Appendix G
Application: Topographic Survey of Hannibal Lock & Dam Proposed Nationwide DGPS Antenna Site (Pittsburgh District)

G-1. Purpose and Background

This survey was performed in 1999 by GRW Aerial Surveys, Inc. under a Task Order issued by the Pittsburgh District Survey Section. The survey was conducted for site plans to be used in design and construction of a proposed US Coast Guard Nationwide DGPS 300 ft antenna, including auxiliary utilities and facilities. The proposed 30-acre ± site was on Corps-owned land adjacent to Hannibal Lock & Dam along the Ohio River. The site plan feature and topographic detail mapping was compiled at a target scale of 1"= 50' and a 1 ft contour interval. Utility mapping was also performed. A total station, RTK, and digital level were used during this project. Field digital data were initially processed in Terramodel, and then exported into both AutoCAD and MicroStation for different users (Tennessee Valley Authority, US Coast Guard, and USACE; all of whom were involved on this project). The overall survey effort performed by GRW is depicted on the following plate and described in their "Quality Control Certification" report in the following section.

G-2. GRW Survey Report

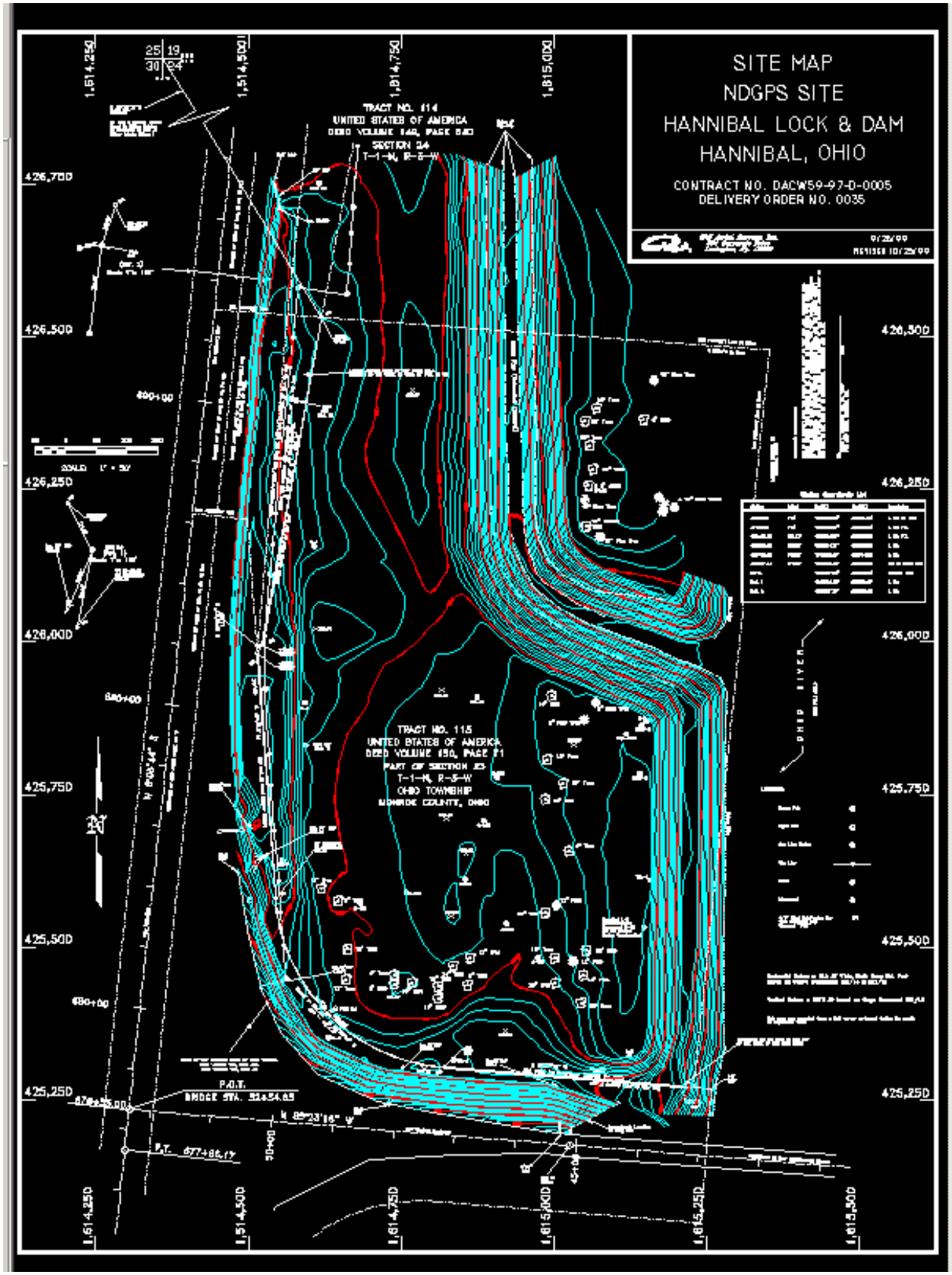
U.S. ARMY CORPS OF ENGINEERS - PITTSBURGH DISTRICT
NDGPS SITE SURVEY, HANNIBAL LOCKS & DAM
CONTRACT NO. DACW59-97-D-0005 DELIVERY ORDER NO. 35

QUALITY CONTROL CERTIFICATION

CONTRACTOR: *GRW Aerial Surveys Inc.*
801 Corporate Drive
Lexington, Ky. 40503
(606)223-3000

SCOPE OF SERVICES:

To provide a detailed map of Tract 113 as delineated on "Exhibit A" attached to the original scope of work. Said map to meet ASPRS, Class I Map Accuracy Standards for a 1"=50' map with a 1' contour interval and to include buildings, trees, roads, sewer service lines, surface & subsurface utility systems e.g. communication, gas, water, electric, telephone, storm drainage features and structures. Said map to be tied horizontally to the NAD 27 West Virginia SPCS North Zone and vertically to the NGVD 29 vertical datum. Control monument coordinates, elevations, and descriptions for existing Corps of Engineers monumentation in the vicinity of the project were provided by the contracting officer.


SITE MAP
NDGPS SITE
HANNIBAL LOCK & DAM
HANNIBAL, OHIO
CONTRACT NO. DACW59-97-D-0005
DELIVERY ORDER NO. 0035
TRACT NO. 114
UNITED STATES OF AMERICA
TRACT NO. 115
UNITED STATES OF AMERICA
OHIO TOWNSHIP
MONROE COUNTY, OHIO
426,750
426,500
426,250
426,000
425,750
425,500
425,250
1,614,250
1,614,500
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1,615,500

To set new control monumentation on the site, outside the construction limits. The survey is to meet or exceed Third Order--Class I, with a relative accuracy of 1:10,000.

