Primary Project Control

Primary project control points shall be established at intervals of no more than one mile apart for all projects. A minimum of three primary control points shall be provided and be published on the G sheet to become a part of the final construction plans. Care should be taken to establish monuments at locations that provide good satellite coverage. A hilltop is a much better location than at the bottom of a sag curve. Do not establish primary control points near trees, structures or bluffs. Do not establish primary control points below power lines or near electric sub-stations, radio towers or cellular towers.

Acceptable primary control points include FENO monuments (1000mm/39.37 inch), ROW rails, concrete reference monuments, County GPS Control monuments and NGS control monuments. Do not use damaged monuments for primary project control. The description of the monument shall include whether the monument was found or set. It is required to set a dimple or cut x on a ROW rail to ensure proper placement of the rod tip and a description of where on the rail the point is established.

One closeup photo and one south horizon photo of the monument shall be taken and placed in a point specific subfolder below the Control folder in the Project Wise directory along with NGS data sheets or County Control data sheets, if applicable. Static raw data for each occupation shall be placed in the point specific sub folder below the Control folder in the Project Wise directory. Receiver static log files shall be named to include point name, receiver type, HI, run times and date. Example: X24_HiperHR_HI_2m_916-330_9-15-22.tps

If primary project control is established using the Iowa RTN rather than static survey observations, use the following instructions. A minimum of three rounds throughout the day, as outlined below, of continuous five-minute observations with a minimum of two-hours between shall be collected on each monument and used in a weighted average to determine final coordinate values. It is advisable to run the a.m. collection process between 8:00 and 9:30 for the first round; run the mid-day collection process between 11:30 and 1:00 for the second round and begin the p.m. collection process at 3:00 and proceed until all observations have been made for the final round. This will ensure observations of both satellite constellations with good geometry have been made. It is required to observe nearby published passive geodetic control marks as part of the primary project control network. Examples of these are a pair of County GPS control points along with an NGS vertical or GPS control point. This process will provide good checks on the network observations. Iowa RTN check observations are to be made on all points in the primary project control network to ensure the observed average control is relative to the Iowa RTN. A three-minute observation on each control point will provide a good check. The local weather forecast as well as the solar forecast should be a determining factor of whether or not data should be collected on any given day. Periods of high humidity or passing storm fronts will cause inaccurate data collection. High solar activity will also contribute to the degradation of satellite timing signals which will cause inaccurate data collection.

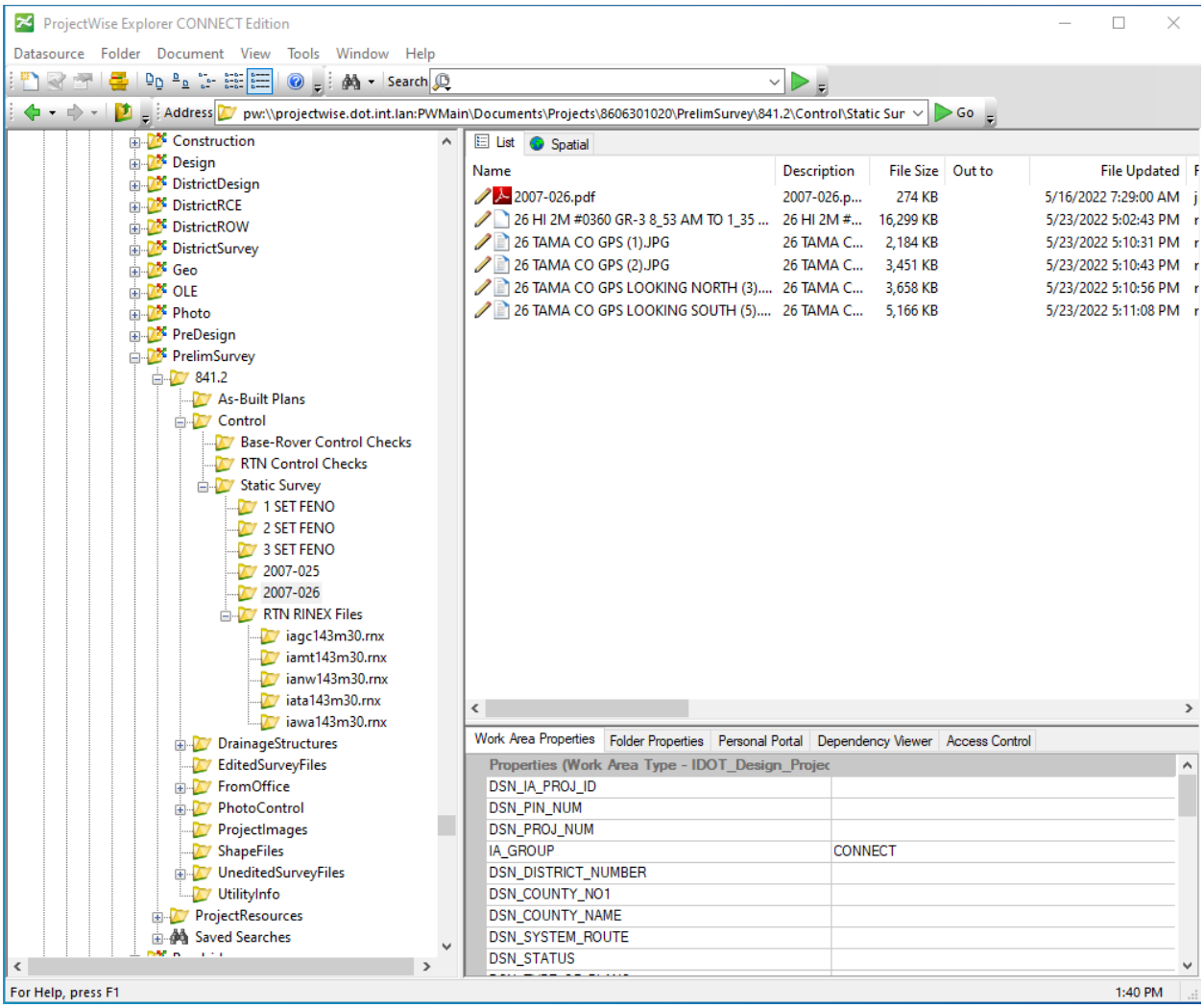
If primary project control is established using static survey observations, use the following instructions. A minimum of two dual frequency receivers shall be used to run concurrent six-hour observations on primary project control point pairs. The observations shall proceed to include the preceding control point in subsequent observations to provide baseline ties between all points in the control group. Example: Day 1 - points 1 and 2 observed, Day 2 - points 2 and 3 observed, Day 3 - points 3 and 4 observed, and so on until all points are tied together. Static post processing software shall be

