Field Work

Wetland Restoration Training

BOARD OF WATER AND SOIL RESOURCES

Site Survey

- Methods
  - VRS

For this presentation we are going to assume that if a Site Survey is deemed necessary that a Survey Grade GPS using VRS will be used. Other methods may be used such as site base surveys, but we are going to assume that VRS is mostly used.

Survey Control

- Establishes and Maintains
  - Horizontal Control
  - Vertical Control
- Used for the life of the Project

When surveying you will need to set up survey control. Survey control is needed to establish and maintain both horizontal and vertical control throughout the life of the project. It provides more accurate and effective projects. Having survey control helps with the Design, Implementation, Monitoring, and Management, Maintenance, and Repair of the project- life of the project.
Establishing control is typically one of the first survey functions to be performed on a new project.

Good Survey Control

- Reduces Errors
- Consistent and Reproducible Location & Elevation
- Allows for Troubleshooting

When good survey control is established, it assures consistent and reproducible location and elevation data. It reduces the possibility of errors. And it more easily allows for troubleshooting to resolve discrepancies that may occur before, during or after the survey.

Vertical Datum

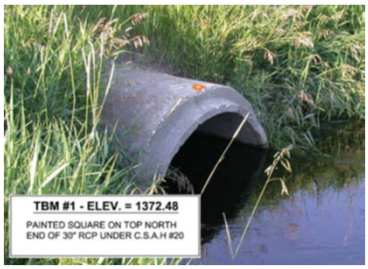
- Surface of zero elevations to which heights of various points are referred.
- VRS is usually pretty close to MSL

Survey control can be split up into Vertical control and Horizontal control. A vertical datum is a surface of zero elevation to which heights of various points are referrenced in order for those heights to be in a consistent system. Elevation only has meaning when it is referenced to some start point. So, for example, mean sea level is considered zero and then in that datum heights are measured off of mean sea level. Generally, VRS is pretty close to geodetic mean sea level elevation upon startup.

Vertical Control

- Absolute Vertical Control
  - Correlating a survey's vertical datum to an established set of control points
  - Today 1988 NAVD is predominately used

- Relative Vertical Control
  - Correlating a survey's vertical datum to a set of locally established control points.



When selecting a vertical datum you can chose to have an absolute vertical control or a relative vertical control. Correlating a survey's vertical datum to an established high accuracy set of control points that are part of the National Geodetic Vertical Network would be establishing an absolute vertical control. Vertical elevation for this network is often referred as "Mean Seal Level" datum. Today, the 1988 NAVD is predominately used across much of North America. Note, that there is an elevation difference between the 1988 NAVD and 1929 NGVD.
A relative vertical control is correlating a survey's vertical datum to a set of locally established control points.

Absolute Vertical Control

Pros

- Is proven and reliable
- **Can always be reproduced!!**
- Has minimal errors
- Better ability to troubleshoot any errors / discrepancies

Cons

- Require some upfront planning
- May take a little more time to locate and establish control

Relative Vertical Control

Pros

- General quick and easy

Cons

- Increased risk of error
- Control elevation can be lost/destroyed
- Not accurately reproducible – short or long-term

How do I choose for my project?

The level of survey control (accuracy) required will primarily be dependent on project type and scope

- Low Eng. Job Class
- Low Risk/Cost Practice
- Short Implementation Timeframe
- Low Maintenance/Monitoring
- Shorter Term Project

- High Eng. Job Class
- High Risk/Cost Practice
- Long Implementation Timeframe
- High Maintenance/Monitoring
- Long Term (Perpetual) Project

Benchmarks

- Permanent
  - High order set and maintained by others

Permanent benchmarks are what the title says they are permanent. They are set and maintained by others. They will be present permanently.

Benchmarks

- Temporary

Temporary benchmarks are benchmarks that created by you. They are rebar or hubs in the ground, they are markings on a telephone pole, or a marking on a culvert. They are not permanent and like I said they are created by you.

Benchmarks

- Construction

Lastly are construction benchmarks. These are benchmarks that are created by you. They serve the purpose for construction, so they only need to be maintained the span of construction. They should be established near construction areas. They allow for more convenient checking and allows other survey equipment like laser levels to be used for construction work. Keep in mind that they should be checked regularly for accuracy as they can be damaged or altered by construction equipment.