To research, survey, and monument the Ohio DOT right-of-way adjoining Tract 113 for the New Martinsville Bridge approach to Ohio Route 7 and Ohio Route 7. Said survey to be performed by a Professional Land Surveyor, licensed in the state of Ohio.

PERSONNEL:

- *Ed Rinehart - Project Manager*

- *Mark Wilmoth - Ohio PLS responsible for the research, survey, computations and staking of the Ohio DOT right-of-way.*

- *Herb Yancey - Survey Party Chief responsible for the collection of the field data used to stake the right-of-way, generate the map, and establish new on site monumentation.*

- *Ray Footland - Instrument man/field survey crew member.*

- *Wolfgang Ziegler - Computations, quality control, and map preparation.*

- *Donna Pizzuto - Map format conversion from AutoCAD to Micro station.*

DATES OF FIELD SURVEY:

SURVEY START DATE - September 13, 1999

SURVEY END DATE - September 16, 1999

EQUIPMENT:

Trimble 4000ssi dual frequency GPS receiver equipped with the RTK out option, used in conjunction with a Trimble TRIMMARK II radio modem as a RTK base station.

Trimble 4800 dual frequency GPS receiver equipped with an internal radio modem in conjunction with a Trimble TSC1 Data Collector/Controller as a RTK rover.

Leica 2002 digital level with a 3 piece fiberglass barcode level rod.

Topcon GTS 303D digital total station used in conjunction with the aforementioned Trimble TSC1 Data Collector/Controller.

PRIMARY CONTROL:

MARTINSVILLE - NGS Third order horizontal/First order vertical

HR1/14 - COE horizontal & vertical

HR1/15 - COE horizontal & vertical

SECONDARY CONTROL:

PEDESTAL MONUMENT - Found on site

METHOD - FIELD:

RTK (Real Time Kinematic GPS) surveying techniques were selected as the primary means of collecting horizontal coordinates and elevations for all aspects of this project.

The base station was initially set up on NGS station MARTINSVILLE. From there coordinates were established at the Pedestal Monument and numerous iron pins (pertaining to property boundaries), lead plugs, new monumentation, and site features (utilities, drainage features...).

The base station was then moved to the Pedestal Monument. From the setup most of the topographic data was collected. In addition some of the monuments observed from the initial setup at MARTINSVILLE were reobserved.

The field personnel noticed some inconsistency in the elevations obtained at some of the stations that were reobserved. The base station was moved back to the NGS Station MARTINSVILLE. From this setup a number of the monuments observed in the two prior setups were observed again. In addition, the right-of-way was monumented.

As an additional check of the right-of-way monumentation, the Topcon total station was used to reobserve the right-of-way monuments, radially from other stations previously controlled via RTK.

A differential leveling loop was run from a COE Bench Mark stamped BM1-631 found at the base of a flagpole. An elevation of 636.57 was verbally given to the field personnel by the Lock Master. Said loop passed through the Pedestal Monument, COE monuments HR1/14, HR1/15, M-8, and two other monuments that had multiple RTK observations.

All field work involving the resurvey and monumentation of the right-of-way was performed under the direct (on site) supervision of Mark Wilmoth.

METHOD - OFFICE - DATA REDUCTION:

Upon the return of the field personnel the digital level and TSC1 Data Collector/Controller were downloaded. The field personnel expressed their concerns regarding the elevation variations. This led to an in depth examination of the raw RTK data. It was found that in some instances the antenna types and method of instrument height measurement had been incorrectly keyed into the TSC1. The raw data file was edited and then reprocessed using Trimble's Tsoffice Software.

The field personnel didn't have a Geoid model data file with them at the time the data was collected. The Geoid 96 geoid model was incorporated during the reprocessing.

The data was initially processed in NAD 83/NAVD 88. It was then converted to NAD 27/NGVD 29 using the COE software CORPSCON.

The differential leveling data was initially reduced using the elevation provided verbally by the Lock Master for the bench mark BM 1-631 as the starting point. The elevations thus derived were compared with the published elevations for stations HR1/14 and HR1/15 provided by the contracting officer. A variation of 0.10' was noted. The level loop was re-reduced using HR1/14 as the starting BM.

The RTK derived NAD 27/NGVD 29 coordinates for COE stations HR1/14 and HR1/15 were compared with the COE published values. A slight variation was noted both horizontally and vertically. The RTK coordinates were translated, rotated, and shifted vertically to bring them into conformity with the published COE values.

MAP GENERATION:

Once satisfied with the surveyed coordinates, they were imported into TERRAMODEL for contour generation. Break lines along grade breaks were used to control contour generation. The contours were exported from TERRAMODEL into a DXF file which was imported into an AutoCAD drawing. A DXF file was created for the surveyed coordinates and also imported into said drawing. Mark Wilmoth created an AutoCAD drawing containing the right-of-way information, it was inserted in said drawing. The map was completed with the addition of annotation, border, and grid.

The completed map was visually inspected by the field personnel and found to be an accurate representation of site.

The completed drawing was e-mailed to the TVA on the afternoon of Wednesday Sept. 29, 1999 and also to the contracting officer on Thursday Sept. 30, 1999. After review, suggested edits were made and it was converted to MicroStation format for final delivery.

CONCLUSION:

When properly implemented the RTK system used in this survey is proven to rapidly and economically provide accurate coordinates at a 2 centimeter level of precision, adequate to the requirements of this project. Errors were found in the data collection but are believed to have been corrected. Unless undetected blunders or systematic errors still exist, the products of this survey meet or exceed the project requirements.

G-3. Scope of Work

The following Scope of Work was developed by the Pittsburgh District and forwarded to GRW with a letter Request for Proposal.

CONTRACT NO. DACW59-97-D-0005

DELIVERY ORDER NO. 0035

SURVEYING AND MAPPING SERVICES

NDGPS SITE

HANNIBAL LOCK & DAM, HANNIBAL, OHIO

SCOPE OF WORK

1. GENERAL SCOPE AND LOCATION OF WORK.

a. The contractor shall provide professional surveying and mapping and related services necessary to accomplish all items of work under this delivery order. The contractor shall perform field surveys and office support functions as required to compile and furnish to the Government a detailed site map and other exhibits suitable for use for engineering design and development of plans and specifications for the construction of a proposed Nationwide Differential Global Positioning System (NDGPS) site. The site, designated as Tract 113, is located at Hannibal Lock and Dam, Hannibal, Ohio. Final products shall be delivered in both digital and hard copy format and include all supporting data and materials developed during the acquisition and compilation process. Exhibits depicting the site location and mapping limits, control data, and other available maps and exhibits will be furnished for the contractor's use in the development of the work.

b. The contents of this scope describes the specific project requirements to be accomplished under this delivery order and the end product required of the contractor. General contract and technical specifications not covered by this scope are contained in applicable portions of the Basic Contract.

