

Vertical Control Network – Phase I Summary:

3/30/2016

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Geodetic basis of project

Giffels Webster, Inc., Washington Township, MI, has established 9 permanent vertical control stations throughout Washington Township as the basis for the Washington Township Bench Mark Control Network. The 9 new monuments were set at locations within public rights of way on or near properties that would most likely preserve these monuments far into the future. In addition to the control stations, 12 miles of terrestrial leveling was completed with 39 benchmarks set.

The new permanent control stations, along with the existing National Geodetic Survey (NGS) control points, provide a township-wide distribution of control stations on the North American Vertical Datum of 1988 (NAVD88). In addition to densifying the vertical control, all of these stations have precise horizontal coordinates established with a Rapid Static GPS network.

The horizontal coordinates are based upon the existing NGS controls and a Continually Operating Reference Station (CORS) within the township. The horizontal coordinate values are based on NAD83(2011) EPOCH-2010.00, State Plane Coordinate System, Michigan South Zone (2113). Through the use of GPS, each station was given a preliminary elevation value until terrestrial leveling is completed during the subsequent phases. Elevations are based on NAVD88 using the GEOID12B model.

With this update to NAVD88, the township will now match to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map datum. It also aligns directly with the broadcasted real-time corrected GPS/GNSS (Global Positioning System/Global Navigation Satellite System) signals from the CORS towers.

The National Geodetic Vertical Datum of 1929 (NGVD29) was used in the past and existing records may reflect the older datum. The conversion between NGVD29 and NAVD88 was calculated using VERTCON, a web based program found on the National Geodetic Survey website at: http://www.ngs.noaa.gov/cgi-bin/VERTCON/vert_con.prl. The program calculates the datum shift between NGVD29 and NAVD88. Bench Mark 21-04 near the center of the township at the southwest corner of 29 Mile Road and Campground Road was used to calculate the shift between the two datums. See results below:

$$\text{NGVD29} = 0.43' + \text{NAVD88}$$

$$\text{NAVD88} = \text{NGVD29} - 0.43'$$

Bench Marks

The bench marks that are used throughout the project are primarily arrows on fire hydrants and MAG Spikes (nails with large heads that have a magnetic field) set horizontally in the face of wood utility poles. Various other distinct and stable points are also used and are described in detail on the benchmark list. Benchmark names consist of the Township Section number where

it lies, followed by a dash, and then a sequential number. Benchmarks in Section 23 for example would be: 23-01, 23-02 and so on.

Terrestrial Leveling Field Data Acquisition and Processing

Approximately 12 miles of leveling circuit was completed as part of this Phase 1. This primary level circuit established 39 new benchmarks at (approximate) 1/4 mile intervals. The leveling was completed through the central portion of the township down Van Dyke and Jewell to 26 Mile Road and then up Van Dyke and Campground to 30 Mile Road. The Leveling data was acquired with a Leica DNA10 Digital Level, Leica GKNL4F 4 meter Barcode Level Rods, and temporary turning points known as “turtles”. The data was obtained by Back Sight/Fore Sight method.

The elevations are based on NGS Control Height Modernization Station 50640 (PID: DI6119) located at the intersection of 30 Mile Road and M-53(POW/MIA Memorial Freeway). The NGS station has an NAVD88 orthometric height of 759.28 feet. Other NGS control stations will be included in the network to corroborate the integrity of the elevations established by NGS from the 2007 National Height Modernization Program. The NGS stations are classified as 2nd Order Class I control. The level data was processed and adjusted using LEICA Geo Office Ver. 8.2 software.

The horizontal locations for the bench marks were acquired at sub-meter accuracy using dual frequency Leica GPS receiver and a Trimble GNSS receiver to enable Geographic Information System (GIS) plotting.

Additional future phases

With the completion of phase I, the additional proposed 4 phases will build upon the central leveling circuit and expand the precise leveling into the township quadrants.

Vertical Control Network – Phase II Summary:

3/24/2017

T. Gonzalez P.S.

The Vertical Control Network was expanded in spring of 2016. Additional vertical control points have been measured with the same methods in Phase I of the project. Secondary level lines were measured to extend the network to the southeastern part of the township bounded by Jewell Road, 26 Mile Road, Hayes Road, and 29 Mile Road and consists of approximately 12 miles of level lines. The leveling circuit established 34 new bench marks.

Vertical Control Network – Phase III Summary:

3/29/2018

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The Vertical Control Network was expanded in the winter/spring of 2018. Additional vertical control points have been measured with the same methods in Phase I & II of the project. Secondary level lines were measured to extend the network to the northeastern part of the

township bounded by 30 Mile Road, Powell Road, Van Dyke Avenue, and 31 Mile Road and Van Dyke Avenue from 31 Mile Road to Durham Street. The network was also extended to the western part of the township along 31 Mile Road from Van Dyke Avenue to Mound Road, then along Mound Road from 31 Mile Road to 29 Mile Road, then along 29 Mile Road from Mound Road to Campground Road. The Network consists of approximately 11 miles of level lines. The leveling circuit established 46 new bench marks.

Vertical Control Network – Phase IV Summary:

3/28/2019

T. Gonzalez P.S.

The Vertical Control Network was expanded in the winter/spring of 2019. Additional vertical control points have been measured with the same methods in Phase I, II & III of the project. Secondary level lines were measured to extend the network from the northeastern part of the township to the northwestern portion of the township. Level lines were extended along Powell Road from 31 mile Road to 32 Mile Road then heading west along 32 Mile Road to the Orchard Trail. Then heading south along the Orchard Trail to 31 Mile Road closing in on the existing control network. Another level line was measured along Campground Road from 31 Mile Road to 32 Mile Road. Then heading west along 32 Mile road to Dequindre Road. Then heading south along Dequindre Road to Inwood Road. Then heading east along Inwood Road to Mound Road closing on the existing control network. The additional vertical control network consists of approximately 12.5 miles of level lines. The leveling circuit established 52 new bench marks.

Vertical Control Network – Phase V Summary:

3/20/2020

T. Gonzalez P.S.

The Vertical Control Network was expanded in the winter/spring of 2020. Additional vertical control points have been measured with the same methods in Phase I, II, III, & IV of the project. Secondary level lines were measured to extend the network from the northwestern part of the township to the south portion of the township along the easterly side of Stony Creek Park. Level lines were extended along 31 mile Road between Dequindre Road and Mound Road, along 30 Mile Road between Mound Road and Campground Road, along Mt. Vernon Road between Inwood Road and 28 Mile Road, along 28 Mile Road between Mt. Vernon Round and Mound Road, along Mound Road between 29 Mile Road and 26 Mile Road, and along 26 Mile Road between Mound Road and Van Dyke Avenue. The additional vertical control network consists of approximately 10.25 miles of level lines. The leveling circuit established 38 new bench marks.