Chesapeake Bay Program | Indicator Analysis and Methods Document

Bay Grass Abundance | Updated June 13, 2025

Indicator Title: Bay Grass Abundance

Relevant Outcome(s): Submerged Aquatic Vegetation (SAV) Outcome

Relevant Goal(s): Vital Habitats

Location within Framework (i.e., Influencing Factor, Output or Performance): Performance

A. Data Set and Source

(1) Describe the data set. What parameters are measured? What parameters are obtained by calculation? For what purpose(s) are the data used?

Acreage distribution and percent coverage of submerged aquatic vegetation in the Chesapeake Bay and its tributaries are measured and calculated from photo-interpreted aerial imagery taken during surveys conducted in the growing season. Satellite imagery is used to augment the aerial imagery when necessary to complete the dataset. Data are collected for tracking, research, and long-term monitoring purposes.

The CBP Segmentation scheme defines 93 segments that are grouped into four salinity zones to reflect the communities of SAV species found in Chesapeake Bay:

- Tidal Fresh Salinity Zone (less than 0.5 ppt)
- Oligohaline Salinity Zone (0.5-5 ppt)
- Mesohaline Salinity Zone (5-18 ppt)
- Polyhaline Salinity Zone (18-25 ppt)

The Bay has also been divided into three geographic zones.

- The Upper Bay Zone includes the Susquehanna River and extends to the Chesapeake Bay Bridge.
- The Middle Bay Zone extends to the southern boundaries of CB5MH, TANMH, and POCMH.
- the Lower Bay Zone extends to the mouth of Chesapeake Bay and includes the James River.

SAV Bed density was categorized into one of four classes based on a subjective comparison with the density scale. These were:

- Class 1 - very sparse (<10% coverage)
- Class 2 - sparse (10-40%)
- Class 3 - moderate (40-70%)
- Class 4 - dense (70-100%)

(2) List the source(s) of the data set, the custodian of the source data, and the relevant contact at the Chesapeake Bay Program.
- Source: Virginia Institute of Marine Science via EPA grant, as well as grants from MD DNR, MDE, VA DEQ, and VA's CRM program.
- Custodian: Christopher Patrick, VIMS (cpatrick@vims.edu), or David Wilcox, VIMS (dwilcox@vims.edu)
- Chesapeake Bay Program Contact (name, email address, phone number): Carin Bisland, bisland.carin@epa.gov, 410-267-5732; Brooke Landry, SAV Workgroup Chair, MD DNR, brooke.landry@maryland.gov, 410-260-8629.

(3) Please provide a link to the location of the data set. Are metadata, data-dictionaries and embedded definitions included?

Please refer to https://www.vims.edu/research/units/programs/sav/reports for the data set and related metadata for each year. For more information about the methods, special report, and bibliography, see question 27.

B. Temporal Considerations

(4) Data collection date(s): Bay-wide: 1978-2024, excluding 1979-1983 (partial surveys were conducted in Virginia) and 1988 when no surveys were conducted. By zones: 1984-2024, excluding 1988 when no survey was conducted.

(5) Planned update frequency (e.g., annual, biannual, etc.):
- Source Data: annual
- Indicator: annual

(6) Date (month and year) next data set is expected to be available for reporting: May 2026

C. Spatial Considerations

(7) What is the ideal level of spatial aggregation (e.g., watershed-wide, river basin, state, county, hydrologic unit code)?

Data are aggregated to 93 tidal water segments for the Chesapeake Bay (2003 revised Chesapeake Bay Program (CBP) segmentation and zonation scheme). These segments are further grouped by salinity zones and then aggregated to the Bay-wide level.

(8) Is there geographic (GIS) data associated with this data set? If so, indicate its format (e.g., point, line polygon).

USGS 7.5-minute quadrangle maps are used to organize the mapping process. 259 quadrangles in the study area include all regions with potential for SAV growth.