2. GOVERNMENT FURNISHED DATA AND MATERIALS. The following data and materials will be furnished for the contractor's use in the development of the work. All original data and materials will remain the property of the Pittsburgh District Corps of Engineers and shall be returned at the completion of the work. The contractor shall be responsible for the safety of original data and materials while in his possession.

3. CHARACTER AND EXTENT OF SERVICES. The contractor shall perform and furnish the following items of work.

a. General Surveying and Mapping Requirements.

(1) General site plan feature and topographic detail mapping compiled at a target scale of 1"= 50', 1' contour interval for that area annotated on furnished exhibit. Collect all existing pertinent features, drainage characteristics, drainage structures, channels, inlets and outlets, etc. Collect all surface utility data and conduct a thorough search for evidence of subsurface utilities. An underground gas line runs through a portion of the site. Gas line markers are visible.

(2) Set control monumentation as required to adequately control construction layout. Monumentation shall be set in an area outside the construction limits so as not to be disturbed during construction phases. Existing control monumentation within the vicinity may be used in lieu of setting new monumentation. All control monumentation, set or found, shall be adequately described and referenced in a standard fieldbook.

(3) Based on information established by record and by field survey, establish and delineate on the ground, with capped re-bars and witness posts, that portion of the Ohio DOT right-of-way bounding Tract 113; commencing at the edge of the right bank of the Ohio River, thence continuing along Tract 113 and Ohio Route 7. This is a critical element that will need to be properly delineated on the ground and properly annotated on the map to ensure the site is contained within COE property. At a minimum, this portion of the field work shall be performed under the on-site direction of a Professional Land Surveyor duly registered in the State of Ohio.

b. Map Compilation and CADD Specifications.

(1) Final maps shall contain all topographic and planimetric features encompassed within the mapping limits. The maps shall properly depict the existing site conditions as necessary to properly support engineering design and development of final plans and specifications for construction of the site. Maps shall comply with and contain, but not be limited to the following.

(2) Contours shall be computer generated from a DTM established by controlling point method of breaklines and random points.

(3) In critical areas, specifically within the proposed location of the tower, spot elevations shall be established and shown on high points and depressions.

(4) Planimetric features, with descriptive data and detailed sketches as appropriate, shall include, but not be limited to: buildings; roads; sewer service lines; utility systems-surface and subsurface-including all appurtenances such as communication, gas, water, electric, telephone, overhead powerlines; storm drainage features and structures, culverts, etc. For overhead communication and power lines, give number and type of wires. Furnish class of power poles; if no class is stamped on the pole, give diameter and height of pole.

(5) Locate and describe (type and size) scattered individual trees.

(6) All Horizontal and Vertical Control shall be shown on the map relative to their true position. Primary control set to control construction phases shall be labeled as such.

(7) Final map compilation product shall be submitted in digital and hard copy form. Digital form shall be delivered on either a 3.5" high density disk or CD and consist of a 3-dimensional file formatted for input and operation on Intergraph MicroStation Platforms. Hard copies shall

include 2 (two) reproducible quality grade mylars, and 1 (one) blueline print per map sheet. The contractor shall provide a digital file and 2 check plots for review prior to final submittal.

(8) Grid ticks shall be placed on the map in 5 inch intervals with coordinate values properly annotated and shown on the top and right edge of each map sheet.

c. Survey Data. The contractor shall deliver all original field books, prints, maps, records, transcripts, and all other materials and associated data utilized in the performance of the work.

4. SURVEYING PROCEDURES AND REQUIREMENTS.

a. Horizontal control shall be initiated from and referenced to existing control established at the L/D project. Controlling points shall meet or exceed Third Order, Class I, Relative Accuracy of 1:10,000.

b. Vertical control shall be initiated from and referenced to existing Bench Marks established at the L/D project. Controlling points shall be contained within a closed level loop utilizing procedural specifications to meet or exceed Third Order Accuracy Standards. Unless otherwise directed, initiating and closing the loop on the same bench mark shall not constitute an acceptable control circuit.

c. Topographic surveys shall follow and meet ASPRS, Class I, Map Accuracy Standards as established for the target scale and indicated contour interval specified in subpara. 3a(1).

d. Total Station with automated data collection shall be considered appropriate instrumentation for performing topographic mapping. Procedural specifications shall be sufficient to meet the accuracy standards specified.

e. All computations shall be performed by the contractor. A copy of all files generated by computer software shall be included in the computer file. Deficiencies shall be recognized and steps to initiate corrective measures shall be taken as required.

5. QUALITY CONTROL AND ASSURANCE. All work shall be performed under adequate supervision and quality control measures. The contractor shall be responsible for implementing internal quality control and assurance measures for all phases of the work. A quality control plan shall be submitted outlining the procedures the contractor will follow to meet the technical specifications prescribed by this delivery order. Upon completion of the work, the contractor shall submit a signed quality control certification. The certification shall describe the internal review process to include the names of personnel responsible for quality assurance reviews for each phase of the work.

6. ACCESS TO WORK. Right-of-entry upon the site will be made available to the contractor. Prior to proceeding with work, the contractor shall contact and visit the Hannibal Lock and Dam office. The lockmaster at Hannibal Lock and Dam is Mr. Dave Walters, 740-483-2305. The contractor shall coordinate his activities with Mr. Walters, or designated alternate, and shall acquaint himself with safety procedures and regulations governing the facility. The contractor shall be responsible for obtaining right-of-entry upon lands not controlled or subordinated to such rights by the Government. Such entry shall be made solely for the purpose of performing the surveys prescribed by this scope. The Contractor shall assume all liability for and save the Government harmless on account of damages to persons or property in the execution of all work performed under this delivery order.

7. COMMENCEMENT OF WORK. The contractor shall be prepared to commence work during the first full work week after receipt of contract award.

8. COMPLETION OF WORK. Completion of work shall include satisfactory performance of topographic mapping and delivery of acceptable final product, control survey field books, computations, and computer files.

9. DELIVERY OF WORK. All costs of deliveries shall be borne by the contractor. A letter of transmittal or shipping form, in duplicate, listing the materials being transmitted shall accompany each delivery, and being properly numbered, dated, and signed. All submittals shall be sent to:

U.S. Army Corps of Engineers, Pittsburgh District
ATTN: CELRP-ED-GM
William S. Moorhead Federal Building
1000 Liberty Avenue
Pittsburgh, PA 15222-4186

10. SCHEDULE OF DELIVERY. All work shall be completed and final deliverable products submitted within NLT 30 Sep 99. In the event the contractor is unable to meet completion schedules due to events beyond his control such as loss time due to inclement weather or other incurred delays, he shall submit a written request with appropriate documentation to extend the contract completion date.

