

RECOMMENDATION OF THE CECIL COUNTY
GIS WORK GROUP
GEODETIC CONTROL SUB-COMMITTEE

for a

**DENSIFICATION OF MONUMENTATION WITHIN
CECIL COUNTY**



Submitted For Consideration To The
Board Of County Commissioners For Cecil County

December 5, 2006 (*second draft*)

GIS Work Group Subcommittee Members

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Mr. Matheu J. Carter, P.E., Capital Facilities Administration
Mr. Jeff Coale, Water & Wastewater
Mr. Van Funk, Department of Public Works
Mr. Bill Henning, PLS, National Geodetic Survey
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Introduction

This proposal outlines the recommendations of the GIS Work Group's Geodetic Control Subcommittee in regards to increasing the number of geodetic control monuments within the County.

A geodetic control monument is essentially a surveyed point whose coordinates have been established, verified, and published for future use by the engineering and surveying communities. Geodetic control is thus not an end in itself, but a means to an end. It is a facilitator of enhanced reliability that provides a common, consistent, and accurate reference system. The process of increasing the number of geodetic controls within a given location is known as a densification of monumentation.

Why does Cecil County need a densification of monumentation ?

Geodetic control networks support surveying, engineering, and GIS (geographic information systems) applications being conducted within the County. The proposed densification will benefit both public sector entities and private landowners and businesses. In a sense, the development of a modern, county-wide control network is akin to a form of infrastructure needed to support current and future needs.

Currently, Cecil County has fifty (50) first order monuments located within its borders. First order monuments, according to representatives from the National Geodetic Survey, should form the backbone of a geodetic control network. Although less accurate monumentation exists, and can be installed, today's surveying and global positioning system (GPS) technologies make it easier to achieve first order positions on monuments.

Twenty-four of the fifty existing monuments were installed in 2005 through the initiative of the Department of Public Works. The map contained in Appendix A shows the locations of the County's first order monuments, and the spreadsheet in Appendix B contains details regarding each monument. The data regarding the monuments' locations and coordinates was obtained from the National Geodetic Survey (NGS), a federal agency charged with registering, administering, and cataloging data regarding geodetic control in the United States.

As seen in Table 1 on the following page, Cecil County's ratio of monuments per square mile is low compared to many of its neighbors and other Maryland counties located in the I-95 corridor. With a monument per square mile ratio of 0.14, Cecil County is significantly lower than seven of the other counties listed in the table. Further, Cecil County's raw number of monuments (50) pales in comparison to its neighbor Harford County, which has 310 first order monuments. These comparisons would be even more lopsided had the Department of Public Works not installed 24 monuments in 2005.

The GIS Work Group recommends that the County take steps to increase the number of first order monuments within the County. As a means to accomplish this, the GIS Work Group has partnered with the Susquehanna Chapter of the Maryland Society of Surveyors and representatives from the National Geodetic Survey. These groups also have a strong desire to see Cecil County benefit from a densification of monumentation.

Table 1 – Ratio of Monuments in Cecil County & other select Maryland counties

County	First Order Monuments	Land Acreage (sq miles)	Monuments per sq mile
Harford	310	440	0.70
Montgomery	276	496	0.56
Prince Georges	261	485	0.54
Carroll	220	449	0.49
Baltimore Co.	200	599	0.33
Baltimore City	71	80.8	0.88
Howard	66	252	0.26
Cecil (current)	50	348	0.14
Anne Arundel	55	416	0.13
Cecil (pre 2005)	26	348	0.07
Queen Anne's	18	372	0.05
Kent	13	279	0.05

The benefits of a densification of monumentation, as mentioned briefly in the previous section, include the following:

- Creation of a common, consistent, and accurate surveyed reference system;
- Providing surveyors with a referenced coordinate system for new projects;
- The densification of monumentation shall facilitate the improvement of the accuracy standards outlined in the GIS Work Group's previous proposal to require the regulated community to provide coordinate points as part of the plan review process;
- With the resulting improved accuracies, relationships to other mapped data contained in the County's geographic information systems (GIS) database can be shown with more confidence and reliability; and
- Accurate information is the key to making informed decisions, and with a quality geodetic control network forming the basis of the survey and GIS data received and created by the County, the quality of all spatial analyses will improve. The quality and thoroughness of decisions made based upon those data sources will also improve.