(9) Are there geographic areas that are missing data? If so, list the areas.

Areas mapped include all regions with potential for SAV growth. Areas that do not have the potential for SAV growth are not mapped.

Spatial gaps occurred in 1984 and 1986, primarily due to flight restrictions around Patuxent Naval Air Station and Aberdeen Proving Grounds. Estimates of acreage in the non-surveyed areas, primarily based on prior and subsequent year surveys, were developed for those years (1984 and 1986). Refer to section H for additional details.

Spatial gaps in 1999 occurred due to hurricane disturbance and subsequent inability to reliably photograph SAV. Spatial gaps in 2001 occurred due to post-nine-eleven flight restrictions near Washington D.C. Spatial gaps in 2003 occurred due to adverse weather in the spring and summer and Hurricane Isabel in the fall. Spatial gaps in 2011 occurred due to adverse weather in the summer. Estimates of acreage in the non-surveyed areas, based on prior year surveys, were developed for those years (1999, 2001, 2003, and 2011). Spatial gaps occurred in 2016 due to flight restrictions over military air space and adverse weather conditions.

Spatial gaps occurred in 2018 due to adverse weather conditions leading to highly turbid water and flight restrictions over military air space. Satellite imagery was acquired to address these gaps but was not sufficient to cover the entire missing area.

Spatial gaps occurred in 2021 due to adverse weather conditions. Satellite imagery was acquired to address these gaps but was not sufficient to cover the missing area.

Spatial gaps occurred in 2023 due to adverse weather conditions and access restrictions. Satellite imagery was acquired to address these gaps but was not sufficient to cover the missing area.

See section H of this document for more details.

(10) Please submit any appropriate examples of how this information has been mapped or otherwise portrayed geographically in the past.

Refer to https://www.vims.edu/research/units/programs/sav/reports/2023 for methods and https://www.vims.edu/research/units/programs/sav/access/maps for an example.

D. Communicating the Data

(11) What is the goal, target, threshold or expected outcome for this indicator? How was it established?

The Bay-wide goal is to have 185,000 acres of underwater grasses in the Chesapeake Bay, with targets of 90,000 acres by 2017 and 130,000 acres by 2025. The SAV restoration goal is based on the known historical expanse of SAV in the Bay and its tributaries.

- Tidal Fresh Salinity Zone: 20,602-acre goal.
- Oligohaline Salinity Zone: 10,334-acre goal.
- Mesohaline Salinity Zone: 120,306-acre goal.
- Polyhaline Salinity Zone: 33,647-acre goal.

(12) What is the current status in relation to the goal, target, threshold or expected outcome? Why? Would you define our outlook[1] toward achieving the outcome goal or target as on course, off course, uncertain, or completed? Upon what basis are you forecasting the outlook?

Bay-wide: In 2024, 82,778 acres of SAV were mapped in the Chesapeake Bay. This is 45% of the Bay SAV goal.

- Tidal Fresh Salinity Zone: 20,218 acres in 2024 achieving 98% of the area's 20,602-acre goal.
- Oligohaline Salinity Zone: 4,730 acres in 2024 achieving 46% of the area's 10,334-acre goal.
- Mesohaline Salinity Zone: 33,031 acres in 2024 achieving 27% of the area's 120,306-acre goal.
- Polyhaline Salinity Zone: 24,800 acres in 2024 achieving 74% of the area's 33,647-acre goal.

The outlook toward achieving the outcome goal is off course. Significant increases and simultaneous decreases in different regions of the Bay resulted in little net change in total SAV coverage between 2023 and 2024 (1% decline, -260 hectares, -641 acres). It is unlikely that we will meet the interim goal of 130,000 acres by 2025.

(13) Has a new goal, target, threshold or expected outcome been established since the last reporting period? Why? No.

(14) Has the methodology of data collection or analysis changed since the last reporting period? How? Why? No.