Permanent/Temporary Benchmarks

- A minimum of 2 are required
- They should be planned to last through construction
- Try to locate as near as possible, but not directly within planned construction areas
- Use permanent benchmarks when nearby

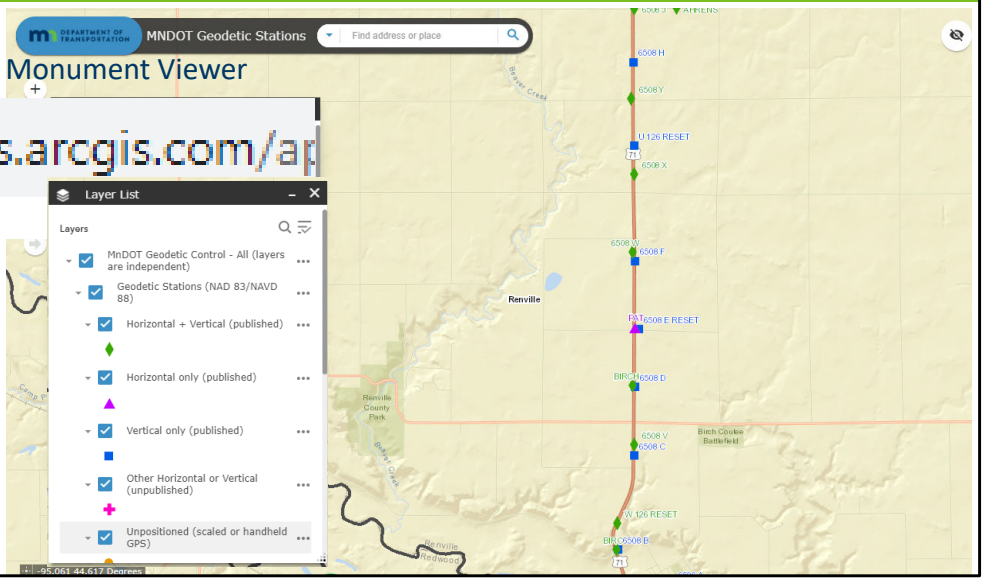
Who has ever located a Geodetic Monument?

YES

NO

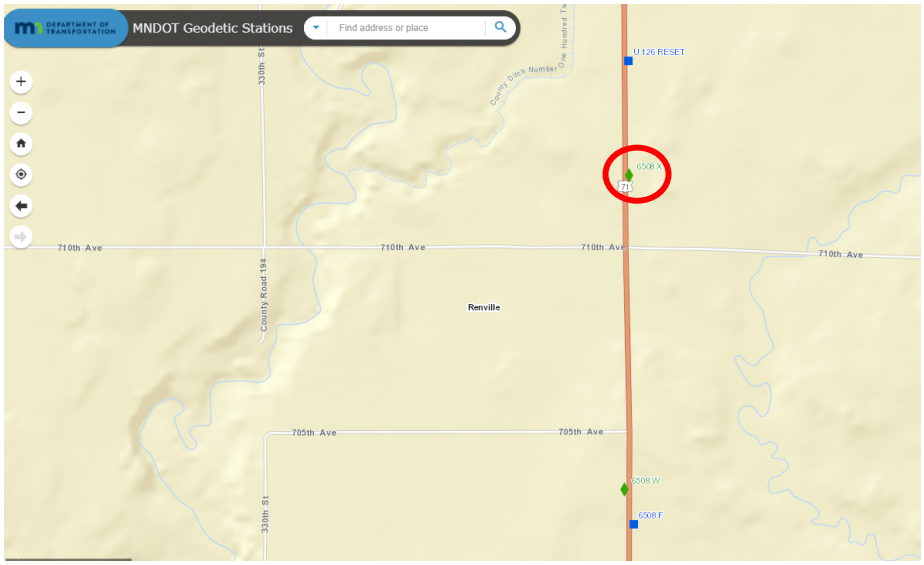
How do I locate a Geodetic Monument?

- MnDOT Geodetics Monument Viewer

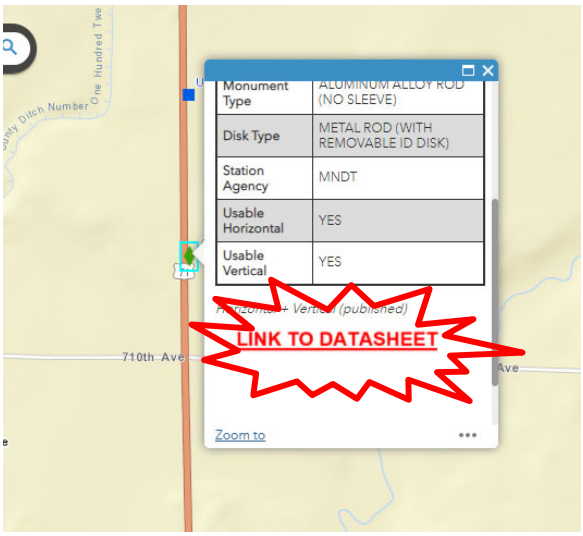


So how do you locate a permanent benchmark. Example of a permanent benchmark is a Geodetic Monument.