Background Regarding Geodetic Control Networks

Two types of monumentation networks exist, the classical model and the continually operating reference station (CORS) model.

In the classical model, the geodetic control network is comprised of numerous passive monuments spaced roughly one to three miles apart. Classical control networks attempt to blanket the entire jurisdiction, thus providing complete coverage throughout a county or city, but due to the large number of monuments required, they have a large initial cost.

One passive monument by itself, however, costs roughly \$1,500. In installing 24 first order monuments in 2005 the Department of Public Works spent approximately \$25,000. While this cost was somewhat smaller than normal (i.e. due to certain circumstances in having a contractor already on hand doing similar field work), this subcommittee feels that \$1,500 is relatively reflective of the future cost per monument outlined in later sections of this proposal.

In the continually operating reference station (CORS) model, the geodetic control network consists of a computerized station built to precise specifications and fewer passive monuments. The computerized station, which is the continually operating reference station, consists of a computer, antenna, and GPS receiver housed outdoors. With an ability to continually obtain data from any of the GPS satellites orbiting the earth, the CORS's connection to the internet allows accurate positioning information to be broadcast to anyone wishing to use the control network. This constant information, which the federal government sees as "locational truth," allows the geodetic control network to include fewer passive monuments.

Although the CORS based model is most likely the network of the future, it has a high start up cost and higher maintenance costs. Sources cite different cost figures, but generally, the cost for the initial CORS station is between \$30,000 to \$50,000, and maintenance (for just the CORS station) costs are roughly \$6,500 per year. These maintenance costs include the cost of utilities, minor structure maintenance, computer processing costs, and a pro-rated cost of equipment replacement. Further, the number of individuals in the County comfortable with using CORS is relatively small, and the subcommittee wants traditional, as well as more technologically oriented, surveying firms to be able to utilize the County's control network.

For these reasons, the GIS Work Group Subcommittee recommends that Cecil County take a hybrid approach in the creation of its geodetic control network.

The Proposed Cecil County Geodetic Control Network

The proposed Cecil County densification of monumentation will incorporate all existing first order monuments within the County, and densification is expected to take place over the course of one to three years.

As seen in Appendix C, the majority of existing first order monuments within the County are located within either the Development District or Suburban District, as taken from the County's Comprehensive Plan. The Development District and Suburban District are areas to which the County wants to direct its growth, and as such, the subcommittee finds that the first phase of densification must include the backfilling of the development district with monumentation at a suitable density.

The subcommittee recommends that new passive, first order monuments be installed within one to three miles of any existing or proposed monuments within these districts. As can be seen in Appendix C, the need for monumentation exists in the following locations:

- Development District – The Route 7 corridor, the Route 272 corridor south of North East, the Fletchwood Road corridor, the Port Deposit / Bainbridge area, and the south and western portions of the Town of Elkton.

- Suburban District – The portion of the Route 222 corridor between Port Deposit and Perryville, the Red Toad Road corridor, the Mechanics Valley Road corridor, the Nottingham Road corridor, the entire portion of the suburban district located in the northeast corner of the County, and the entire portion of the suburban district located on the Elk Neck Peninsula.

The actual locations of the monuments will be decided by the GIS Work Group if/when funding is provided by the Board of County Commissioners. Their locations however, will most likely be within State Highway Administration rights of way, County road rights of way, or on County owned property. If monuments are placed on private property (which may be unavoidable in certain cases), the GIS Work Group will need to obtain the express written consent of the landowner prior to installation.

