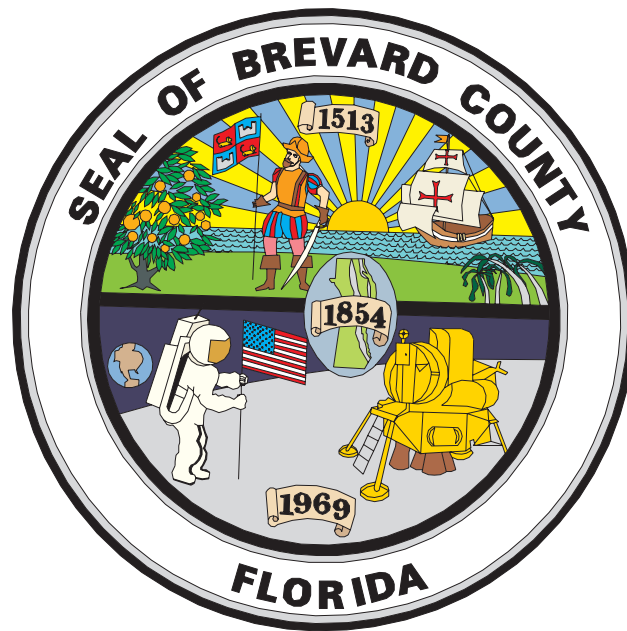


BREVARD COUNTY
TRANSPORTATION ENGINEERING
DEPARTMENT OF SURVEYING AND MAPPING



**VERTICAL CONTROL MANUAL FOR
SUBDIVISION PLATS, ROADWAY,
PEDWAYS AND UTILITY
EXPANSION PLANS**

August 2004

By: Samuel R. Vanderwarker

VERTICAL CONTROL MANUAL

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EFFECTIVE: August 1, 2004
OFFICE: Surveying and Mapping

Vertical Control Network Bench Levels

General Purpose:

These are the minimum guidelines and requirements comprising the **Brevard County Vertical Control Manual**. This manual has been created to establish standardized procedures for densification of the County's vertical control network. As the vertical data is processed and adjusted, all control information will be added to the County's GIS database and linked to the web site to furnish vertical control to the public for all surveying and mapping operations.

This manual establishes minimum requirements and does not exclude or prohibit the Surveyor & Mapper from adherence to more stringent procedures when required by Federal or State agencies.

These guidelines and requirements are applicable, but are not limited, to all subdivision plats, subdivision and commercial asbuilts, topographic surveys, control surveys, prepared for Brevard County and/or submitted to Brevard County for developmental review.

General Instructions:

The following procedures are a hybrid form of various standards and specifications. The field procedures as outlined have been developed by Brevard County to establish consistency in obtaining the required accuracy listed for the County's vertical control network.

a) Required accuracy:

Maximum allowable error of level run in miles = $0.05 \text{ Ft } \sqrt{\text{Miles}}$

b) Leveling Equipment:

- 1) Automatic Level
- 2) Automatic Level with Micrometer
- 3) Electronic Digital Level
- 4) Level Rods – Philadelphia type or precise/semi-precise with invar strip.

c) Calibrations and Adjustments:

Prior to running a bench line or loop the level shall be peg tested. The results of the peg test shall be shown in the field book. Any adjustments made shall be shown, and have a second peg test performed to check adjustment. (See Example B, Page 9)

d) Bench Mark Monumentation:

“Permanent Monuments” are Brevard County engraved 2.5” diameter brass disk uniquely stamped and set in concrete that is recognizable, durable, and immovable. Disks cemented or epoxied in concrete head wall and storm drain structures are acceptable. Each “Permanent Monument” must have a proper stamping which will be provided by the Surveying and Mapping Department. The stamping will be the P.I.D number for the GIS database.