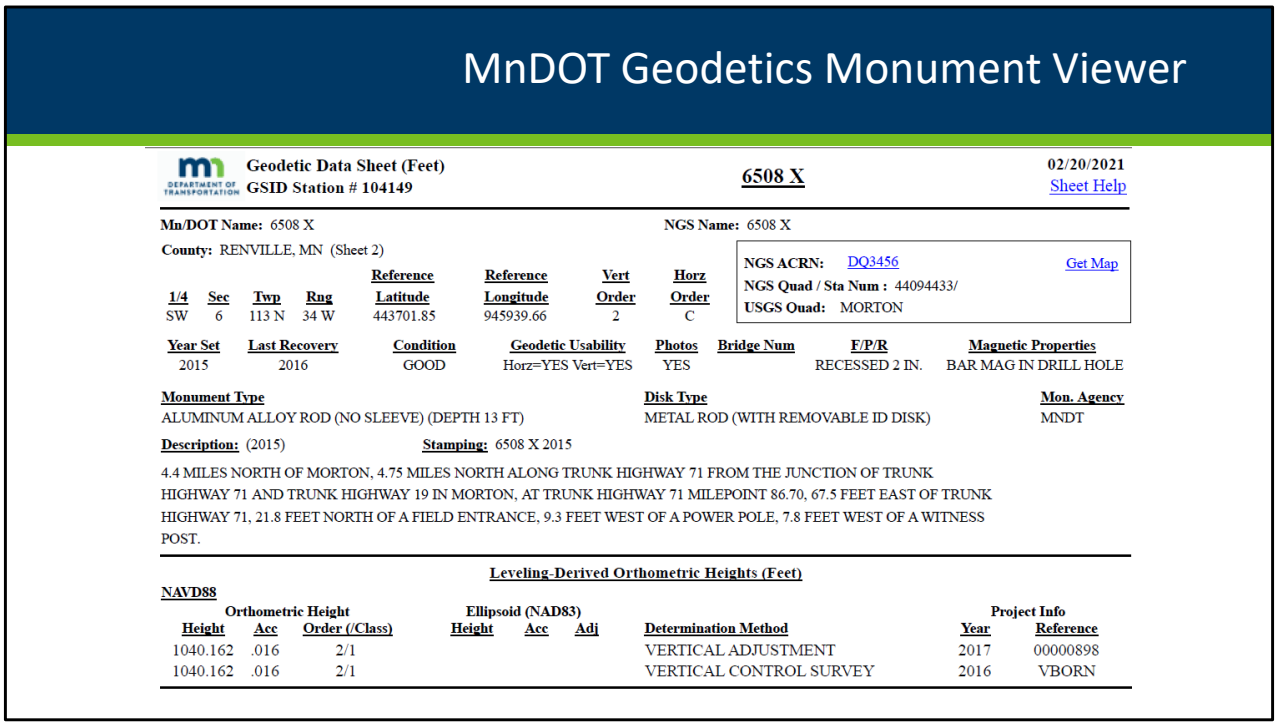
MnDOT Geodetics Monument Viewer



MnDOT Geodetic Monument Viewer



MnDOT Geodetics Monument Viewer



Geodetic Data Sheet (Feet)
GSID Station # 104149

6508 X

02/20/2021
Sheet Help

Mn/DOT Name: 6508 X
NGS Name: 6508 X
County: RENVILLE, MN (Sheet 2)

NGS ACRN: DQ3456 Get Map
NGS Quad / Sta Num : 44094433/
USGS Quad: MORTON

1/4	Sec	Twp	Rng	Reference Latitude	Reference Longitude	Vert Order	Horz Order
SW	6	113 N	34 W	443701.85	945939.66	2	C

Year Set	Last Recovery	Condition	Geodetic Usability	Photos	Bridge Num	F/P/R	Magnetic Properties
2015	2016	GOOD	Horz=YES Vert=YES	YES		RECESSED 2 IN.	BAR MAG IN DRILL HOLE

Monument Type	Disk Type	Mon. Agency
ALUMINUM ALLOY ROD (NO SLEEVE) (DEPTH 13 FT)	METAL ROD (WITH REMOVABLE ID DISK)	MNDT

Description: (2015) **Stamping:** 6508 X 2015

4.4 MILES NORTH OF MORTON, 4.75 MILES NORTH ALONG TRUNK HIGHWAY 71 FROM THE JUNCTION OF TRUNK HIGHWAY 71 AND TRUNK HIGHWAY 19 IN MORTON, AT TRUNK HIGHWAY 71 MILEPOINT 86.70, 67.5 FEET EAST OF TRUNK HIGHWAY 71, 21.8 FEET NORTH OF A FIELD ENTRANCE, 9.3 FEET WEST OF A POWER POLE, 7.8 FEET WEST OF A WITNESS POST.