(15) What is the long-term data trend (since the start of data collection)?
Bay-wide: Since 1984, SAV acreage has increased from 38,958 acres to 82,778 acres in 2024. This is **above** the long-term average of 70,506 acres which has fluctuated between 38,958 acres and 108,078 acres over this time period.

- Tidal Fresh Salinity Zone: Since 1984, acreage has increased from 6,911 to 20,218 acres in 2024 which is **above** the long-term average of 14,322 acres. This zone has fluctuated between 6,900 acres and 25,481 acres over this same time period.

- Oligohaline Salinity Zone: Since 1984, acreage has increased from 653 to 4,730 acres in 2024 which is **below** the long-term average of 7,122 acres. This zone has fluctuated between 653 acres and 13,919 acres over this same time period.

- Mesohaline Salinity Zone: Since 1984, acreage has increased from 15,636 to 33,031 acres in 2024 which is **above** the long-term average of 31,360 acres. This zone has fluctuated between 15,636 acres and 62,933 acres over this same time period.

- Polyhaline Salinity Zone: Since 1984, acreage has increased from 15,027 to 24,800 acres in 2024 which is **above** the long-term average of 17,677 acres. This zone has fluctuated between 9,960 acres and 24,800 acres over this same time period. The 2024 acreage marks a new maximum for this zone.

(16) What change(s) does the most recent data show compared to the last reporting period? To what do you attribute the change? Would you characterize that change in the recent progress[2] as an increase, decrease, no change, or completed for this outcome?

In 2024, 82,778 acres of SAV were reported for the Chesapeake Bay. This is a 1% decrease from the 2023 total of an estimated 83,419 acres.

- Tidal Fresh Salinity Zone: increased from an estimated 19,823 acres to 20,218 acres. *

- Oligohaline Salinity Zone: increased from an estimated 3,422 acres to 4,730 acres. *

- Mesohaline Salinity Zone: decreased from 38,371 acres to 33,031 acres.

- Polyhaline Salinity Zone: increased from 21,803 acres to 24,800 acres.

* This area was not fully mapped in 2023.

Significant increases and simultaneous decreases in different regions of the Bay resulted in little net change in total SAV coverage between 2023 and 2024 (1% decline, -260 hectares, -641 acres). The Polyhaline and Oligohaline zones saw significant increases in SAV, there was a modest increase in the Tidal Fresh zone, and the Mesohaline zone suffered significant declines. The Polyhaline zone increased 14% relative to 2023 (1,212 hectares, 2,996 acres). Segments across the Polyhaline all increased with the largest gains (hectares/acres) occurring in Mobjack Bay, Poquoson Flats, and nearby Western Shore areas. Significantly, this is the most SAV reported in the Polyhaline Zone in the history of the survey, surpassing the previous record set in 1993 by 317 hectares (784 acres). These gains, largely attributable to eelgrass, add to a pattern of consecutive year over year increases in the Polyhaline since the 2019 crash and extension of the meadows into deeper waters. This may indicate improved water clarity in this area of the Bay. The Tidal Fresh Zone was stable, exhibiting a 2% increase (160 hectares, 394 acres), and the Oligohaline Zone showed a 38% increase (529 hectares, 1,308 acres) relative to 2023, driven by simultaneous recoveries in multiple areas including the

Sassafras, Gunpowder, Back, and Middle Rivers, as well as increases in observed SAV in the Potomac River. In contrast, the Mesohaline underwent a 14% decline (-2,161 hectares, -5,340 acres), which largely occurred along the Eastern Shore of Maryland in the Choptank (-895 hectares, -2,212 acres) and Little Choptank Rivers (-302 hectares, -746 acres) as well as Tangier Sound (-802 hectares, -1,982 acres). The declines in the Choptank mirror measured reductions in water quality within the river, highlighting the strong coupling between water quality and SAV within the Chesapeake Bay, and down-bay declines in Tangier Sound may be connected. These contrasting changes observed throughout the system reflect the incredible diversity of geographic regions, land-use regimes, SAV species, and local environmental conditions that contribute in aggregate to Bay-wide SAV status each year.