Example of Stamping: (See Example C Page 10)

Examples of Acceptable Benchmark Location:

- 1) Brevard County 2½ inch Domed Brass Disk cemented or epoxied into a Drill Hole on Top of a level Concrete Headwall. (NOT RIP RAP)
- 2) Brevard County 2½ inch Domed Brass Disk cemented or epoxied into a Drill Hole on Top of Concrete Drainage Structures.
- 2) Poured in Place 10" round Concrete Monument with a Brevard County 2½ inch Domed Brass Disk.
(See Example D, Page 11)
- 4) Deep Rod Monument. (Driven to Refusal)
(See Example E, Page 12)

e) Acceptable Primary Control Benchmarks

- 1) USC&GS
- 2) NGS
- 3) FDOT (with documentation)
- 4) Brevard County BM (set after Sept. 2002)

f) NON Acceptable Benchmark Monumentation:

Chiseled squares in sidewalks, fire hydrants, nails in telephone poles, "PK or MAG nails" in pavements, etc. are not "Permanent Monuments."

Also please be advised that a turning point is not an acceptable Bench Mark for future vertical densification. Should future densification be required as with a multi-phase subdivision acceptable permanent benchmarks would need to be set along the primary level route. These permanent benchmarks would then be used to densify into each phase.

g) Maximum Foresight and Backsight Distance:

The maximum length of sight shall not exceed 196 feet. There may be situations where the maximum length cannot be met due to the safety of the field crew in which case safety will always prevail.

The backsight and foresight distance at each setup shall be balanced within 10 feet.

h) Leveling Monumentation: (Turning Point)

Hard and stable objects that are available on the ground may be used as turning points provided they have a distinct high point and fall within the allowable backsight / foresight distance. If existing objects are not available then set PK or MAG Nails in asphalt or a bridge spike or iron rod driven firmly into the ground at the required distance.

i) Field Notes:

All * Field Notes shall be kept in a standard hard cover field book. Field Notes must contain the following:

1) Level Notes:

Project Name

County's subdivision name / number

(If BM is for platting purposes)

Name of Field Personnel

Date

Conditions: Wind, Temp. and Sky

Section, Township and Range

Complete description and elevation of primary and secondary bench mark utilized in the level circuit.

Type, Model and Serial Number of Leveling Instrument

3 – wire reading format

Type and Model of Sighting or Bar Code Rod

Elevation's Datum being used

Page reference to sketch of control point

* All notes shall be submitted to Brevard County Surveying and Mapping Dept. and shall be incorporated into the GIS as metadata associated with each benchmark (s).

Example of Notes: (See Example F and G, Page 13 and 14)

All *Reference Notes shall be kept in a standard hard cover field book. Reference notes must contain the following:

2) Bench Mark Reference Notes:

Project Name

County's subdivision name / number
(If BM is for platting purposes)

Name of Field Personnel

Date

Conditions: Wind, Temp. and Sky

Section, Township and Range

Approximant Latitude and Longitude (WGS84)

All information about the control bench mark including
Agency of Publication and P.I.D.

Description how to reach the Bench Mark

(3) Three references to existing features; I.E. trees,
fences, power poles, manholes, EP, and ect..

* All notes shall be submitted to Brevard County Surveying and
Mapping Dept. and shall be incorporated into the County GIS
database as metadata associated with each benchmark (s).

Example of Reference Notes: BM Control (See Example H Page 15)
BM Set (See Example I Page 16)

j) Datum:

The Datum which will normally be used on all County projects is
the North American Vertical Datum of 1988 unless otherwise
directed by the County Surveyor's office.

k) Rod Reading Procedures:

The 3-wire method shall be the utilized for all County projects
unless otherwise authorized by the County Surveyor's office.

The users of this Manual are encouraged to assist in the
maintenance of the Vertical Control Network by notifying the County
Survey Department in case of disturbance or obliteration of Bench
Marks and/or apparent mistakes in descriptions of elevations of Bench
Marks. For updates and changes see Appendix A Page 17.