Future phases of the monumentation effort and expansion of the control network will likely be focused within the Town Districts surrounding the Towns of Cecilton, Chesapeake City, and Rising Sun. These future phases, however, will be subject to the approval of the Board of County Commissioners via the budgeting process in future years. The phased nature of the program may also, at some point in the future, include a continually operating reference station (CORS). The densification of monumentation being proposed as part of this plan in no way prevents or impedes utilizing a CORS based approach in the future.

Additionally, in an effort of defray costs of future phases of this densification of monumentation, the subcommittee will be proposing an amendment to Section 5.4 of the Subdivision Regulations. Said amendment would require the developer of a subdivision obtaining concept plat approval for in excess of 100 units, lots, or sites, to install a first order monument in the subdivision prior to recordation of the final subdivision plat. Given the small cost (roughly \$1,500) of one monument in comparison to other forms of infrastructure (such as roads, water lines, sewer lines, etc), the subcommittee does not believe this would place an undue financial burden on a developer.

Monument Specifications

All monumentation installed as part of this proposal shall be installed to first order horizontal standards and third order (class one) vertical standards, as established by the National Geodetic Survey (NGS). The monuments shall also be “blue booked” into the NGS’s database. The blue booking process provides a quality check and verification of the data associated with the monuments, and inclusion of the data in the NGS’s internet database provides a mechanism for easy public access to the data.

For visualization purposes, photographs of an existing first order monument (JMT 24) are included in Appendix D. As seen in the photos, the monument consists of a concrete block in which a three inch stamped aluminum disk has been set. Only a small portion of the monument is above ground, making it relatively unobtrusive, but a substantial concrete mass exists underground. A diagram showing the portion of the monument located underground is also contained in Appendix D.

COSTS

In order to fund the first phase of this densification of monumentation proposal, the subcommittee requests that the Board of County Commissioners provide \$75,000 to the Office

of Planning & Zoning's Fiscal Year 2008 budget. The GIS Coordinator shall be responsible for administering the funds and shepherding the project to its completion.

At a minimum, given the \$1,500 per monument cost estimate mentioned previously, the funding will provide for the installation and blue booking of 50 new first order monuments.

However, as part of this proposal, the County has entered into a cooperative partnership with Susquehanna Chapter of the Maryland Society of Surveyors and the National Geodetic Survey. This partnership, which must be formalized with a memorandum of understanding, will delegate certain portions of the project's completion to each group. The County shall be responsible for obtaining the necessary materials and physically installing the monuments. The Susquehanna Chapter of the Maryland Society of Surveyors shall provide the surveyed documentation and information necessary to certify the monuments, and the National Geodetic Survey shall blue book the monuments based upon the information provided to them by the Susquehanna Chapter.

This private-public partnership benefits all involved. In terms of overall project costs, for example, NGS estimates that the strict submission and reporting requirements for blue booking the monuments adds thirty percent to similar projects' costs. Thus, due to the services in kind provided by the County's partners, the \$75,000 being requested of the Board of County Commissioners may go much further than providing 50 monuments.

In terms of timing, all of the partners involved in this proposed project are eager to begin work on the project. Should this funding request be approved, the various partners and the GIS Work Group will begin working on additional project specifics (i.e. determining monument locations, sending out request for proposals for materials, coordinating the surveyor volunteers' efforts, etc) such that once funding becomes available on July 1, 2007, we may earnestly begin work.

In conclusion, the GIS Work Group humbly requests that the recommendations presented and the funding levels proposed herein be approved by the Board of County Commissioners of Cecil County. Funding of a densification of monumentation shall create a common, consistent, and accurate surveyed reference system that enables improved project control and improved decision making for future land use projects.

REFERENCES

California Spatial Reference Center. "A Master Plan for a Modern California Geodetic Control Network." March 12, 2003.

Federal Geodetic Control Committee. "Standards and Specifications for Geodetic Control Networks." September 1984.

