Fort Belknap Indian Community, Fort Peck, and Wind River Reservations

Mapping Project Phases



Phase 1: 100% Complete: The purpose is to merge the survey grade accuracy world with the GIS world. The Low Distortion Projection (LDP) will allow anyone doing surveying, engineering, and GIS development to coordinate and associate all projects onto one simple mathematical base. **The group received the "ACEC 2013 Engineering Excellence Award" for phase 1**

Phase 2: Priority switch, see phase 4: 1. For QC purposes control points, including High Accuracy Reference Network (HARN) points for Fort Peck were established. National Geodetic Survey (NGS) no longer maintains passive control, replaced by OPUS-DB solutions that depend on CORS. Because of NGS change the tribal mapping team has added **Phase 4, CORS to the mapping project.** With CORS we will be able to do same control work in 5 hours versus 100+ hours

Phase 3 (100% complete): Mapping Handbook and User guide: Objective: 1. Guide for current and future users 2. QC procedures, testing methods best practices 3. Adding coordinate systems to software (ESRI, Leica, Trimble, Carlson, Topcon) 4. History and development of coordinate systems 5. History of Montana projections (State Plane) 6. Types of projections, managing map distortion **The group received the "ACEC 2015 Engineering Excellence Award" for phase 3**

Phase 4 (95% complete): Tribal Continuously Operating Reference Stations (CORS) Objective: 1. Foundation for all GPS users (survoyors and GIS data collectors) 2. Enhance quality and production of survey grade GPS data 3. Technology is similar to cell towers, the closer the CORS the better the speed and accruacy of the data collected 5. Enhance the Montana Height Modernization Program for reservation lands (see executive summary) 6. create state of the art foundation for geodetic ctl to supplement outdated NGS Ctl Mark program **The group received the "ACEC 2013 Engineering Excellence Award" for phase 4**

Phase 5 (10% complete): Establishing a Real Time Network (RTN). The purpose of the RTN is: 1. establish catalyst for GPS users to georeferenced data 2. standardized infrastructure for machine controlled equipment including intelligent compaction. Benefits include: 1. need for user to establish permanent/semi-permanent base station eliminated 2. RTN can monitor its own QC 3. Loss of one station does not result in failure of system 4. and best of all "All users of the system are using a common, established reference coordinate frame", surveying and mapping has been standardized NOTE: Densification of CORS needed, current layout meets NGS standards for RTN additional CORS needed

Phase 6: Collecting data in tribal coordinate systems (CFedS, County, BOR, BLM, Indian Health Service, Housing Programs, BIA, Water & Sewer Program adopt plan) Note, data can be collected along roads that are in the trbes TTP inventory as part of the tribes master transportation plan of creating a tribal roads ROW map for planning purposes.

Phase 7 (75% Complete): Crea GIS foundation so data can be safely stored and communicated with other departments (

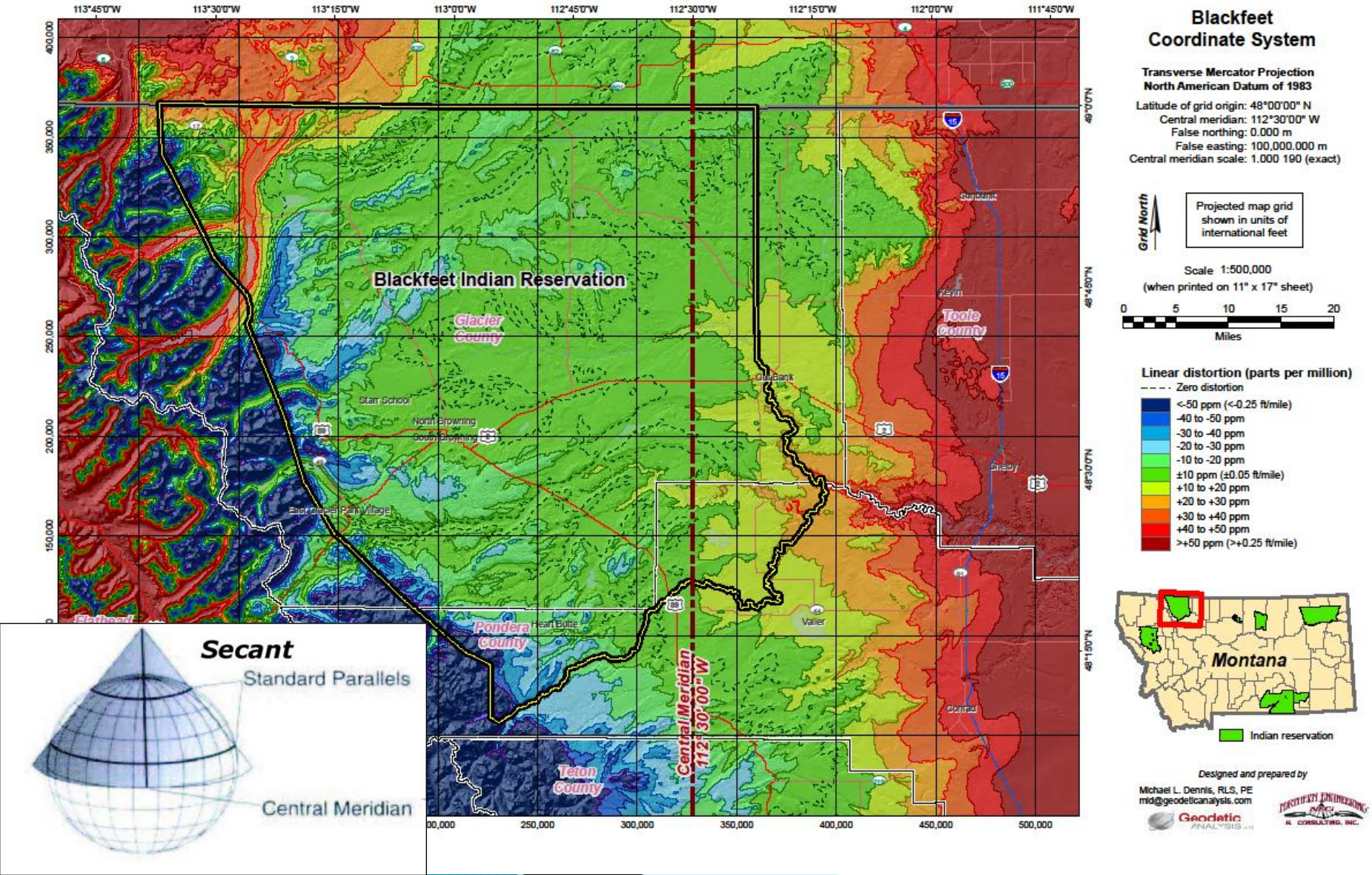
Phase 8: LiDAR & Orthorectified Photogra (numerous partners needed, USGS?, DEMD (BIA)?, Housing?, Montana Library?, FEMA? TIGER, Others?

Phase 9: Legislative adoption will provide fundamenta ntance by engineering, surveying, and mapping professionals within tribes as well as other Federal Agencies such as BLM, NGS and FEMA

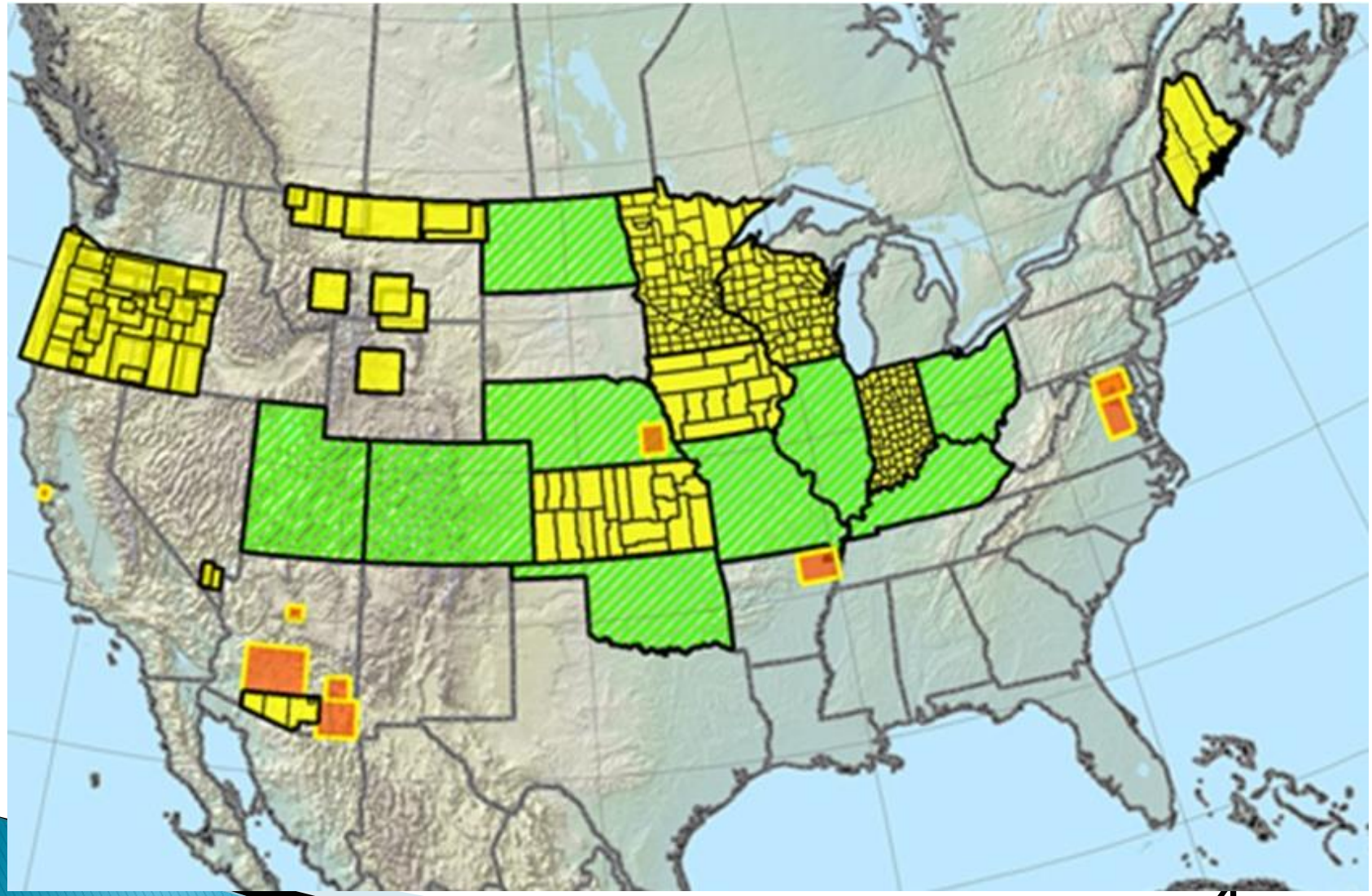
Phase 10: Measure project success. Success is defined by 1. How m mbers have been inspired to become surveyors, engineer technicians, engineers, GIS technicians, GIS coordinators and GIS professionals?

Phase 1: Coordinate Systems

Example: Blackfeet Coordinate System



Low Distortion Projections Locations



Phase 3

Handbook & User Guide

Free Downloads

Rocky Mountain Tribal Leaders Website

www.rmtlc.org

Resources➔ Mapping & Surveying

or

Montana Association of Registered Land Surveyors (MARLS) http://marls.com/

Resources ➔ RMTCRS Information

Rocky Mountain Tribal Transportation Association

John Smith, President
John Healy, Vice President
Connie Thompson, Secretary

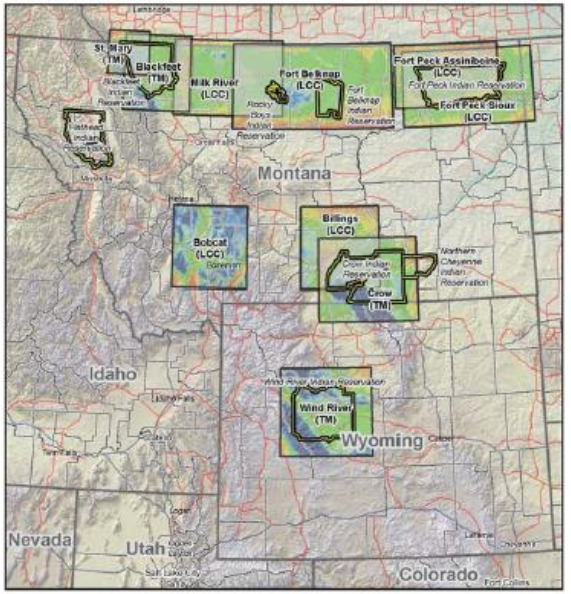
Board of Directors
Don White, Blackfeet
Cleo Hamilton, Fort Peck
Robert Stewart, Crow
Vashti Dawn Plentyhoops, Crow

Michael L. Dennis, RLS, PE
Geodetic Analysis, LLC
(928) 322-0956

Rocky Mountain Tribal Coordinate Reference System

Handbook and User Guide

For the
Blackfeet
Crow
Fort Belknap
Fort Peck
& Wind River Reservations



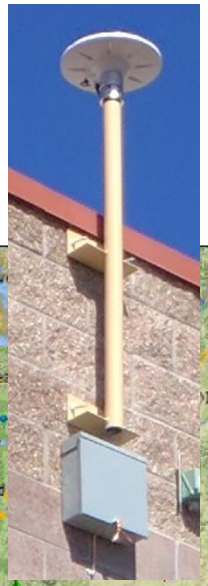
Version – v1.0
30 September 2014

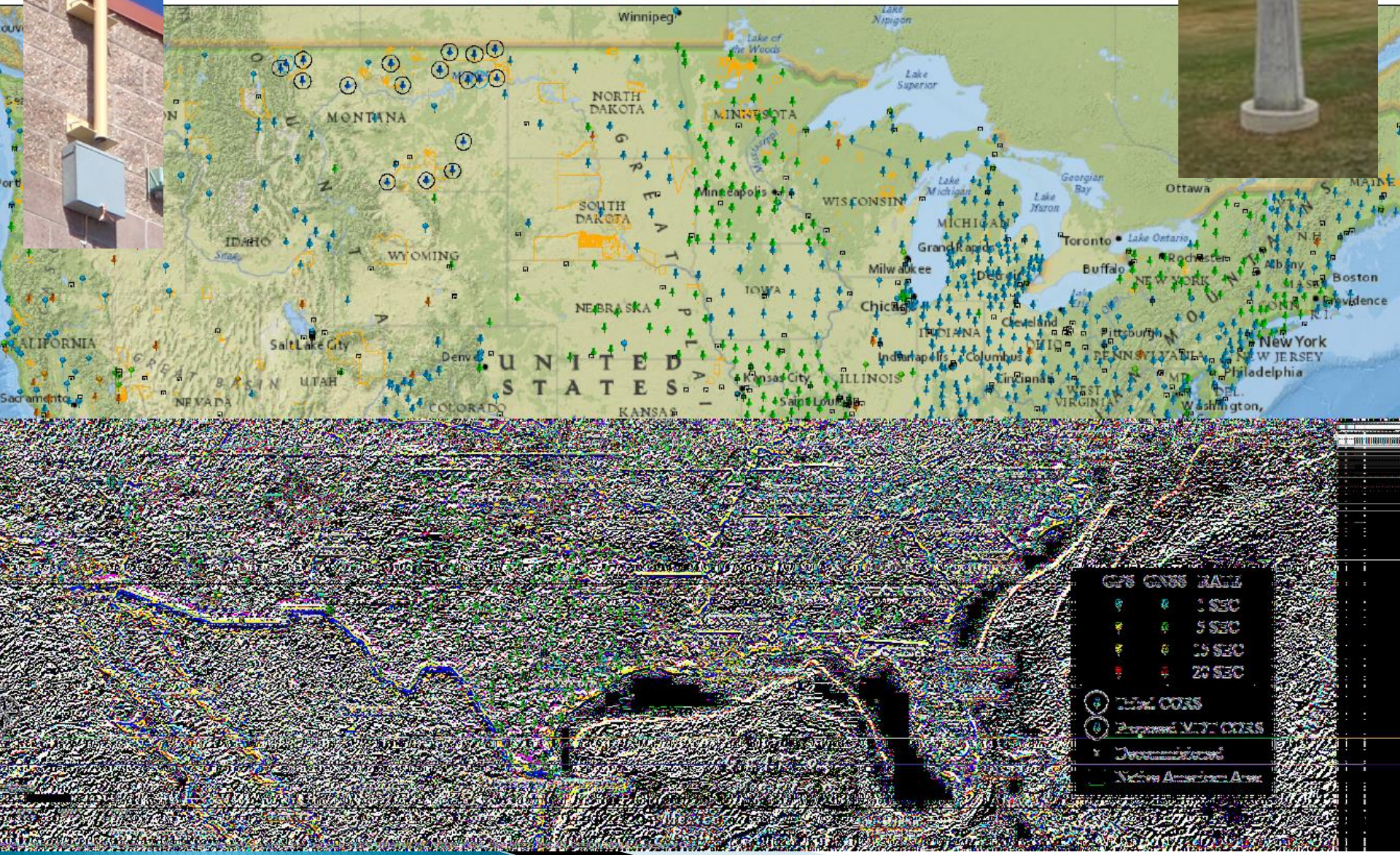
Rocky Mountain Tribal Coordinate Reference System
Embed in the Software

Phase 4

Continuously Operating Reference Station (CORS)

Continental United States with Proposed MDT & Tribal CORS

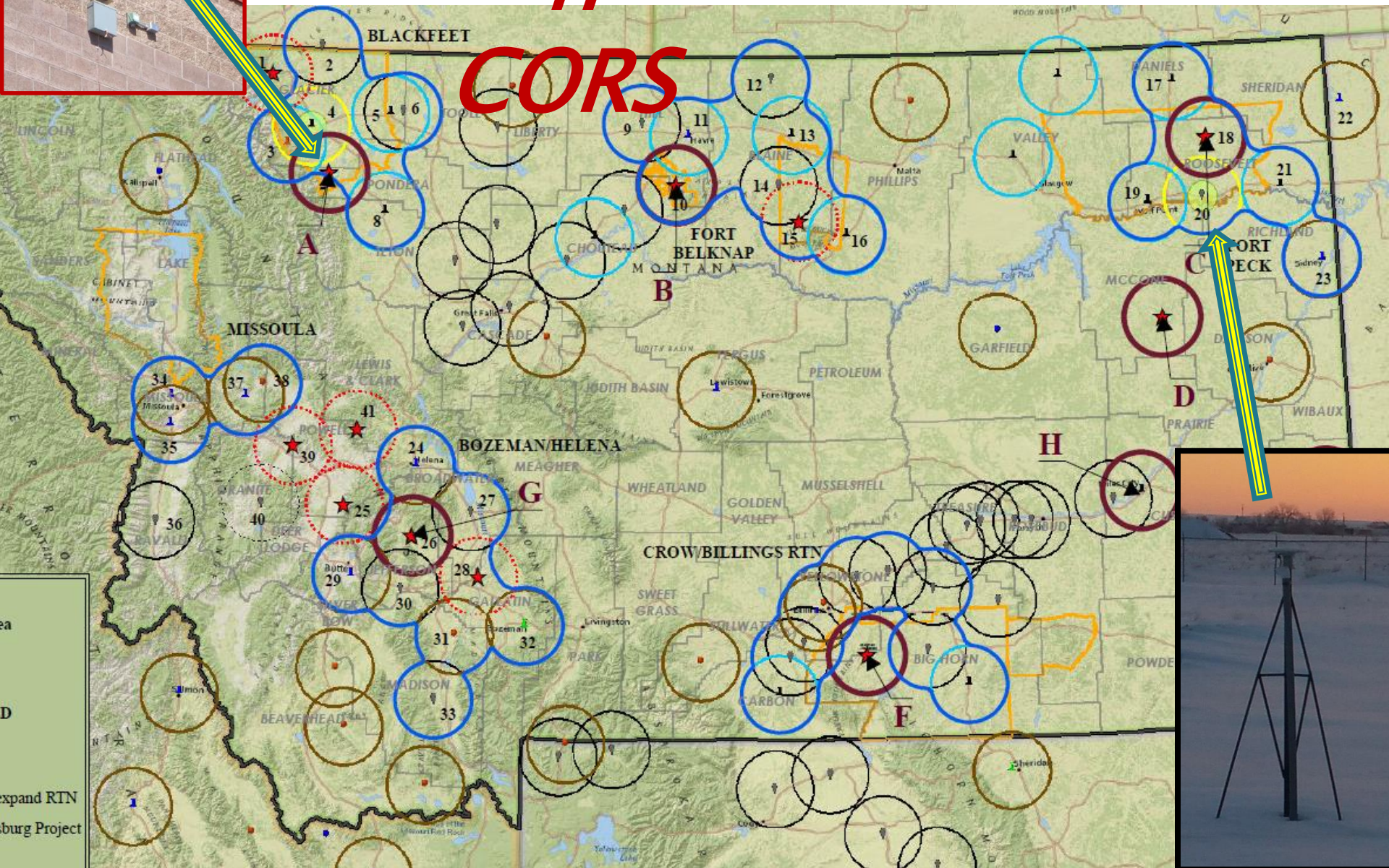




Fort Peck
Poplar, MT CORS

Blackfeet CORS

Phase 4: CORS


National Geodetic Survey
Continuously Operating Reference Station
GPS GNSS RATE
1 SEC
5 SEC
15 SEC
20 SEC
Tribal CORS
Proposed Tribal/MDT CORS
Proposed MLIA Grant CORS
NGS CORS 25 km radius
BLACKFEET
FORT BELKNAP
MONTANA
MISSOULA
BOZEMAN/HELENA
CROW/BILLINGS RTN
A
B
C
D
F
G
H

Real Time Network (RTN) Phase 5

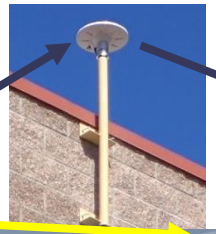
Phase 5 – Real Time Network

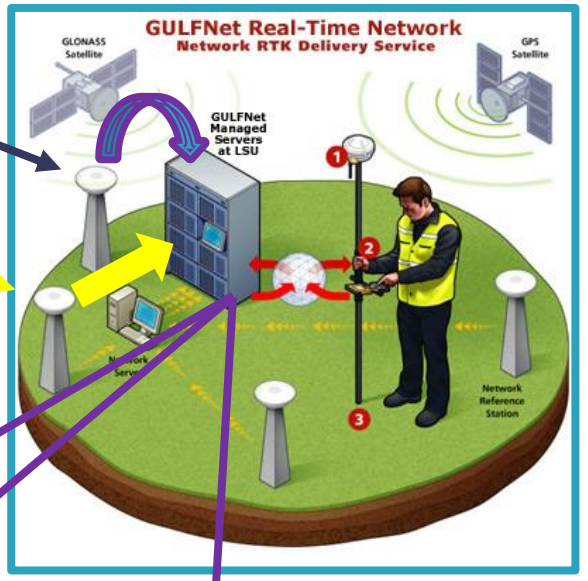
RTN = Real Time Network

Phase 5 – Real Time N

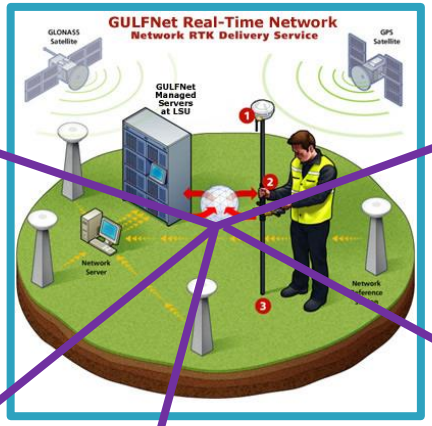
RTN = Real Time Network

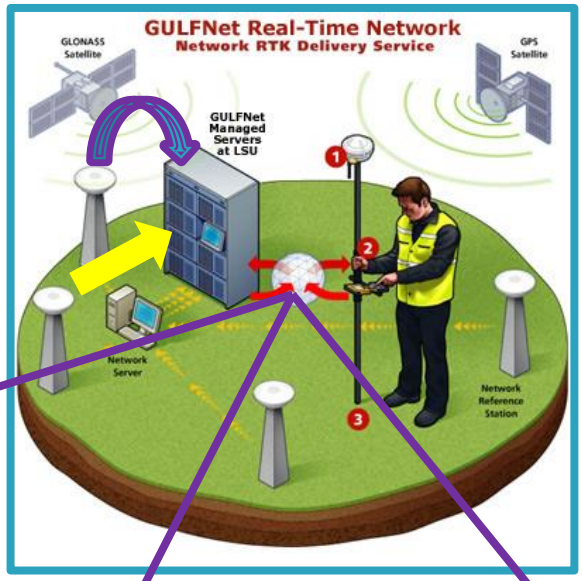
Fort Belknap




GULFNet Real-Time Network
Network RTK Delivery Service
GLONASS Satellite
GPS Satellite
GULFNet Managed Servers at LSU
Network Reference Station