11. PROJECT COORDINATOR OR MANAGER. The project coordinator representing the Government shall be Mr. Stephen LeBlanc, Survey and Mapping Section, 412-395-7328. Questions pertaining to survey control should be directed to Mr. Don McQuillan, Chief, Field Survey Unit, 412-395-7333.

12. INVOICES. The Contractor shall submit invoices for payment on a monthly basis. Payment requests shall be submitted on an ENG93. Two original copies with two original signatures are required with each request. Payment estimates shall be SUBMITTED TO MR. PHIL ORLANDO AT:

U.S. ARMY ENGINEER DISTRICT, PITTSBURGH
ATTN: CEORP-ED-DT (MR. PHIL ORLANDO)
1000 LIBERTY AVENUE
PITTSBURGH, PA 15222.

G-4. Government Cost Estimate and Contractor Cost Proposal

The following cost estimate for this Task Order was prepared by the Pittsburgh District Survey Section.

GOVERNMENT ESTIMATE OF COST

CONTRACT NO. DACW59-97-D-0005
DELIVERY ORDER NO.35

NDGPS SITE SURVEY - HANNIBAL LOCK & DAM

Category	Task	Quantity		Unit Price	Amount
	PROJECT MANAGEMENT				
Project Manager	Overall Project Management/Supervision	12	hrs	$ 80.43	965.16
Land Surveyor	1. Project Planning	8	hrs		
	2. QC Review/Computations/Reports	16	hrs		
	Total	24	hrs	$ 53.46	1283.04
	FIELD SURVEYS				
Land Surveyor	1. Recon/On-Site Coordination-Supervision/Computations	36	hrs		
	2. Travel	12	hrs		
	Total	48	hrs	$ 53.46	2566.08
Survey Party Chief	1. Recon/Establish Control	8	hrs		
	2. Field Surveys to Establish Site Right-of-Way	12	hrs		
	3. Field Surveys for Map Compilation	16	hrs		
	4. Travel	12	hrs		
	Total	48	hrs	$ 36.25	1740.00
Instrument Operator	1. Recon/Establish Control	8	hrs		
	2. Field Surveys to Establish Site Right-of-Way	12	hrs		
	3. Field Surveys for Map Compilation	16	hrs		
	4. Travel	12	hrs		
	Total	48	hrs	$ 29.65	1423.20
	Map Compilation/Data Generation				
CADD Supervisor	Supervision/QC Review	8	hrs	$ 58.59	468.72
CADD Operator	Map Compilation	40	hrs	$ 36.20	1448.00
	OTHER				
Per Diem	Field Survey Party (6 3-man party days)	18	days	$ 80.00	1440.00
Misc. Services	Misc. Supplies and Services			$ 100.00	100.00
				Subtotal	**11434.20**
				Profit 11%	**1257.76**
				TOTAL	**12691.96**

Based on the above Government Cost Estimate, the 6 day field estimate for this 1in = 50 ft scale boundary, topographic, and utility survey amounts to approximately $425 per acre ($12,700 ÷ 30), at a production rate of 5 acres/day. The IGE broke down the field work as follows: primary control 1.0 days, boundary (right-of-way) 1.5 days, and 2.0 days to perform the planimetric, topographic, and utility detail. Given an actual 854 shot points were taken during the estimated 3.5 days of topographic survey, this works out to roughly 250 points per 8-hour day. These rates cannot be extended to other projects since the basic components (boundary work, topographic relief, and utility detail) will vary widely from project to project.

The contractor's proposal was nearly identical to the Government Estimate. Both estimates assumed 48 hours of field survey time. The contractor proposed 4 hours time for a Project manager and 80 hours for a licensed land surveyor (vice 12 hours and 72 hours in the Government Estimate, respectively). The contractor's proposal of $12,941 ($249 over the Government Estimate) was accepted and the Task Order awarded for this amount. See following negotiation memorandum.

CELRP-ED-GM *1 September 1999*

MEMORANDUM THRU

Chief, Geotechnical Branch

FOR Chief, Contracting Division

SUBJECT: Acceptance of GRW Aerial Surveys, Inc. Cost Proposal for Professional Surveying Services under Contract No. DACW59-97-D-0005, Delivery Order No. 35, NDGPS Site Survey, Hannibal Lock and Dam, Hannibal, Ohio.

1. This memorandum transmits acceptance of GRW Aerial Surveys, Inc., cost proposal to perform the Professional Surveying Services prescribed under the subject task order. The Scope of Work, Independent Government Estimate dated 1 September 1999 in the amount of $12,691.96, and request for proposal was submitted to CT-O on 1 September 1999. In response to the ensuing RFP, GRW Aerial Surveys, Inc., submitted a proposal dated 1 September 1999 in the amount of $12,940.74, $248.78 above the Government Estimate. ED-GM reviewed the Contractor's proposal and all labor and non-labor categories are acceptable.

2. Please initiate action to award the subject Delivery Order in the amount of $12,940.74. Funds are available under PR&C W81ET 4924 26557. Point of contact for this action is the undersigned.

Encl *STEPHEN LEBLANC*
Chief, Survey and Mapping Section

G-5. Data Collector Coordinate File

The following "CR5" file is excerpted from the Trimble TSC1 Data Collector/Controller used to collect topographic data on this site. Each data point has the following format:

POINT NUMBER, X (ft), Y (ft), H (NGVD 29), FEATURE DESCRIPTOR

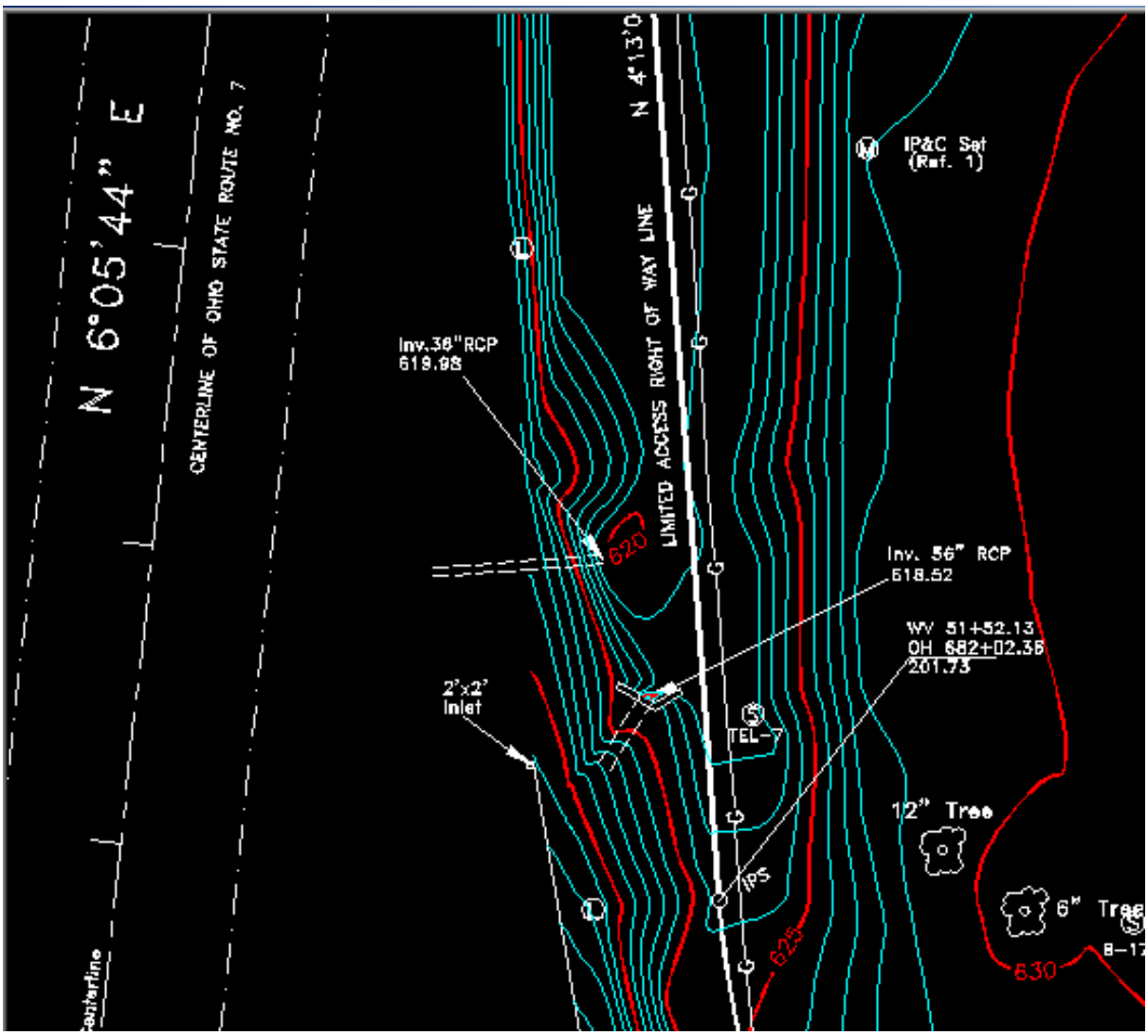
Coordinates are on the West Virginia SPCS North Zone (NAD 27) and elevations on NGVD 29. A total of 854 points were collected on this project. (Only selected features are shown of the 854 total points that were shot).

1, 425020.22, 1617558.18, 663.83,MARTINSVILLE
2, 424974.11, 1617518.56, 666.02,RM 2
3, 424992.50, 1617606.37, 665.91,RM 1
4, 431633.86, 1611493.19,1223.17,FOUND SEC CORIPCCLAUS6456
5, 431629.01, 1611564.15,1227.54,FND IP NO ID
6, 431819.94, 1611576.81,1267.85,FND IP CLAUS
7, 426417.60, 1614366.02, 636.78,FND IPC CLAUS 6456
8, 426458.16, 1614104.24, 647.84,FND IPC CLAUS 6456
9, 426210.78, 1614068.00, 648.19,FND IPC CLAUS 6456
10, 426172.40, 1614313.38, 632.99,FND IPC CLAUS 6456
11, 424768.72, 1614200.14, 636.78,FND IPC BIEDENBACH
12, 424769.85, 1614185.44, 640.17,FND IP
13, 425566.02, 1614209.99, 634.57,FND IPIPE NO ID
14, 425706.06, 1614233.83, 634.44,IRON FENCE POST
15, 427404.67, 1615326.78, 633.10,COE PLUG L-27
16, 427488.90, 1615325.18, 633.17,COE PLUG L-25
17, 427741.49, 1615320.52, 633.11,COE DISK M-7
18, 425399.12, 1614642.56, 629.46,CP IPC SET # 34
19, 425830.81, 1614594.13, 629.11,CP IPC SET # 35
20, 426396.15, 1614577.71, 626.67,CP IPC SET # 36
21, 426310.72, 1614534.91, 623.22,DISTURBED REBAR
22, 426411.75, 1614400.42, 631.33,FOUND IPC CLAUS 6458
23, 426199.30, 1614368.06, 630.43,FOUND IPC CLAUS 6458
24, 426164.26, 1614364.34, 629.64,FOUND IPC CLAUS 6458
25, 424359.48, 1614144.26, 641.52,IP CLAUS BY TESTIMONY
26, 424355.19, 1614144.02, 641.66,BEIDENBACH IPC 7881
27, 424235.60, 1614135.24, 643.36,BEIDENBACH IPC 7881
28, 424478.70, 1614198.06, 637.40,RF RISOR IPC 7093
29, 424462.66, 1614377.42, 624.55,CLAUS IPC 6456
30, 424460.37, 1614402.17, 623.73,CLAUS IPC 6456
31, 423972.37, 1614301.52, 625.56,CLAUS IPC 6456
32, 423970.11, 1614326.49, 624.64,CLAUS IPC 6456
33, 427997.32, 1614599.57, 637.08,CL INT 7 AND 536
34, 427567.82, 1614552.63, 635.20,CL 7
35, 427003.15, 1614494.02, 633.10,CL 7
36, 426445.87, 1614434.60, 633.43,CL 7
37, 425969.93, 1614383.87, 630.62,CL 7
38, 425445.17, 1614327.57, 628.80,CL 7
39, 425211.48, 1614302.48, 629.67,CL 7
40, 424790.98, 1614403.10, 632.01,FACE CURB ONRAMP
41, 424961.71, 1614470.06, 637.09,FACE CURB ONRAMP
46, 425175.57, 1615025.78, 663.37,CL BRIDGE
47, 425196.91, 1614984.27, 661.74,FACE CURB OFF RAMP
55, 425625.69, 1614482.05, 631.07,FACE CURB OFF RAMP
56, 425006.79, 1617114.26, 666.24,CL BRIDGE