Federal Geographic Data Committee. "Geospatial Positioning Accuracy Standards." 1998.

Henning, William. "Geodetic Issues: Presentation to Cecil County Government." October 19, 2006.

National Geodetic Survey. "Guidelines for New and Existing Continuously Operating Reference Stations." February 2006.

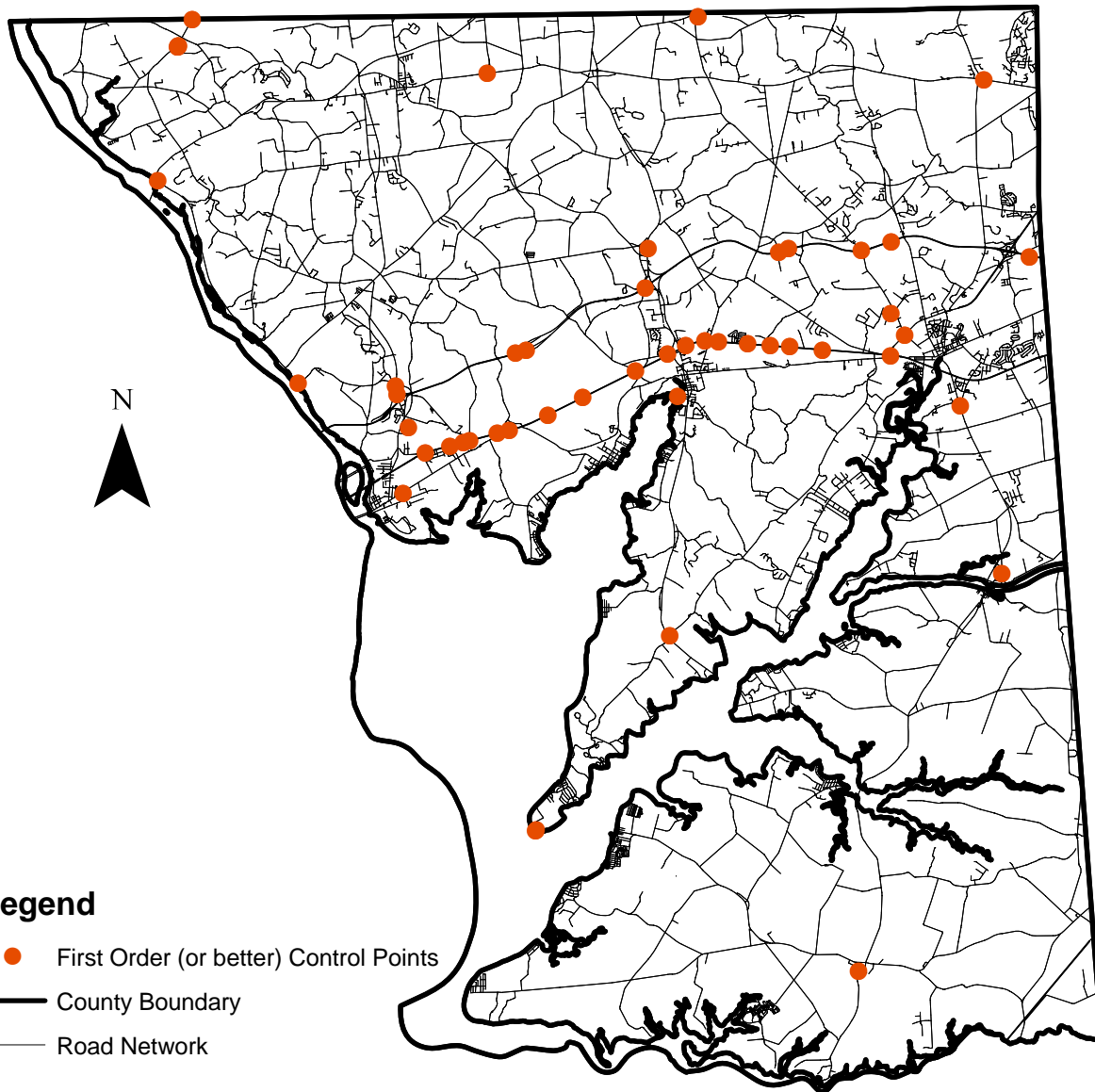
National Geodetic Survey. "NOAA Manual NOS NGS 1: Geodetic Bench Marks." September 1978.