PLSS
Blackfeet

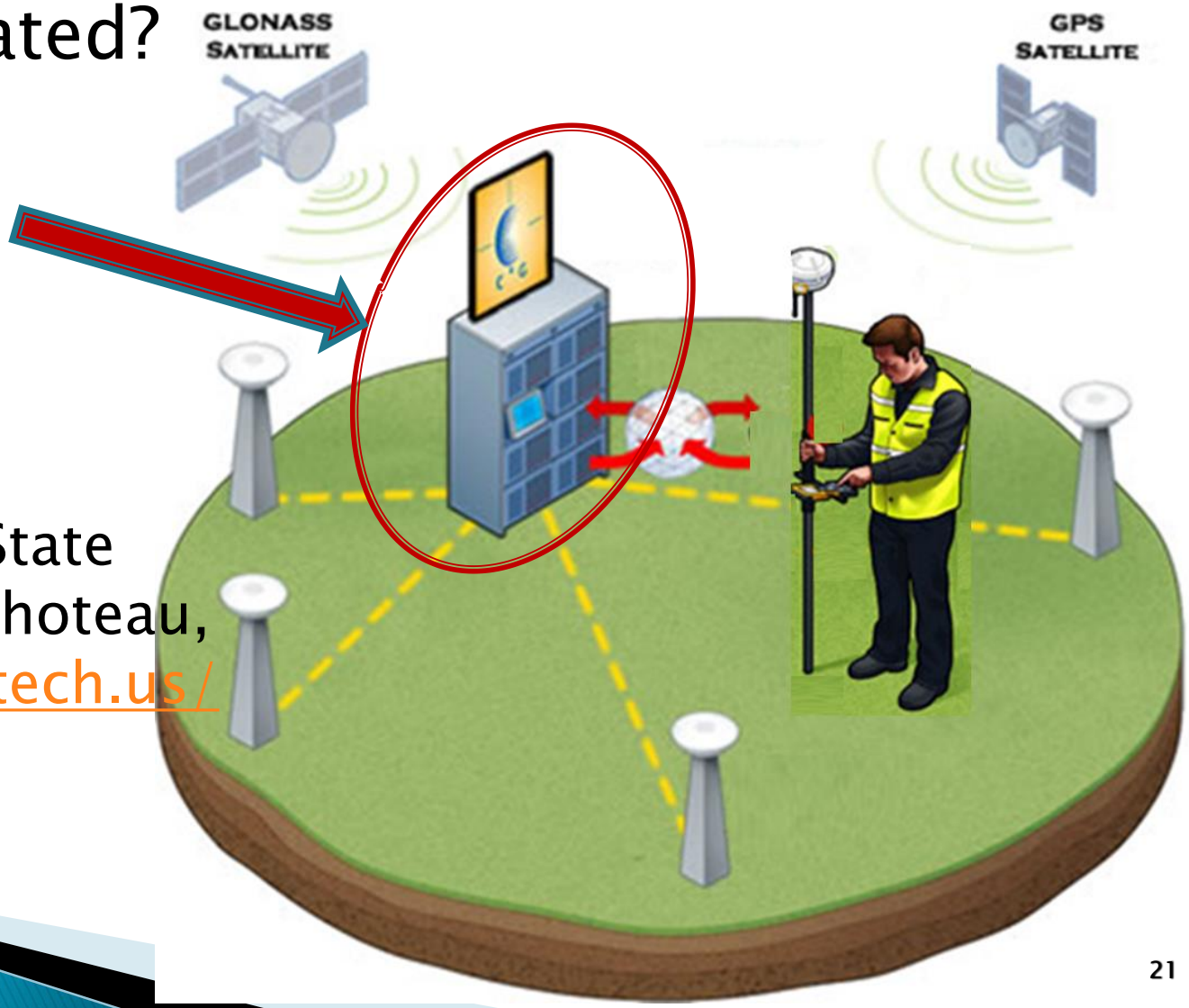

GULFNet Real-Time Network
Network RTK Delivery Service
GLONASS Satellite
GPS Satellite
GULFNet Managed Servers at LSU
Network Server
1
2
3


GULFNet Real-Time Network
Network RTK Delivery Service
GLONASS Satellite
GPS Satellite
GULFNet Managed Servers at LSU
Network Server
Network Reference Station
1
2
3


CASE IH
7120
CASE IH

RTN: Current Status

Where is the system located?



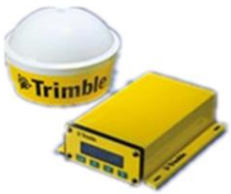
State Agency:
1. State Library
2. MDT

Pilot Project:
1. Washington State
2. FarmTech: Choteau, MT http://farmtech.us/

What program?

1. Leica Spider?
2. Trimble?
3. Topcon?
4. Geo++?

* *needs to be universal*



Phase 6

Survey Grade GIS Layer

Objective: Create a highly accurate and comprehensive survey grade GIS system based on GPS data.

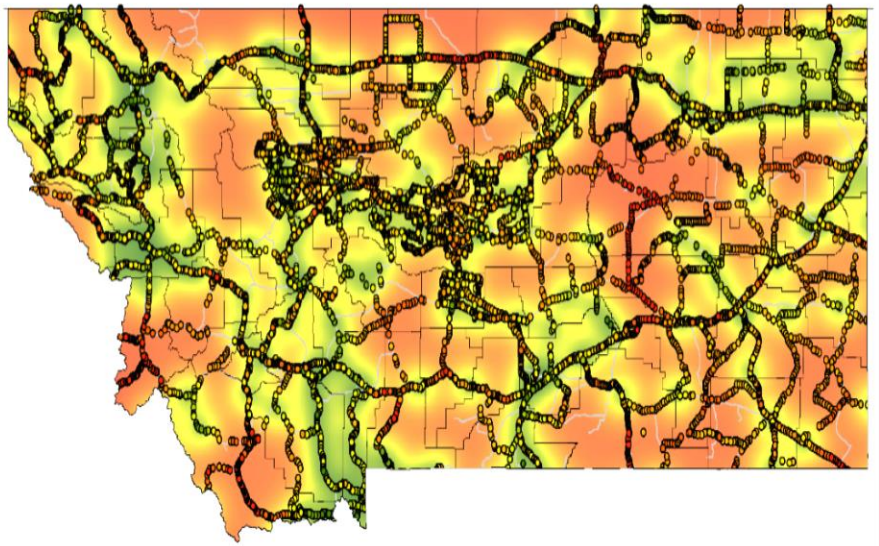
Phase 2

Establish Passive Control Networks

Objective: Establish ground based control points for project control and quality assurance.

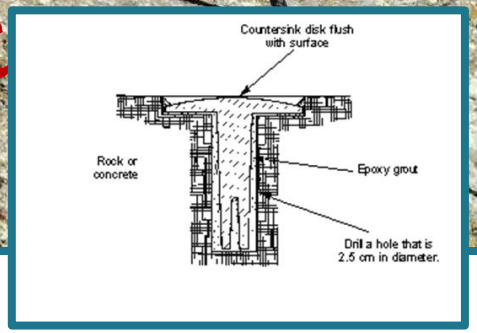
Phase 6d = Phase 2: Tribal Control

Use NGS, MDT, Section Corners, and ¼ Corners



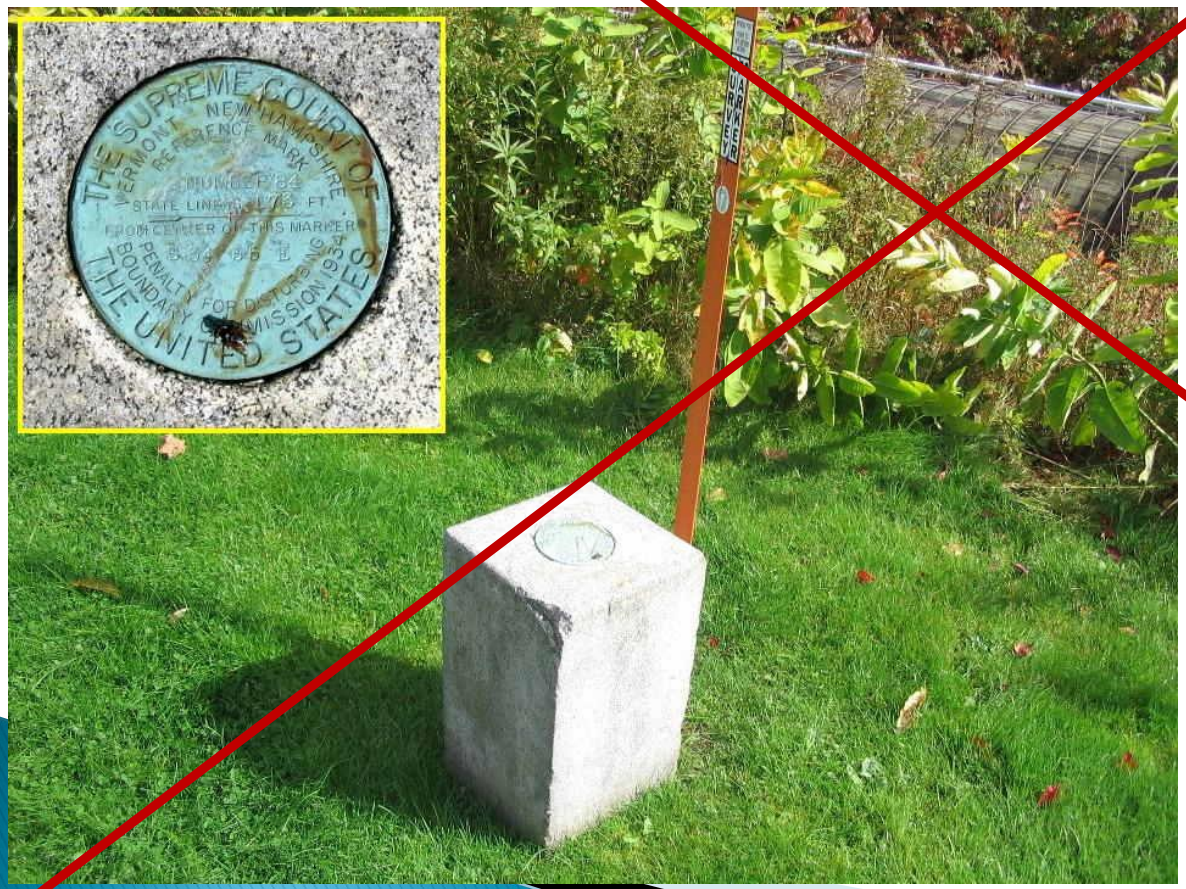
NORTHERN ENGINEERING & CONSULTING, INC.

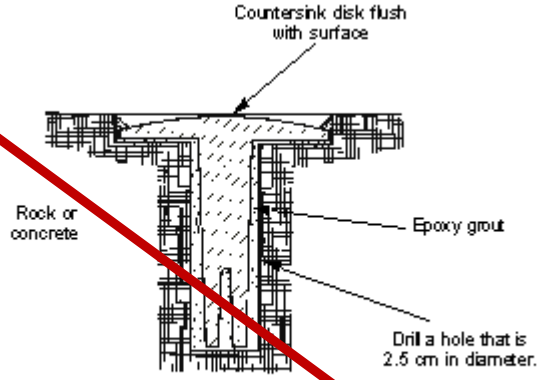
Phase 6d = Phase 2: Tribal Control



Phase 2

Control Networks Passive Control





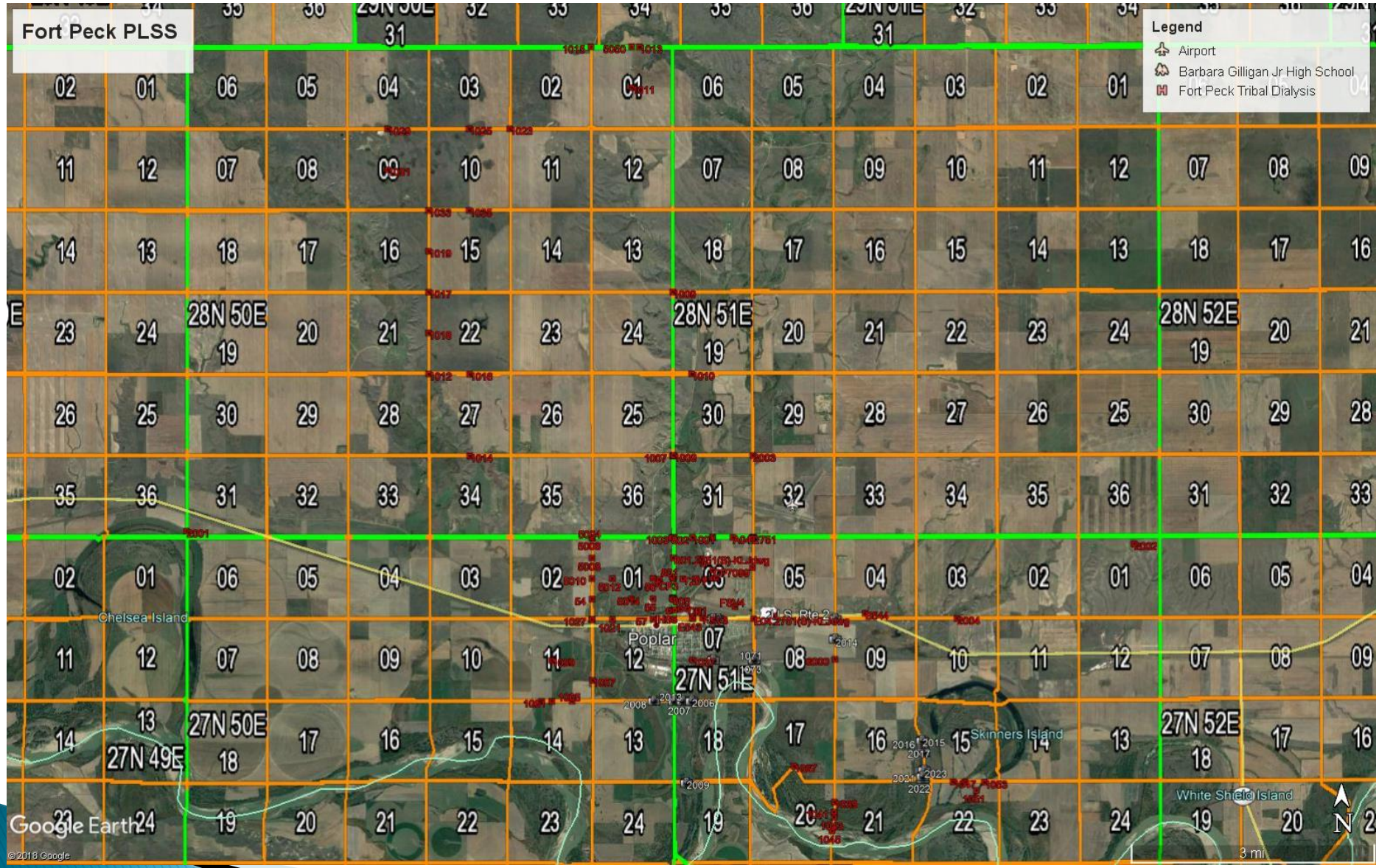
Phase 6

Data Collection

a) ~~Survey Procedure Handbook~~ – Done
b) Roads – Ownership, Condition, Type
c) Tribal Control Points
d) NGS Benchmarks (Prep 2022 NAV-D datum)
e) PLSS Collection Section, ¼ Corners
f) Utility Asbuilts
g) ROW, Easements, Plats to Data Base

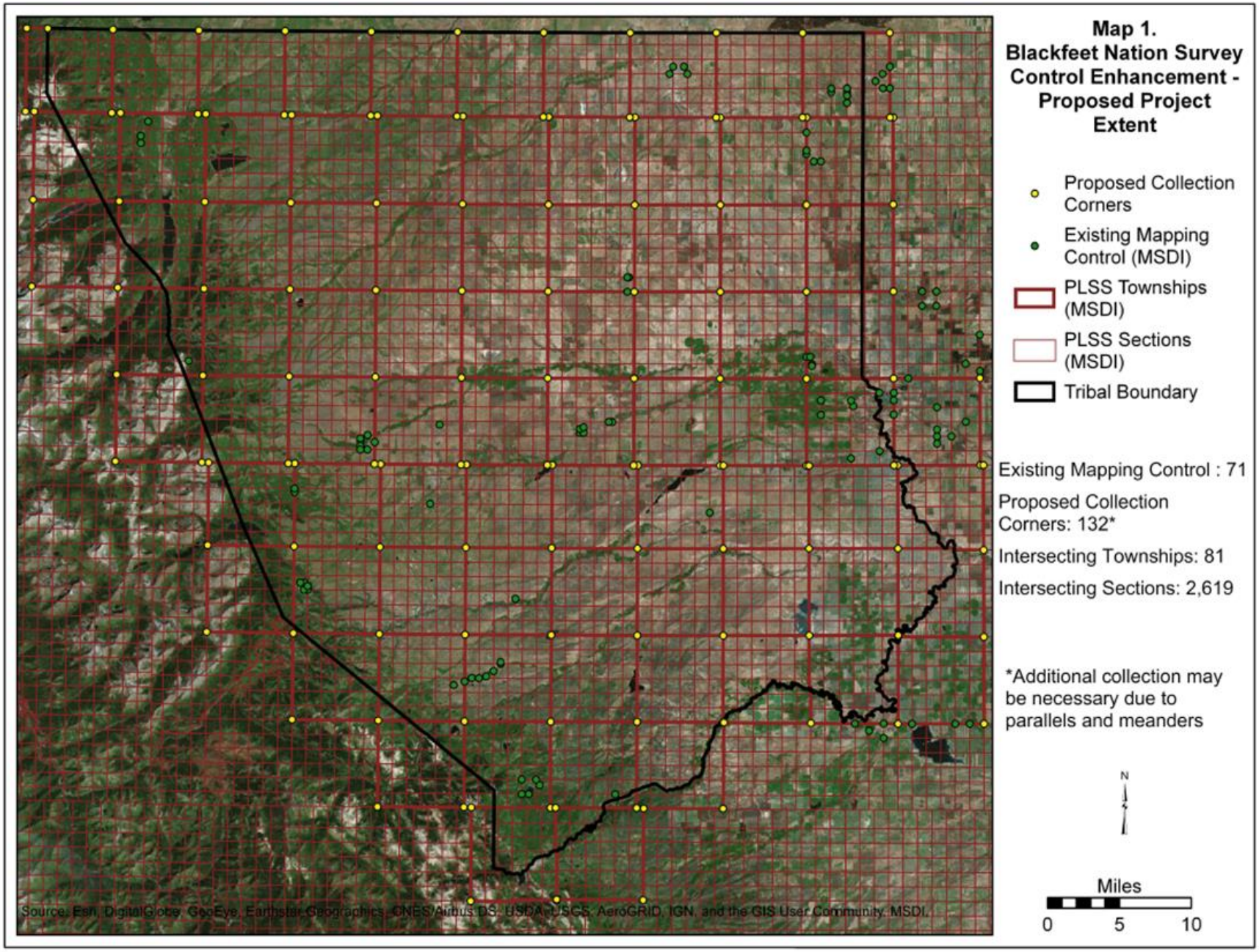
Fort Peck CORS

Phase 6e: PLSS




PLSS
Blackfeet

Phase 6e: PLSS



Phase 6 - *Data Collection*

1. Survey Procedure Handbook

2. *Roads – Ownership, Condition, Type*
3. *Tribal Control Points*
4. *NGS Benchmarks (Prep 2022 NAV-D datum)*
5. *PLSS Collection Section, ¼ Corners*
6. *Water Asbuilts*
7. *ROW, Easements, Plats to Data Base*

Phase 6
Data Collection

1.Survey Procedure Handbook

2.Roads – Ownership, Condition, Type (RIFDS)

3.Tribal Control Points

4.NGS Benchmarks (Prep 2022 NAV-D datum)

5.PLSS Collection Section, ¼ Corners

6.Water Asbuilts

7.ROW, Easements, Plats to Data Base

Phase 6
Data Collection

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2. *Roads – Ownership, Condition, Type*
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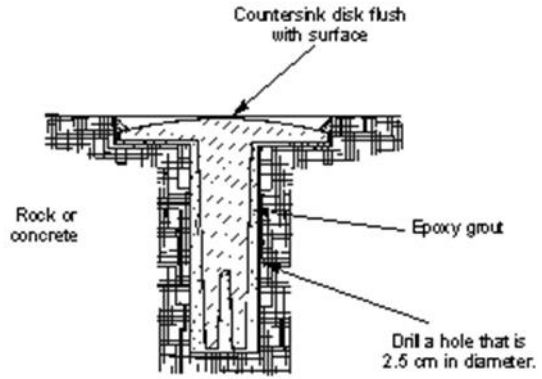
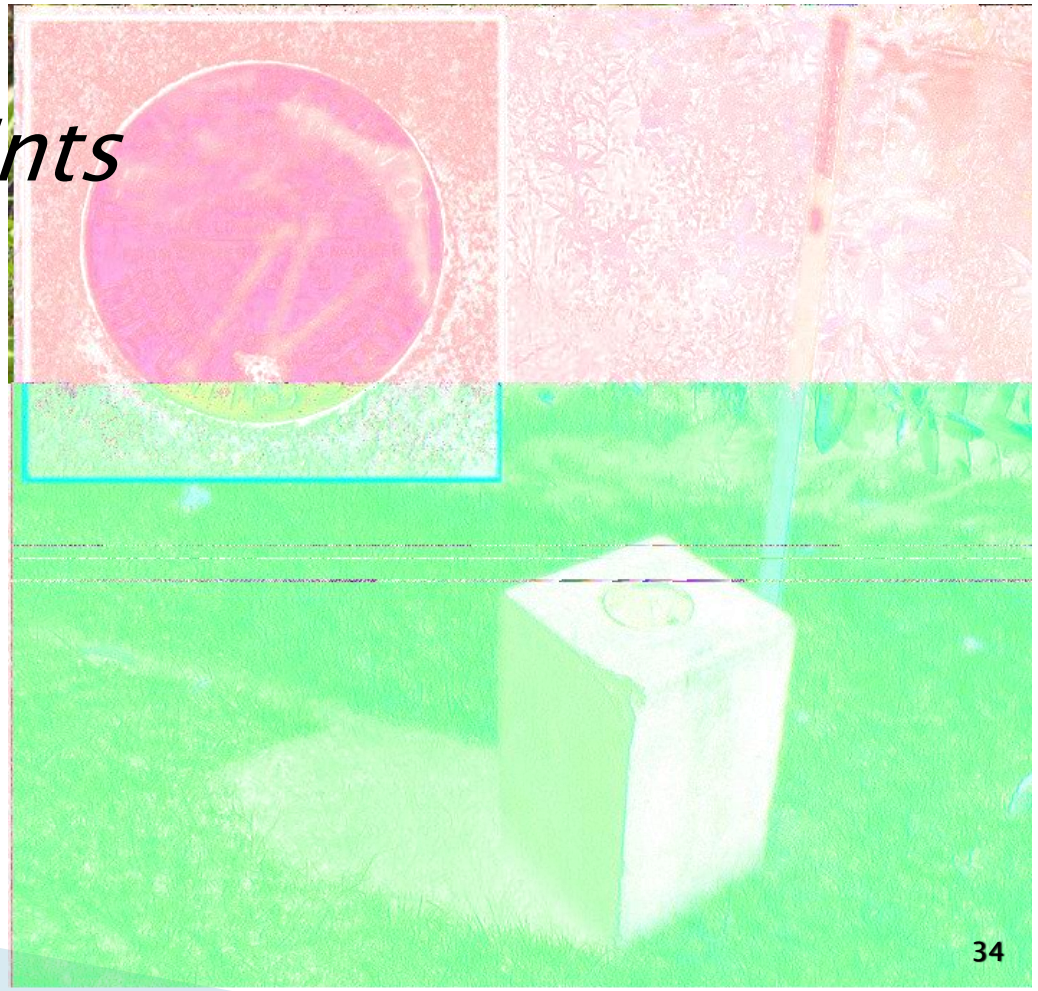
5. *PLSS Collection Section, ¼ Corners*
6. ***GIS Data Platform***
7. *Water Asbuilts*
8. *ROW, Easements, Plats to Data Base*





