CAPE WIND

SUBMERGED AQUATIC VEGETATION

DIVER SURVEY

To:

Cape Wind Associates LLC
75 Arlington Street. Suite 704
Boston, MA 02116

Attn: Leonard Fagan

From:

Woods Hole Group, Inc.
81 Technology Park Drive
East Falmouth, MA 02536 USA
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July 2003

Cape Wind Submerged Aquatic Vegetation (SAV) Diver Survey

A visual check of the areas specified by ESS Group, Inc. and Len Fagan was conducted on June 17, 18, and July 1, 2003 at sites, AV-SS16, AV-SS56, AV SS58, and AV-EGG (Appendix 1 ESS Scope of Work).

Positioning was obtained by using a Leica 421B DGPS system with a DGPS accuracy of less than one meter.

Two field oceanographers, Robert Morris and Carl Johnsen, dove at each site. George Hampson was on board as a diver and Marine Biologist to help identify the aquatic vegetation. Each search was conducted using a 100-foot search line that was marked every ten feet for reference. The divers spaced themselves at ten foot increments, based on the visibility at each site, and swept 360 degrees. The divers then moved out to the next mark and swept 360 degrees. This was done out to 100 feet. The divers identified the aquatic vegetation as they searched and took photographs and samples for George Hampson to identify.

The eelgrass (*Zostra marina)* areas in the inner harbor area, defined by AV-EGG were mapped to provide a definition of the area covered.

Of the three offshore sites, eelgrass was only found at the site designated AV-SS58. A detailed list of what was found at each site is listed below.

AV-SS16:

41° 30' 56.8545" N

70° 20' 50.1448" W

A diver survey was conducted on June 18, 2003 at 0745-0815.

Weather conditions were overcast with rain. Wind was light out of the southeast. Wave height was two to three feet. Water temp was 55 degrees F. The survey found no evidence of eelgrass (*Zostera marina*) or widgeon grass (*Ruppia maritima*). The divers did find sargassum weed (*Sargassum filipendula*) a benthic form, kelp (*Laminaria agardhii)* and codium (*Codium fragile)*, all sub aquatic vegetation. Animal life consisted of numerous welk (*Busycon ssp.)*, starfish (*Asterias forbsii)*, black bass (*Centropristhis striata)*, one Fluke (*Paralichthys dentatus)*, one Horseshoe Crab (*Limulus polyphemus)*, and one 3.5 foot long smooth dogfish (*Mustelus canis)*. The bottom was covered with limpids.

AV-SS56:

41° 29' 19.2837" N

70° 23' 07.3126" W

A diver survey was conducted on June 17, 2003 at 0715 to 0832. Weather was sunny and calm. Wave height was one to two feet. Water temp was 55 degrees F.

The survey found no evidence of eelgrass (*Zostera marina*) or widgeon grass (*Ruppia maritima*). The divers did find sargassoum, kelp, and codium. Animal life consisted of numerous welk, starfish, and rock bass. The bottom was covered with limpids.

AV-SS58:

41° 30’ 03.8600” N

70° 22’ 37.3232” W

A diver survey was conducted on June 17, 2003 at 1345 to 1432. Weather was sunny and calm. Wave height was one to two feet. Water temp was 55 degrees F.

The survey found eelgrass (*Zostra marina*) at the site (Figures 1, 2 and 3). The eelgrass was located at the center from 10 to 15 feet at a bearing of 45 degrees from the center point in the northeast quadrant. Another large patch of eelgrass was discovered between 40 and 70 feet from the center at a bearing of 45 degrees in the northeast quadrant of the survey area (Figure 1). The width of the eelgrass area was 30 to 40 feet. The coverage within the beds was estimated to be 50 to 70 percent of the area defined. The divers also found *sargassoum* weed, kelp, and *codium*.