Leveling-Derived Orthometric Heights (Feet)

NAVD88

Orthometric Height			Ellipsoid (NAD83)				Project Info	
Height	Acc	Order (/Class)	Height	Acc	Adj	Determination Method	Year	Reference
1040.162	.016	2/1				VERTICAL ADJUSTMENT	2017	00000898
1040.162	.016	2/1				VERTICAL CONTROL SURVEY	2016	VBORN

The DataSheet will give you a description of where the marker is located, it lists the latitude and longitude and the elevation. Also at the bottom of the Datasheet will be images of the location and of the monument.

MnDOT Geodetics Monument Viewer

Location picture from the Datasheet.

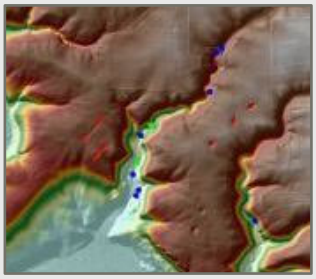
MnDOT Geodetics Monument Viewer

Here is a picture of the actual monument from the Datasheet.
By shooting a Geodetic Monument you are linking your project to a permanent monument. For a project like a Grassed Waterway this is not necessary, but for a project like a Wetland Restoration with a perpetual easement this might be preferred because of the reasons we spoke about earlier in this presentation.
You will need to calibrate your project to the coordinates & elevation of the geodetic monument.

Developing Site Topography

LiDAR Data ⟷ Field Survey

Both/Hybrid?



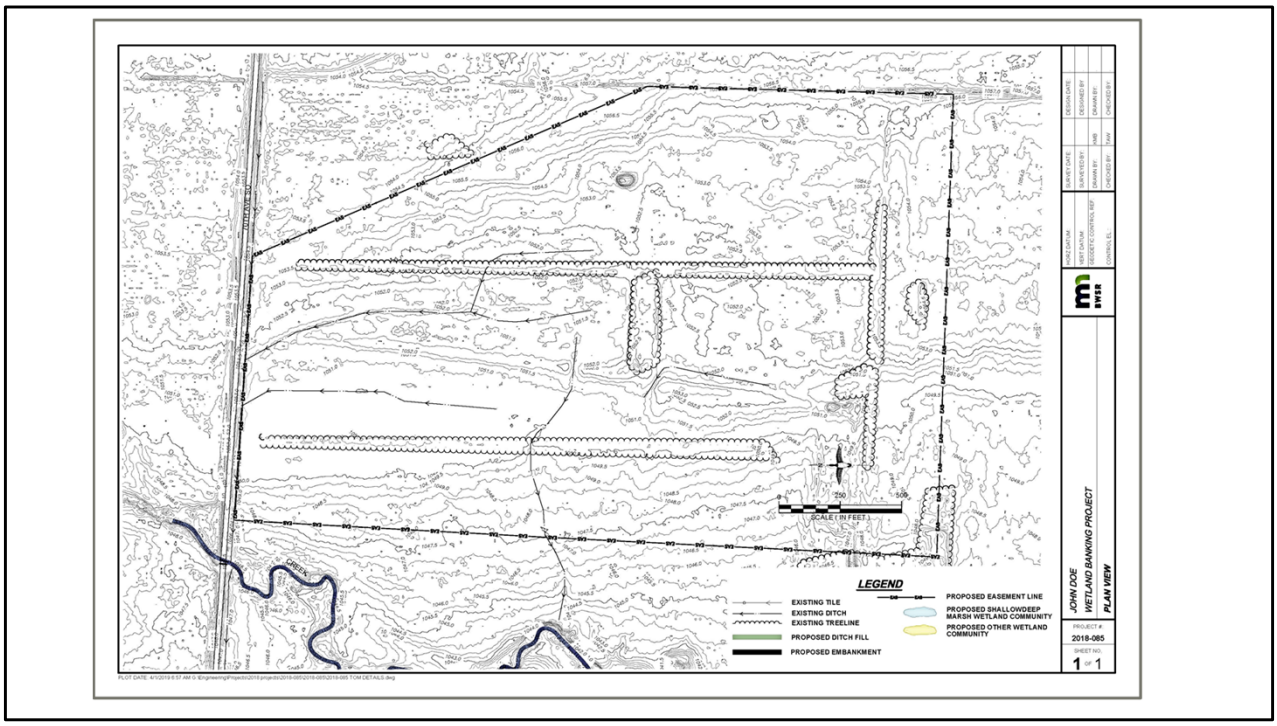
Now that we just talked however many minutes are surveying and benchmarks; how do you know if a survey is needed? Part of any restoration plan will be to develop a concept map and part of the map will include developing site topography. Now that topography could come from LiDAR, survey, or a combination of both.