Subdivision Ordinance Chapter 62-841(D)

Benchmarks:

“Plats shall have a minimum of one (1) permanent Benchmark established on site in an accessible location. Plats that contain 40 acres or more, must have a minimum of two (2) permanent Benchmarks. The Vertical Control Requirements are outlined in the Brevard County Vertical Control Manual and can be obtained upon request by the Surveyor of Record.

The Benchmarks shall be shown and described on the plat. The stamping, elevation, datum and primary BM must be labeled on the plat or in the notes. The primary benchmark used to establish the vertical control must be based on a published benchmark, (USC&G, NGS, *FLDOT and **Brevard County Bench Marks). The plat benchmarks must be part of a closed and adjusted vertical control circuit that meets and or exceeds the vertical control accuracy requirements of Brevard County. The Benchmarks shall consist of a brass or aluminum County disk set in concrete or other permanent materials. The stamping on the disk must include the County identification number and year.

County Surveying and Mapping will provide the disk(s) and Benchmark identifying number. The field notes of the vertical control run must be provided with the final submittal.”

*FLDOT Bench Marks must be accompanied with vertical control documentation.

**Brevard County Bench Marks established prior to September 2002 are not acceptable for control Bench Marks.

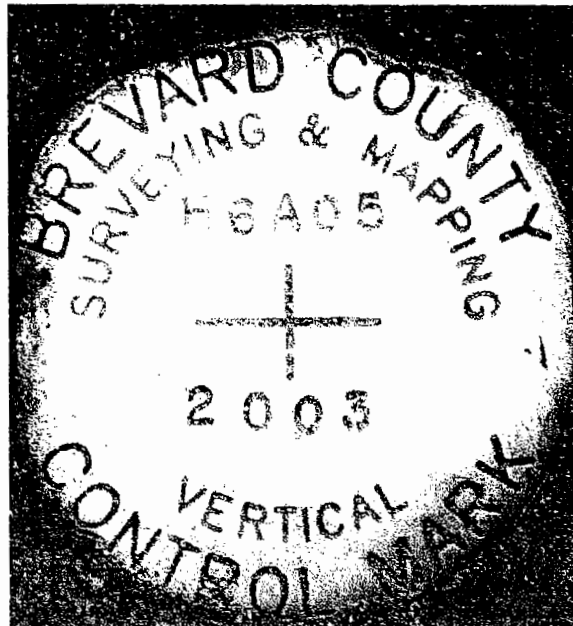
Example B:

Peg Test Notes

SEC 12 T. 27 R. 38	388/36
JOB# 04-12-847	PEG TEST
BY S. VANDERWARKER	25 DEC, 2004
BY C. DAVIS	TEMP: + 67°F
BY R. RINCONES	SKY: CLEAR
	WIND: 0 TO 5 M.P.H.
PEG TEST #1	
T @ C	ROD @ B 5.721
	- ROD @ A 5.590
DIFFERENCE IN ELEVATION = 0.131	
PEG TEST #2	
T @ C	ROD @ B 5.914
	ROD @ A 5.790
DIFFERENCE IN ELEVATION = 0.124	
CHECK AFTER ADJUSTMENT	
PEG TEST #2	
T @ D	ROD @ A 5.219
	+ DIFFERENCE 0.124
ROD READING @ B = 5.343	
NOTE: ERROR OF 0.010' ADJUSTED OUT BY BRINGING HORIZONTAL CROSSHAIR ON READING 5.150 AT POINT B. ADJUSTED BY: S. VANDERWARKER	
CHECK AFTER ADJUSTMENT	
PEG TEST #2	
T @ D	ROD @ A 5.219
	+ DIFFERENCE 0.124
ROD READING @ B = 5.342	
NOTE: ERROR OF 0.001' NO ADJUSTMENT MADE	