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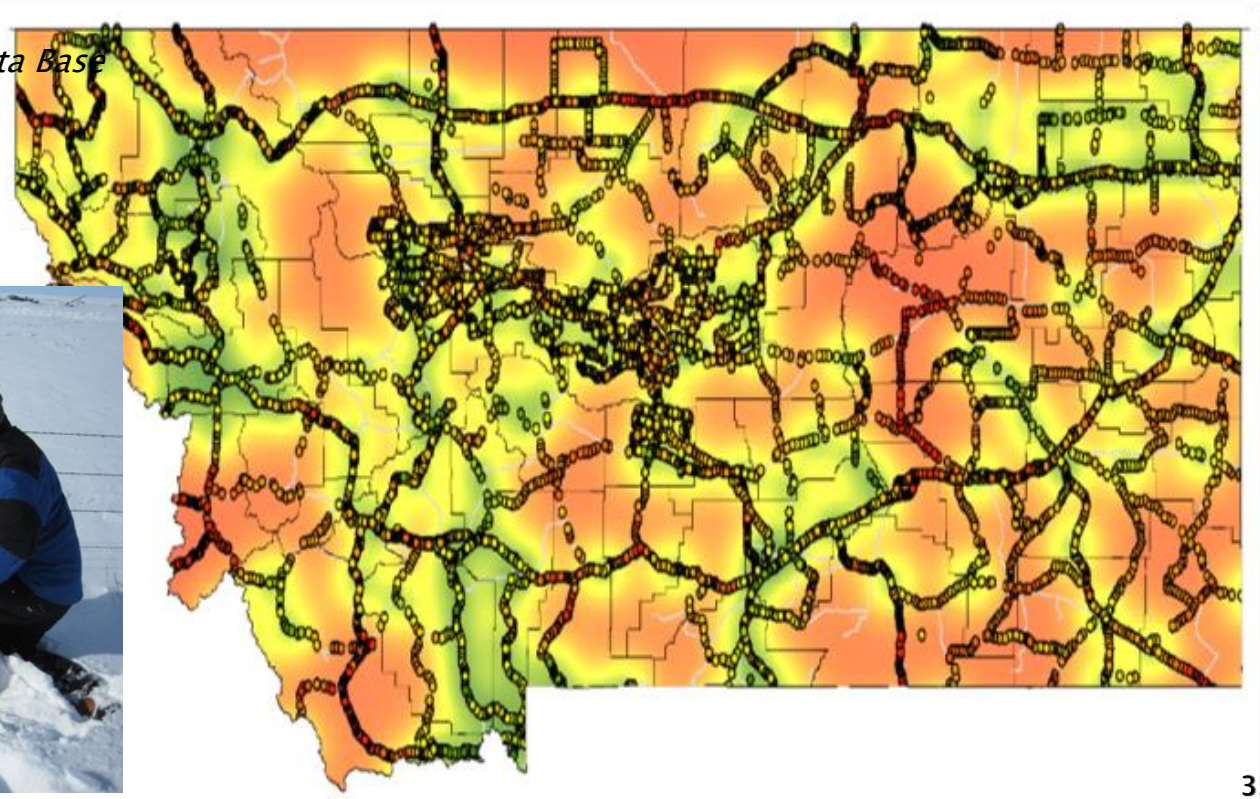

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2. *Roads – Ownership, Condition, Type*
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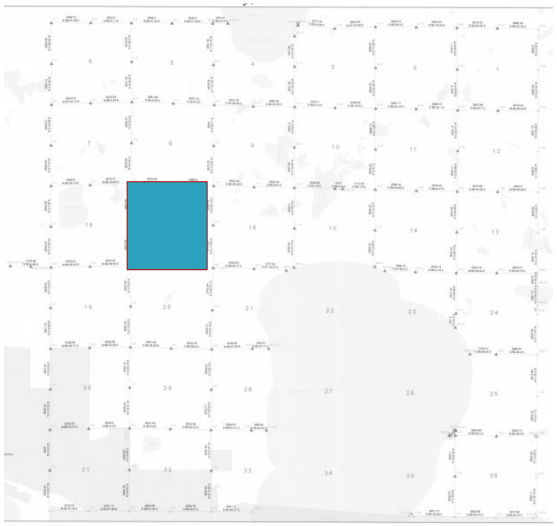
4. *NGS Benchmarks (Prep 2022 NAV-D datum)*
5. *PLSS Collection Section, ¼ Corners*
6. *Water Asbuilts*
7. *ROW, Easements, Plats to Data Base*

Section Breakdown



CROW WING COUNTY SURVEYOR

TWP. DEERWOOD
SEC. 7 T. 46 R. 28
DATE 10/12/09 BY DON SIGETY
RLS #23945

● IRON PIPE, CAST IRON MONUMENT, ETC.

■ CROW WING COUNTY SQUARE TUBULAR MONUMENT WITH STAMPED ALUMINUM CAP

NAD83 COUNTY COORDINATES

N 222073.7086
E 633537.2164

N 222087.315
E 635775.245

N
E

S89-39-06W
2238.07

ROUND CAP'D MON FND

1½" PIPE FND

1374.80
N03-19-04W

N00-38-54W
2627.85

220714.8213
635854.8122

1¾" PIPE FND

PIPE FND

SERPENT LAKE

N 219446.025
E 633566.954

N
E

S00-42-38E
2734.89

CALC'D CORNER IN LAKE

1½" PIPE FND

N85-23-19E
2381.24

¾" IP FND

1½" PIPE FND

MC

MC
N 216719.412
E 633700.913

2297.79
N 85-30-59E

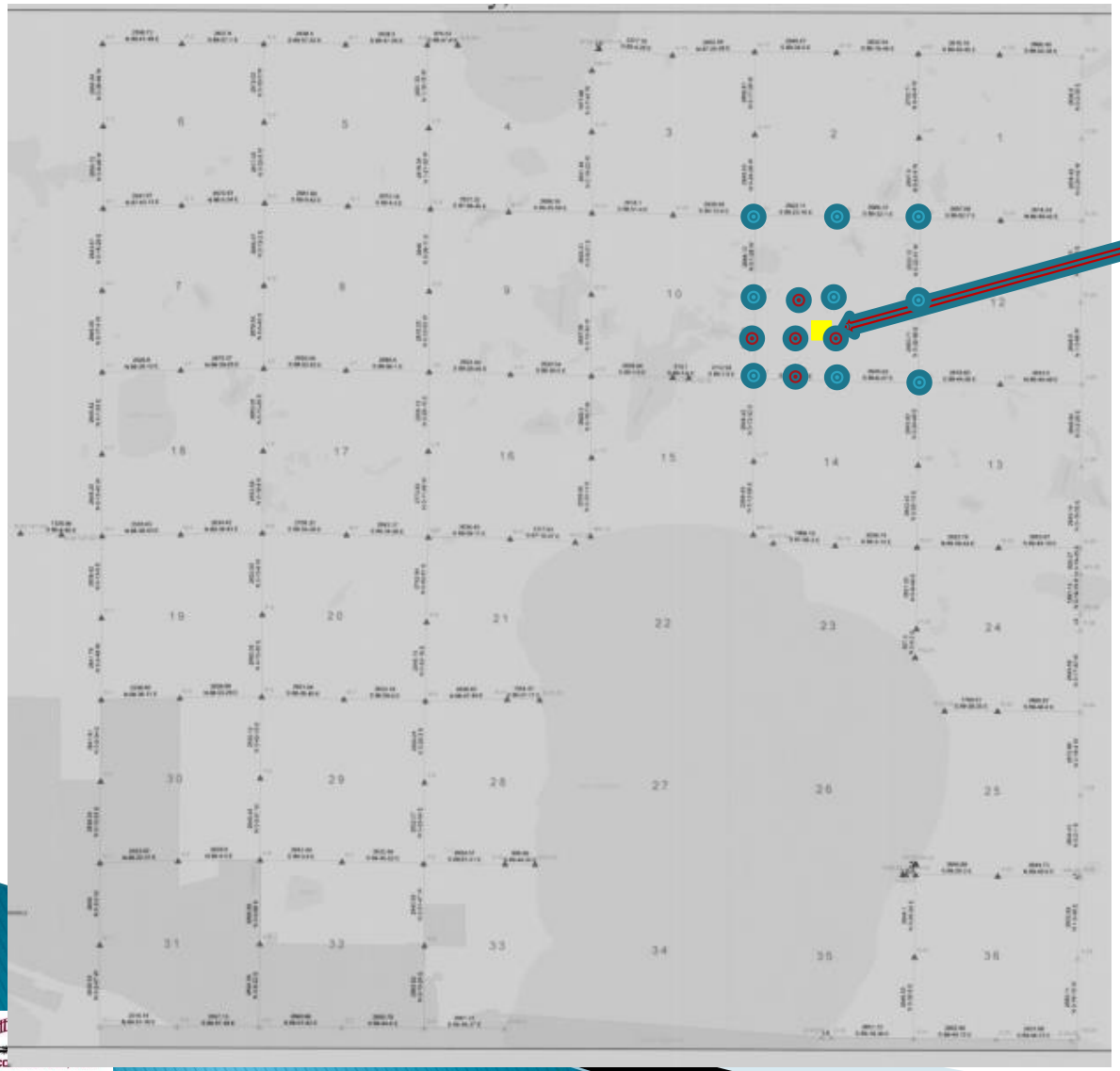
MC

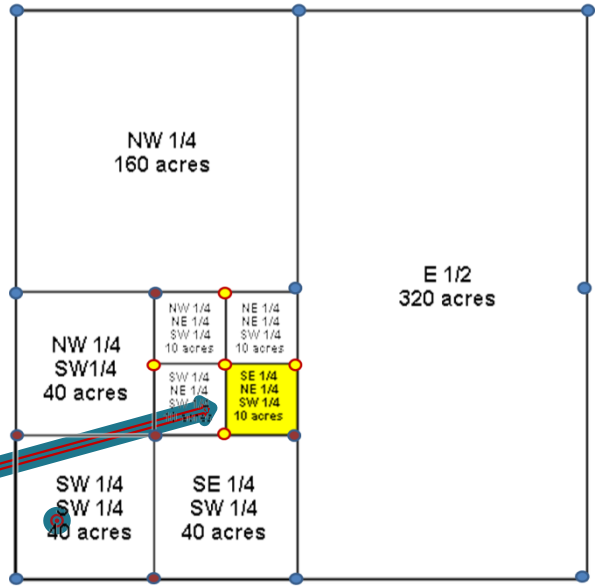
N 216711.343
E 633600.874

N 216910.8583
E 636074.4436

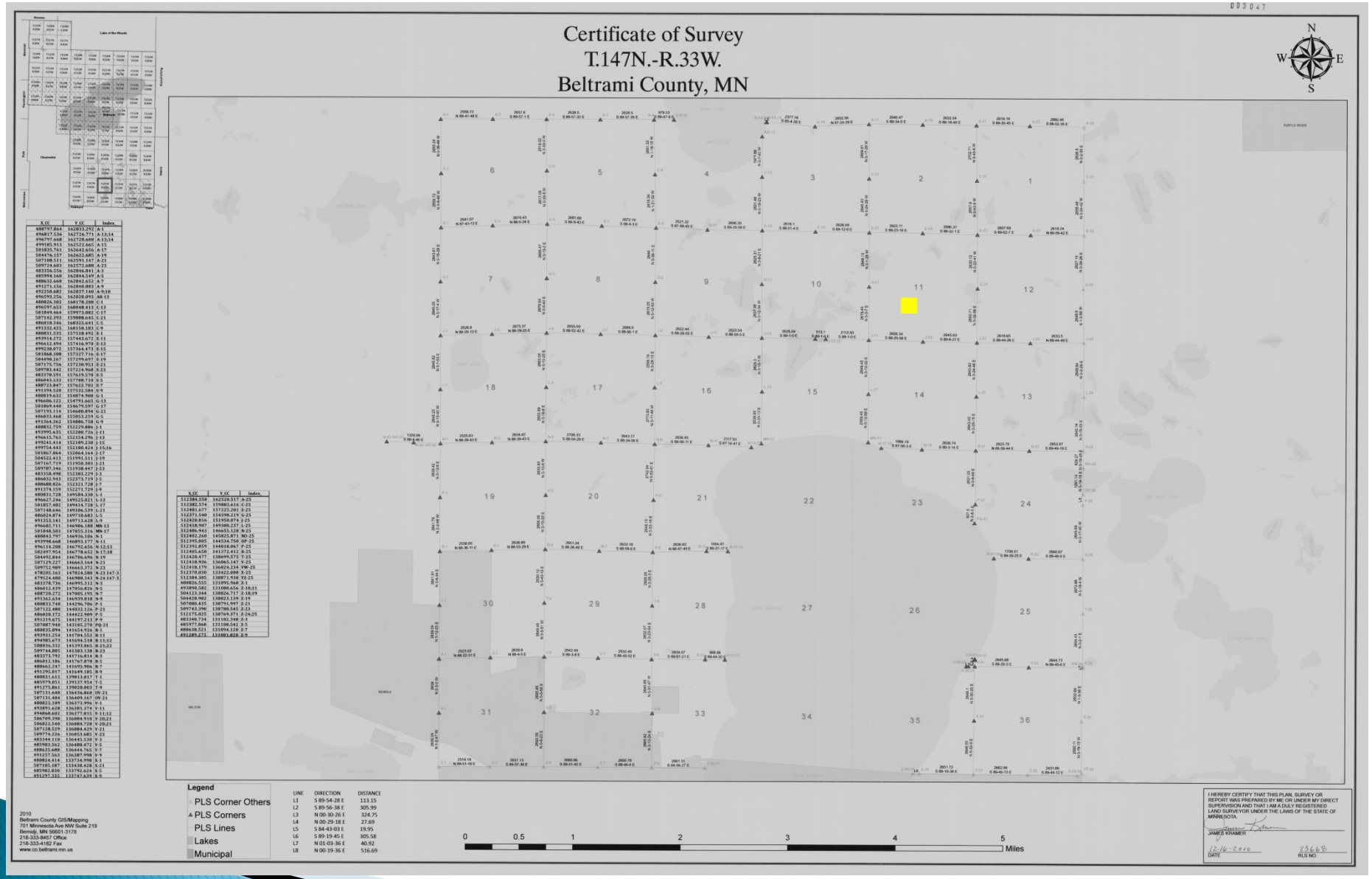
N 217090.483
E 638365.204

10 acres

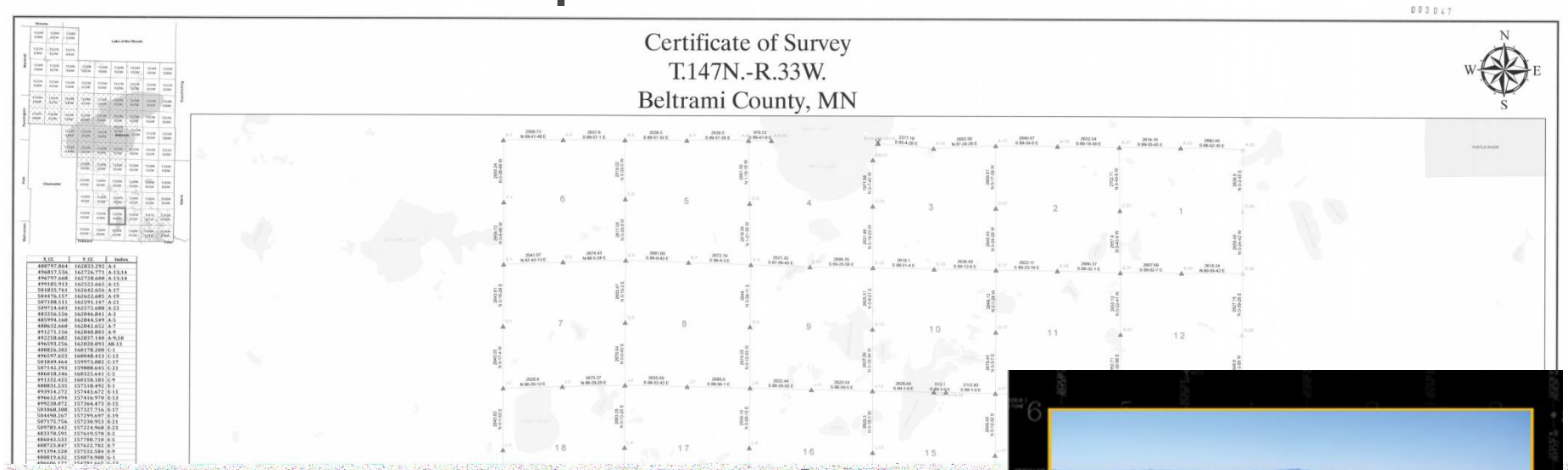



NW 1/4
160 acres
E 1/2
320 acres
NW 1/4
SW1/4
40 acres
NW 1/4
NE 1/4
SW 1/4
10 acres
NE 1/4
NE 1/4
SW 1/4
10 acres
SW 1/4
NE 1/4
SW 1/4
10 acres
SE 1/4
NE 1/4
SW 1/4
10 acres
SW 1/4
SW 1/4
40 acres
SE 1/4
SW 1/4
40 acres

Entire Townships



Entire Townships



Bureau of Indians Land Surveyor (BILS)
BLM – Thomas Laakso

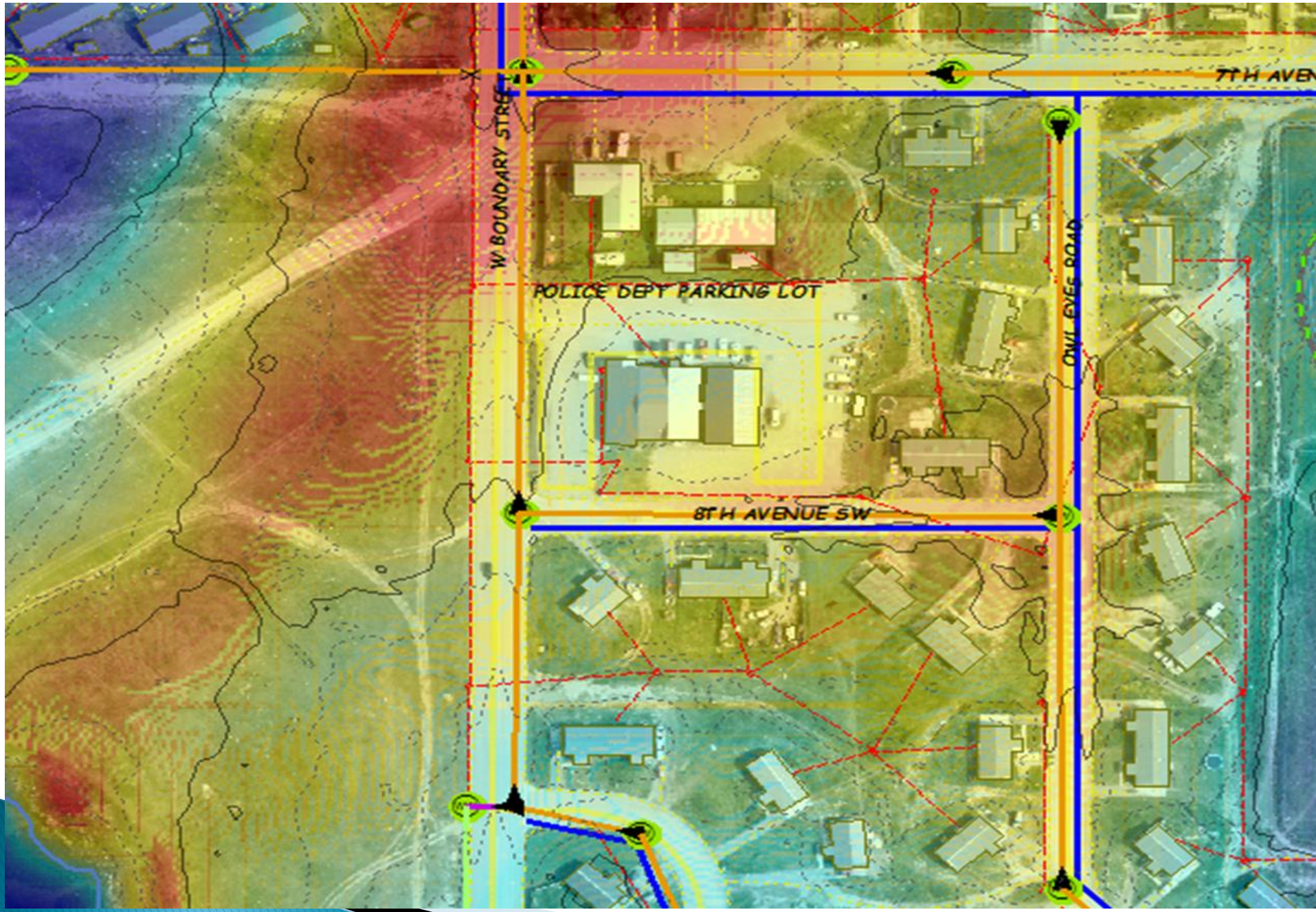
Phase 6
Data Collection

1. *Survey Procedure Handbook*
2. *Roads – Ownership, Condition, Type*
3. *Tribal Control Points*
4. *NGS Benchmarks (Prep 2022 NAV-D datum)*
5. *PLSS Collection Section, ¼ Corners*

6. Water & Sewer Asbuilts

7. *ROW, Easements, Plats to Data Base*


SLKFT IRR YARD


7TH AVE
W BOUNDARY STREET
POLICE DEPT PARKING LOT
OWL EYES ROAD
8TH AVENUE SW

Phase 6
Data Collection

1. *Survey Procedure Handbook*
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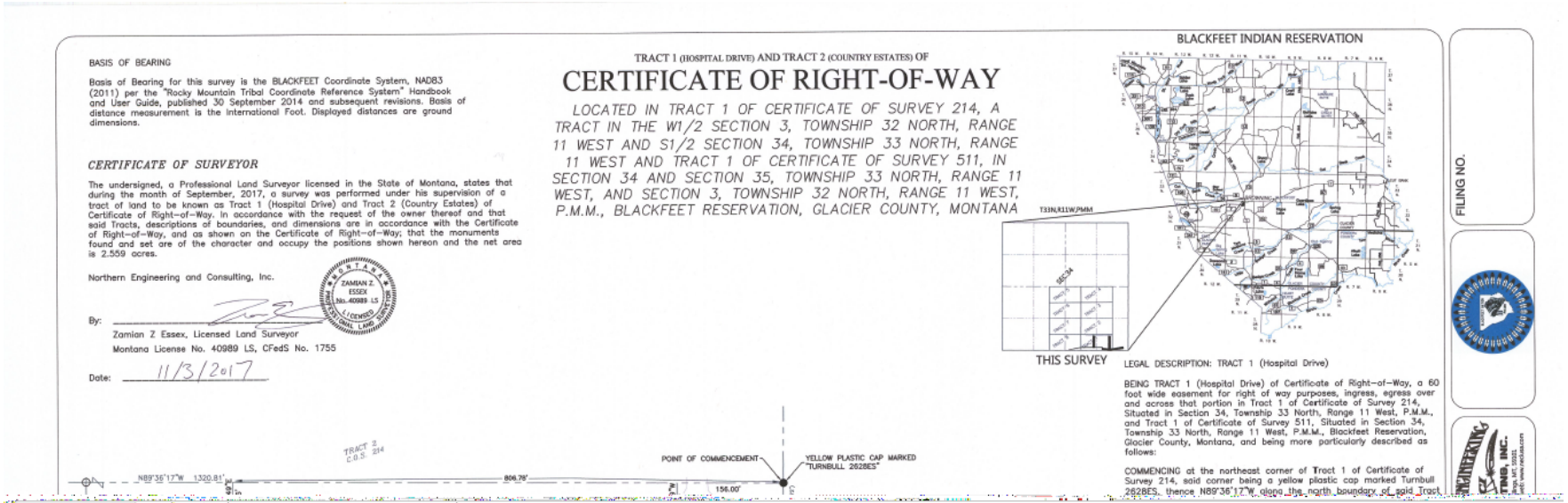
ROW Map



BASIS OF BEARING

Basis of Bearing for this survey is the BLACKFEET Coordinate System, NAD83 (2011) per the "Rocky Mountain Tribal Coordinate Reference System" Handbook and User Guide, published 30 September 2014 and subsequent revisions. Basis of distance measurement is the International Foot. Displayed distances are ground dimensions.