Developing Site Topography

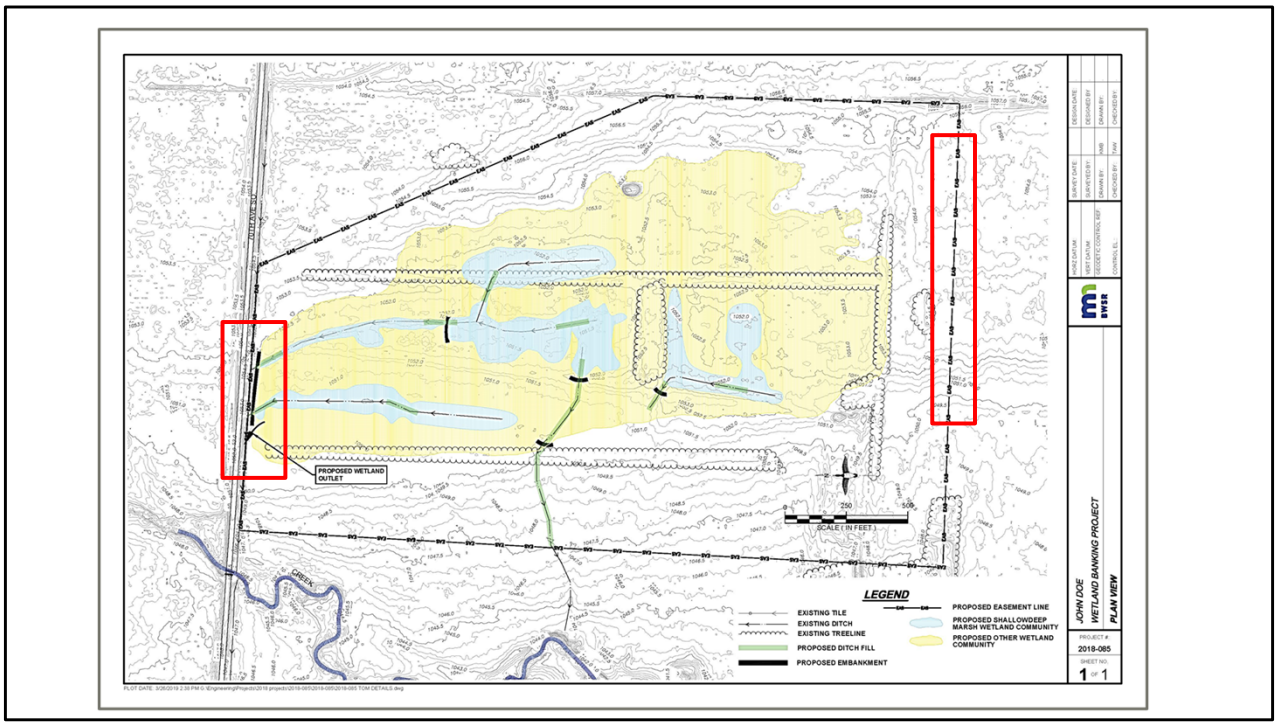
- Create LiDAR topo map
- Identify what needs to be surveyed
- Identify what other data needs to be field collected
- Conduct field work
- Merge survey & LiDAR
- Finalize topo map

You will likely start off by creating a Topo map from LiDAR and creating a rough concept plan from that. From that concept plan you will be able to better gage what areas will need to be surveyed and what other data items you will need. After you know what you need in the field you would conduct that field work. Back in the office then if applicable you would merge the survey and the LiDAR data together – which might also include adjusting the LiDAR data – to create a final topo map used for design. When merging the survey & LiDAR be aware that the LiDAR may need to be adjusted to match the elevations that were obtained when surveying.

Here is a flat, ditch drained landscape. The LiDAR with 2’ or 5’ contours may not show much detail.



Here is taking the LiDAR and making the contours at a 0.5’ interval. We are able to see a little more detail with the smaller contour interval. Depending on what the goals of the project are it might be necessary to show more detail.