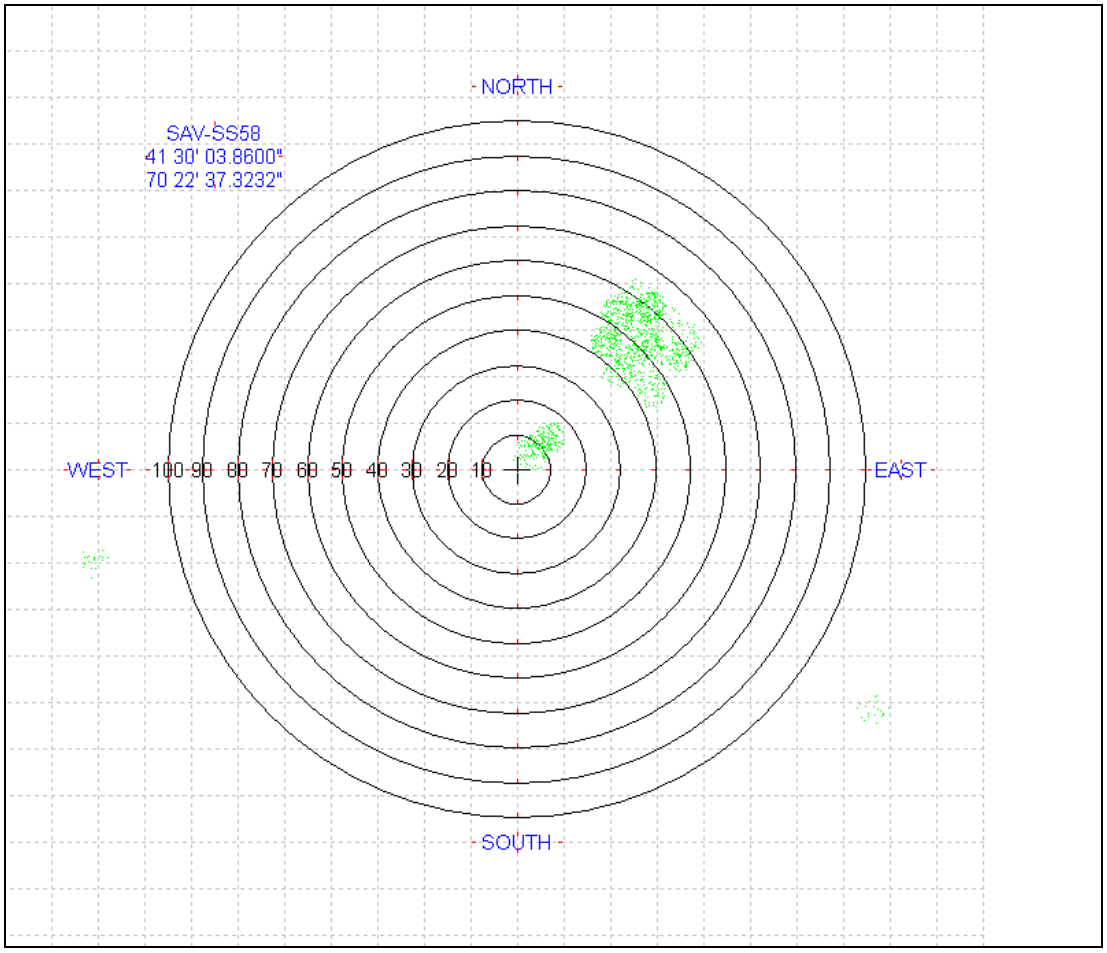

Figure 1. Location and Extent of Eelgrass (*Zostra marina*) at AV-SS58

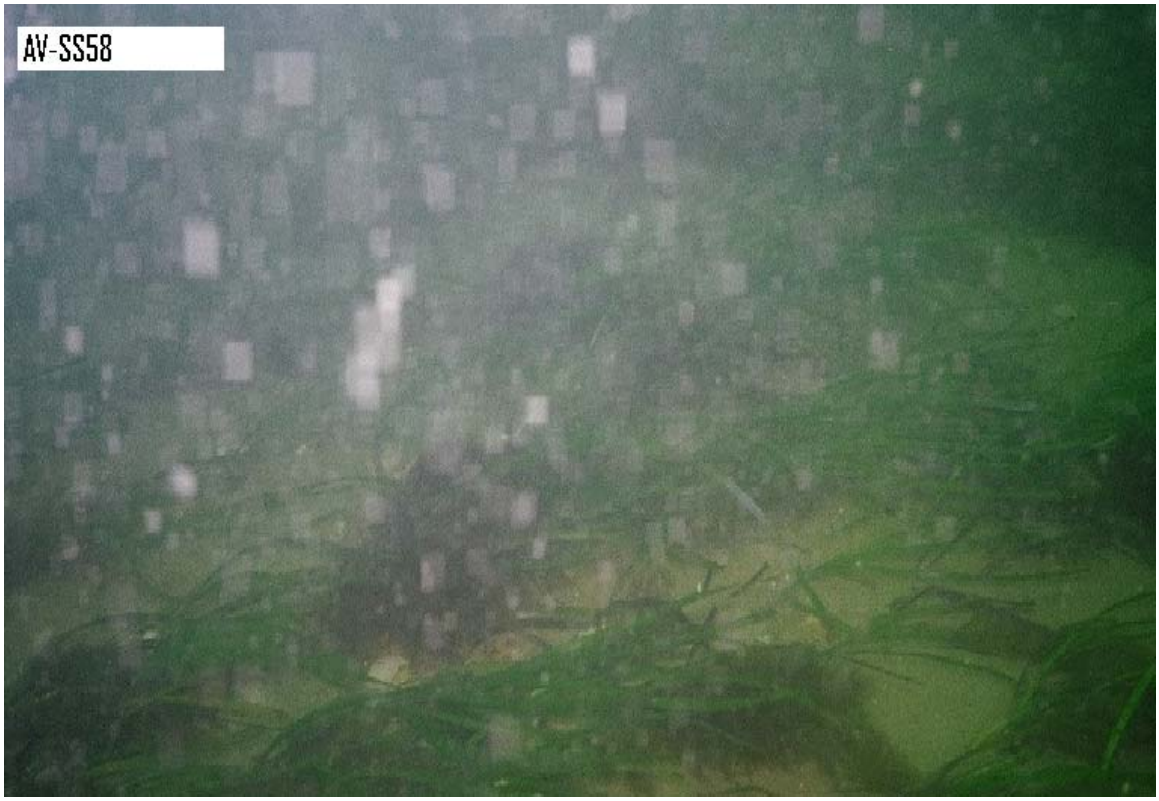

Figure 2. Underwater Photograph of Eelgrass (*Zostra marina*) at AV-SS58

Figure 3. Underwater Photograph of Eelgrass (*Zostra marina*) at AV-SS58

SAV Survey of AV-EGG:

41° 30' 03.8600" N

70° 22' 37.3232" W

Survey was conducted on July 1, 2003 at 0653 to 0852. Low tide was at approximately 0800.

Positioning was obtained by using a Leica 421B DGPS system with a DGPS accuracy of less than one meter.

A navigation computer running Hypack MAX software was used to log positions.

George Hampson, Ben Potter, and Rob Morris used a combination of free diving and visual observation, from a small research vessel, to delineate the eelgrass beds.

We detected patchy eelgrass beds at the center point of SAV-EGG. The coverage at these patchy, three to four-foot diameter, areas was 100 percent.

A more continuous eelgrass bed was found north and east of the center point; the coverage was 100 percent and is shown in Figure 4.

A detailed list of the outer extents of the eelgrass bed positions can be found in Table 1.

A detail of general observations of the survey area can be found in Table 2.

Ruppia maritime was not found at this site.

Codium was found along the edge of the channel in water depths of 5 to 10 feet.