CERTIFICATE OF SURVEYOR

The undersigned, a Professional Land Surveyor licensed in the State of Montana, states that during the month of September, 2017, a survey was performed under his supervision of a tract of land to be known as Tract 1 (Hospital Drive) and Tract 2 (Country Estates) of Certificate of Right-of-Way. In accordance with the request of the owner thereof and that said Tracts, descriptions of boundaries, and dimensions are in accordance with the Certificate of Right-of-Way, and as shown on the Certificate of Right-of-Way; that the monuments found and set are of the character and occupy the positions shown hereon and the net area is 2.559 acres.

Northern Engineering and Consulting, Inc.

By: _____

Zamian Z Essex, Licensed Land Surveyor

Montana License No. 40989 LS, CFedS No. 1755

Date: 11/3/2017

TRACT 1 (HOSPITAL DRIVE) AND TRACT 2 (COUNTRY ESTATES) OF

CERTIFICATE OF RIGHT-OF-WAY

LOCATED IN TRACT 1 OF CERTIFICATE OF SURVEY 214, A TRACT IN THE W1/2 SECTION 3, TOWNSHIP 32 NORTH, RANGE 11 WEST AND S1/2 SECTION 34, TOWNSHIP 33 NORTH, RANGE 11 WEST AND TRACT 1 OF CERTIFICATE OF SURVEY 511, IN SECTION 34 AND SECTION 35, TOWNSHIP 33 NORTH, RANGE 11 WEST, AND SECTION 3, TOWNSHIP 32 NORTH, RANGE 11 WEST, P.M.M., BLACKFEET RESERVATION, GLACIER COUNTY, MONTANA

BLACKFEET INDIAN RESERVATION

T33N,R11W,PMM

SEC34

THIS SURVEY

LEGAL DESCRIPTION: TRACT 1 (Hospital Drive)

BEING TRACT 1 (Hospital Drive) of Certificate of Right-of-Way, a 60 foot wide easement for right of way purposes, ingress, egress over and across that portion in Tract 1 of Certificate of Survey 214, Situated in Section 34, Township 33 North, Range 11 West, P.M.M., and Tract 1 of Certificate of Survey 511, Situated in Section 34, Township 33 North, Range 11 West, P.M.M., Blackfeet Reservation, Glacier County, Montana, and being more particularly described as follows:

COMMENCING at the northeast corner of Tract 1 of Certificate of Survey 214, said corner being a yellow plastic cap marked Turnbull 2628ES, thence N89°36'17"W along the north boundary of said Tract

FILING NO.

TRACT 2 C.O.S. 214

N89°36'17"W 1320.81'

806.78'

POINT OF COMMENCEMENT

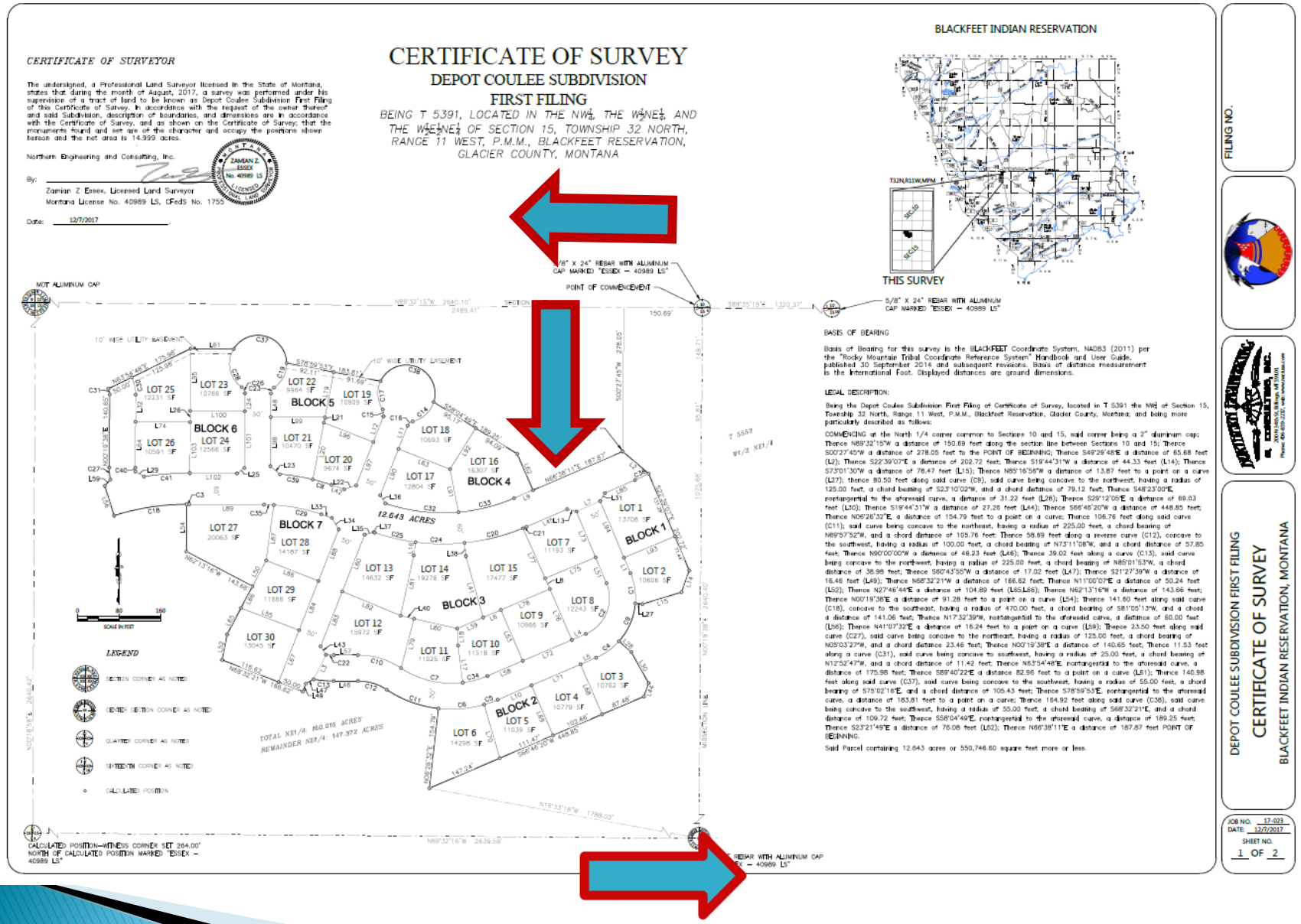
YELLOW PLASTIC CAP MARKED "TURNBULL 2628ES"

156.00'

NORTHERN ENGINEERING NEC CONSULTING, INC.

ROW Map

Plat



CERTIFICATE OF SURVEY

DEPOT COULEE SUBDIVISION

FIRST FILING

BEING T 5391, LOCATED IN THE NW¼, THE W½NE¼, AND THE W½E½NE¼ OF SECTION 15, TOWNSHIP 32 NORTH, RANGE 11 WEST, P.M.M., BLACKFEET RESERVATION, GLACIER COUNTY, MONTANA

CERTIFICATE OF SURVEYOR

The undersigned, a Professional Land Surveyor licensed in the State of Montana, states that during the month of August, 2017, a survey was performed under his supervision of a tract of land to be known as Depot Coulee Subdivision First Filing of this Certificate of Survey. In accordance with the request of the owner thereof and said Subdivision, description of boundaries, and dimensions are in accordance with the Certificate of Survey, and as shown on the Certificate of Survey; that the monuments found and set are of the character and occupy the positions shown hereon and the net area is 14.999 acres.

Northern Engineering and Consulting, Inc.

By: _____

Zamian Z Essex, Licensed Land Surveyor
Montana License No. 40989 LS, CFedS No. 1755

Date: 12/7/2017

ZAMIAN Z. ESSEX No. 40989 LS LICENSED LAND SURVEYOR

BLACKFEET INDIAN RESERVATION

T32N,R11WMPM

SEC 10 SEC 15

THIS SURVEY

5/8" X 24" REBAR WITH ALUMINUM CAP MARKED "ESSEX – 40989 LS"

POINT OF COMMENCEMENT

5/8" X 24" REBAR WITH ALUMINUM CAP MARKED "ESSEX – 40989 LS"

NOT ALUMINUM CAP

BASIS OF BEARING

Basis of Bearing for this survey is the BLACKFEET Coordinate System, NAD83 (2011) per the "Rocky Mountain Tribal Coordinate Reference System" Handbook and User Guide, published 30 September 2014 and subsequent revisions. Basis of distance measurement is the International Foot. Displayed distances are ground dimensions.

LEGAL DESCRIPTION:

Being the Depot Coulee Subdivision First Filing of Certificate of Survey, located in T 5391 the NW¼ of Section 15, Township 32 North, Range 11 West, P.M.M., Blackfeet Reservation, Glacier County, Montana; and being more particularly described as follows:

COMMENCING at the North 1/4 corner common to Sections 10 and 15, said corner being a 2" aluminum cap; Thence N89°32'15"W a distance of 150.69 feet along the section line between Sections 10 and 15; Thence S00°27'45"W a distance of 278.05 feet to the POINT OF BEGINNING; Thence S49°29'48"E a distance of 65.68 feet (L2); Thence S22°39'07"E a distance of 202.72 feet; Thence S19°44'31"W a distance of 44.33 feet (L14); Thence S73°01'30"W a distance of 78.47 feet (L15); Thence N85°16'56"W a distance of 13.87 feet to a point on a curve (L27); thence 80.50 feet along said curve (C9), said curve being concave to the northwest, having a radius of 125.00 feet, a chord bearing of S23°10'02"W, and a chord distance of 79.12 feet; Thence S48°23'09"E, nontangential to the aforesaid curve, a distance of 31.22 feet (L28); Thence S29°12'05"E a distance of 69.03 feet (L30); Thence S19°44'31"W a distance of 27.26 feet (L44); Thence S66°46'20"W a distance of 448.85 feet; Thence N06°26'32"E, a distance of 154.79 feet to a point on a curve; Thence 106.76 feet along said curve (C11); said curve being concave to the northeast, having a radius of 225.00 feet, a chord bearing of N69°57'52"W, and a chord distance of 105.76 feet; Thence 56.89 feet along a reverse curve (C12), concave to the southwest, having a radius of 100.00 feet, a chord bearing of N73°11'08"W, and a chord distance of 57.85 feet; Thence N89°00'00"W a distance of 46.23 feet (L46); Thence 39.02 feet along a curve (C13), said curve being concave to the northwest, having a radius of 225.00 feet, a chord bearing of N85°01'53"W, a chord distance of 38.98 feet; Thence S60°43'55"W a distance of 17.02 feet (L47); Thence S21°27'39"W a distance of 16.46 feet (L49); Thence N68°32'21"W a distance of 166.62 feet; Thence N11°00'07"E a distance of 50.24 feet (L52); Thence N27°46'44"E a distance of 104.89 feet (L65,L66); Thence N62°13'16"W a distance of 143.66 feet; Thence N00°19'38"E a distance of 91.28 feet to a point on a curve (L54); Thence 141.60 feet along said curve (C18), concave to the southeast, having a radius of 470.00 feet, a chord bearing of S81°05'13"W, and a chord distance of 141.06 feet; Thence N17°32'39"W, nontangential to the aforesaid curve, a distance of 50.00 feet (L56); Thence N41°07'32"E a distance of 18.24 feet to a point on a curve (L59); Thence 23.50 feet along said curve (C27), said curve being concave to the northeast, having a radius of 125.00 feet, a chord bearing of N05°03'27"W, and a chord distance 23.46 feet; Thence N00°19'38"E a distance of 140.65 feet; Thence 11.53 feet along a curve (C31), said curve being concave to southwest, having a radius of 25.00 feet, a chord bearing of N12°52'47"W, and a chord distance of 11.42 feet; Thence N63°54'48"E, nontangential to the aforesaid curve, a distance of 175.98 feet; Thence S89°40'22"E a distance 82.96 feet to a point on a curve (L61); Thence 140.98 feet along said curve (C37), said curve being concave to the southeast, having a radius of 55.00 feet, a chord bearing of S75°02'16"E, and a chord distance of 105.43 feet; Thence S78°59'53"E, nontangential to the aforesaid curve, a distance of 183.81 feet to a point on a curve; Thence 164.92 feet along said curve (C38), said curve being concave to the southwest, having a radius of 55.00 feet, a chord bearing of S68°32'21"E, and a chord distance of 109.72 feet; Thence S58°04'49"E, nontangential to the aforesaid curve, a distance of 189.25 feet; Thence S23°21'49"E a distance of 76.08 feet (L62); Thence N66°38'11"E a distance of 187.87 feet POINT OF BEGINNING.

Said Parcel containing 12.643 acres or 550,746.60 square feet more or less.

LEGEND

- SECTION CORNER AS NOTED
- CENTER SECTION CORNER AS NOTED
- QUARTER CORNER AS NOTED
- SIXTEENTH CORNER AS NOTED
- CALCULATED POSITION

CALCULATED POSITION–WITNESS CORNER SET 264.00' NORTH OF CALCULATED POSITION MARKED "ESSEX – 40989 LS"

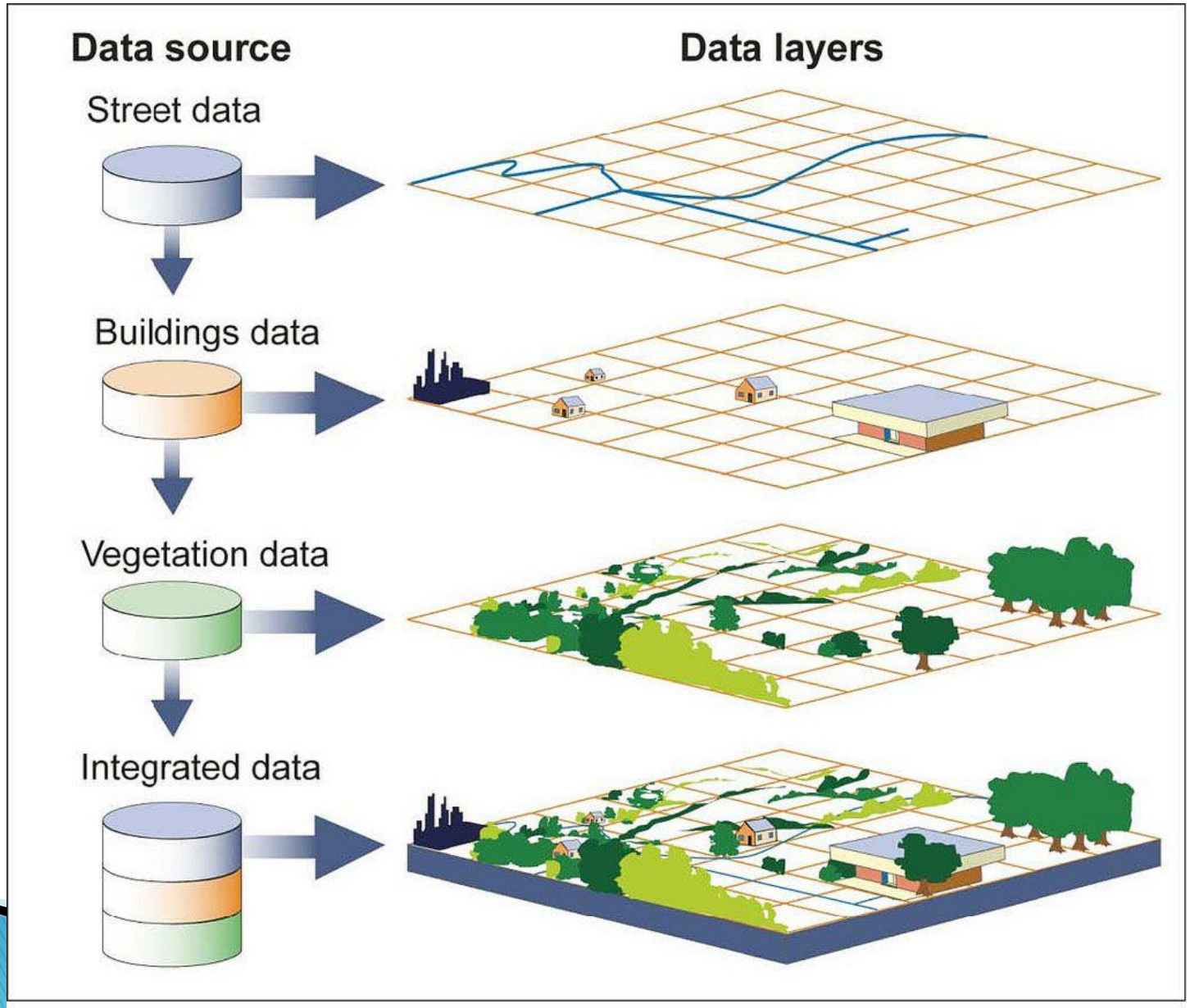
5/8" X 24" REBAR WITH ALUMINUM CAP MARKED "ESSEX – 40989 LS"

FILING NO.

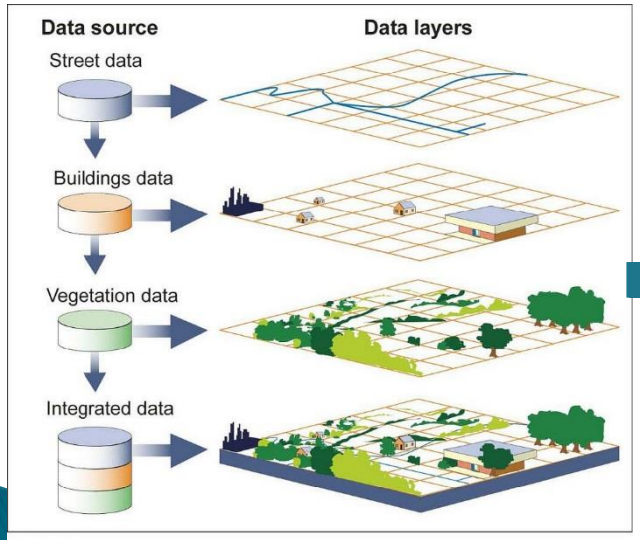
DEPOT COULEE SUBDIVISION FIRST FILING
CERTIFICATE OF SURVEY
BLACKFEET INDIAN RESERVATION, MONTANA

JOB NO. 17-023
DATE 12/7/2017
SHEET NO. 1 OF 2

Phase 7: GIS Foundation



GIS

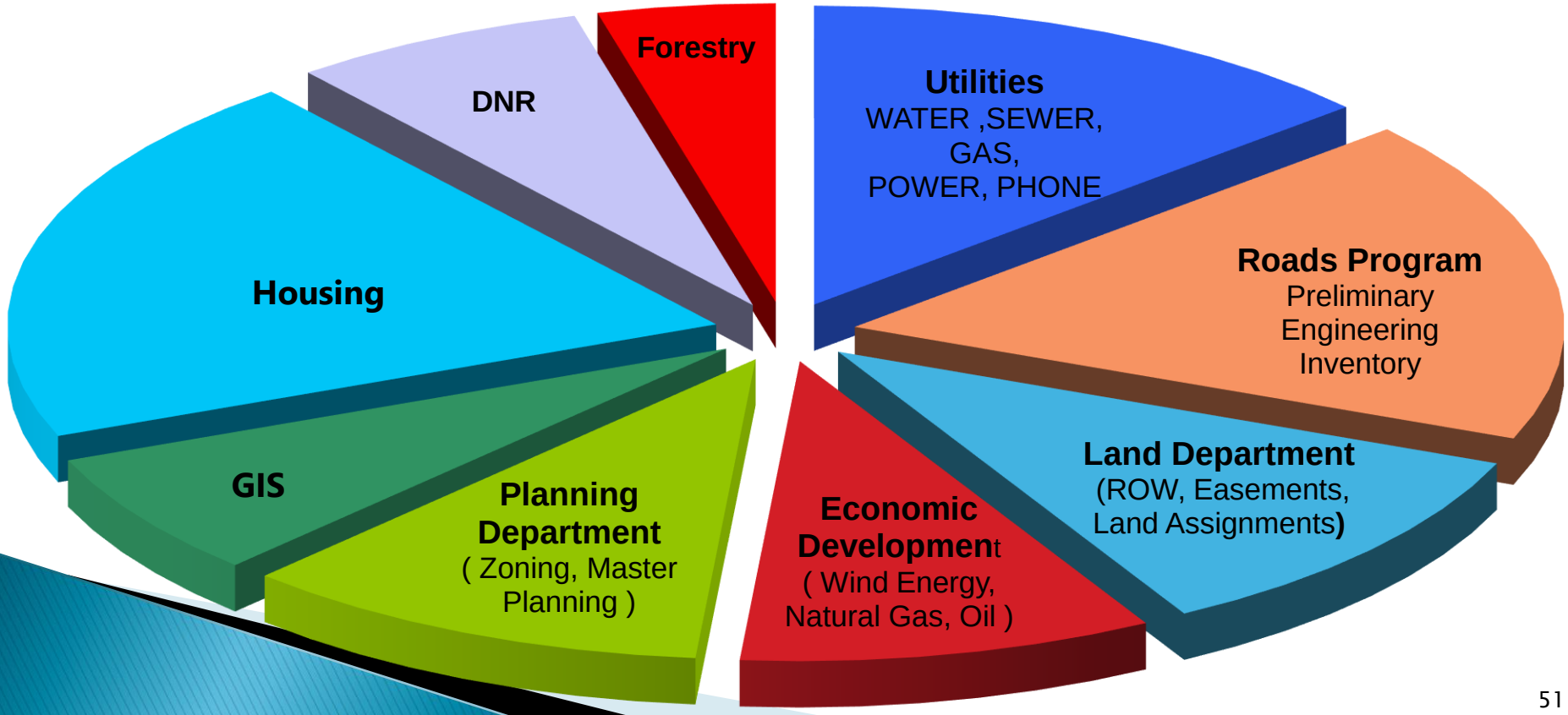


Source: GAO.

Housing
Utilities
Roads
Long Range Planning
Needs Assesment
Economic Development
Grants
Strategic Planning
Funding Alternatives
Business Development
Analysis Matric
Reports
GIS Processing and Storage
Info
Inforrmation
Info
Info
DATA COLLECTION

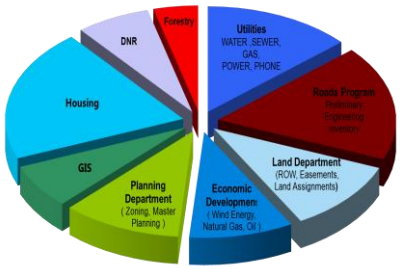
DATA COLLECTION
Everyone Benefits

In 5, 10, 15, 20 years…



In 5, 10, 15, 20 years… the survey and engineering data produced/collected will be easily retrievable!