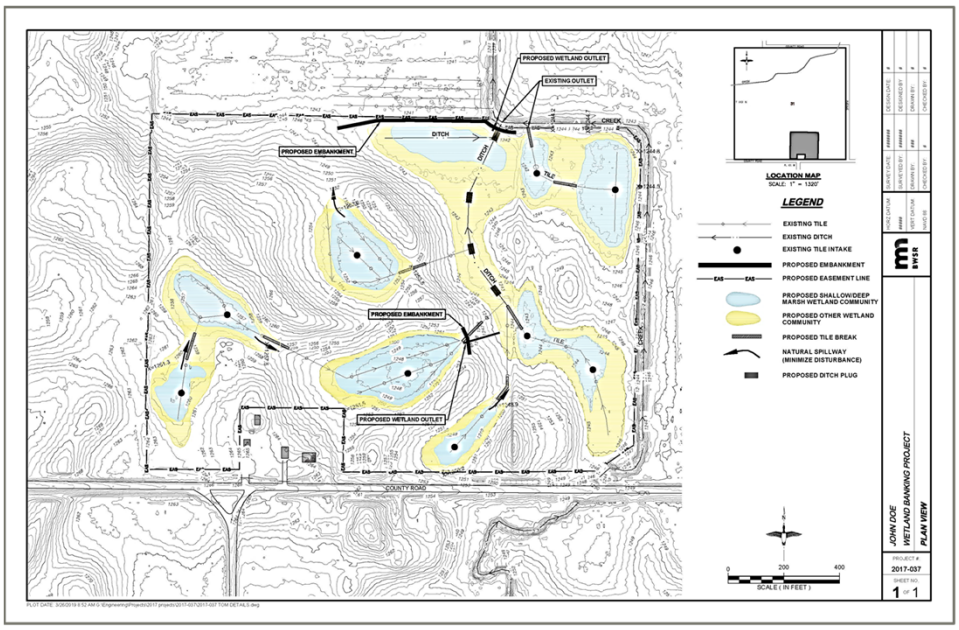


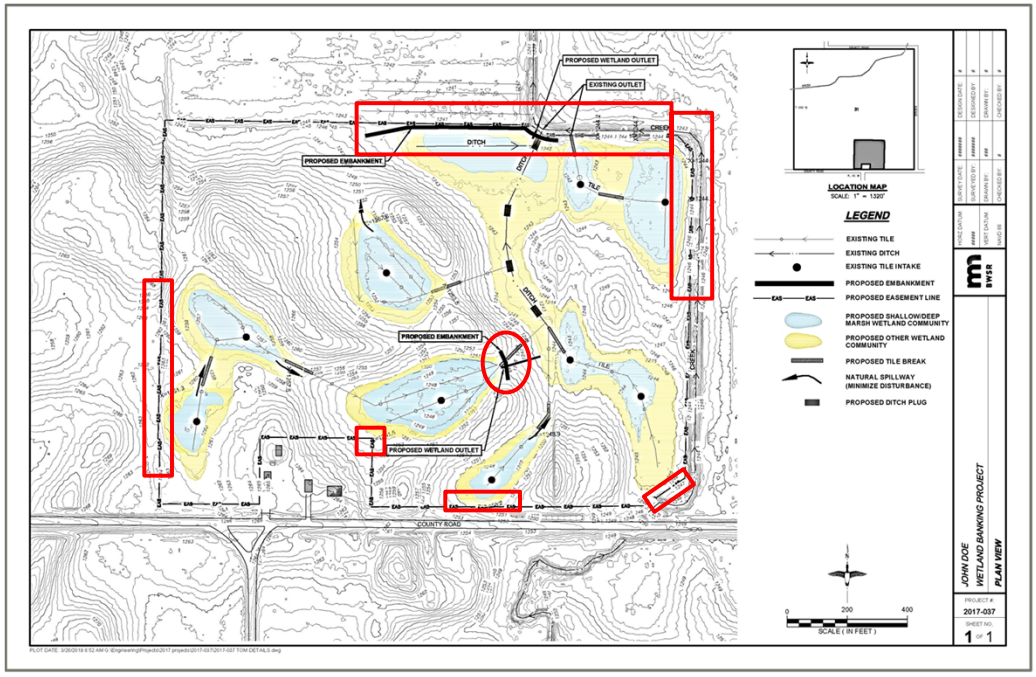
If the yellow area is the proposed wetland area the red blocked areas will be areas for sure you will need to get additional survey. Any area where an embankment or structure will be located a detailed survey will be needed. It is very important that if there are any boundaries that may be questionable or may be a low spot will need to be surveyed to verify that the wetland pool will not affect non-easement areas. Ditches may need to be surveyed for quantities.


4
510th St

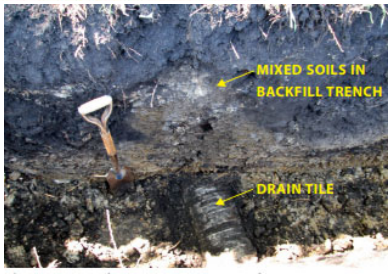

1240
1250
1260
1270
1280
510th St
4

Mark ONE area you think will need to be surveyed.