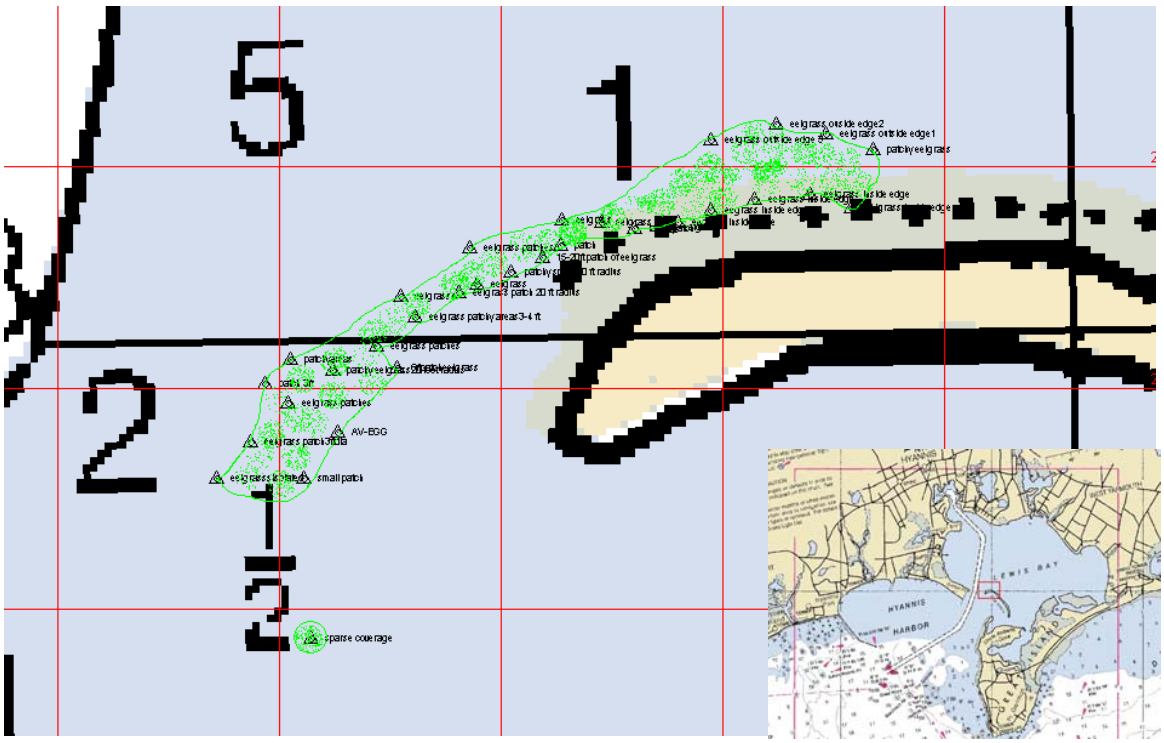

Figure 4. Location and extent of Eelgrass (*Zostra marina*) at AV-EGG

Table 1. Eel Grass Bed Extents, Positions

Point Description	Massachusetts State Plane NAD 1983		WG884	
	Northing	Easting	Latitude	Longitude
AV-EGG center point	992652.65	2693760.07	41.63311275	-70.26911645
small patch	992621.76	2693717.93	41.63299833	-70.26923167
sparse coverage	992627.94	2693573.46	41.63260167	-70.26921667
eelgrass isolated	992543.39	2693717.40	41.63300000	-70.26951833
patchy areas	992609.71	2693826.48	41.63329667	-70.26927000
patch 3ft	992586.75	2693804.37	41.63323692	-70.26935514
5ft patch eelgrass	992705.52	2693818.75	41.63327167	-70.26892000
eelgrass	992709.09	2693882.33	41.63344600	-70.26890356
eelgrass patches	992771.40	2693926.60	41.63356500	-70.26867333
Eelgrass	992777.34	2693893.89	41.63347500	-70.26865333
large patch	992921.07	2693943.94	41.63360667	-70.26812500
eelgrass	992952.49	2693945.01	41.63360833	-70.26801000
eelgrass inside edge 1	992960.18	2693949.37	41.63362000	-70.26798167
eelgrass inside edge 2	992990.09	2693960.13	41.63364833	-70.26787167
eelgrass inside edge 3	993028.68	2693970.40	41.63367500	-70.26773000
eelgrass inside edge 4	993079.19	2693974.78	41.63368500	-70.26754500
eelgrass inside edge 5	993116.74	2693962.56	41.63365000	-70.26740833
patchy eelgrass	993136.03	2694015.08	41.63379333	-70.26733500
eelgrass outside edge1	993093.44	2694029.65	41.63383500	-70.26749000
eelgrass outside edge 2	993048.66	2694038.11	41.63386000	-70.26765333
eelgrass outside edge 3	992989.17	2694023.89	41.63382333	-70.26787167
eelgrass	992855.79	2693951.51	41.63363000	-70.26836333
eelgrass patch	992891.82	2693949.60	41.63362333	-70.26823167
patch	992854.75	2693929.02	41.63356833	-70.26836833
15-20ft patch of eelgrass	992838.06	2693917.24	41.63353667	-70.26843000
patchy spots 20 ft radius	992808.62	2693904.66	41.63350333	-70.26853833
eelgrass patch 20 ft radius	992761.50	2693886.37	41.63345500	-70.26871167
eelgrass patchy areas 3-4 ft	992722.63	2693864.55	41.63339667	-70.26885500
eelgrass patches	992687.46	2693838.53	41.63332667	-70.26898500
patchy eelgrass 20 foot radius	992648.13	2693816.70	41.63326833	-70.26913000
eelgrass patches	992607.10	2693786.35	41.63318667	-70.26928167
eelgrass patch 3 ft dia	992573.42	2693751.85	41.63309333	-70.26940667