National Geodetic Survey. "Input Formats and Specifications of the National Geodetic Survey Database: the NGS Blue Book." <http://www.ngs.noaa.gov/FGCS/BlueBook>

State of Idaho. "Implementation plan for Geodetic Mapping and Control." Not dated.

Appendix A

Map of First Order Geodetic Control Points within Cecil County



Cecil County
Office of Planning & Zoning
November 17, 2006
Drawn by DRB



Appendix B

Details regarding first order (or better) geodetic control points in Cecil County

Coordinates are in NAD 83 State Plane meters

(Meters are used because it is the unit of measurement used by MD Property View, the County's GIS base layer)

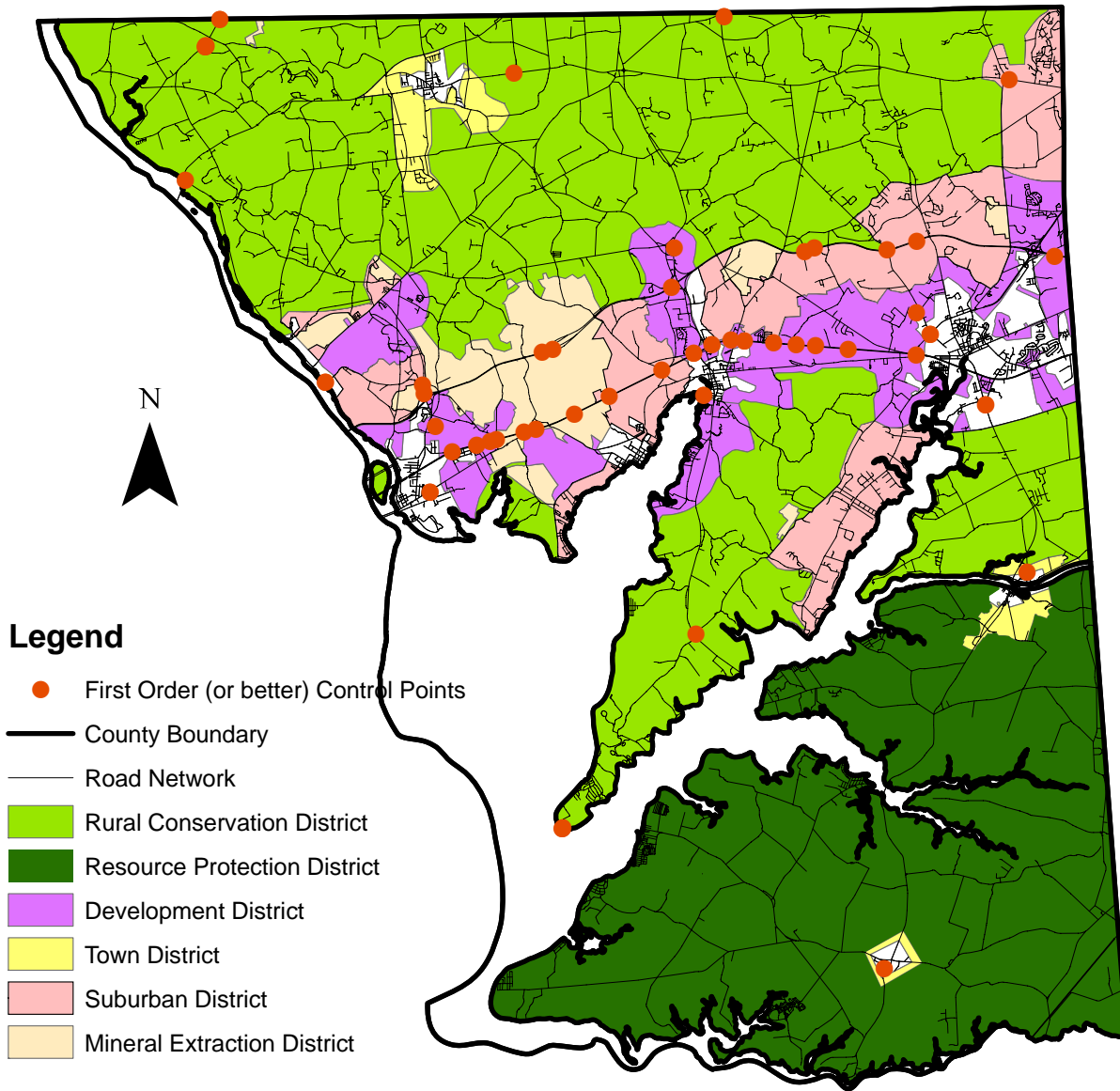
X coordinate = easting. Y coordinate = northing