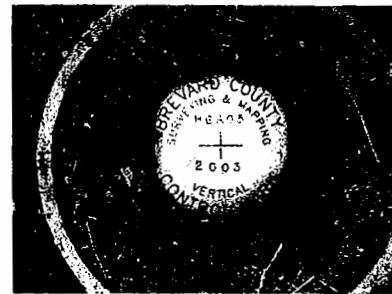
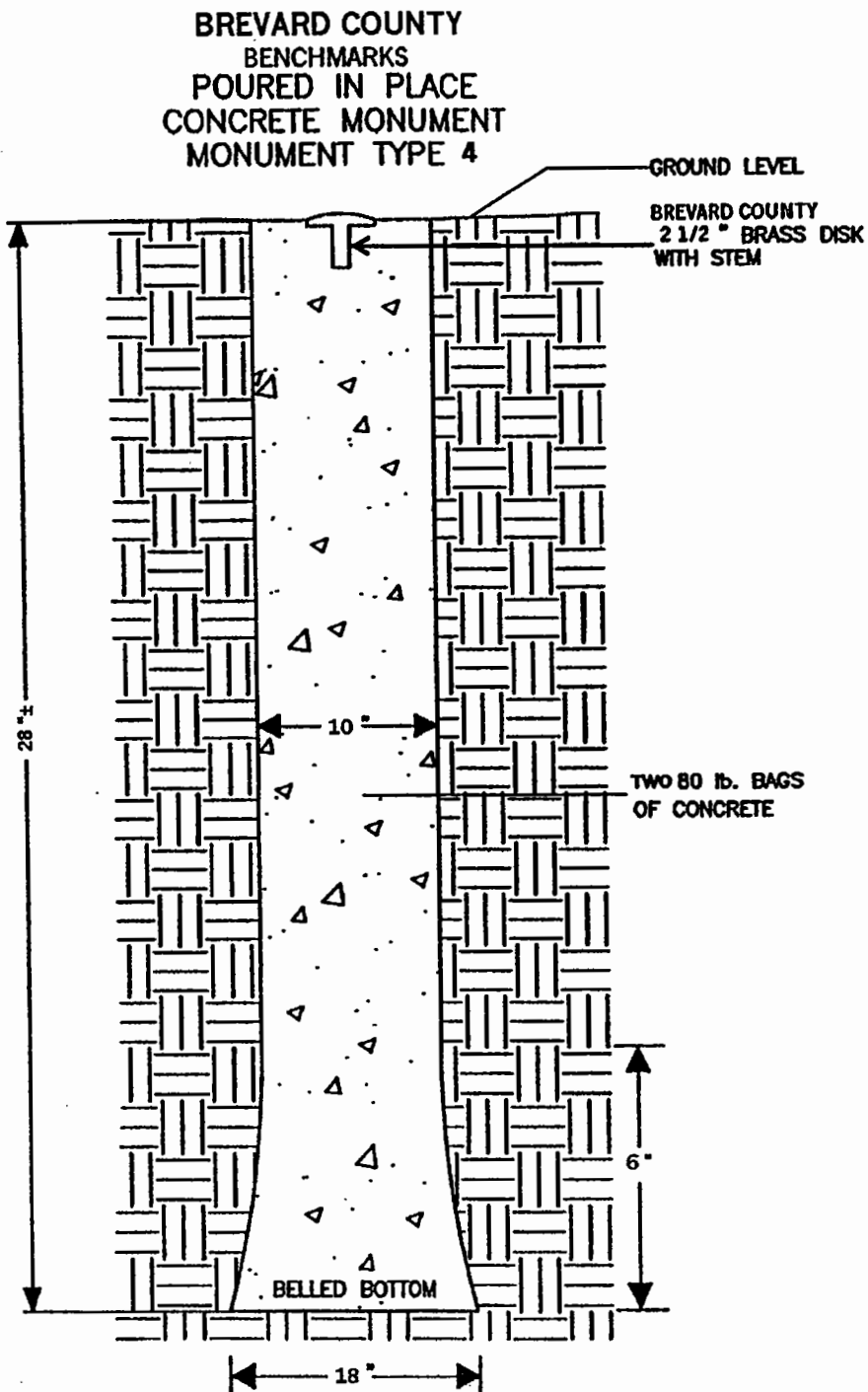
Example C:

STANDARD STAMPING
FOR
BENCH MARKS



Example D:

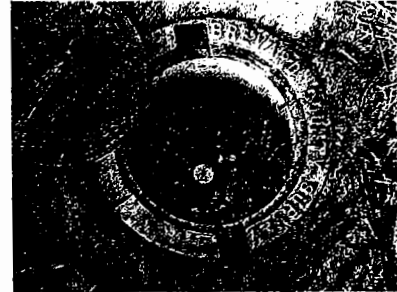
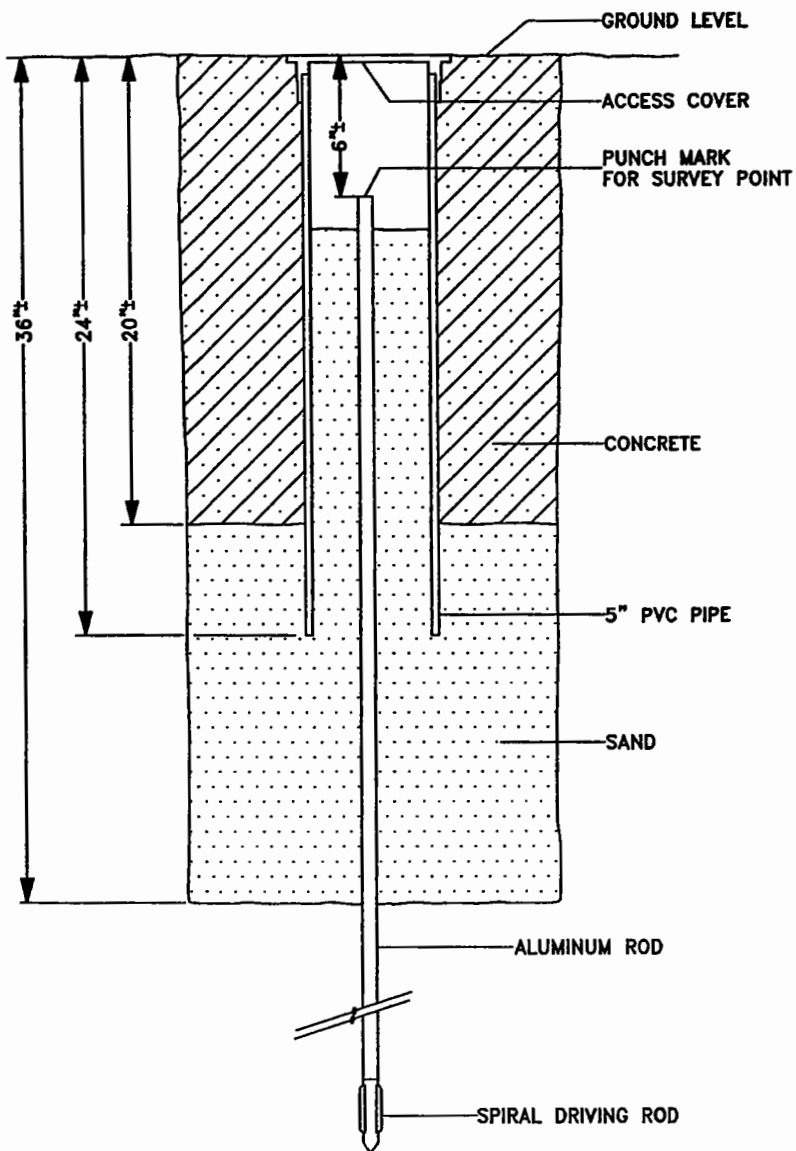
BREVARD COUNTY'S CONCRETE MONUMENT



Example E:

Deep Rod Monument

SCHEMATIC OF
DEEP ROD MONUMENT SYSTEM
MONUMENT TYPE 1



Example F:

3 Wire Set-up Notes

JOB # 04-12-847	VERTICAL CONTROL RUN	388/37
M.S. VANDERWARKER	25 DEC. 2004	TOPCON: AT-63
R.C. DAVIS	TEMP: 72°F	S.M.: AX6720
R. RINCONES	SKY: CLEAR	ROD: PHILADELPHIA TYPE
	WIND: 0 to 5 M.P.H.	
START LEVEL RUN ON "L 2967" AND ENDED ON "R 2967" SEE FB/P 388/29 FOR MORE INFORMATION ON "R 2967"		
LEVEL RUN IS SHOWN IN FB/P 388/37-43		
PEG TEST IN FB/P 388/36		
B.M. # L 2967	PID # AJ2531	
B.M. # R 2967	PID # AJ2537	
B.M. # L 2967 ELEVATION		
NAVD 88 = 12.441		
NGVD 29 = 13.776		
SEE FB/P 388/30		
B.M. # R 2967 ELEVATION		
NAVD 88 = 9.439		
NGVD 29 = 10.791		
SEE FB/P 388/29		

Example G:

3 Wire Notes

JOB # 04-12-847		VERTICAL CONTROL RUN				388/38	
ED S. VANDERWARKER		25 DEC. 2004				TOPCON: AT-G3	
R. C. DAVIS		TEMP: ± 72°F				S/V: AX 6720	
D. R. RINCONES		SKY: CLEAR				ROD: PHILADELPHIA TYPE	
		WIND: 0 to 5 MPH.					
BEGIN LEVEL RUN							
DATA FILE # L2967.3							
						NAVD88	NEVD89
						A.D.J.	ADJ.
STA	BS + MEAN	HI	FS - MEAN	ELEV.	ELEV.	ELEV. DESCRIPTION	
	4.769				(BM)		
L2967	4.617	4.6167	18.0277		12.441	12.441	(BM) FOUND: USCHGS B.M. L2967 BRASS DISK SET IN 1 1/2" ROUND CM. PID # 11251 SEE FB/P 388/30
	4.464						
	5.095		4.751				
TP1	4.822	4.8227	17.2754	4.605	4.6050	12.4527	BRIDGE SPIKE (B.S.)
	4.551		4.459				
	6.328		5.412				
TP2	5.857	5.8567	17.9927	5.139	5.1393	12.1360	B.S.
	5.387		4.867				
	5.701		4.205				
388-26	4.902	4.9027	17.0387	3.729	3.7283	14.2643	14.265
	4.105		3.251				15.600 BREVARD COUNTY B.M. 12" ROUND CM. BCSM "388-26 2004" B.M. SEE FB/P 388/26 FOR INFO
	6.420		3.658				
TP3	5.470	5.4700	21.7740	2.862	2.8630	16.3040	MAG NAIL (M.M.) IN ASPHALT N.W. COR. OF BRYAN AVE. AND LINCOLN AVE.
	4.520		2.069				

Example H:

BENCH MARK CONTROL REFERENCE NOTES

Job # 04-12-847

S. VANDERWARKER 22 DEC. 2004
 TEMP: $\pm 79^{\circ}$ F.
 APPROX. SKY: OVERCAST
 LAT: 28-23-01.6N. WIND: 0 TO 5 MPH
 LONG: 080-42-09.3W.
 (WGS-84)

SEC. 23 - TWN 24 - RNG 36

FOUND AS DESCRIBED
 SEE NGS. PID # AJ2531

NAVD 88: 9.231'