PROPOSED WETLAND OUTLET
EXISTING OUTLET
DITCH
PROPOSED EMBANKMENT
PROPOSED EMBANKMENT
PROPOSED WETLAND OUTLET
COUNTY ROAD
LOCATION MAP
SCALE: 1" = 1320'
LEGEND
EXISTING TILE
EXISTING DITCH
EXISTING TILE INTAKE
PROPOSED EMBANKMENT
PROPOSED EASEMENT LINE
PROPOSED SHALLOW/DEEP MARSH WETLAND COMMUNITY
PROPOSED OTHER WETLAND COMMUNITY
PROPOSED TILE BREAK
NATURAL SPILLWAY (MINIMIZE DISTURBANCE)
PROPOSED DITCH PLUG
0
200
400
SCALE (IN FEET)
JOHN DOE
WETLAND BANKING PROJECT
PLAN VIEW
PROJECT #
2017-037
SHEET NO.
1 OF 1
BWSR

Tile Investigation



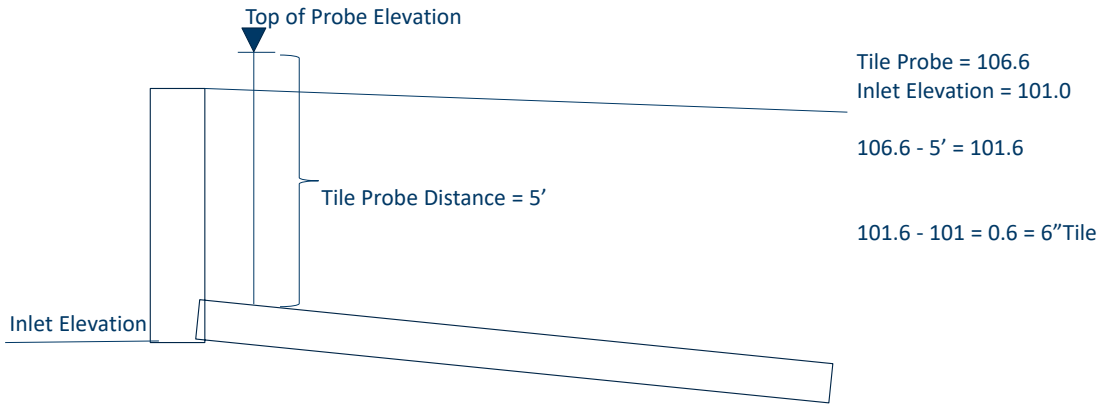
You will hopefully be given a tile map and will have done some arial tile investigation in the office, but it is also important to locate and confirm tile systems in the field. The existence of tile intakes is an obvious clue as to the location and presence of tile. Otherwise, you will be using tile maps, arial photographer, indicators in the field, experience, witchcraft and maybe some luck to locate tile lines. If there are shared tile drainage systems with neighboring properties, you may need to make arrangements with the neighboring property owners to allow for a complete assessment of the system. Your assessment of the drainage systems should provide information on alignments (location), flow directions, elevations and sizes of the tile, tile intakes, and tile outlets.

In some situations your assessment will include using a tile probe as pictured on the left and in other situations it may be necessary to utilize a backhoe, as pictured on the bottom right.

Put a green check mark if you have used a tile prob.

Tile Probe

- How to determine size of a tile with a Tile Probe



A tile probe can tell you location as well as it can sometimes help in determining the size of the tile.

Backhoe

- Excavate 3’
- Use Tile Probe to find exact location of tile
- May need to excavate further
- Use shovels for minimal risk of damage

If a backhoe tile investigation is needed typically the contractor will excavate approximately 3’ and then a tile probe will be used to try and find the exact location of the tile. If more excavation is needed then that will be completed or you may want to us shovels to help in minimizing any risk of damage to the tile.

Geotechnical Investigation

- BWSR Wetland Restoration Guide – Section 3
  - Investigate topsoil depths
  - Investigate sediment depths
  - Investigate foundation conditions
  - Investigate borrow areas
  - Investigate substrate conditions

Source: BWSR Wetland Restoration Guide

For most wetland projects, the soils assessment is straightforward. It includes a review of the published soil survey and separate on-site soil investigations to support both the engineering and vegetation design components of the project. Soil attributes such as texture, organic matter content, and pH influence the selection of plant species that will be best suited for specific areas or hydrologic regimes within a project. Physical or geotechnical soil properties such as permeability, compressibility, and strength can affect the design and construction of the project. The extent or presence of sediment in the wetland, or other soil disturbances, must also be considered.