- ROW's
- Easements
- Land Surveys
- Land Corners
- Utility Asbuilts
  - Water & Sewer Lines
  - Gas Lines
  - Power Lines
- Irrigations Structures
- Topographic Surveys

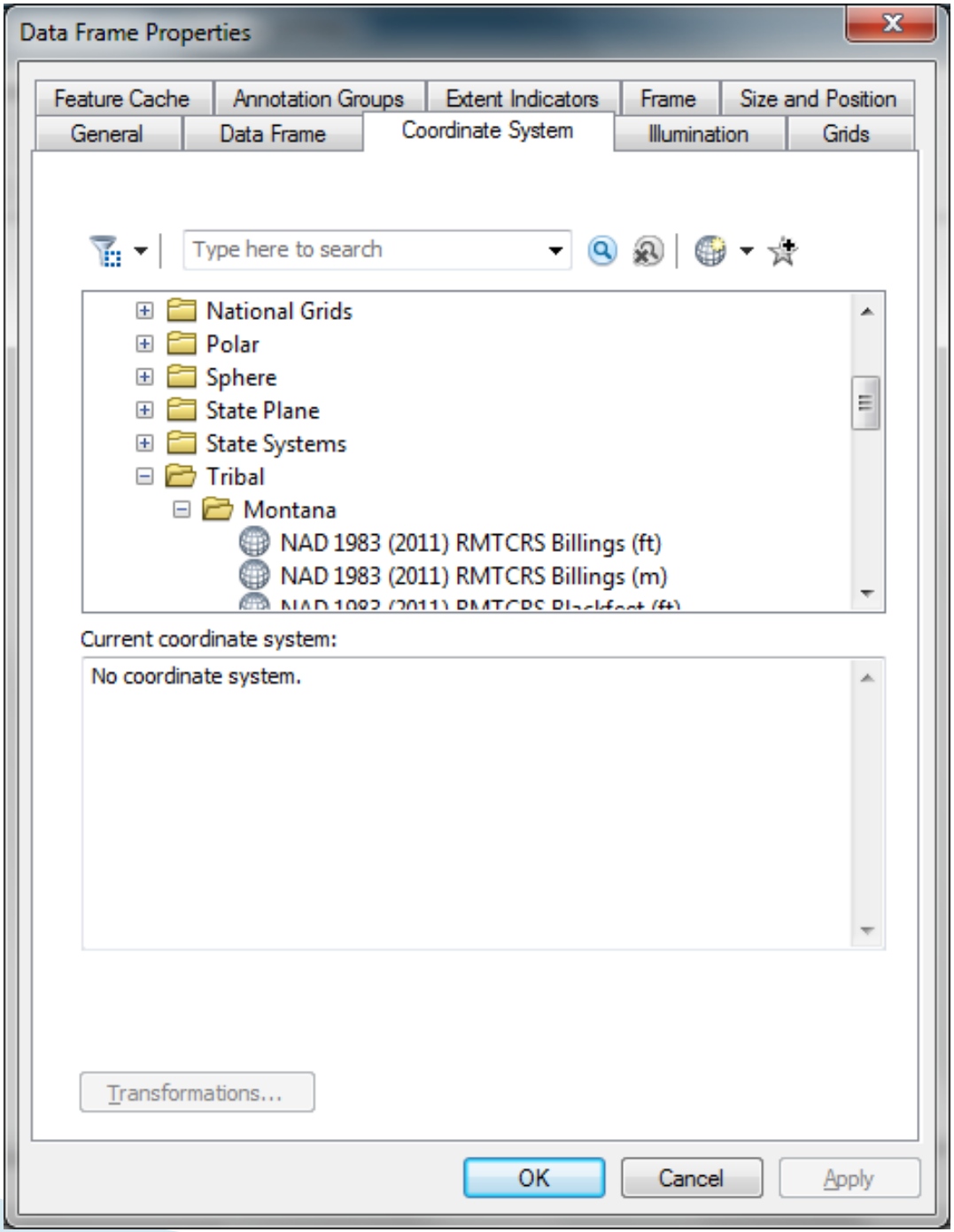


Who collects the data?

1) Engineers
2) Surveyors

Phase 7

GIS Foundation

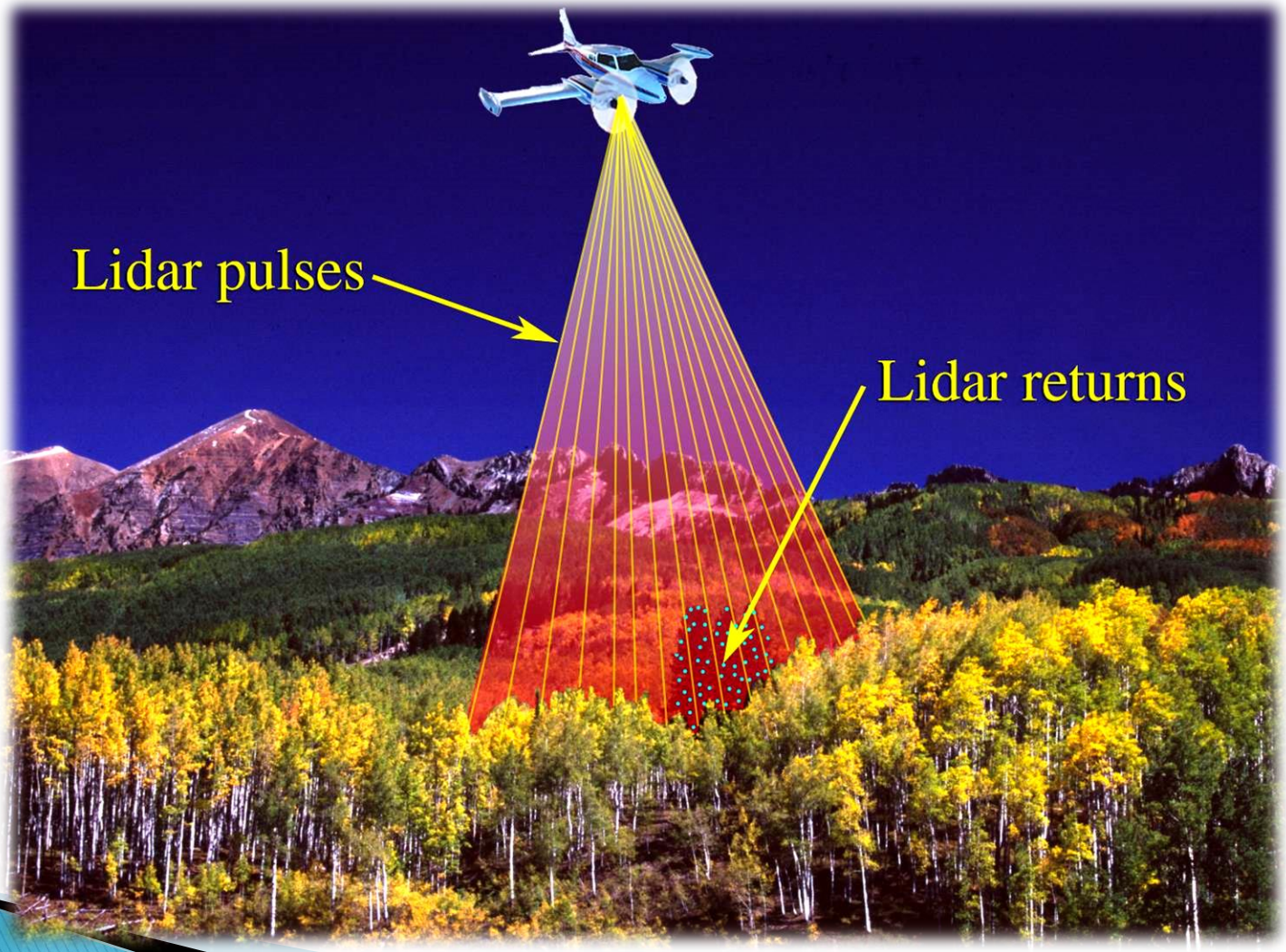


Phase 8

LiDAR & Orthorectified - Photogrametry

Objective: Obtain highly accurate topographic mapping and orthorectified aerial photography for use in planning and design projects.

Pulses vs. Returns (Point Clouds)



Courtesy of USGS - Stoker


4400 ft

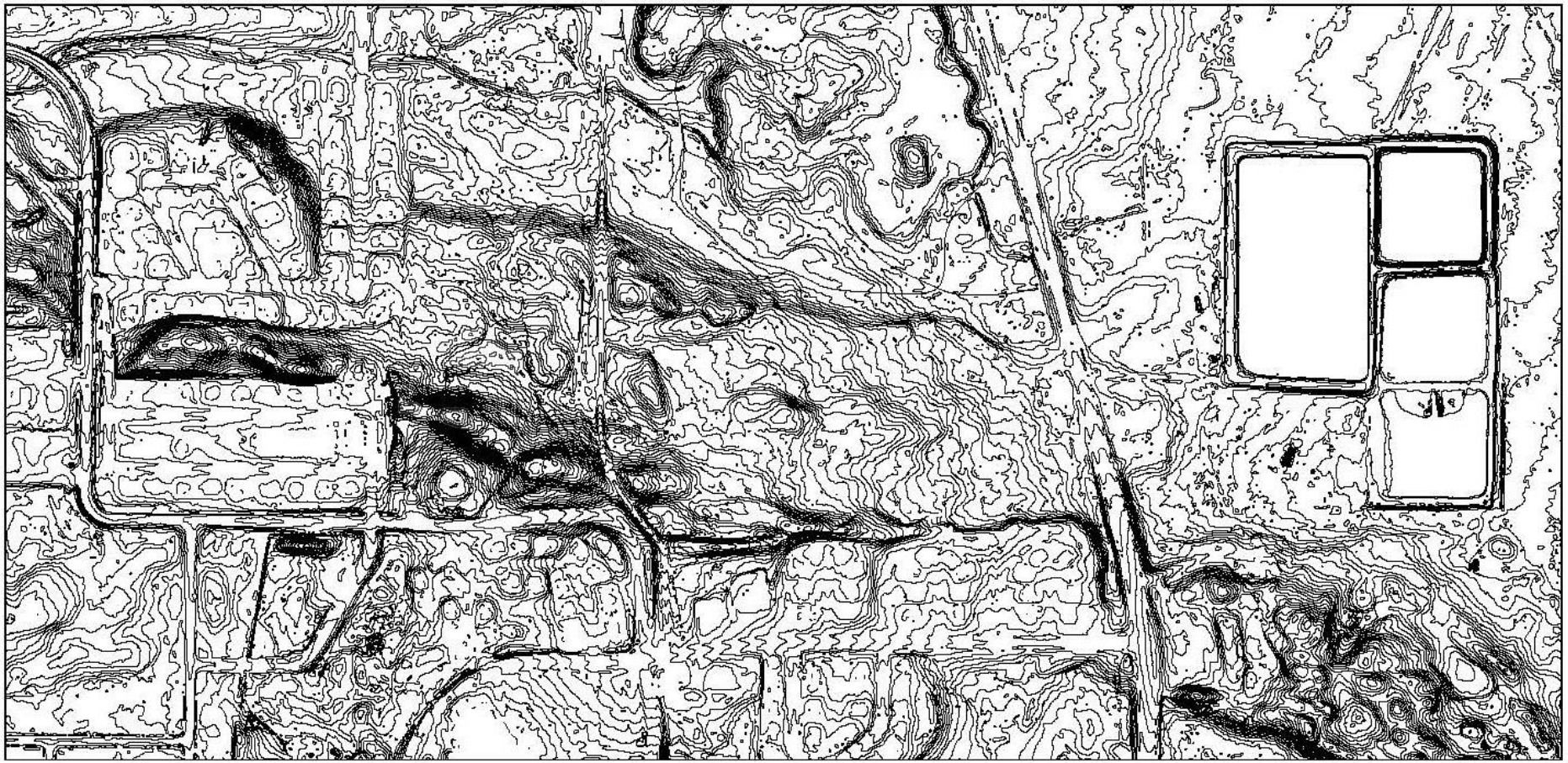
Browning, Montana: Blackfeet
1 foot contours
32 points/square meter

5. Accuracy Assessments

In order to verify the quality of the final ground surface, data from the ground survey conducted in the area was compared to the LiDAR ground surface. Northern Engineering and Consulting, Inc. provided 12 static gps control points and 390 real-time kinematic (RTK) gps measurements. The check points were distributed among multiple flight swaths. To assess the absolute accuracy, the coordinates of the RTK ground points were compared to the closest laser ground points. The table below lists the results summarized by land cover type.

RTK Surface Type	RTK Survey Sample Size	Root Mean Square Error	Minimum dZ	Maximum dZ	Average Dz
Hard Surface	121	0.189 ft.	-0.452 ft.	+0.412 ft.	+0.005 ft.
Short Grass	94	0.187 ft.	-0.415 ft.	+0.451 ft.	+0.005 ft.
Medium Grass	102	0.271 ft.	-0.385 ft.	+0.596 ft.	+0.140 ft.
Tall Grass	73	0.120 ft.	-0.142 ft.	+0.296 ft.	+0.057 ft.

Contour Maps – 1 Foot



Aerial Photos

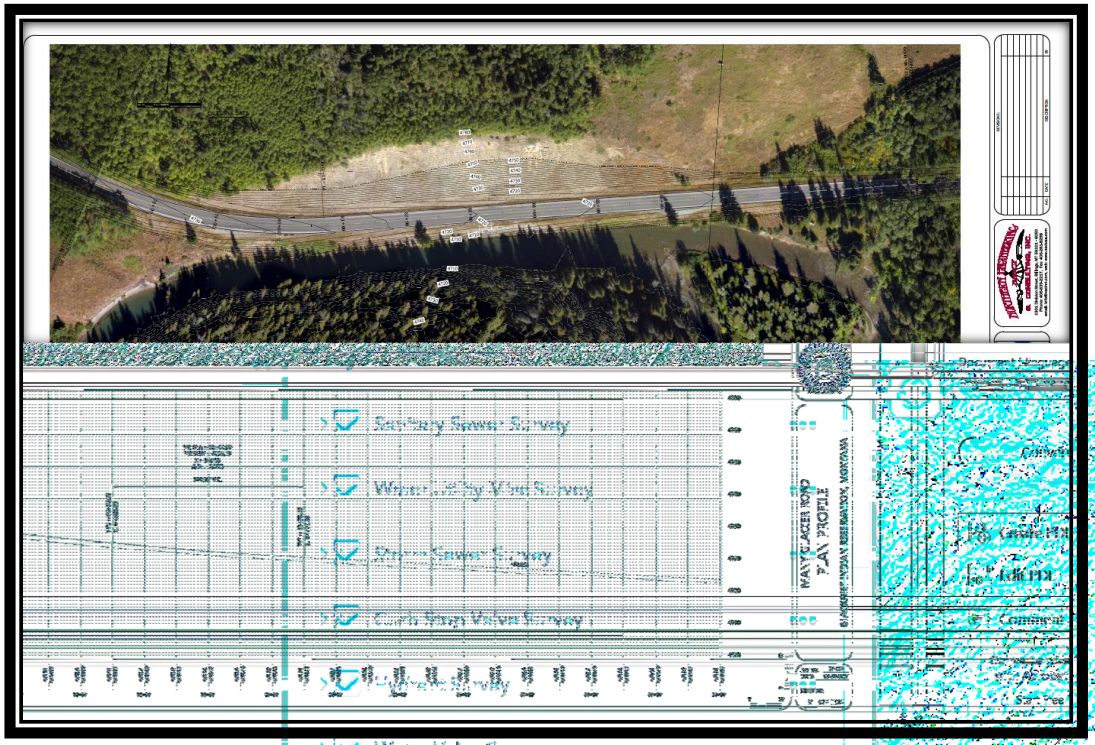
Site conditions:


GRAPHIC SCALE
LINER TREATMENT LAGOON (SEE DETAILS AND SPECIFICATION)
EROSION CONTROL BLANKET (SEE DETAILS AND SPECIFICATION)
MH 6
EROSION AND SEDIMENT
CONTROL PLAN
1) The Contractor shall obtain all permits prior to start of construction.
2) All exposed soil areas must have temporary erosion protection or permanent
cover according to the following.

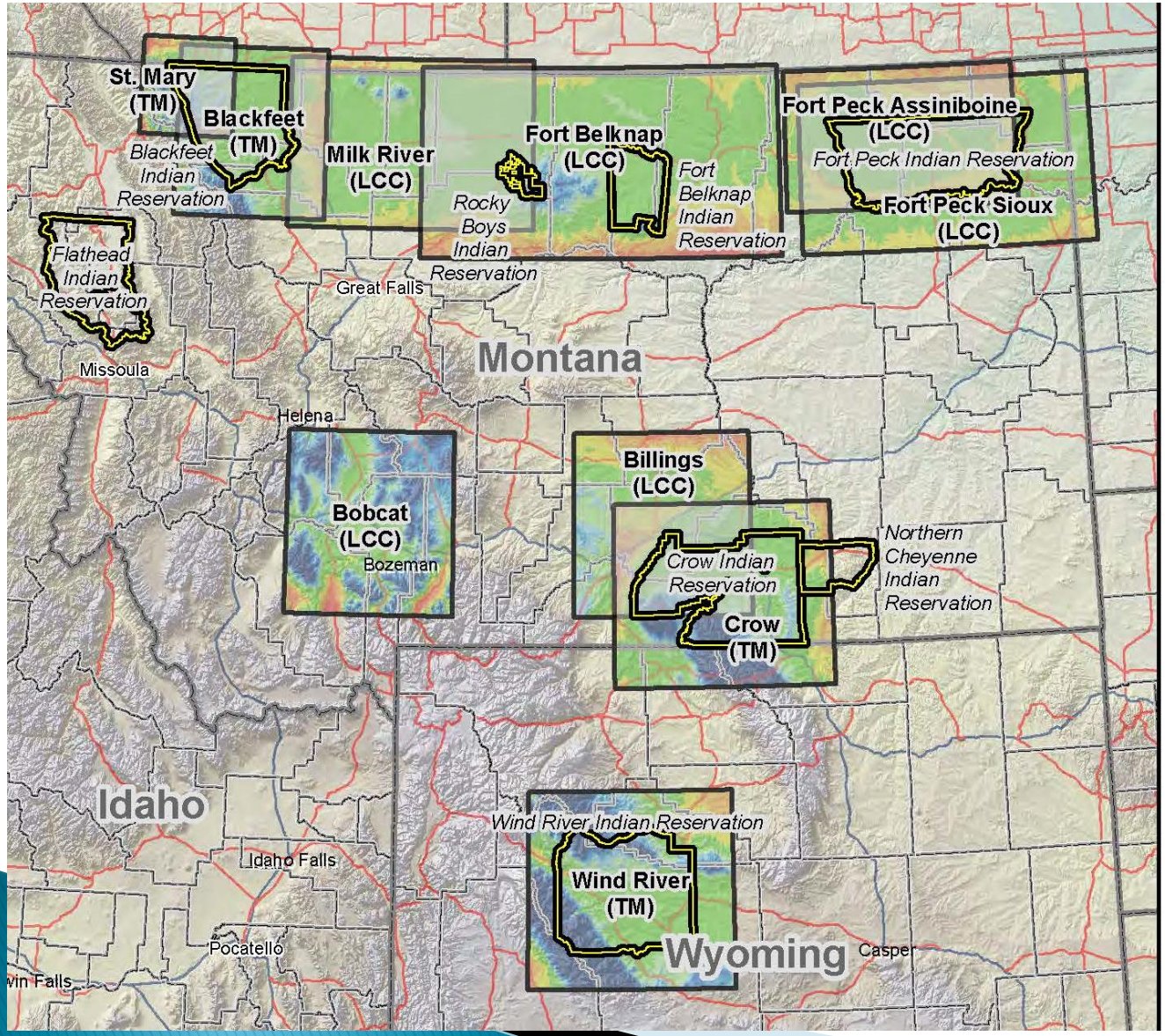
LiDAR & Ortho-rectified Photos

- With LiDAR you can design more efficiently:
  - plans can be taken to 30% without field surveys
  - permission to survey eliminated in some cases
  - hydraulic studies can be done without addition field surveys
  - water pipe sizing and water tower elevations can be designed using elevation data from LiDAR

Many Glacier Road



Phase 9: Legislative Action



- Legislative Action
  - Tribal Adoption
  - County Adoption
  - State Adoption


Questions?
Concerns?
Advice?
Various low distortion projection coordinate systems adopted by government agencies in the coterminous United States
0 200 400 600
Miles
130°W
120°W
110°W
100°W
90°W
80°W
70°W
50°N
45°N
40°N
35°N
30°N
25°N

GIS

What is it and what can it do?

- A geographic information system (**GIS**) is a framework for gathering, managing, and analyzing data. ESRI

Explore, manage, visualize and analyze

GIS

What is it and what can it do?

- A geographic information system (GIS) is a framework for gathering, managing, and analyzing data. ESRI

- Explore, manage, visualize and analyze

Needs

- A comprehensive Geographic Information System to manage and share spatially related data amongst Tribal departments and interests to improve the management, maintenance, and utilization of Tribal assets
- To create a process and strategy to accomplish this
- To create a training mechanism to enable tribes to implement the process and strategy

Approach

- So why start with the Road Information Field Data System?
  - The current system provided by the BIA does not provide an easily accessible visual representation of the inventory
  - Being able to easily identify routes for maintenance projects, such as snow removal, is a priority for Tribal Transportation Departments
  - Accuracy of data catalogued in RIFDS impacts funding through the Tribal Transportation Program (TTP)

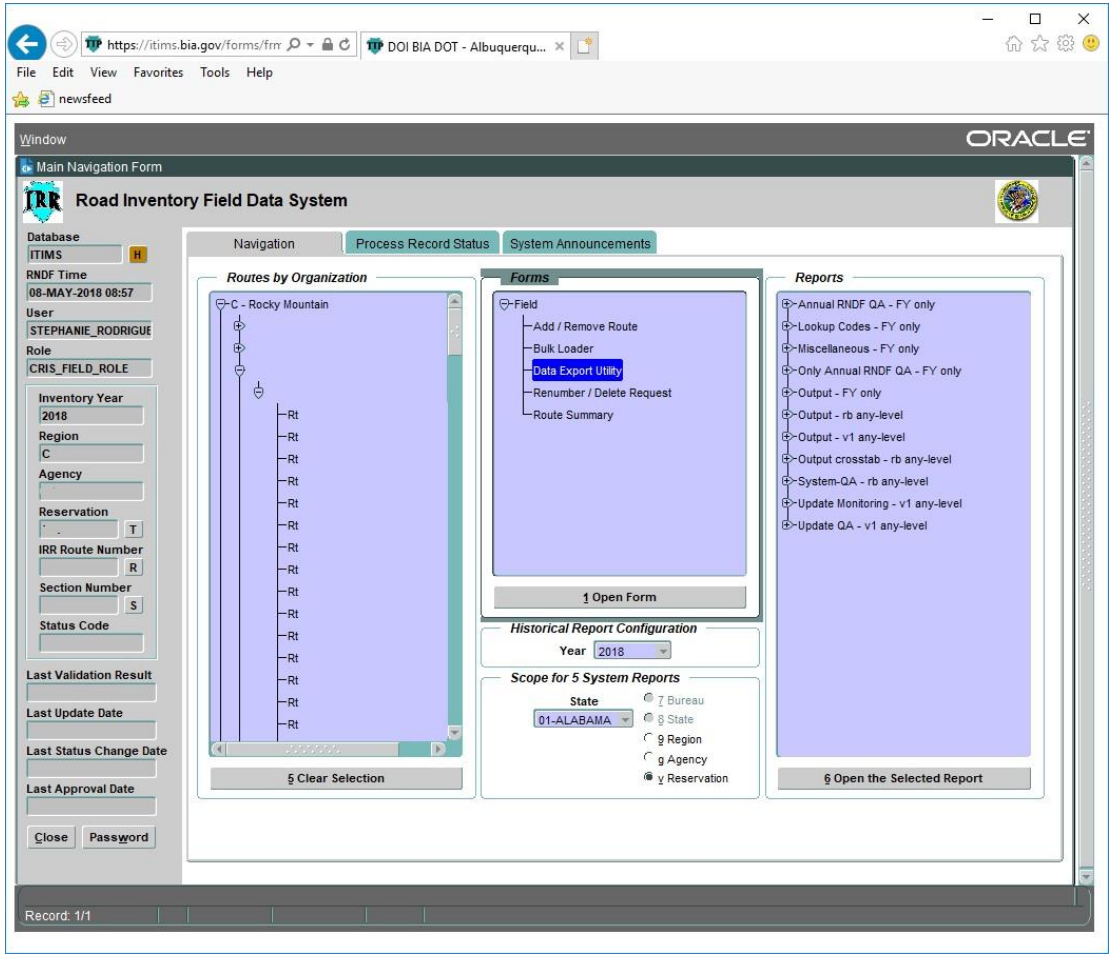
Where to begin?