In 2024, high density beds accounted for 65 percent of the total acreage, which is 3 percent higher than 2023. The density classifications for the beds in 2024 are as follows:

- 2% of the beds had densities of <10% (Class 1)
- 10% of the beds had densities of 10-40% (Class 2)
- 24% of the beds had densities of 40-70% (Class 3)
- 65% of the beds had densities of 70-100% (Class 4)

(17) What is the key story told by this indicator?

Underwater grasses provide significant benefits to aquatic life and serve many critical ecological functions in the Bay and its tributaries, such as:

- Providing shelter for young striped bass, blue crabs and other species
- Improving water clarity by helping suspended sediment particles settle to the bottom
- Adding oxygen to the water
- Reducing shoreline erosion.

Scientists believe that having more grasses in the Bay and rivers will dramatically improve the entire ecosystem. The expectation is that as nutrient and sediment pollution decrease and water clarity improves, underwater grass acreages should expand. Experts closely monitor underwater grasses because their well-being is dependent on good local water quality. Therefore, their abundance is an excellent measure of the Bay's health.

Trends in the distribution and abundance of SAV over time are useful in understanding trends in water quality (Moore, et. al. 2004). Loss of SAV indicates poor water quality, whereas increases in SAV indicates improving water quality. Review of photographic evidence from a number of sites dating back to 1937 suggests that between 200,000 to 600,000 acres of SAV may have historically grown along the shoreline of the Bay (Moore, et. al. 2004). However, by 1984, the SAV community had fallen to a low of about 38,000 acres (Virginia Institute of Marine Science).

SAV abundance is now included in the water quality standards in Maryland and Virginia.

E. Adaptive Management

(18) What factors influence progress toward the goal, target, threshold or expected outcome?

The loss of SAV from shallow waters of Chesapeake Bay, which was first noted in the early 1960s, is a widespread, well-documented problem (Batiuk, et al., 2000). Although other factors, such as climatic events and herbicide toxicity, may have contributed to the decline of SAV in the Bay, the primary causes are eutrophication and associated reductions in light availability (Batiuk, et. al., 2000). Like any other plant, SAV needs sunlight to grow and survive. Two significant pressures that impact the growth of SAV are sediment and excess nutrient pollution. Sediment (loose particles of clay and silt that are suspended in the water) makes the water cloudy and blocks sunlight from the plants. Similarly, excess nutrients in the water fuel the growth of algae, which also block sunlight from the plants. When SAV lacks the sunlight it needs, it cannot survive.

Sea level rise and increased Bay water temperatures from environmental changes pose risks to achieving the acreage goal, particularly in the polyhaline region of the Bay. Therefore, as part of their management strategy, the workgroup has committed to advocating management approaches that reduce stressors so that SAV may be more resilient to the effects of environmental changes. See the management strategy at http://www.chesapeakebay.net/documents/22042/2f_sav_6-24-15_ff_formatted.pdf for more information.

(19) What are the current gaps in existing management efforts?

The partnership lacks information about a number of restoration and protection research topics. See page 6 of the relevant management strategy at http://www.chesapeakebay.net/documents/22042/2f_sav_6-24-15_ff_formatted.pdf for more information.

(20) What are the current overlaps in existing management efforts?

The SAV workgroup works closely with the Water Quality and Maintain Healthy Watersheds Goal Implementation teams, as water clarity and quality are factors that influence success.

(21) According to the management strategy written for the outcome associated with this indicator, how will we (a) assess our performance in making progress toward the goal, target, threshold or expected outcome, and (b) ensure the adaptive management of our work?