<i>Monument Name</i>	<i>USGS Quad</i>	<i>Horz. Order</i>	<i>Digi Y Coord</i>	<i>Digi X Coord</i>	<i>Tax Map</i>	<i>Grid</i>	<i>Parcel</i>
A T 2	Bay View	1	219,943.20	494,650.11	20	20	117
A Team	Bay View	1	219,789.29	494,287.80	20	20	702
Apple	Newark West	A	226,186.63	501,898.39	14	4	479
Brendle	Havre de Grace	1	214,519.58	480,126.31	29	10	Rt. 222
Cecil	Bay View	B	219,925.88	489,438.52	19	20	77
Cecilton	Cecilton	B	193,170.56	497,248.21	100	0	106
City	Elkton	A	207,889.68	502,567.03	43	5	1
Dawson	Conowingo Dam	1	227,412.17	471,972.93	2	19	186
Dawson Eccentric	Conowingo Dam	1	227,432.89	471,997.41	2	19	200
Dawson RM 3	Conowingo Dam	1	227,412.98	471,979.97	2	19	186
Dawson RM 4	Conowingo Dam	1	227,438.17	472,001.24	2	19	200
Desi	Havre de Grace	1	216,162.14	484,915.40	24	22	Rt. I-95
Elkt	Elkton	1	214,113.79	501,027.44	320	14	2436
Endo	Newark West	1	219,642.67	503,594.50	304	6	Rt. I-95
Geese	Newark West	1	220,181.56	498,462.74	20	24	151
Geese AZ MK	Newark West	1	219,864.48	497,352.61	20	23	618
Irwin	Bay View	1	228,535.00	491,292.77	5	16	184, Lot 2
JMT 01	Elkton	1	217,528.42	498,454.58	305	17	588
JMT 02	Havre de Grace	1	214,859.20	480,069.55	29	10	146
JMT 03	Havre de Grace	1	213,300.63	480,547.19	29	16	14
JMT 04	Havre de Grace	1	210,877.25	480,348.96	34	10	89
JMT 05	Havre de Grace	1	212,359.46	481,170.86	29	23	637
JMT 06	Havre de Grace	1	212,600.33	482,076.53	29	24	368
JMT 07	Havre de Grace	1	212,753.47	482,580.30	30	19	62
JMT 08	Havre de Grace	1	212,816.34	482,821.58	30	19	42
JMT 09	Havre de Grace	1	213,088.23	483,846.55	30	20	116
JMT 10	Havre de Grace	1	213,205.12	484,288.68	30	21	59