Table 2. SAV-EGG Detail Positions of SAV Observations

Point Description	Massachusetts State Plane NAD 1983		WG8 84	
	Northing	Easting	Latitude	Longitude
No eelgrass	992855.64	2693393.92	41.63210000	-70.26839333
No eelgrass	992990.39	2693592.66	41.63264000	-70.26789000
large patch	992921.07	2693943.94	41.63360667	-70.26812500
eelgrass	992952.49	2693945.01	41.63360833	-70.26801000
eelgrass inside edge 1	992960.18	2693949.37	41.63362000	-70.26798167
eelgrass inside edge 2	992990.09	2693960.13	41.63364833	-70.26787167
eelgrass inside edge 3	993028.68	2693970.4	41.63367500	-70.26773000
eelgrass inside edge 4	993079.19	2693974.78	41.63368500	-70.26754500
eelgrass inside edge 5	993116.74	2693962.56	41.63365000	-70.26740833
No eelgrass	993144.54	2693993.94	41.63373500	-70.26730500
patchy eelgrass	993136.03	2694015.08	41.63379333	-70.26733500
eelgrass outside edge1	993093.44	2694029.65	41.63383500	-70.26749000
eelgrass outside edge2	993048.66	2694038.11	41.63386000	-70.26765333
eelgrass outside edge 3	992989.17	2694023.89	41.63382333	-70.26787167
eelgrass	992855.79	2693951.51	41.63363000	-70.26836333
No eelgrass	992935.97	2694048.02	41.63389167	-70.26806500
codium	992957.79	2694051.38	41.63390000	-70.26798500
No eelgrass	993073.16	2694077.34	41.63396667	-70.26756167
No eelgrass	993168.03	2694070.81	41.63394500	-70.26721500
No eelgrass	993288.73	2694042.8	41.63386333	-70.26677500
No eelgrass	993323.43	2693975.27	41.63367667	-70.26665167
No eelgrass	993317.25	2693929.63	41.63355167	-70.26667667
No eelgrass	993222.46	2693930.69	41.63355833	-70.26702333
eelgrass center	993122.34	2693984.51	41.63371000	-70.26738667
eelgrass center1	993098.18	2693985.38	41.63371333	-70.26747500
eelgrass center2	993068.08	2693987.37	41.63372000	-70.26758500
eelgrass center3	993043.44	2693989.44	41.63372667	-70.26767500
eelgrass center4	993019.81	2693984.85	41.63371500	-70.26776167
eelgrass center5	992996.6	2693982.69	41.63371000	-70.26784667
eelgrass center6	992972.55	2693975.67	41.63369167	-70.26793500
eelgrass center7	992956.23	2693969.96	41.63367667	-70.26799500
eelgrass center8	992926.18	2693968.31	41.63367333	-70.26810500
eelgrass patch	992891.82	2693949.6	41.63362333	-70.26823167
patch 3-4 ft dia	992854.75	2693929.02	41.63356833	-70.26836833
15-20ft patch of eelgrass	992838.06	2693917.24	41.63353667	-70.26843000
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eelgrass patches	992687.46	2693838.53	41.63332667	-70.26898500
patchy eelgrass20 foot radius	992648.13	2693816.7	41.63326833	-70.26913000
eelgrass patches	992607.1	2693786.35	41.63318667	-70.26928167
eelgrass patch 3ftdia	992573.42	2693751.85	41.63309333	-70.26940667

APPENDIX 1. EES EELGRASS SURVEY SCOPE OF WORK

ESS Group, Inc.

888 Worcester Street, Suite 240
Wellesley, Massachusetts 02482
p 781.431.0500
f 781.431.7434

MEMORANDUM

TO: Robert Catalano – Woods Hole Group
DATE: June 9, 2003
FROM: Ann McMenemy, PWS
SUBJECT: Scope of Work – Eelgrass Survey
PROJECT NO.: E159-004.1
COPY TO: Terry Orr, Heather Heater

As previously discussed with Heather Heater (ESS Group, Inc.) and Len Fagan (Cape Wind Associates), ESS would like your divers to conduct a field identification of Submerged Aquatic Vegetation (SAV) beds in the vicinity of the proposed Cape Wind project site. The coordinates of four suspected SAV beds, identified by either MassGIS mapping or the results of side-scan imaging, were previously forwarded to your attention by Len Fagan and are attached to this memo. The following Scope of Work for the proposed field investigation is required:

- **Spot Check:** Confirm whether SAV beds are present within a 100-foot radius of the coordinates identified on the attached table. If present, specify the location of the SAV bed (either on a coordinate system or as a distance and direction from the coordinates given in the attached table), and an approximate water depth.