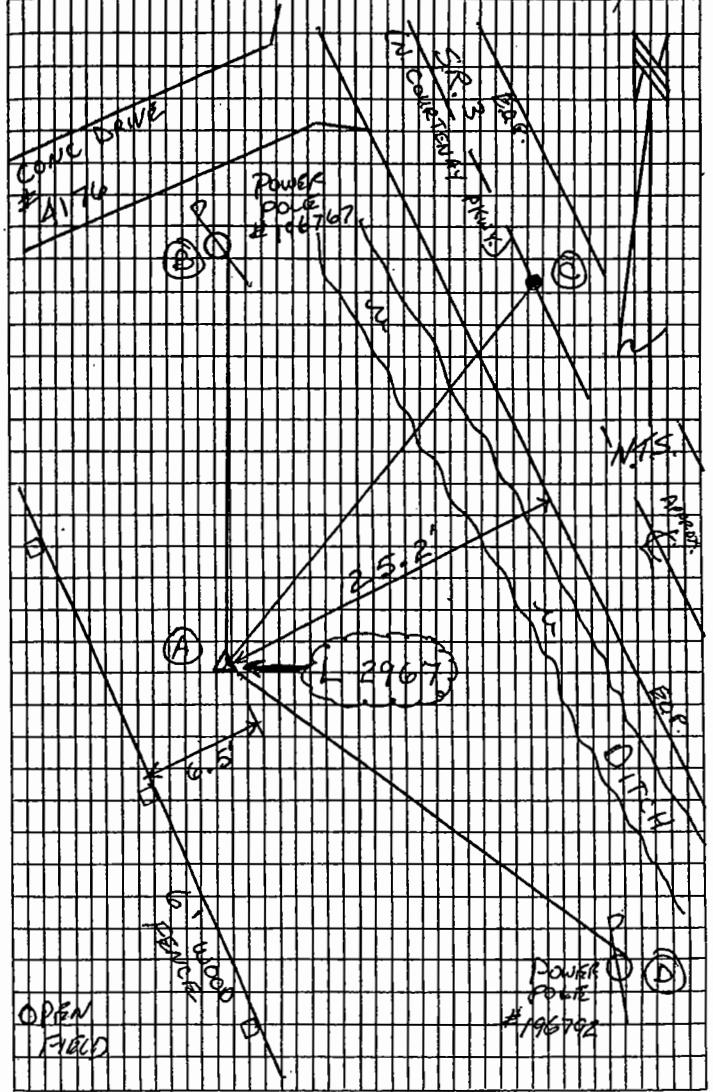
NGVD 29: 10.596'

- (A) FND: 12" ROUND CM. W/A USCGS 3" BRASS
 BM. DISK "L2967" 1992" 0.4" BELOW
 N.G.
- (B) FND: POWER POLE # 196767
- (C) FND: MAG NAIL + DISK "LB 4211" IN ASPHALT ROAD
- (D) FND: POWER POLE # 196792

STATION	AZIMUTH	DISTANCE
From (A) to (B)	5°	27.6'
(A) to (C)	40°	34.7'
(A) to (D)	125°	30.1'

STATION # L 2967

388/30



Example I:

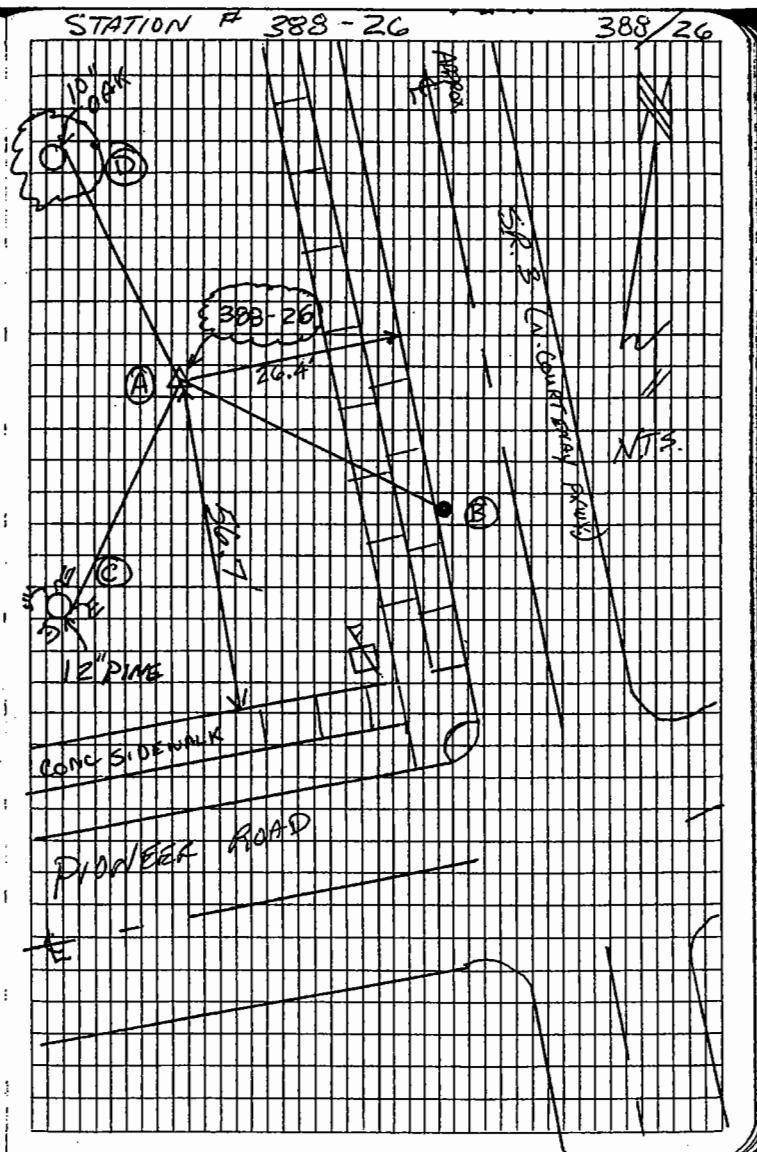
SET BENCH MARK REFERENCE NOTES

JOB # 04-12-847

BY S. VANDERWARKER	20 DEC. 2004
DR R. RINEONES	TEMP: + 71° F
	SKY: CLEAR
APPROX.	WIND: 0 to 5 MPH.
LAT: 28-23-55.2 N.	
LONG: 080-12-19.9 W.	
(WGS-84)	
SAC 14 - TWN 24 RNG 36	
TO REACH STATION FROM INTERSECTION OF STATE ROAD 528 AND STATE ROAD 3, GO SOUTH ON SR 3 FOR 0.85 MILES TO PIONEER ROAD AND STATION AT THE NORTHWEST CORNER OF INTERSECTION.	
NAVD 88 =	13.595'
NGVD 29 =	14.960'

(A) SET 10" ROUND C.M. W/ BREVARD COUNTY SURVEYING + MAPPING VERTICAL CONTROL MARK 2.5" BRASS DISK "388-26 2004" AT 0.5' BELOW N.G.
 (B) FND: PK NAIL + DISK "LB424" IN ASPHALT ROAD.
 (C) 12" PINE TREE.
 (D) 10" OAK TREE

STATION FROM	TO	AZIMUTH	DISTANCE
(A)	(B)	115°	38.1'
(A)	(C)	215°	38.6'
(A)	(D)	334°	36.2'



Appendix A

This Single publication is designed to establish General Specifications of Vertical Control Surveys set by Brevard County issued in the Subdivision Ordinance Section 62-2841. Because requirements and methods for acquisition of Vertical Control are changing rapidly, this publication is being released in loose-leaf format so that it can be updated more conveniently and efficiently. Recipients of this publication wishing to receive updated information should complete and mail, fax or e-mail the form below. Comments on the contents and format of this publication are welcomed and should be addressed to:

BCS&M, V-Control (Survey Department)
2725 Judge Fran Jamieson Way
BLDG. – A, Suite 220
Viera, FL 32940
Email: sam.vanderwarker@brevardcounty.us

- Please inform me of updated information for General Specifications of Vertical Control Surveys.

Name: _____

Address: _____

E-Mail: _____

Phone # _____

Fax # _____