Monument Name	USGS Quad	Horz. Order	Digi Y Coord	Digi X Coord	Tax Map	Grid	Parcel
JMT 11	Havre de Grace	1	213,779.79	485,722.92	30	16	116
JMT 12	North East	1	214,421.24	487,011.55	30	12	8
JMT 13	North East	1	215,397.70	488,973.17	31	2	908
JMT 14	North East	1	216,021.22	490,164.49	25	21	86
JMT 15	North East	1	214,449.22	490,539.33	401	0	204
JMT 16	North East	1	216,339.93	490,834.57	25	22	296
JMT 17	North East	1	216,511.69	491,554.91	25	23	489
JMT 18	North East	1	216,485.55	492,051.89	25	23	263
JMT 19	North East	1	216,403.24	493,133.04	25	24	689
JMT 20	North East	1	216,357.08	493,980.75	26	19	322
JMT 21	North East	1	216,303.13	494,703.38	26	20	233
JMT 22	North East	1	216,171.64	495,911.15	26	21	54
JMT 23	Elkton	1	215,976.44	498,445.06	313	6	244
JMT 24	Elkton	1	216,719.80	498,965.71	310	7	2182
Lapidum AZ MK	Havre de Grace	1	214,937.39	476,447.57	700	0	86
Lucy	Havre de Grace	1	216,061.97	484,518.54	24	21	Rt I-95
Madix	Conowingo Dam	1	228,428.47	472,520.78	2	14	113
Mom	Bay View	1	218,484.59	489,339.27	25	8	17
Neck	North East	A	205,584.60	490,249.73	41	21	375
Seal	Rising Sun	A	226,452.98	483,472.80	11	2	153
Turkey Point Reset	Spesutie	1	198,374.65	485,266.54	50	22	3
Turkey Point RM 4	Spesutie	1	198,395.33	485,293.20	50	22	3
Wingo	Conowingo Dam	1	222,440.80	471,241.43	15	24	None

Appendix C

Existing First Order Monuments in Relationship to the Land Use Districts in the Comprehensive Plan



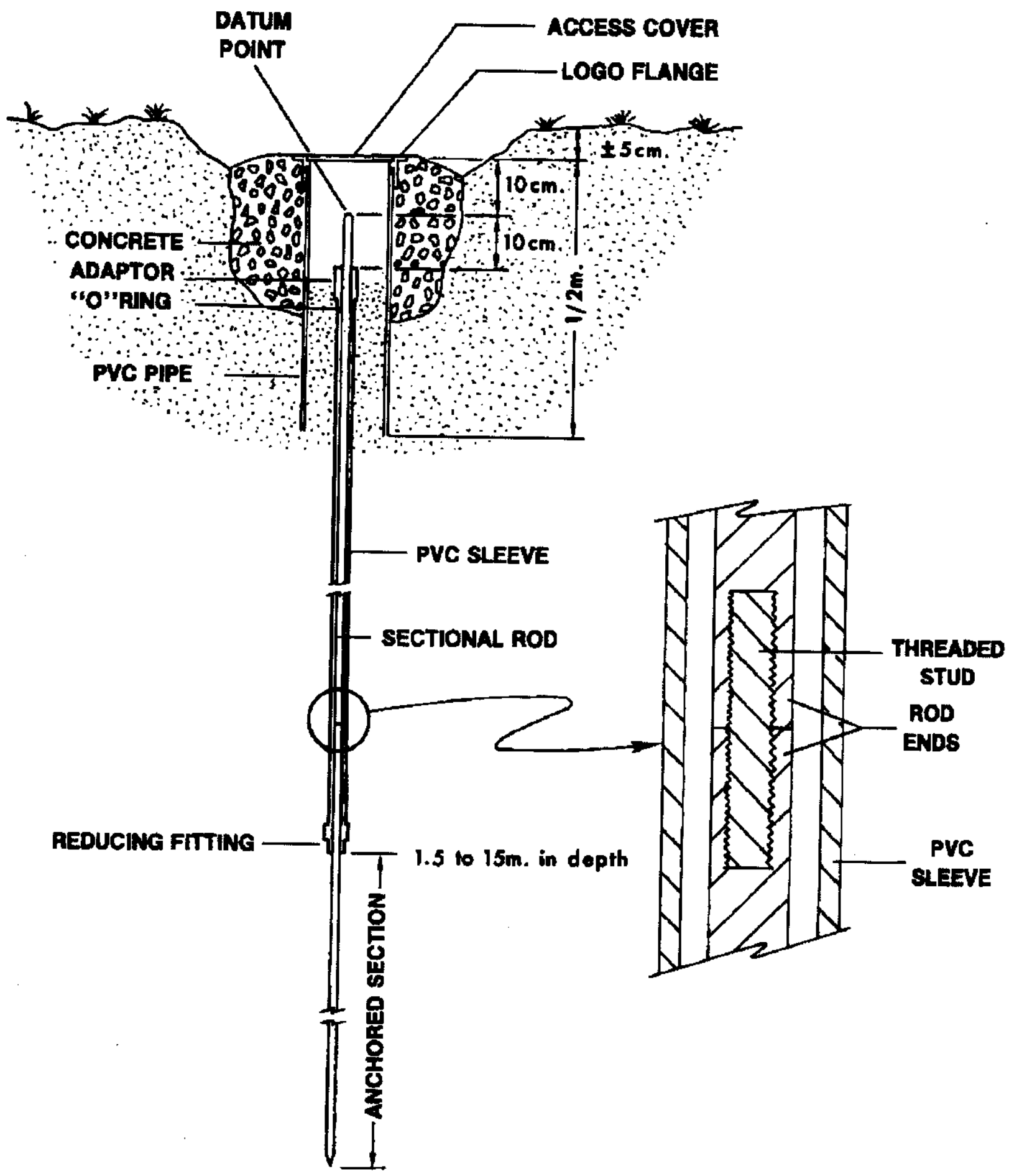
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Cecil County
Office of Planning & Zoning
November 17, 2006
Drawn by DRB