- Identify the current processes in place for cataloging Routes in RIFDS and how to access this information:
  - RIFDS training
  - Other colleagues and Tribal members with previous training and experience to identify challenges and places for improvement
  - Cooperation and communication with BIA TTP representatives
  - Cooperation and communication with end users who need RIFDS information to complete their daily tasks

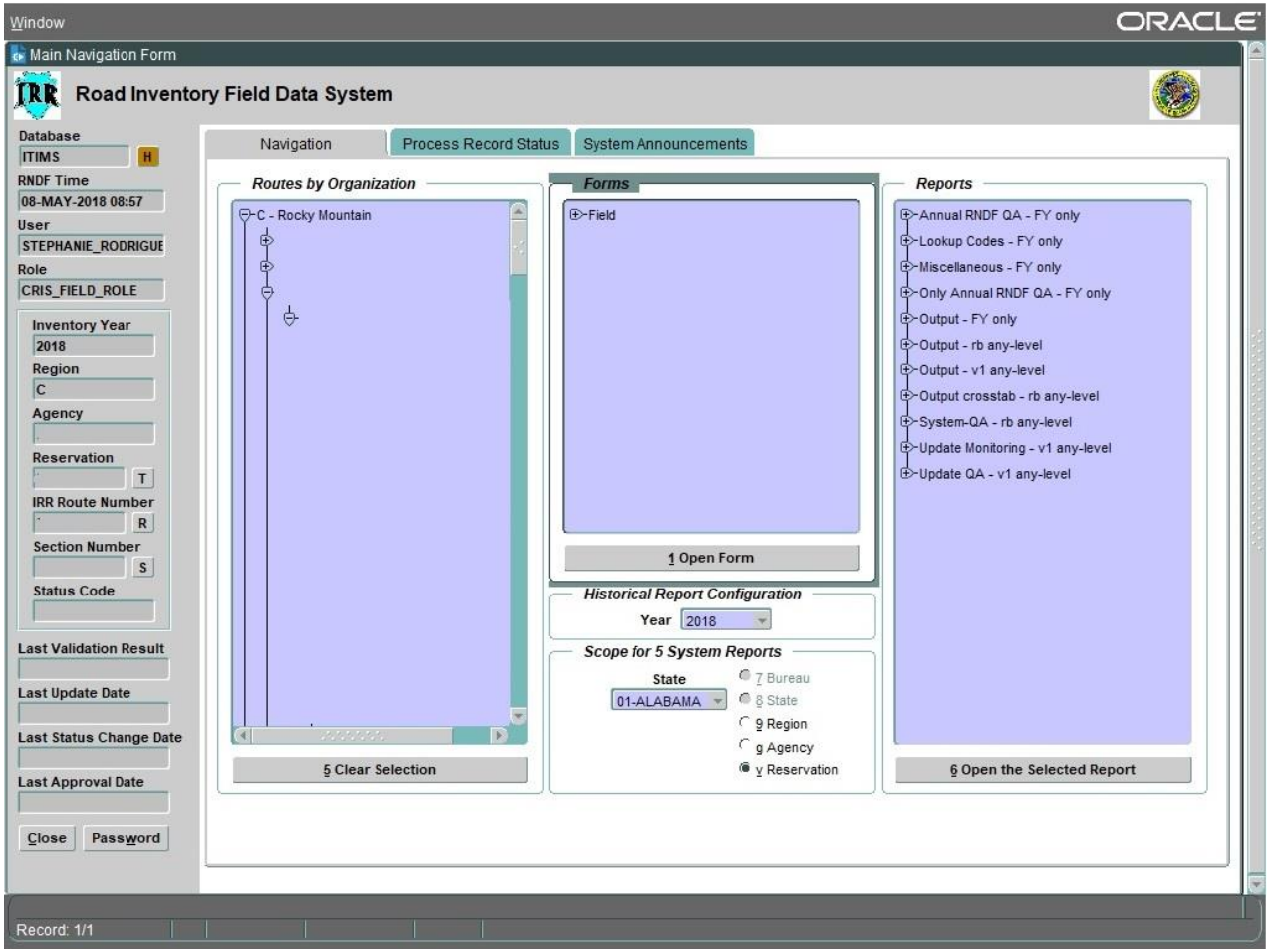
Challenges Identified in Current Process:

- Visualization and identification of Routes difficult
  - Most efficient current strategy for many is to consult strip maps, narratives, and the legacy knowledge of those previously involved in submitting Routes
    - Access to RIFDS is limited and gaining access is a complicated and lengthy process, a lapse in authorization can seriously impact a Tribes ability to see and update their data
    - When former Tribal, BIA, and consultant depart, their extensive personal knowledge goes with them
  - Challenges in visualizing and tracking Routes without a spatial context leads to duplicates, overlaps, ghost trails, proposed projects since abandoned, and unintentional omissions from the system.

RIFDS


https://itims.bia.gov/forms/frm
DOI BIA DOT - Albuquerqu...
File Edit View Favorites Tools Help
newsfeed
Window
ORACLE
Main Navigation Form
Road Inventory Field Data System
Database
ITIMS
RNDF Time
08-MAY-2018 08:57
User
STEPHANIE_RODRIGUE
Role
CRIS_FIELD_ROLE
Inventory Year
2018
Region
C
Agency
Reservation
IRR Route Number
Section Number
Status Code
Last Validation Result
Last Update Date
Last Status Change Date
Last Approval Date
Close
Password
Navigation
Process Record Status
System Announcements
Routes by Organization
C - Rocky Mountain
Rt
5 Clear Selection
Forms
Field
Add / Remove Route
Bulk Loader
Data Export Utility
Renumber / Delete Request
Route Summary
1 Open Form
Historical Report Configuration
Year 2018
Scope for 5 System Reports
State
01-ALABAMA
7 Bureau
8 State
9 Region
g Agency
y Reservation
Reports
Annual RNDF QA - FY only
Lookup Codes - FY only
Miscellaneous - FY only
Only Annual RNDF QA - FY only
Output - FY only
Output - rb any-level
Output - v1 any-level
Output crosstab - rb any-level
System-QA - rb any-level
Update Monitoring - v1 any-level
Update QA - v1 any-level
6 Open the Selected Report
Record: 1/1

RIFDS


Window
ORACLE
Main Navigation Form
Road Inventory Field Data System
Database
ITIMS
H
RNDF Time
08-MAY-2018 08:57
User
STEPHANIE_RODRIGUE
Role
CRIS_FIELD_ROLE
Inventory Year
2018
Region
C
Agency
Reservation
T
IRR Route Number
R
Section Number
S
Status Code
Last Validation Result
Last Update Date
Last Status Change Date
Last Approval Date
Close
Password
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Routes by Organization
C - Rocky Mountain
5 Clear Selection
Forms
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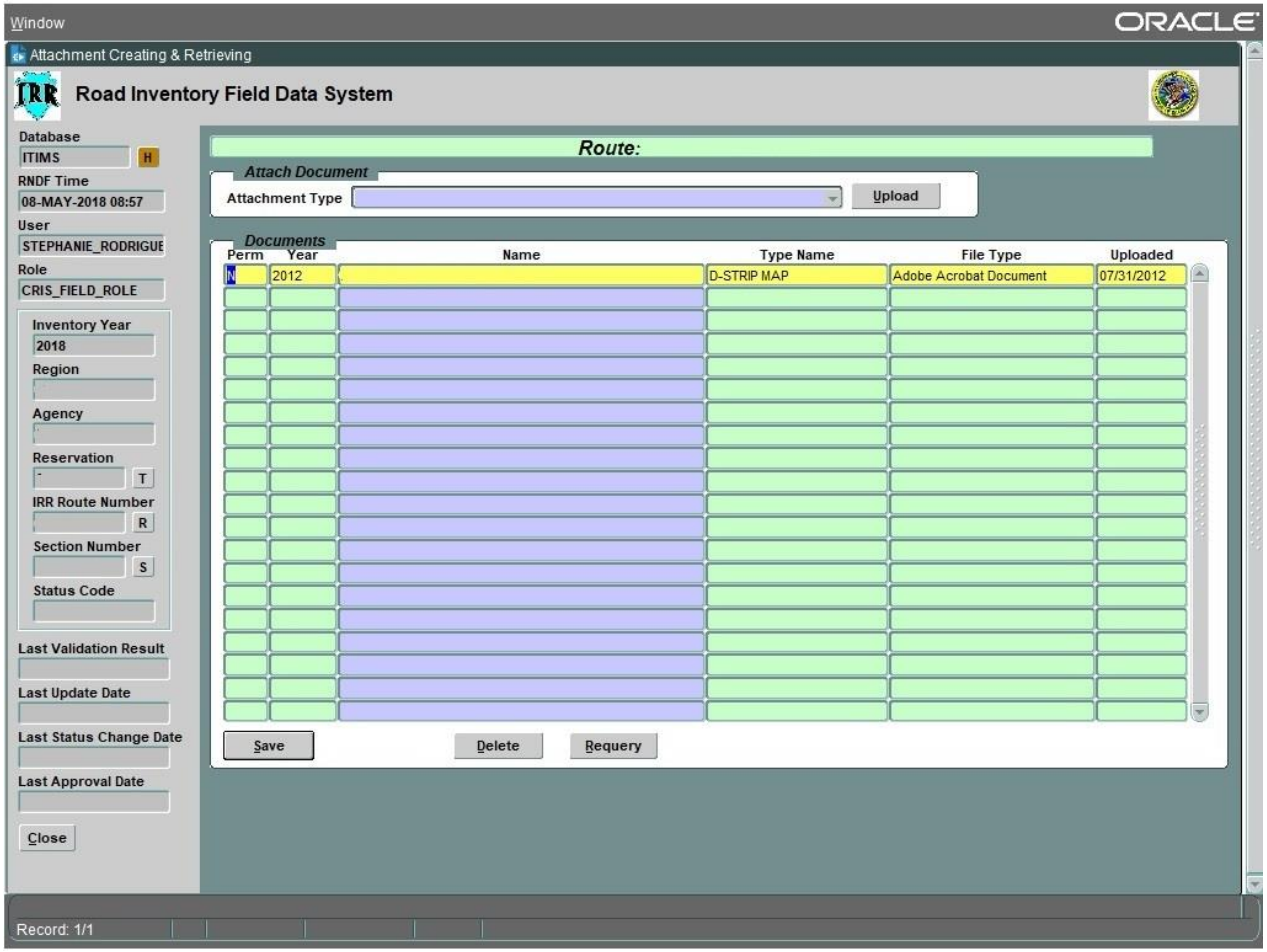
1 Open Form
Historical Report Configuration
Year
2018
Scope for 5 System Reports
State
01-ALABAMA
7 Bureau
8 State
9 Region
g Agency
v Reservation
Reports
Annual RNDF QA - FY only
Lookup Codes - FY only
Miscellaneous - FY only
Only Annual RNDF QA - FY only
Output - FY only
Output - rb any-level
Output - v1 any-level
Output crosstab - rb any-level
System-QA - rb any-level
Update Monitoring - v1 any-level
Update QA - v1 any-level
6 Open the Selected Report
Record: 1/1

RIFDS


Window
ORACLE
Attachment Creating & Retrieving
Road Inventory Field Data System
Database
ITIMS
H
RNDF Time
08-MAY-2018 08:57
User
STEPHANIE_RODRIGUE
Role
CRIS_FIELD_ROLE
Inventory Year
2018
Region
Agency
Reservation
T
IRR Route Number
R
Section Number
S
Status Code
Last Validation Result
Last Update Date
Last Status Change Date
Last Approval Date
Close
Route:
Attach Document
Attachment Type
Upload
Documents
Perm
Year
Name
Type Name
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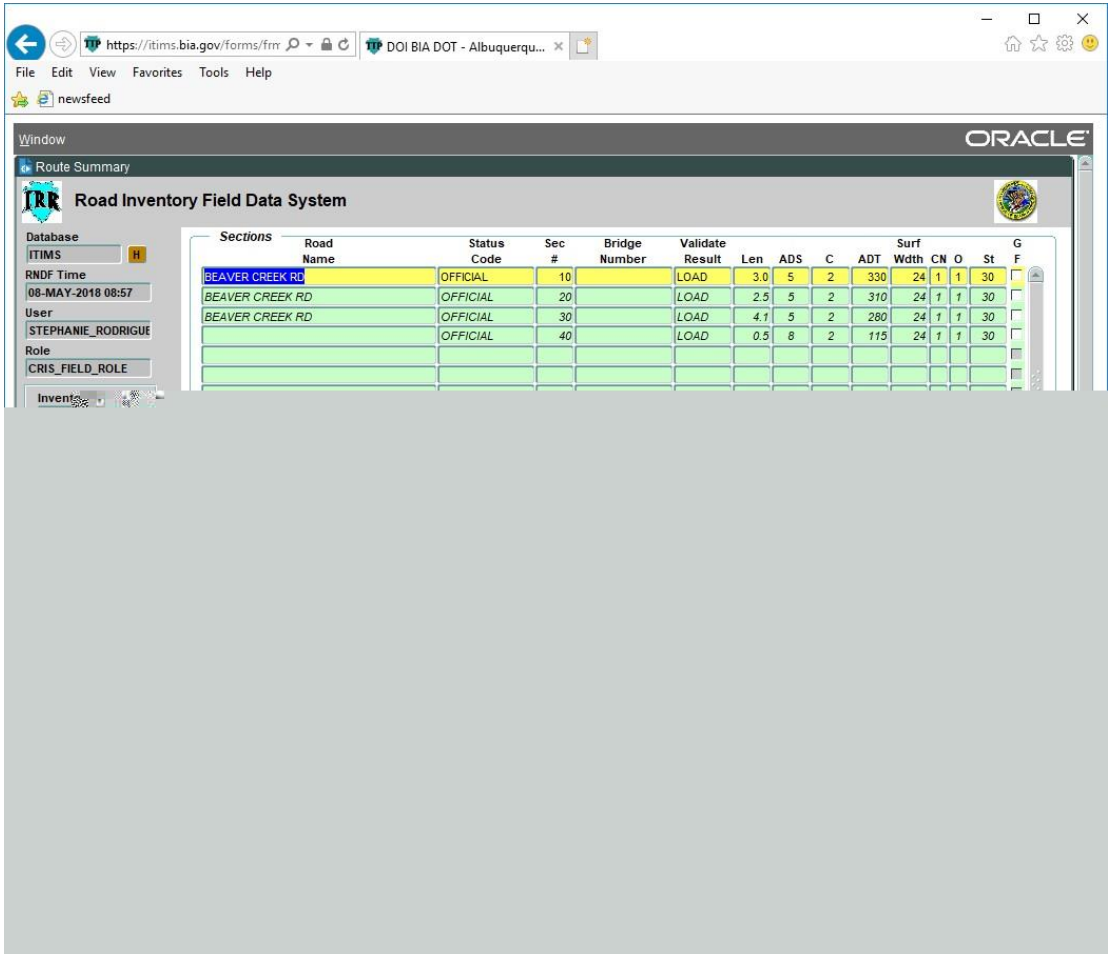
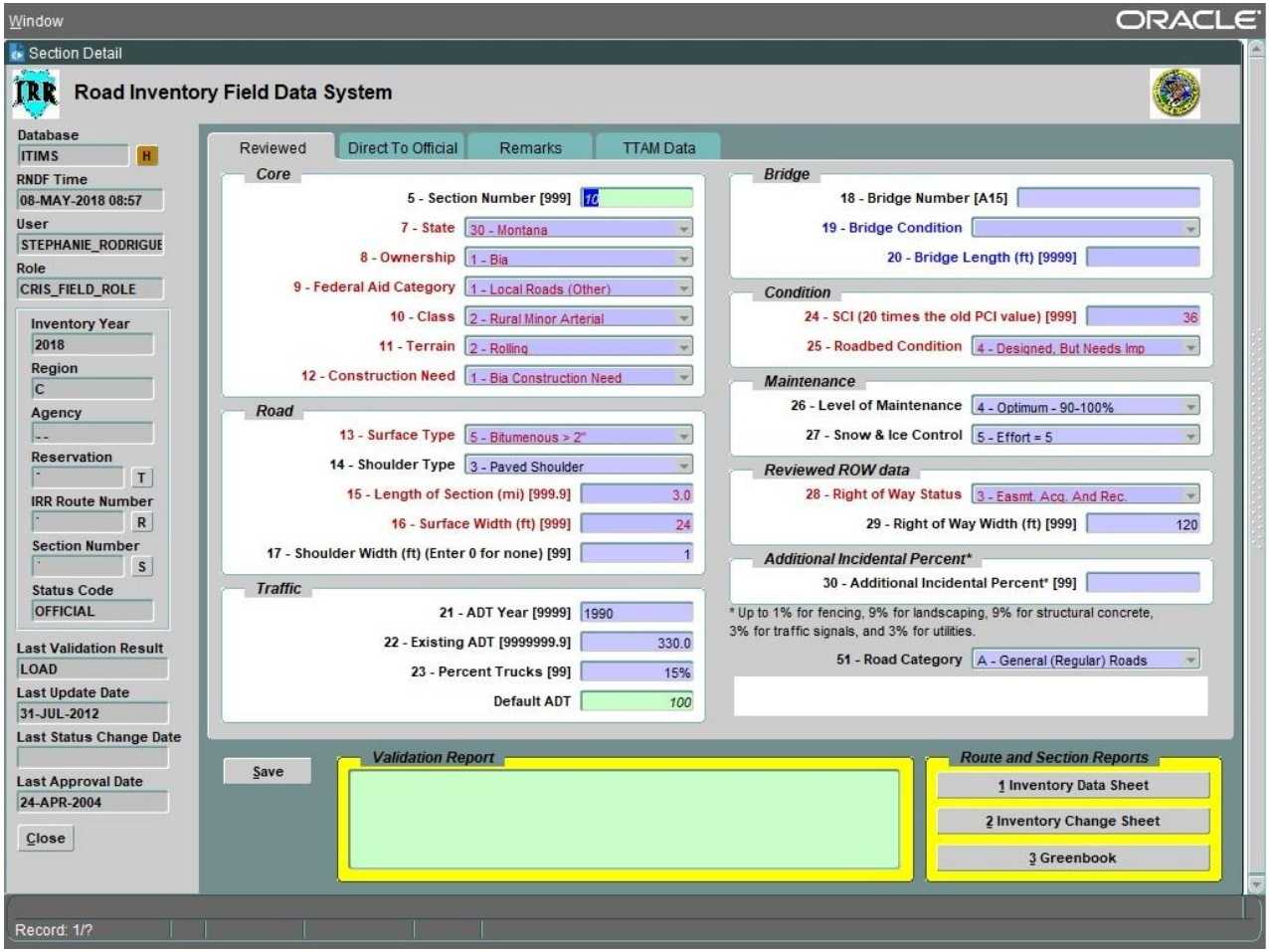
07/31/2012
Save
Delete
Requery
Record: 1/1

RIFDS


https://itims.bia.gov/forms/frm
DOI BIA DOT - Albuquerqu...
File Edit View Favorites Tools Help
newsfeed
Window
ORACLE
Route Summary
Road Inventory Field Data System
Database
ITIMS
RNDF Time
08-MAY-2018 08:57
User
STEPHANIE_RODRIGUE
Role
CRIS_FIELD_ROLE
Sections
Road Name | Status Code | Sec # | Bridge Number | Validate Result | Len | ADS | C | ADT | Surf Wdth | CN | O | St | G F
BEAVER CREEK RD | OFFICIAL | 10 | | LOAD | 3.0 | 5 | 2 | 330 | 24 | 1 | 1 | 30
BEAVER CREEK RD | OFFICIAL | 20 | | LOAD | 2.5 | 5 | 2 | 310 | 24 | 1 | 1 | 30
BEAVER CREEK RD | OFFICIAL | 30 | | LOAD | 4.1 | 5 | 2 | 280 | 24 | 1 | 1 | 30
OFFICIAL | 40 | | LOAD | 0.5 | 8 | 2 | 115 | 24 | 1 | 1 | 30

RIFDS


Window
ORACLE
Section Detail
Road Inventory Field Data System
Database
ITIMS
H
RNDF Time
08-MAY-2018 08:57
User
STEPHANIE_RODRIGUE
Role
CRIS_FIELD_ROLE
Inventory Year
2018
Region
C
Agency
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Reservation
T
IRR Route Number
R
Section Number
S
Status Code
OFFICIAL
Last Validation Result
LOAD
Last Update Date
31-JUL-2012
Last Status Change Date
Last Approval Date
24-APR-2004
Close
Reviewed
Direct To Official
Remarks
TTAM Data
Core
5 - Section Number [999]
7 - State
30 - Montana
8 - Ownership
1 - Bia
9 - Federal Aid Category
1 - Local Roads (Other)
10 - Class
2 - Rural Minor Arterial
11 - Terrain
2 - Rolling
12 - Construction Need
1 - Bia Construction Need
Road
13 - Surface Type
5 - Bitumenous > 2"
14 - Shoulder Type
3 - Paved Shoulder
15 - Length of Section (mi) [999.9]
3.0
16 - Surface Width (ft) [999]
24
17 - Shoulder Width (ft) (Enter 0 for none) [99]
1
Traffic
21 - ADT Year [9999]
1990
22 - Existing ADT [9999999.9]
330.0
23 - Percent Trucks [99]
15%
Default ADT
100
Bridge
18 - Bridge Number [A15]
19 - Bridge Condition
20 - Bridge Length (ft) [9999]
Condition
24 - SCI (20 times the old PCI value) [999]
36
25 - Roadbed Condition
4 - Designed, But Needs Imp
Maintenance
26 - Level of Maintenance
4 - Optimum - 90-100%
27 - Snow & Ice Control
5 - Effort = 5
Reviewed ROW data
28 - Right of Way Status
3 - Easmt. Acq. And Rec.
29 - Right of Way Width (ft) [999]
120
Additional Incidental Percent*
30 - Additional Incidental Percent* [99]
* Up to 1% for fencing, 9% for landscaping, 9% for structural concrete, 3% for traffic signals, and 3% for utilities.
51 - Road Category
A - General (Regular) Roads
Save
Validation Report
Route and Section Reports
1 Inventory Data Sheet
2 Inventory Change Sheet
3 Greenbook
Record: 1/?

Strip Maps

AREA C BILLINGS

AGENCY 55 FORT BELKNAP

RESERVATION 204 FORT BELKNAP

ROUTE 3 4 3.4
(NO.) (CLASS) (LENGTH MI.)