- **Photographs:** Take photographs of the ocean floor at the coordinates specified and at any SAV beds identified in their vicinity (i.e., within a 100-foot radius).

- **Identification:** If SAV is present in the vicinity of the coordinates, determine whether the species is eelgrass (*Zostera marina*), widgeon grass (*Ruppia maritima*), or a combination. Descriptions and photographs of each species are attached. If there is any question regarding the identification, please collect a sample of the plant (including both roots and leaves), place it in a bottle or "Ziploc"-style bag with seawater, and deliver to ESS as soon as possible for identification.

- **Delineation**: For the SAV bed near Egg Island only (Target AV-Egg), delineate the extent of the bed with a GPS unit (3 meter accuracy or better). GPS data should be post-processed and converted into a form compatible with GIS mapping (e.g., .csv file).

Should you have any questions regarding this Scope of Work, please do not hesitate to contact me at (781) 489-1130.

RECOVERY OF SUBMERGED AQUATIC VEGETATION
Points identified for sampling

ID	Location	Latitude	Longitude
AV-SS16	5000' NW of Met-Tower-Survey Line G6	41° 30' 56.8454"	70° 20' 50.1448"
AV-SS56	SW of Met-Tower-Survey Line G1	41° 29' 19.2837"	70° 23' 07.3126"
AV-SS58	W of Met-Tower-Survey Line G17	41° 30' 03.8600"	70° 22' 37.3232"
AV-EGG	W of Egg Island on Edge of Federal Channel	41° 37' 59.2059"	70° 16' 08.8187"

*Targets AV-SS16, AV-SS56, and AV-SS58 were identified as locations containing submerged aquatic vegetation in OSI's "Marine Geophysical Survey and Sediment Sampling Program for Nantucket Sound."

**Target AV-EGG is a location mapped by the Mass DEP as containing Eelgrass.

Ruppia maritima

Name: Widgeon Grass (*Ruppia maritima*)

Distribution: Moderate to high salinity waters of Chesapeake and Coastal Bays.

Description: Very fine, much branched plant with numerous bristle-like alternate leaves 3 to 10 cm long and 0.5 mm wide with stiff, fibrous roots. From July through September, distinctive flowers are visible in the leaf axils, and following germination the spadix elongates and the beaked fruits appear as if on an umbel appear. There are two forms of this plant; an upright plant with free floating branches and a prostrate type.

Similar Species: Sago pondweed (leaves 0.5 - 2 mm wide), slender pondweed (leaves with a visible midrib), horned pondweed (opposite leaves).

Reproduction: By seed

Comments: One of the most abundant species of SAV in Chesapeake and Coastal Bays, widgeon grass undergoes large fluctuations in abundance from year to year. A prolific seed producer, Widgeon grass can colonize large areas very rapidly.

If you don't think your plant is represented above try going **back a level** and choosing again.

If you have questions regarding Bay Grasses please contact DNR's **Mike Naylor** **at 410-260-8652** or **mnaylor@dnr.state.md.us.**

Return to the **Bay Grass Restoration** Web Site

Return to the **Chesapeake Bay** Web Site

Zostera marina

Name: Eelgrass (*Zostera marina*)

Distribution: High salinity areas of the Chesapeake Bay (approximately from the Choptank River south to the mouth of the bay) and Coastal Bays.

Description: Alternate, ribbon like leaves with sheathing bases to 1 m. long and 3-5 mm wide. Flowers from May-June.

Reproduction: By seed and rhizome.

Comments: Eelgrass is the most abundant and most persistent SAV species in the high-salinity parts of Chesapeake and Coastal Bays. Eelgrass is particularly important as juvenile blue crab and sea trout habitat. Eelgrass populations are among the most stable of Chesapeake and Coastal Bays due to the ability of the beds to persist year round.

If you don't think your plant is represented above try going **back a level** and choosing again.