Appendix D – Photographs of an Existing First Order Monument





Appendix E
Proposed Amendment to Section 5.4 of the Subdivision Regulations

AMENDMENT TO THE CECIL COUNTY
SUBDIVISION REGULATIONS

WHEREAS, Article 66B of the Annotated Code of Maryland empowers the County to enact Subdivision Regulations and to provide for the administration, enforcement, and amendment of the same; and;

WHEREAS, the Planning Commission has recommended an amendment to the Cecil County Subdivision Regulations regarding the provisions of said Regulations involving Monuments and Markers;

WHEREAS, a public hearing regarding said proposed amendment was held before the Planning Commission on _____ 2007, and;

WHEREAS, the Planning Commission recommended approval of said amendment to the Board of County Commissioners, and;

WHEREAS, a public hearing regarding said proposed amendment was held before the Board of County Commissioners on _____ 2007; and

WHEREAS, all requirements of Article 66B of the Annotated Code of Maryland, with regard to the amendment of the Cecil County Subdivision Regulations have been met:

NOW, THEREFORE, BE IT ENACTED, by the Board of County Commissioners of Cecil County, State of Maryland, that the following amendment be and is hereby enacted:

[Addition]
{Deletion}

SECTION 5.4 - Monuments and Markers

5.4.6 - A developer that has obtained concept plat approval for greater than 100 units, lots, or sites shall install a first order monument in the subdivision prior to recordation of any final subdivision plat. Said monument must be installed per National Geodetic Survey requirements, be installed under the supervision of a professional surveyor licensed in the State of Maryland, and must be bluebooked into the National Geodetic Survey database. This requirement shall pertain to all subdivisions in excess of 100 units, lots, or sites regardless of when concept plat approval was granted.

Date Adopted

Attest:

Alfred C. Wein, Jr., County Administrator

William C. Manlove, President

Mark H. Guns, Vice President

Rebecca J. Demmler, Commissioner

Brian Lockhart, Commissioner

Wayne L. Tome, Sr., Commissioner