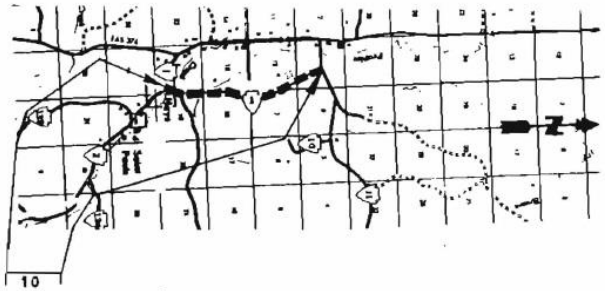
ESTIMATED COSTS FOR IMPROVEMENT

RIGHT OF WAY	M-$	
INCIDENTAL CONSTRUCTION		6.8
GRADE & DRAIN		
BASE AND/OR SURFACING		40.8
BRIDGES		
TOTAL	M-$	47.6

DATE OF THIS REPORT 02/01/88

COUNTY BLAINE
T26N, R23E

FORT BELKNAP INDIAN RESERVATION

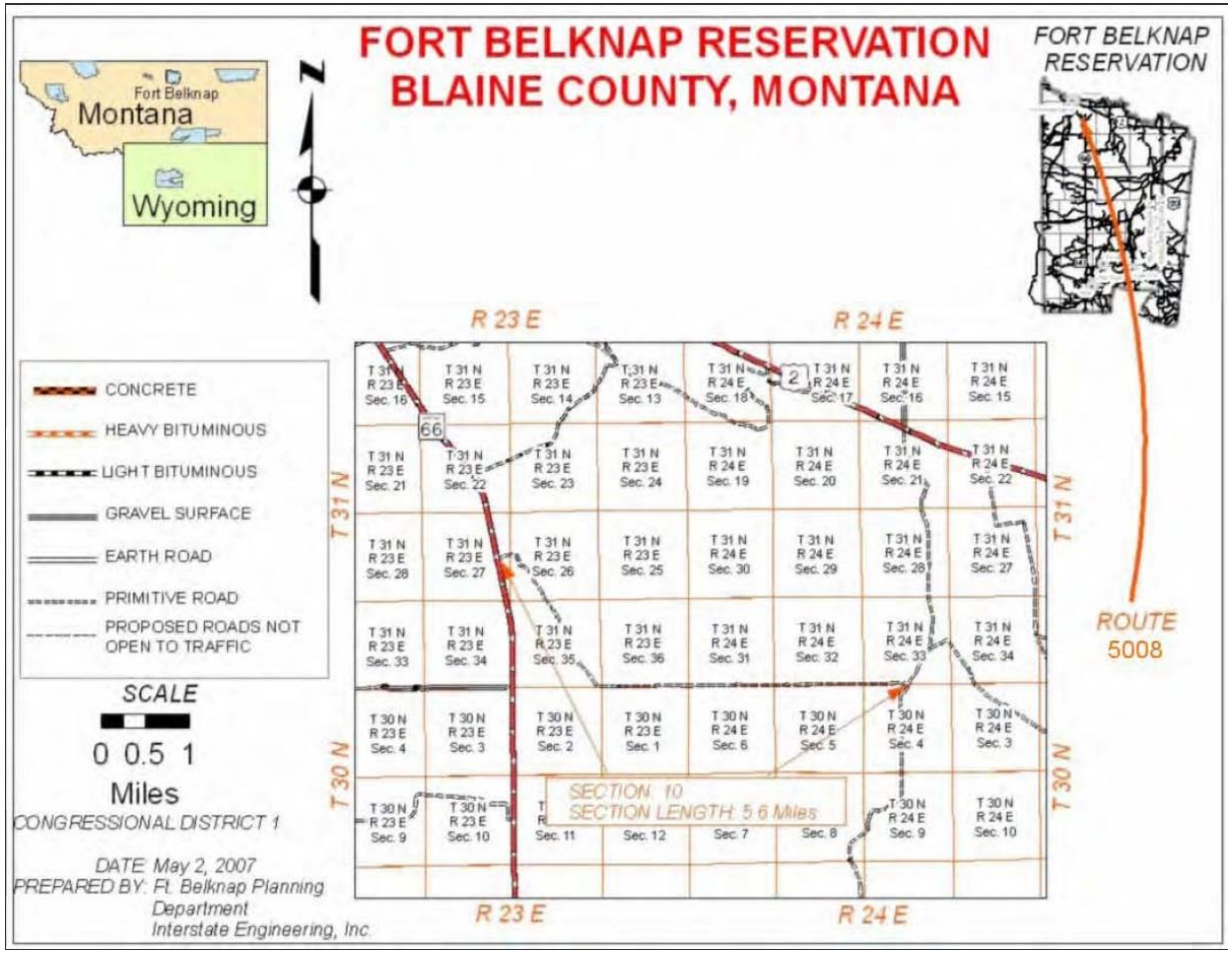


PAGE 3
HAYS CUT OFF
ROUTE 3

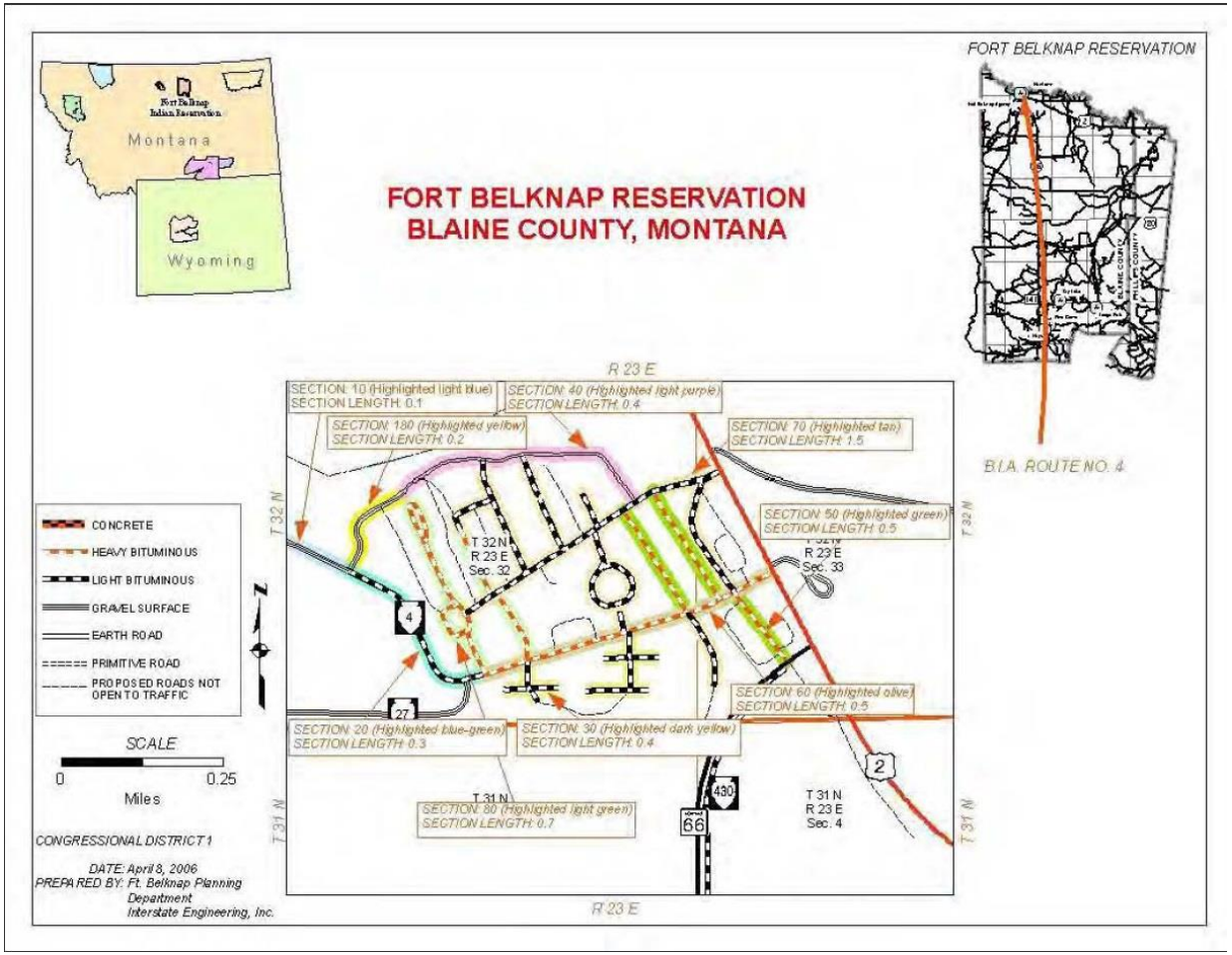
02/01/88
Atlas Map 2 of 3

SECTION NUMBER		10
COUNTY		5
CONGRESSIONAL DISTRICT		2
STATE		MT
LENGTH OR BRIDGE MILEPOST	(MILES)	3.4
JURISDICTION NAME		
NUMBER	(NO.)	0
BRIDGE NUMBER	(NO.)	
LENGTH	(L.F.)	
SURFACE WIDTH	(FT.)	24
TYPE		HBIT
SHOULDER WIDTH	(FT.)	3
TYPE		STAB
ROADWAY WIDTH	(FT.)	30
RIGHT OF WAY WIDTH	(FT.)	120
ADT (YEAR)	(YR.)	1974
(EXISTING)	(V.P.D.)	30
(EST. FOR ADT YEAR + 20)	(V.P.D.)	150
ADEQUACY DESIGN STANDARD NO.	(NO.)	14
FUTURE SURFACE TYPE		HBIT
RATING		96
SURFACE WIDTH & TYPE	(25)	25
SHOULDER WIDTH & TYPE	(6)	5
STOPPING SIGHT DISTANCE	(8)	8
NON-PASSING SIGHT DISTANCE	(6)	6
HORIZONTAL ALIGNMENT	(8)	8
GRADIENT	(6)	6
SAFETY	(6)	6
FOUNDATION CONDITION	(15)	15
WEARING SURFACE CONDITION	(10)	7
DRAINAGE CONDITION	(5)	5

Strip Maps


FORT BELKNAP RESERVATION
BLAINE COUNTY, MONTANA
Fort Belknap
Montana
Wyoming
N
FORT BELKNAP RESERVATION
R 23 E
R 24 E
T 31 N
T 30 N
CONCRETE
HEAVY BITUMINOUS
LIGHT BITUMINOUS
GRAVEL SURFACE
EARTH ROAD
PRIMITIVE ROAD
PROPOSED ROADS NOT OPEN TO TRAFFIC
SCALE
0 0.5 1
Miles
CONGRESSIONAL DISTRICT 1
DATE: May 2, 2007
PREPARED BY: Ft. Belknap Planning Department
Interstate Engineering, Inc.
SECTION 10
SECTION LENGTH: 5.6 Miles
ROUTE 5008

Strip Maps


FORT BELKNAP RESERVATION
BLAINE COUNTY, MONTANA
Montana
Wyoming
FORT BELKNAP RESERVATION
B.I.A. ROUTE NO. 4
R 23 E
SECTION: 10 (Highlighted light blue)
SECTION LENGTH: 0.1
SECTION: 40 (Highlighted light purple)
SECTION LENGTH: 0.4
SECTION: 180 (Highlighted yellow)
SECTION LENGTH: 0.2
SECTION: 70 (Highlighted tan)
SECTION LENGTH: 1.5
SECTION: 50 (Highlighted green)
SECTION LENGTH: 0.5
SECTION: 60 (Highlighted olive)
SECTION LENGTH: 0.5
SECTION: 20 (Highlighted blue-green)
SECTION LENGTH: 0.3
SECTION: 30 (Highlighted dark yellow)
SECTION LENGTH: 0.4
SECTION: 80 (Highlighted light green)
SECTION LENGTH: 0.7
T 32 N
T 31 N
T 32 N
R 23 E
Sec. 32
T 32 N
R 23 E
Sec. 33
T 31 N
R 23 E
Sec. 4
CONCRETE
HEAVY BITUMINOUS
LIGHT BITUMINOUS
GRAVEL SURFACE
EARTH ROAD
PRIMITIVE ROAD
PROPOSED ROADS NOT OPEN TO TRAFFIC
SCALE
0
0.25
Miles
CONGRESSIONAL DISTRICT 1
DATE: April 8, 2006
PREPARED BY: Ft. Belknap Planning Department
Interstate Engineering, Inc.

So How Do We Improve the Process?

- Streamline the data evaluation process by creating a value-added system to improve the efficiency of data collection, attachment creation, and data input, all while creating a Geographic Information System to visualize and improve utility for end users of the information.

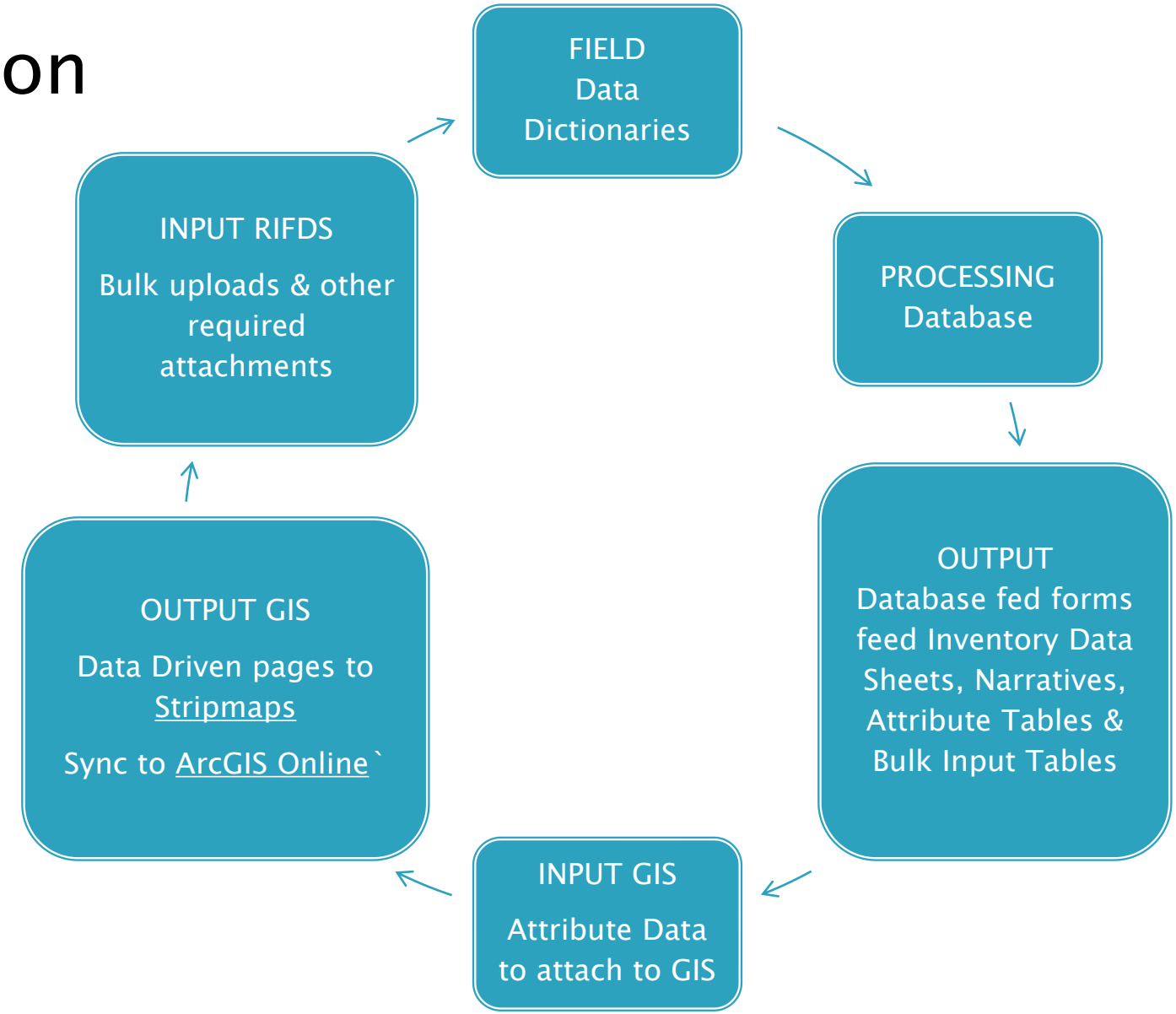
For each tribe, the first step is to evaluate what data is currently available:

- What is currently in a Tribal GIS?
  - Surveyed roads?
  - GPS'd roads?
  - Digitized roads?
- What is available through RIFDS?
  - Accuracy of strip maps?
  - Accuracy and presence of coordinates for section nodes?
- What is available publicly?
  - Quality and completeness of State data?
  - Quality and completeness of Census data?
  - Quality and completeness of USGS data?

Once Data Needs were Established, the rest were developed.

- A full circle approach to streamline both RIFDS entry and GIS incorporation

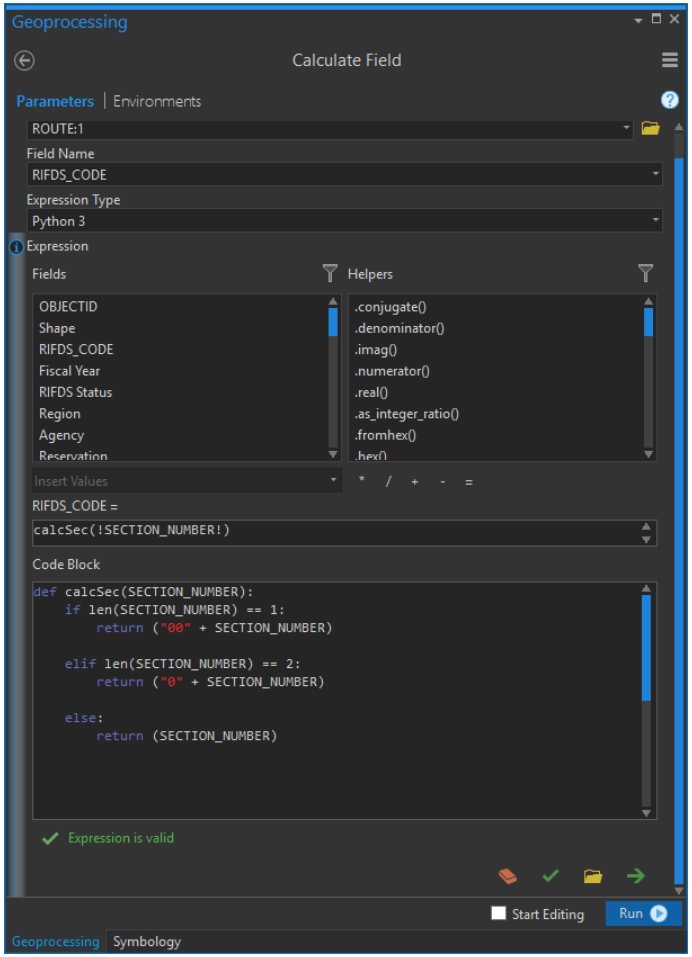
Vision


FIELD
Data
Dictionaries
PROCESSING
Database
OUTPUT
Database fed forms
feed Inventory Data
Sheets, Narratives,
Attribute Tables &
Bulk Input Tables
INPUT GIS
Attribute Data
to attach to GIS
OUTPUT GIS
Data Driven pages to
Stripmaps
Sync to ArcGIS Online`
INPUT RIFDS
Bulk uploads & other
required
attachments

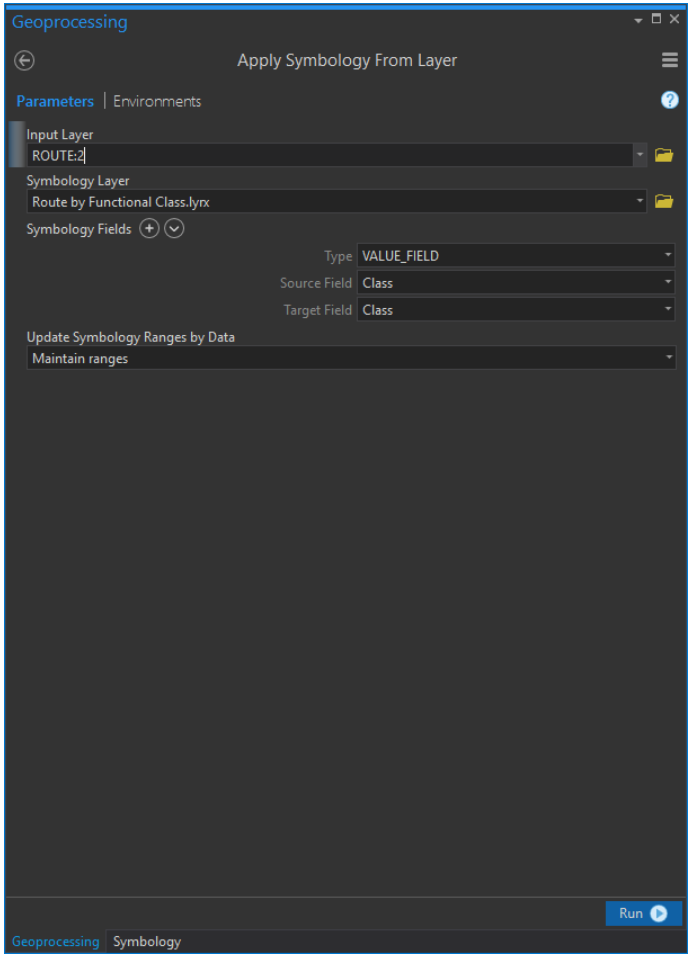
Streamlining

- In addition to the tools described above customized additional interfaces were created to improve the ease of sharing and training, including:
  - Pre-programmed queries & formulas
  - Layer symbologies
  - Labeling preferences

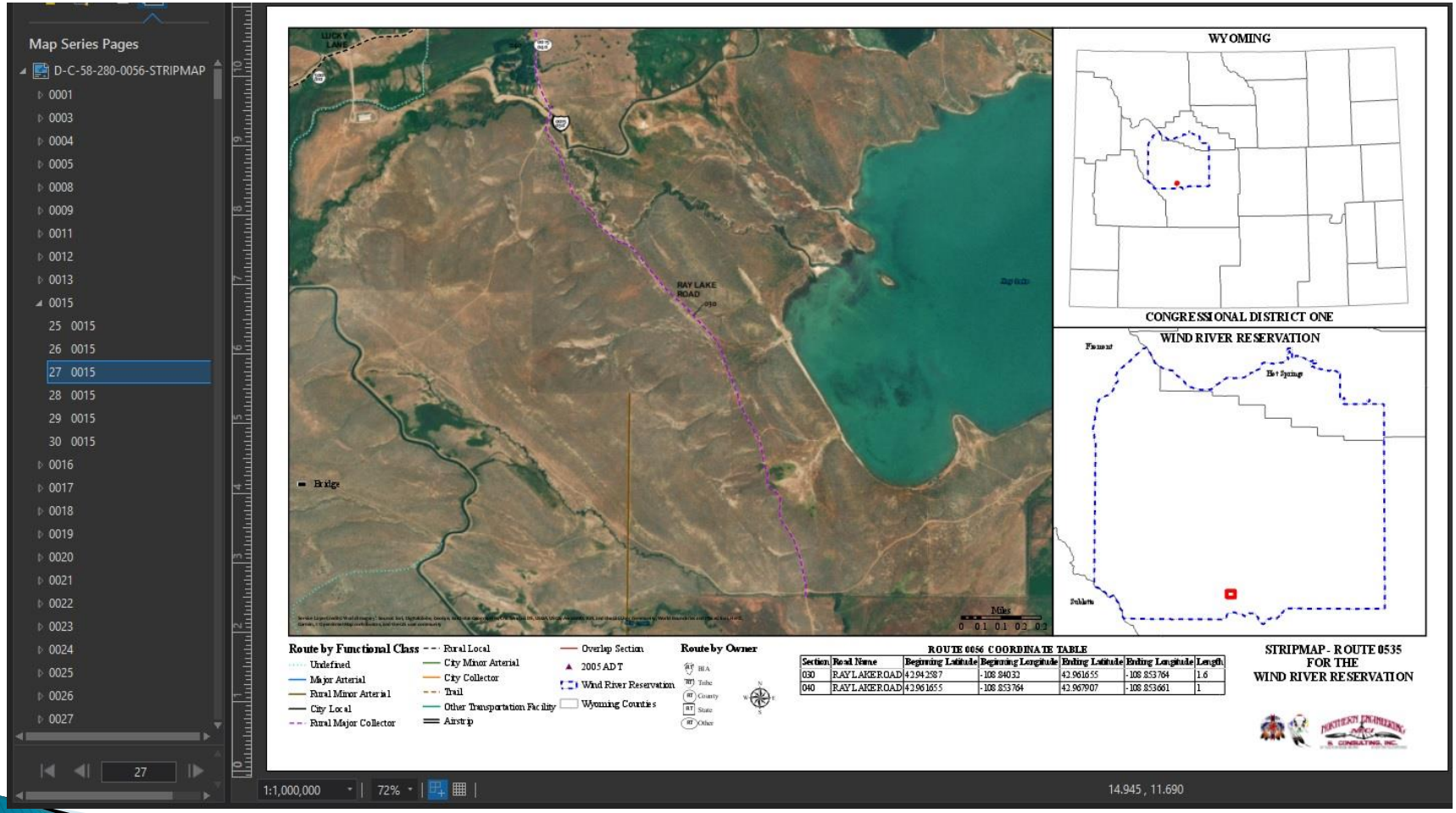
Calculate Field



Layer Symbology



Strip map from map series



Training

- With the creation of templates and approach, a training system was possible to bring in Tribal members to begin implementation of the system and science
- Fort Belknap was the first too participate in this process with my colleague Dawn Chandler joining me for on the job training in Billings
- As a result of this, the Fort Belknap roads are online