57, 427990.66, 1614462.40, 643.71,FND DRILL HOLE
58, 428007.24, 1614497.69, 638.90,FND PK
59, 428021.10, 1614316.77, 647.37,FND IPC NO ID
60, 428004.10, 1614286.56, 648.03,FND IP NO ID
61, 425982.83, 1614514.77, 621.49,ROW 92
62, 425994.62, 1614522.46, 621.60,ROW 91
63, 426532.18, 1614620.42, 628.09,ROW 90
64, 425579.69, 1614544.51, 623.76,ROW 93
65, 425302.54, 1614821.67, 627.00,ROW 94
66, 425271.23, 1615209.86, 618.49,POL FOR ROW 95
67, 426156.87, 1614607.43, 626.63,STAKE C-5
68, 425900.57, 1614592.24, 627.72,STAKE C-4
69, 425641.69, 1614555.84, 621.65,STAKE TLE-7
70, 425351.95, 1614631.41, 627.15,STAKE C-3
71, 425314.51, 1614835.75, 627.78,STAKE TLE-4
72, 425322.45, 1615124.01, 633.67,STAKE C-2
73, 425609.72, 1615158.08, 634.46,STAKE TLE-1
74, 425784.73, 1615140.76, 634.61,STAKE MAST-2
75, 425863.87, 1615144.24, 633.92,STAKE MAST-1
76, 425869.77, 1615151.38, 633.69,STAKE C-1
77, 425849.30, 1615118.70, 633.92,STAKE EQU AREA
78, 425909.87, 1614874.35, 631.27,STAKE TLE-10
79, 425778.09, 1614907.26, 632.19,STAKE C-175
80, 425707.21, 1614885.09, 632.10,STAKE C-100
81, 425611.30, 1614854.95, 631.92,STAKE TOWER
82, 425538.40, 1614922.72, 630.19,STAKE A-100
83, 425482.97, 1614974.17, 630.87,STAKE A-175
84, 425589.48, 1614758.57, 631.00,STAKE B-100
85, 425572.28, 1614683.48, 630.58,STAKE B-175
86, 425340.67, 1615022.17, 629.50,TB
87, 425324.53, 1615070.77, 631.90,TB
122, 426452.73, 1614807.76, 631.08,TB
129, 426795.22, 1614800.28, 631.07,GRD
130, 426798.46, 1614749.29, 631.22,GRD
135, 426772.48, 1614550.93, 631.82,GRD
136, 426833.30, 1614548.73, 631.72,DITCH LINE
137, 426806.90, 1614545.55, 631.34,DITCH LINE
138, 426782.66, 1614543.28, 631.20,DITCH LINE
139, 426723.25, 1614540.92, 630.68,GRD
197, 425507.37, 1614580.40, 626.81,GRD
216, 426501.01, 1614623.78, 627.28,GRD
232, 426194.67, 1614565.04, 625.38,GRD
233, 426129.70, 1614589.51, 627.34,TB
244, 425565.84, 1614609.06, 628.92,TB
245, 425520.08, 1614620.02, 629.06,GRD
397, 425713.74, 1615235.86, 616.68,TB
398, 425781.74, 1615230.48, 616.71,GRD
406, 425701.27, 1615209.47, 617.87,TS
407, 425628.20, 1615208.12, 617.67,TS
417, 425708.73, 1615214.61, 617.24,TS
425, 425323.50, 1615200.70, 618.10,TS
426, 425406.84, 1615013.75, 630.69,GRD
427, 425436.22, 1615016.99, 631.67,GRD
428, 425949.56, 1615064.81, 625.07,SLOPE
433, 426056.38, 1614899.52, 626.31,SLOPE
434, 426118.43, 1614870.39, 625.73,SLOPE
435, 426200.95, 1614861.15, 624.78,TB
436, 426240.47, 1614860.22, 624.53,TB
437, 426286.00, 1614858.01, 625.52,TB