Topsoil Conditions

- Excavations
- Borrow Sites
- Embankment

Accurate measurement of topsoil depths is most critical when the planned construction at a project site includes excavations; borrow sites, or embankment construction. Topsoil present in construction areas usually is removed and then replaced as part of the final grading process. The amount of topsoil that will be stripped and re-used can have a significant effect on design, construction sequencing, and project budget. Therefore, it is recommended that accurate topsoil depth measurements be obtained during the site assessment phase. It may be necessary to locate alternative sources of topsoil if suitable amounts are not readily available to support stabilization and the establishment of vegetation in construction areas.

Sediment Deposition

- Assess
  - Soil Color
  - Soil Texture
  - Hydrochloric Acid Test

Over time, sediment accumulation can cover the original wetland soils and any remnant native wetland plant seedbank that may exist. Removing accumulated sediment aids in the restoration of historic hydrology and, if done correctly as part of the planned construction activities, can release and allow the germination of remnant vegetation from the seedbank.

There are three methods commonly used to determine the presence and depth of sediment. They include assessing soil color, texture, and performing a hydrochloric acid test.

Determining sediment depths through an assessment of soil color is often the easiest and most obvious means of diagnosis. Lighter soil colors being present above darker soil colors is usually an obvious indication of sediment.

Assessment of soil texture is another method to help determine the boundary between sediment and the original wetland soil surface. Possible evidence of this boundary includes changes in soil texture, organic content, and the presence of dead plant material or crustacean shells, such as snails, within the underlying soil profile. Sediment will generally be a denser, course or fined grained soil material containing little to no organic material.

The third method of assessment is testing for effervescence using hydrochloric acid (HCL). The HCL test is very diagnostic and easy to perform. Soils effervesce if they

contain calcium carbonate and a dilute acid solution is applied. Carbonates in the soil react with the dilute acid and carbon dioxide gas is given off. The gas will be seen as frothy bubbles and produces a fizzling sound. In general, wetland soils will not effervesce whereas upland soils will. When using this test method test the soil profile with one drop of acid every twoinches or so in depth where the sediment boundary is suspected

Foundation Conditions

Source: BWSR Wetland Restoration Guide

With many wetland restoration projects, earthwork activities include the construction of simple, lowhead earthen embankment structures. To design and construct these structures, a basic assessment of the underlying foundation soils will be necessary. Evaluating foundation conditions for simple structures can be as easy as taking a few borings with a hand auger or soil probe. More complex projects could include embankment or other construction in areas where more permeable or poor strength underlying soils exist. Foundation treatments may be necessary to address these soil conditions. If so, a comprehensive investigation and analysis of the site soils is needed.

Borrow Areas

- Usually identified through soil survey and verified during construction

Earthen embankments and other earthfills require suitable soil “borrow” material for their construction. The physical requirements for borrow material will vary depending on the height and scope of the earthen embankment or other planned earthfills. In many situations, suitable borrow areas can be preliminarily identified through a review of the published soil survey. Final evaluations are then made as a result of on-site explorations done at the time of construction. In other situations, the suitability and characteristics of borrow soils will be important for the design of the project. The objective should be to find suitable borrow material as close as possible to potential construction areas. Many wetland soils are suitable for use as fill in low-head earthen structures and are often preferred over upland borrow areas, as their use pro - vides an opportunity to enhance wetland depths and diversity. Excavations within the bed of any existing or drained wetland need careful evaluation of the soil sub - strate; excavations in some locations might penetrate through an impermeable substrate layer into a pervious sediment substrate or sand lens, impacting the ability of the site to retain water. To avoid this problem, the wetland site assessment should always include borings when excavations within it are planned.

Geotechnical Investigation

- NRCS NEH Part 631 Chapter 2 – MN NRCS Guide to Subsurface Investigation
  - Section II: Additional Requirements for Embankments with Storage
    - Does not include Scrapes associated with Wetland Restoration Projects

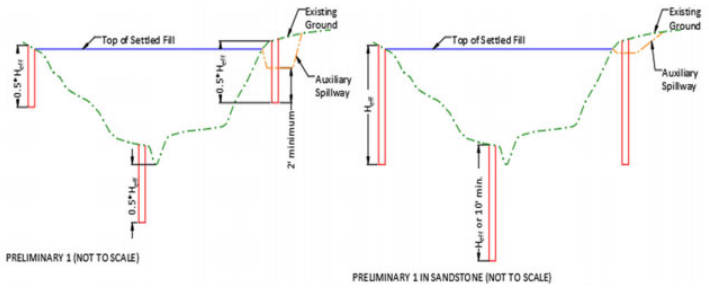


Figure II-4. Boring Locations for Preliminary Site Investigation Level 1

Depending on the level of investigation will require the number and location of borings. Also

Take-away

- Vertical & Horizontal Control
  - Relative
  - Absolute
- Benchmarks will need to be established
  - Permanent
  - Temporary
  - Construction
- Tile Investigation
- Soils Investigation