Outcomes

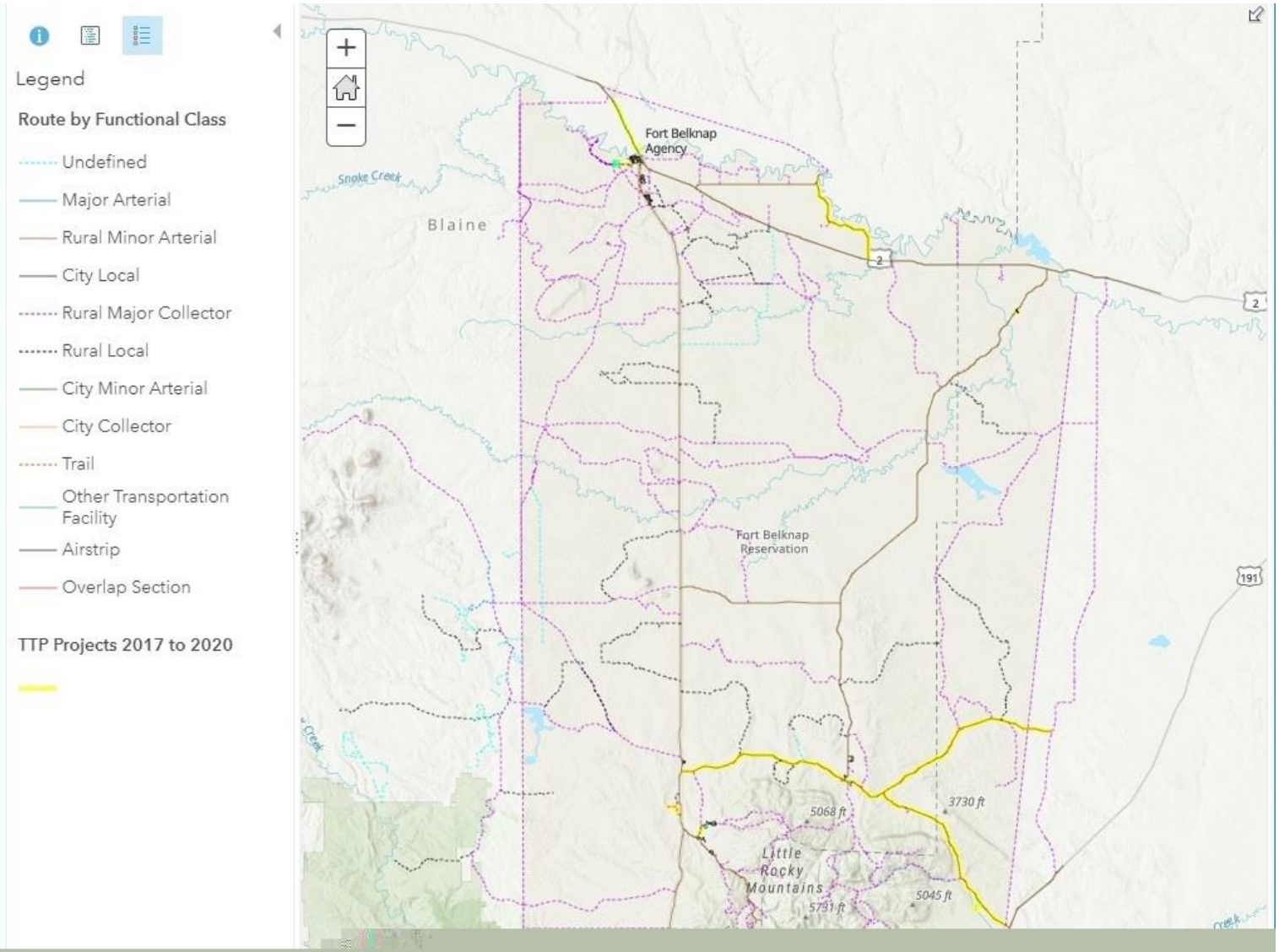
- Blackfeet, Fort Belknap, Fort Peck, and Wind River Tribes are in various stages of development of GIS for their TTP programs
- The final products will be hosted online
- Online hosting and sharing through ArcGIS Online:
  - Enables integration of other sources of data (federal, state, other Tribal) to create a more complete picture of Tribal assets for Leaders and decision makers.
- Enable Tribal & Departmental control of data accessibility and security settings

Next Steps

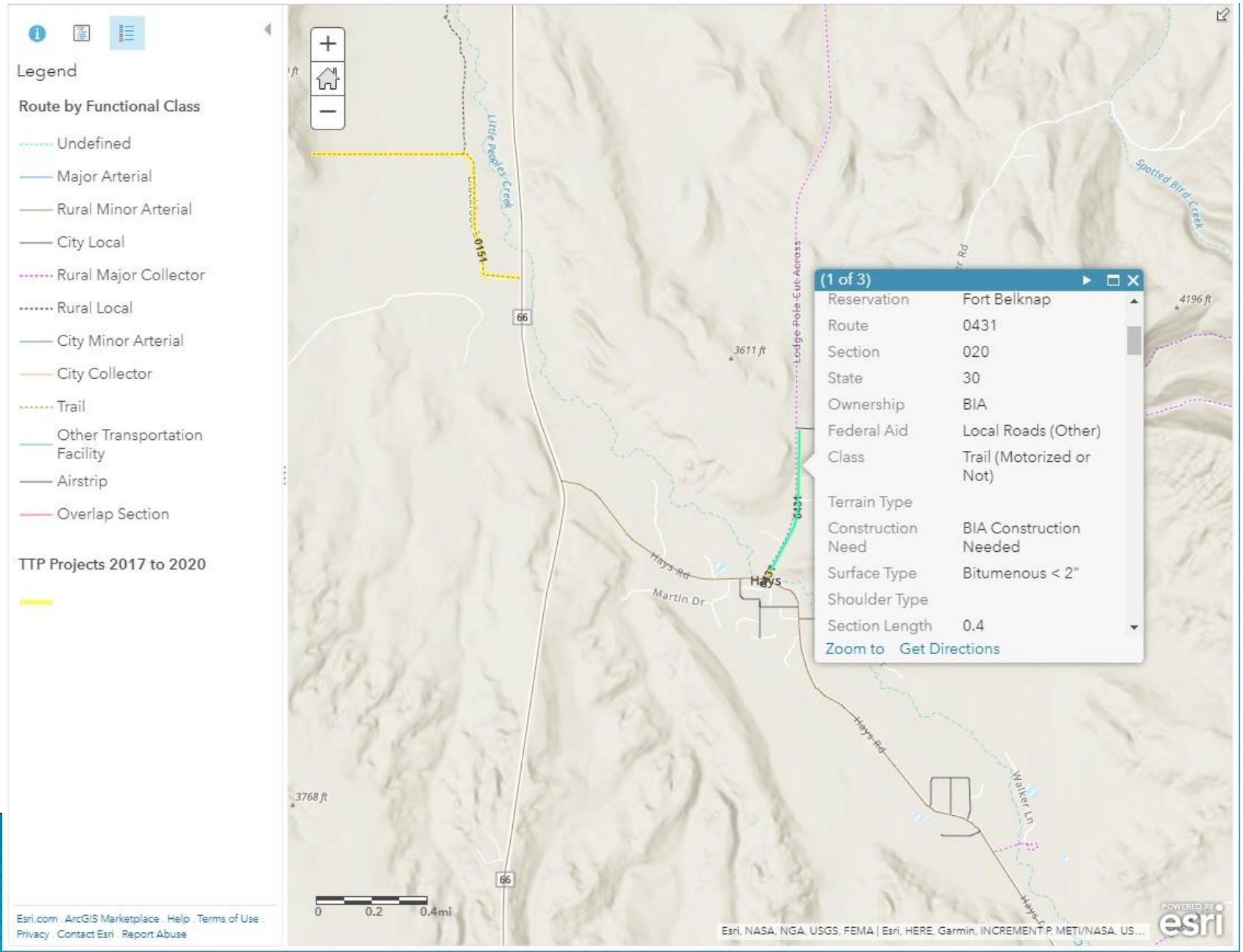
- Error tracking & repair
  - Utilization of new information to update existing registered Routes, including but not limited too:
    - Elimination of improper or duplicate Routes
    - Update of appropriate lengths
    - Update of nodes
    - Input of unintentionally omitted Routes
- Continued training
  - Training for launching and managing ArcGIS Online
  - Continued collaborative development as future challenges are addressed


SECO

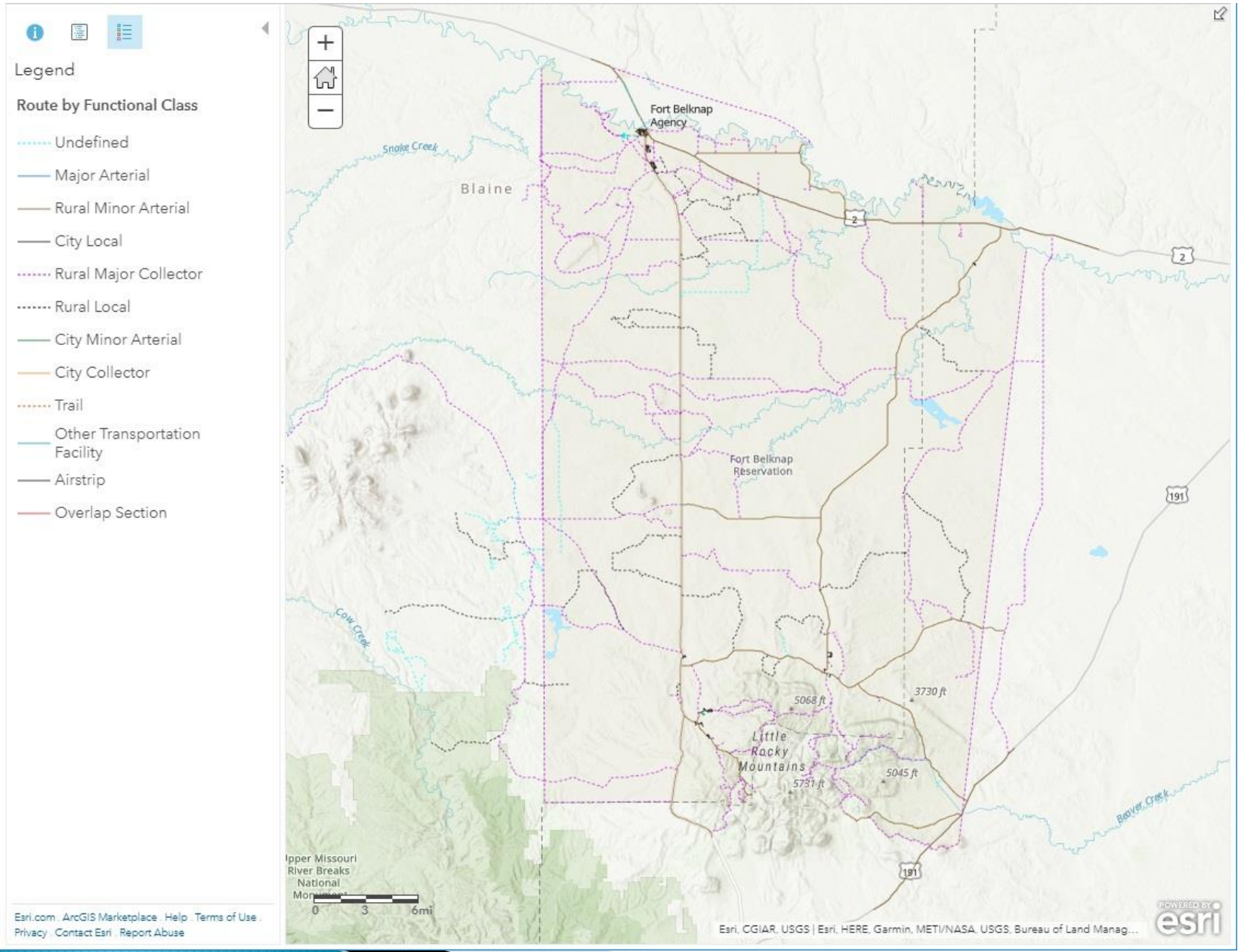
TTP Project Explorer



TTP Explorer Zoom



RIFDS


Legend
Route by Functional Class
Undefined
Major Arterial
Rural Minor Arterial
City Local
Rural Major Collector
Rural Local
City Minor Arterial
City Collector
Trail
Other Transportation Facility
Airstrip
Overlap Section
Fort Belknap Agency
Snake Creek
Blaine
Fort Belknap Reservation
Cow Creek
Little Rocky Mountains
5068 ft
3730 ft
5731 ft
5045 ft
Beaver Creek
2
191
0 3 6mi
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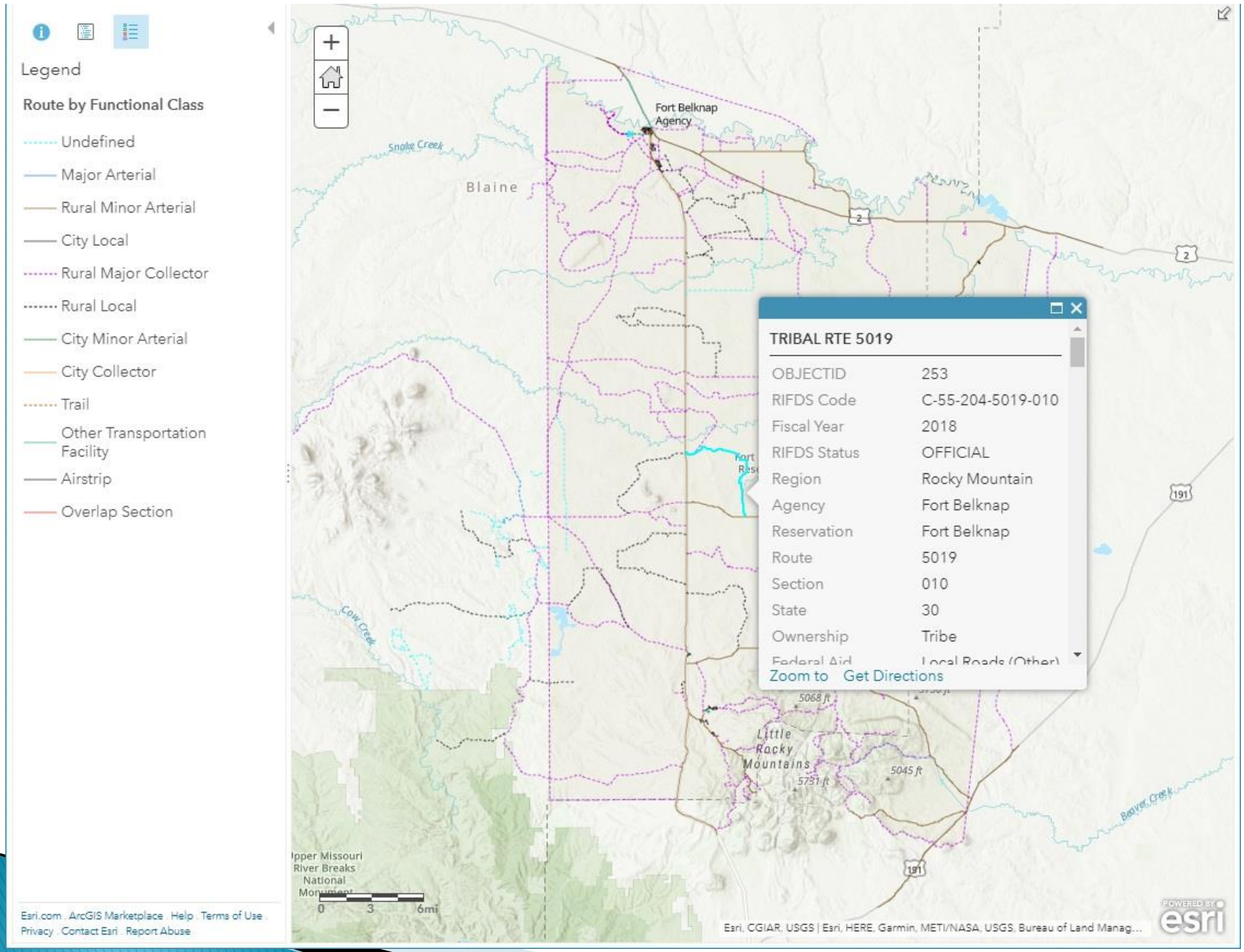
RIFDS


Legend
Route by Functional Class
Undefined
Major Arterial
Rural Minor Arterial
City Local
Rural Major Collector
Rural Local
City Minor Arterial
City Collector
Trail
Other Transportation Facility
Airstrip
Overlap Section
Fort Belknap Agency
Snake Creek
Blaine
TRIBAL RTE 5019
OBJECTID 253
RIFDS Code C-55-204-5019-010
Fiscal Year 2018
RIFDS Status OFFICIAL
Region Rocky Mountain
Agency Fort Belknap
Reservation Fort Belknap
Route 5019
Section 010
State 30
Ownership Tribe
Federal Aid Local Roads (Other)
Zoom to Get Directions
Little Rocky Mountains
5068 ft
5045 ft
5731 ft
Cow Creek
Beaver Creek
Upper Missouri River Breaks National Monument
0 3 6mi
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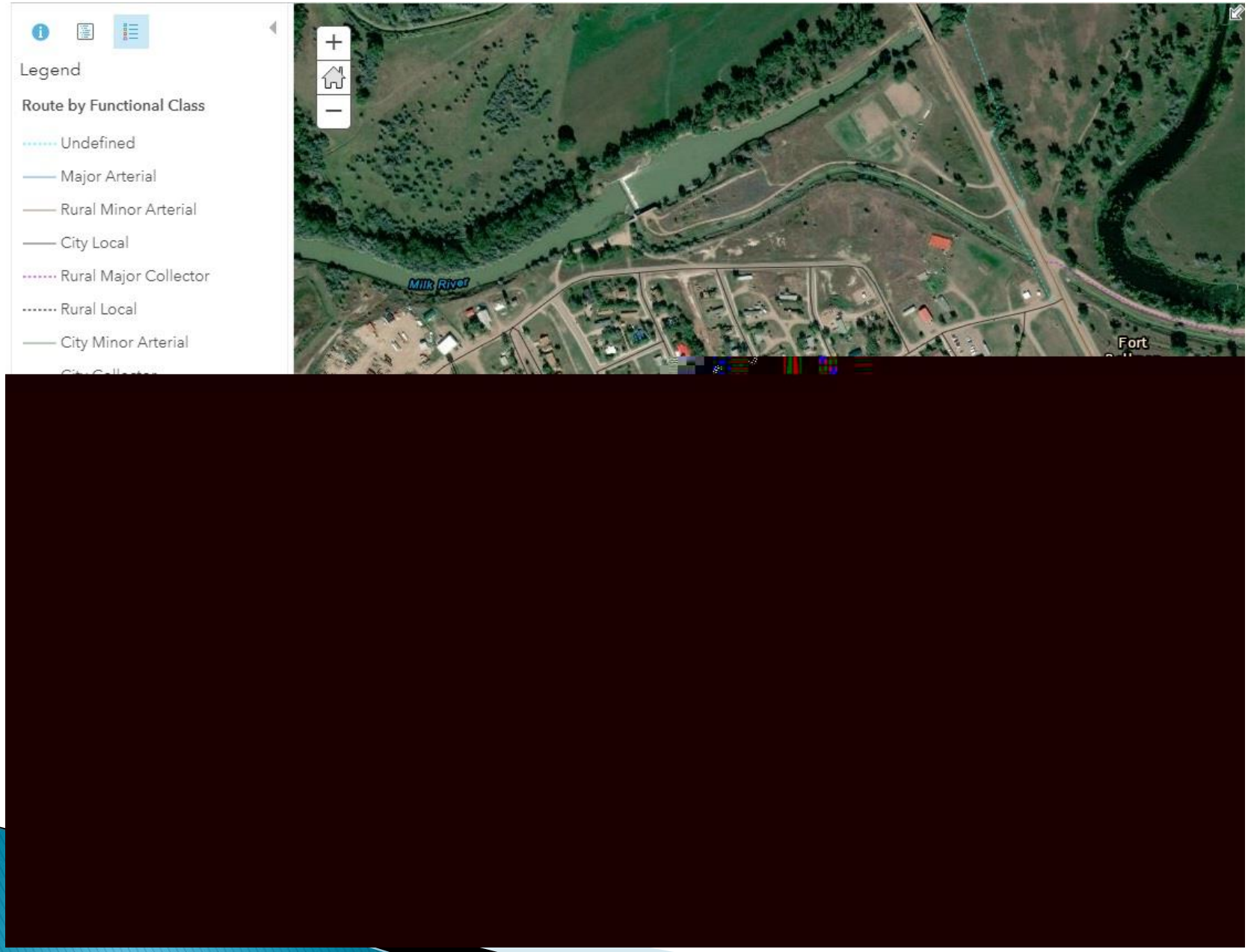
esri

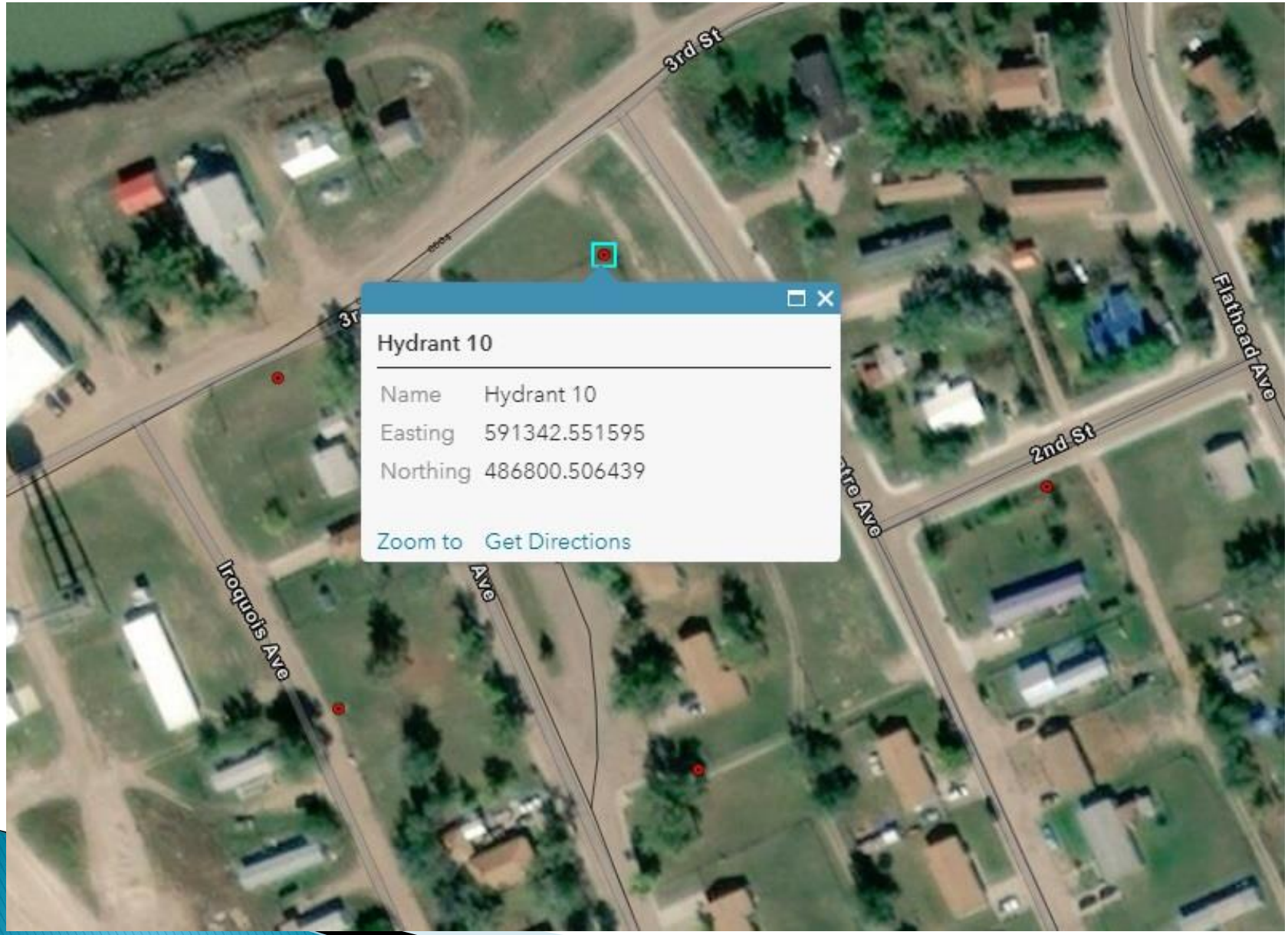
RIFDS


Legend
Route by Functional Class
Undefined
Major Arterial
Rural Minor Arterial
City Local
Rural Major Collector

RIFDS


Legend
Route by Functional Class
Undefined
Major Arterial
Rural Minor Arterial
City Local
Rural Major Collector
Rural Local
City Minor Arterial
Milk River
Fort

Fire Hydrant Locate



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