438, 426351.26, 1614857.85, 625.71,TB
489, 425653.00, 1614757.14, 631.10,GRD
490, 425624.91, 1614753.60, 631.11,GRD
504, 425429.36, 1614659.89, 629.71,GRD
505, 425497.03, 1614662.04, 629.65,12 IN TREE
506, 425447.36, 1614659.90, 629.71,12 IN TREE
507, 425424.52, 1614738.42, 631.07,GRD
508, 425439.52, 1614738.43, 631.07,4 IN TREE
530, 425742.78, 1614985.84, 632.49,15 INT REE
531, 425768.16, 1615015.67, 632.69,24 IN TREE
532, 425807.77, 1614989.29, 633.51,15 IN TREE
533, 425872.50, 1615049.31, 634.15,8 IN PINE
534, 425900.66, 1615068.51, 633.67,8 IN PINE
535, 425912.66, 1614996.09, 633.71,15 IN TREE
536, 425927.14, 1615196.78, 616.80,EDGE RIPRAP
560, 426715.93, 1614917.75, 607.27,TOE RIPRAP
574, 426120.81, 1614949.85, 603.41,TOE RIPRAP
594, 425223.02, 1615260.90, 602.28,TOE RIPRAP
595, 425334.49, 1615177.23, 625.70,GRD
700, 426227.01, 1615147.28, 628.37,GRD
701, 426213.68, 1615178.35, 628.04,10 IN PINE
702, 426214.83, 1615180.57, 628.16,GRD
703, 426226.83, 1615180.57, 628.16,10 IN PINE
704, 426220.99, 1615197.49, 628.16,10 IN PINE
705, 426237.39, 1615172.36, 628.16,10 IN PINE
706, 426276.41, 1615156.89, 628.67,GRD
707, 426329.14, 1615156.35, 628.78,GRD
708, 426353.51, 1615157.09, 628.87,GRD
709, 426364.57, 1615147.12, 628.59,8 IN TREE
710, 426405.70, 1615161.76, 628.54,GRD
711, 426429.06, 1615163.99, 628.83,12 IN PINE
712, 426482.02, 1615161.02, 628.57,GRD
713, 426535.06, 1615158.80, 628.53,GRD
714, 426583.46, 1615154.92, 628.65,GRD
715, 426588.27, 1615118.04, 627.81,GRD
716, 426582.93, 1615071.18, 627.24,GRD
717, 426540.02, 1615068.13, 627.09,GRD
718, 426488.68, 1615072.06, 627.40,GRD
719, 426432.18, 1615073.43, 627.43,GRD
720, 426378.10, 1615076.50, 627.13,GRD
721, 426383.42, 1615070.02, 627.33,10 IN TREE
722, 426362.17, 1615051.14, 628.14,36 IN TREE
723, 426322.61, 1615058.71, 627.80,36 IN TREE
724, 426283.63, 1615064.19, 628.15,20 IN TREE
725, 426271.96, 1615101.08, 627.69,GRD
728, 426172.21, 1615075.89, 627.57,10 IN PINE
729, 426189.73, 1615052.44, 627.61,18 IND BL TREE
730, 426233.59, 1615051.07, 627.52,10 IN PINE
731, 426256.47, 1615056.56, 627.98,3 6 IN APPLE TREES
732, 425445.91, 1614653.63, 630.40,12 IN TREE
733, 425497.77, 1614659.05, 743.06,12 IN TREE
734, 425576.15, 1614647.02, 630.61,6 IN TREE
735, 425596.55, 1614619.53, 629.79,12INTREE
736, 425449.31, 1614561.48, 626.12,GAS MARKER
737, 425502.63, 1614558.88, 625.50,GAS LINE
741, 425836.63, 1614532.94, 620.71,GAS LINE
742, 425923.18, 1614527.63, 620.73,GAS MARKER
743, 426009.97, 1614526.18, 621.93,GAS LINE
744, 426110.58, 1614535.76, 621.74,GAS MARKER
745, 426251.01, 1614548.18, 624.90,GAS LINE
749, 426712.38, 1614671.40, 629.70,GAS MARKER
750, 426715.77, 1614527.03, 632.74,TOB
751, 426675.88, 1614522.12, 633.04,TOB
752, 426637.86, 1614518.70, 633.14,TOB--END GUARDRAIL
753, 426608.03, 1614513.86, 633.32,TOB--GUARDRAIL
754, 426510.54, 1614505.47, 632.94,TOB--GUARDRAIL
755, 426413.01, 1614498.76, 631.96,TOB--GUARDRAIL
756, 426388.72, 1614502.67, 630.79,LIGHTPOLE
757, 426306.32, 1614491.69, 630.62,TOB--GUARDRAIL
758, 426306.32, 1614491.68, 630.62,TOB--GUARDRAIL
759, 426202.40, 1614483.18, 630.02,TOB--GUARDRAIL
765, 425797.40, 1614478.26, 626.41,LIGHTPOLE
766, 425718.97, 1614479.63, 628.07,TOB--GUARDRAIL
767, 425616.51, 1614492.51, 630.48,TOB--GUARDRAIL
768, 425576.57, 1614502.21, 631.98,LIGHTPOLE
769, 425624.85, 1614481.15, 630.87,GRATE 2X2
770, 425492.44, 1614514.45, 635.46,TOB--GUARDRAIL
771, 425396.39, 1614542.87, 640.03,TOB--GUARDRAIL
772, 425434.34, 1614519.51, 638.83,GRATE 2X2
773, 425312.22, 1614603.22, 644.69,TOB--GUARDRAIL
774, 425262.81, 1614687.18, 649.41,TOB--GUARDRAIL
775, 425241.25, 1614730.71, 651.93,GRATE 2X2
776, 425238.87, 1614788.54, 653.80,TOB--GUARDRAIL
782, 425193.36, 1615020.39, 663.68,TOB--GUARDRAIL
783, 425193.40, 1615026.76, 663.94,BRIDGE CORNER
784, 425191.66, 1615011.12, 662.48,GRATE 2X2
785, 425203.41, 1615027.36, 660.03,END WING WAL2FT WIDE
786, 425200.61, 1615021.72, 661.27,TOB
798, 425441.16, 1614560.75, 626.50,TOE
799, 425296.03, 1614746.99, 628.55,INV 18 IN CMP
800, 425445.00, 1614558.31, 627.54,INV 18 IN CMP
801, 425444.88, 1614558.36, 626.04,INV 18 IN CMP
802, 425547.18, 1614527.57, 624.38,TOE
803, 425704.80, 1614505.33, 620.49,TOE
804, 425703.61, 1614511.78, 619.61,DITCH LINE
805, 425693.39, 1614504.90, 619.98,INV 30 IN RCP
806, 425780.53, 1614501.01, 620.16,DITCH LINE
807, 425783.47, 1614492.17, 620.65,TOE
808, 425826.61, 1614489.07, 620.64,TOE
815, 426181.60, 1614497.41, 622.32,TOE
816, 426276.28, 1614504.41, 623.01,TOE
817, 426277.47, 1614511.75, 622.31,DITCH LINE
818, 426382.31, 1614528.03, 622.63,DITCH LINE
819, 426386.29, 1614516.29, 623.10,TOE
820, 426487.29, 1614541.95, 622.90,DITCH
825, 426591.83, 1614537.12, 626.52,DITCH
826, 426594.63, 1614533.65, 626.09,ANCHOR
827, 426593.65, 1614532.15, 627.74,ANCHOR
828, 426595.13, 1614522.32, 629.86,P POLE
829, 426487.59, 1614521.55, 623.47,DITCH
830, 426701.78, 1614546.38, 628.72,HEADWALL CORNER
831, 426709.29, 1614547.13, 628.74,HEADWALL CORNER
832, 426712.80, 1614554.30, 628.68,HEADWALL CORNER
833, 426708.10, 1614551.57, 624.96,INV 24IN RCP
834, 426753.18, 1614542.71, 630.76,GRATE 2.5X3
842, 426748.30, 1614543.59, 631.11,EDGE CONC
843, 429836.04, 1614770.60, 630.79,PLUG 1-14 FND
844, 430800.45, 1614744.08, 640.65,PLUG 1-15 FND
845, 428011.55, 1614675.67, 636.09,BIEDENBACH 7881 IPC
846, 427752.42, 1615253.36, 636.66,BM 1-631
847, 427074.21, 1615333.09, 633.04,M-8 COE DISK
848, 425532.41, 1615147.65, 637.54,PED MON
850, 426752.26, 1614616.21, 629.67,CP IPC SET # 38
851, 425650.33, 1614531.03, 621.61,WING WALL
852, 425652.76, 1614511.07, 624.56,HEADWALL COR
853, 425645.45, 1614522.77, 624.66,HEADWALL COR
854, 425647.16, 1614520.11, 618.52,56 IN RCPINV