used to determine final coordinate values. Final coordinate values shall be determined using nearby Iowa RTN base station data as the constraining control. This will ensure that all project control is relative to the Iowa RTN. It is required to observe and process nearby published passive geodetic control marks as part of the primary project control network. Examples of these are a pair of County GPS control points along with an NGS vertical or GPS control point. This process will provide good checks on the network observations. Iowa RTN check observations are to be made on all points in the primary project control network to ensure the static post processed control is relative to the Iowa RTN. A three-minute observation on each control point will provide a good check. The local weather forecast as well as the solar forecast should be a determining factor of whether or not data should be collected on any given day. Periods of high humidity or passing storm fronts will cause inaccurate data collection. High solar activity will also contribute to the degradation of satellite timing signals which will cause inaccurate data collection.

There is software available that uses the almanacs to predict satellite coverage and DOP (dilution of precision). The following link is useful for mission planning. http://www.gnssplanning.com/#/settings

After primary project control is established using either method outlined above, GNSS base and rover observations are required on all points in the control network. Iowa RTN validation files and GNSS base and rover files are to be placed in the appropriate subfolder under the Control folder. The files required are the raw data file, QC file and comma delimited .txt file.

Below is an example of a Control folder configuration used for a static post processed control network.



Temporary Project Control

Temporary project control points may be established, using GNSS base and rover observations, at the project site. A good rule to follow is to make three-minute observations on all control to be used with a total station. Examples of temporary control could be benchmarks on nearby structures or points placed in the ground such as rebar, nails, etc. Temporary project control will be loaded into the mapping file and all check shots are to be included there as well. It is good practice to research plan benchmarks in or nearby the project corridor and include observations on those plan bench marks in the project mapping files. Again, a three-minute base and rover observation will yield good results for as-built plan to field survey checks.

It is always required to call out datums, projections and models used for all project control. An example of this below:

PROJECT DATUM: NAD83(2011) for EPOCH 2010.00 (IaRTN 2019 ADJUSTMENT)

COORDINATE SYSTEM: IOWA REGIONAL COORDINATE SYSTEM ZONE 9

(U.S. SURVEY FOOT)

VERTICAL DATUM: NAVD88

GEOID MODEL: 2018u3

We are using the low distortion projection known as the Iowa Regional Coordinate System. Use of this system enables all end users to use GNSS equipment or total stations at a scale factor of 1. There is no need to calculate combined scale factors or do site calibrations to be relative to the Iowa RTN or the primary project control. It is the responsibility of the end user to understand vendor specific software settings to ensure proper usage of the project datum and coordinate system.

Last but not least, always use fixed height GPS rover poles or Geodetic tripods for observations. Ensure that rod bubbles are calibrated through 360° of movement. Use geodetic tripods or fixed height poles with thumb release tripods or two bipods fixed to the pole for long static occupations. Measure rods from receiver ARP to rod tip for accurate reporting of instrument height. If rod tips are worn, replace them and remeasure.