If you have questions regarding Bay Grasses please contact DNR's **Mike Naylor** **at 410-260-8652** or **mnaylor@dnr.state.md.us.**

APPENDIX 2. LEICA DGPS SPECIFICATIONS

Marine GPS

MX421… The World's Smartest GPS/DGPS Receiver/Antenna

The World's Smartest GPS/DGPS Receiver/Antenna... A Complete Solution

The latest Leica Marine GPS/ DGPS receiver is going to be a surprise to everyone, not the least our customers. It doesn't look like a receiver, it doesn't even really look like an antenna, because it's not either, it's both.

Leica and IBM Join Forces

Put quite simply, there is no other GPS/DGPS receiver–antenna on the market that is so advanced; with IBM's SiGe Technology, a built in 12 channel GPS receiver, and Leica's proprietary multi-path mitigation technique.

Built to Withstand The World's Oceans

The Smart Antenna is also extremely rugged with a well sealed, waterproof enclosure and a heavy duty connector. It's built to withstand the toughest environments.

Top Quality Antenna

The Smart Antenna features superior multi-path rejection, and boasts RF jamming resistance and uncompromised phase center stability.

One Stop Shopping and Legendary Leica Geosystems Service

As your requirements change, Leica Geosystems will continue to provide you with new, innovative solutions, whether you're a fair weather sailor or a seasoned mariner you've got it all covered. All the cables and fixtures are included and, of course, the Smart Antenna is backed by Leica Geosystems, with the largest service and support network of any survey instrument manufacturer in the world. Contact us today to learn more about this revolution in the making.

Leica

Smart Antenna Specifications

Features At A Glance

Leica's latest GPS technology developed jointly with IBM brings you the "World's Most Accurate Smart Antennas".

- **Built-in high precision 12 channel GPS receiver.**
- **Submeter DGPS accuracy and better than 3 meters in autonomous GPS mode.**
- **Optional 5 Hz update of position (MX421B).**
- **Optional 1 PPS output.**
- **Output of raw data, code and phase (MX421L).**
- **Integrated dual channel beacon receiver and unique toroidal H-field beacon antenna design (MX421B).**
- **Rugged enclosure.**
- **Stainless steel threaded insert.**
- **Entirely waterproof.**
- **Flush or pole mount.**

Configurations:

MX421:	Autonomous GPS sensor for connection to any NMEA device.
MX421L:	Autonomous GPS sensor for output of raw data (code and phase) in compressed binary format, referred to as Leica Binary (LB2).
MX421B:	DGPS sensor for connection to any NMEA device. Can also be set to output GGA at 5Hz.

GPS Receiver:

Type:	L1 frequency, C/A Code (SPS), 12 channel Leica receiver, manufactured with IBM's leading SiGe Technology. Employs Leica's famous technology for multipath rejection, ionosphere modeling and robustness in positioning.
Sensitivity:	-143 dBM Costas threshold.

DGPS Beacon Receiver/Antenna:

Frequencies:	283.5 – 325 kHz in 500 Hz steps.
Minimum Signal:	15 _V/m.
Station Selection:	Automatic or manual on the primary receiver channel.
Dynamic Range:	90 dB.
Adjacent Channel Rejection:	40 dB (500 Hz).
Antenna:	H-field, toroidal (Patent pending) .

System:

Accuracy:	GPS better than 3 meters RMS. DGPS 1 meter RMS.
Position output:	1 Hz. Optionally 5Hz (MX421B).
Output:	NMEA GGA, GLL, GRS, GSA, GSV,GST, RMC, VTG, ZDA, MSS (MX421B), Leica Binary, LB2 (MX421L).
Input:	GLL, ZDA, MSK (MX421B), Setup commands, Leica Binary, LB2 (MX421L).
Environmental:	IEC 60945 compliant "exposed category".

Physical:

Operating Temperature:	-25 to + 60 degrees C.
Mount:	Stainless Steel Insert 1"x 14 threads per inch, Flush mount or pole mount.
Cable:	10 meters (25) Feet. Shielded 8 conductor.
Power:	10.5 to 32 VDC, 200 m/A at 12 VDC. 230 m/A at 12 VDC.
Weight:	660 g (MX421B). 200 g (MX421).
Size:	H x Dia. 3 inch (89mm) x 7 1/8 inch (182mm).
Physical:	Rugged well sealed enclosure. Heavy-duty connector.

Options and Accessories:

Extra cable.	
Connector box:	1PPS output.
Antenna Mount:	Stainless steel precision mount.
Antenna Pillar:	Stable antenna base.

Leica TQM ISO 9001 *Total Quality Management Our commitment to total customer satisfaction.*

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