G-6. Samples from Final CADD Output Drawing

The AutoCAD screen capture below depicts a portion of the Terramodel generated contours at the northwestern region of this site. The red contours are at 5-ft intervals, with the blue at intermediate 1-ft intervals. The ground shot data from which a DTM, TIN, and contours were generated are not shown on the final plan in this view--occasional spot elevations are shown in low gradient areas. Ground shots were taken about every 40 to 50 ft in low gradient areas, and denser along breaklines and high relief. The underground gas line is indicated by the "G" line just east of the right-of-way line. Trees are symbolized using a standard library symbol as shown. Trees in this area were attributed by diameter only--the species of each individual tree could have been attributed had this been required in the original Scope. Pine trees were differentiated by symbology. Light poles within the road right-of-way are symbolized by an "L" in a circle. Inverts on culverts are indicated by leader arrows.



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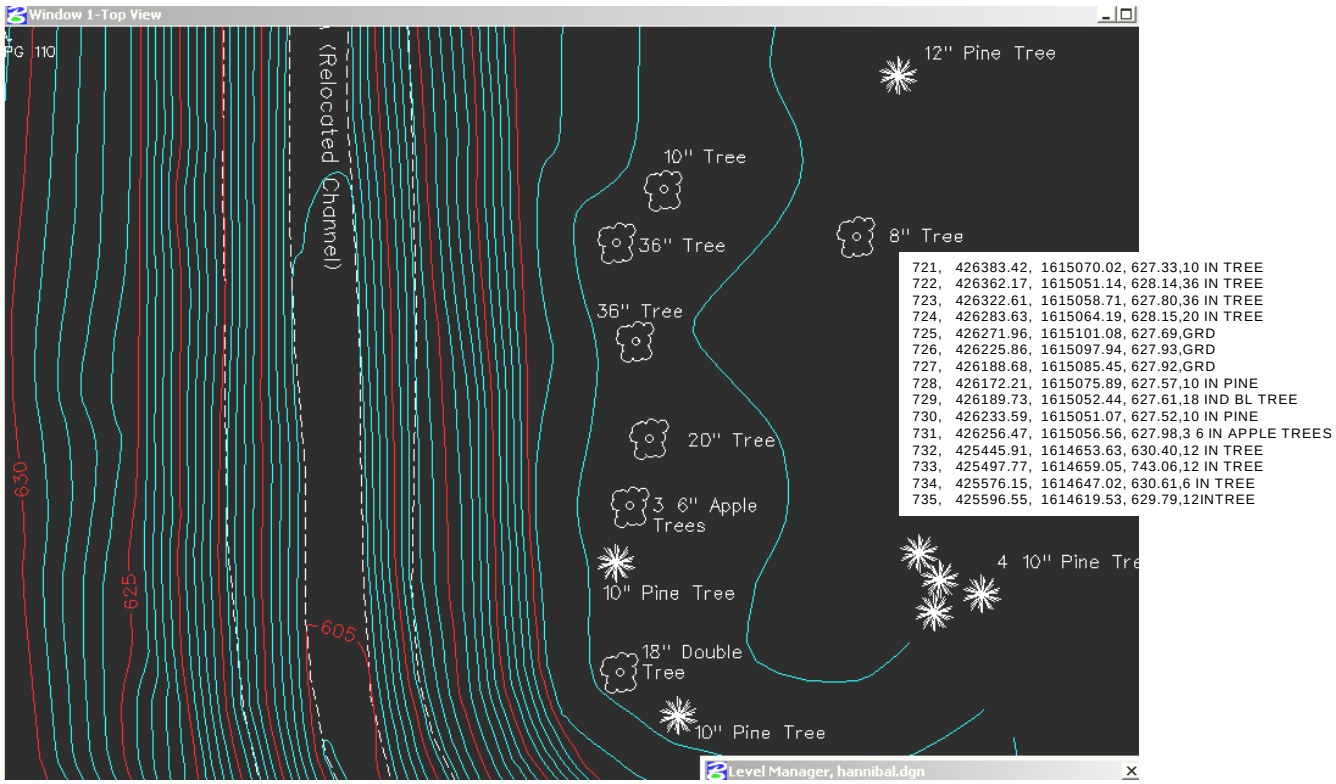
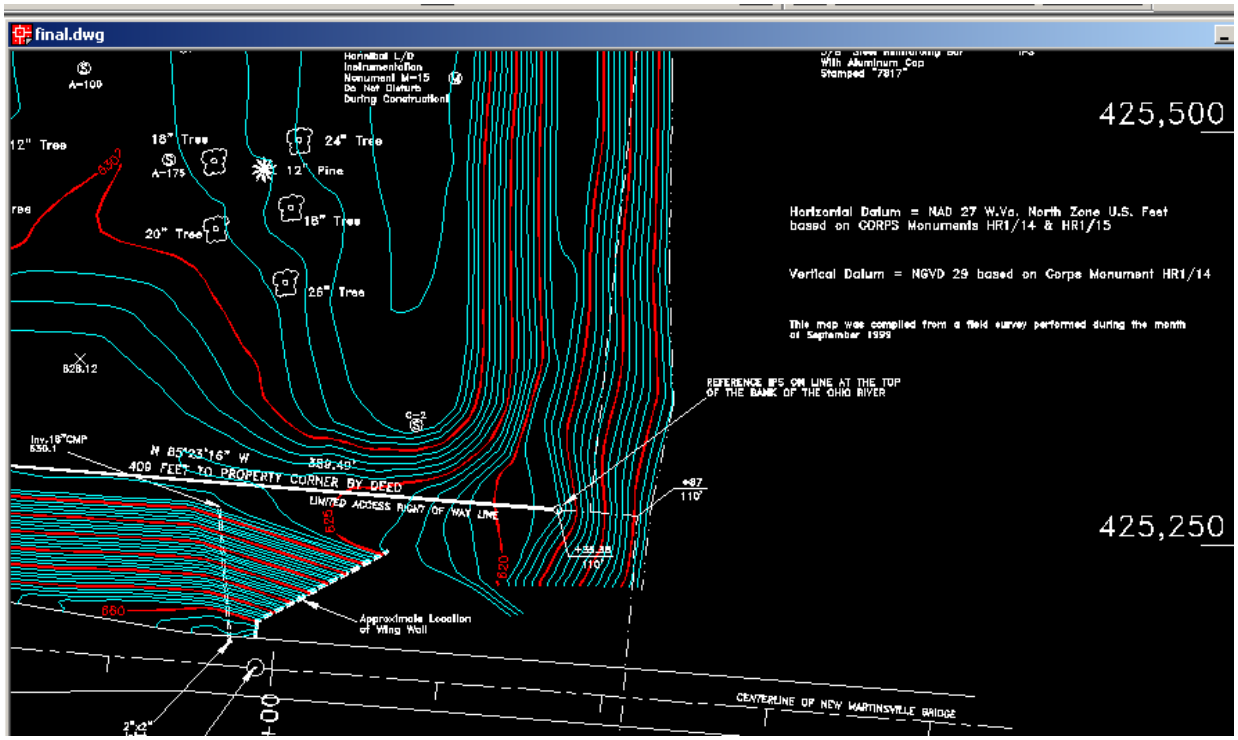
The following MicroStation screen capture depicts the symbology used for various features. A portion of the CR5 data collector file shows the origin of the points--e.g., the 3 6-in apple trees are shot number 731. The ground elevation of the trees is not shown since it can be interpolated from the contours. If needed, these elevations are in the database.



The following AutoCAD screen capture shows the note block indicating the horizontal and vertical datums, and the date of survey. The lock and dam monitoring pedestal monument (M-15) is indicated at the top center. This point was used as a base for much of the radial topography shot at the site.