(a) The Partnership uses this data to assess progress towards the acreage goal for SAV by calculating what percentage of the goal has been reached and by identifying areas where the most progress needs to be made. Refer to the ChesapeakeProgress (http://www.chesapeakeprogress.com/abundant-life/sav) for more information.

(b) Each year, the workgroup meets to review the data, track the progress, and discuss any new challenges or opportunities. These meetings provide a forum to review performance and adjust management strategies if appropriate based on identified trends, priority areas, and research needs.

F. Analysis and Interpretation

Please provide appropriate references and location(s) of documentation if hard to find.

(22) What method is used to transform raw data into the information presented in this indicator? Please cite methods and/or modeling programs.

Please refer to https://www.vims.edu/research/units/programs/sav/reports for methods and tools used to develop Orthorectification and Mosaic Production, Photo Interpretation and Bed Delineation in the 2024 report.

(23) Is the method used to transform raw data into the information presented in this indicator accepted as scientifically sound? If not, what are its limitations?

Yes. This indicator has undergone extensive technical and peer review by state, Federal and nongovernment organization partner members of the SAV workgroup. See Chesapeake Bay SAV special reports at https://www.vims.edu/research/units/programs/sav/_pubs/special-reports/ and bibliography at https://www.vims.edu/research/units/programs/sav/_pubs/sav_biblio. The SAV distribution data files are located at https://www.vims.edu/research/units/programs/sav/reports. The SAV indicator is published at http://www.chesapeakeprogress.com/abundant-life/sav.

(24) How well does the indicator represent the environmental condition being assessed? The indicator uses direct measures of SAV, thus the indicator is directly representative of the environmental condition of bay grasses. Trends in the distribution and abundance of SAV over time are useful in understanding trends in water quality (Moore, et. al. 2004). Loss of SAV indicates poor water quality, whereas increases in SAV indicate improving water quality. Review of photographic evidence from a number of sites dating back to 1937 suggests that between 200,000 to 600,000 acres of SAV may have historically grown along the shoreline of the Bay (Moore, et. al. 2004). However, by 1984, the SAV community had fallen to a low of about 38,000 acres (Virginia Institute of Marine Science).

(25) Are there established reference points, thresholds, ranges or values for this indicator that unambiguously reflect the desired state of the environment?

Yes. Please refer to Historical analysis of SAV in the Potomac River and Analysis of Bay-wide Historic SAV to establish a New Acreage Goal. K. A. Moore, D. J. Wilcox, B. Anderson, T. A. Parham, and M. D. Naylor. Report to EPA Chesapeake Bay Program. April 2004 at

https://mobjack.vims.edu/sav/special_reports/Final_SAV_Historical_Report_2004.pdf
Refer to page 12.

(26) How far can the data be extrapolated? Have appropriate statistical methods been used to generalize or portray data beyond the time or spatial locations where measurements were made (e.g., statistical survey inference, no generalization is possible)?

No statistical methods have been established to date for this program that would allow for extrapolation of data to areas where data isn't available, or to use limited data to estimate bay-wide totals in the absence of real data. The project team is, however, currently seeking funding opportunities to determine ways to use limited aerial imagery and SAV bed data in a statistically sound way to extrapolate to unmapped regions in the event of reduced funding for the survey.

G. Quality

Please provide appropriate references and location(s) of documentation if hard to find.

(27) Were the data collected and processed according to a U.S. Environmental Protection Agency-approved Quality Assurance Project Plan? If so, please provide a link to the QAPP and indicate when the plan was last reviewed and approved. **If not, please complete questions 28-30.**

Yes. Data collection, analysis, and management methods are described in the Quality Assurance Project Plan (QAPP) on file for the EPA grant to the Virginia Institute of Marine Sciences (VIMS) and available at the VIMS web site (http://mobjack.vims.edu/sav/VIMS_SAV_QAPP_2021.pdf). See Chesapeake Bay SAV special reports at https://www.vims.edu/research/units/programs/sav/_pubs/special-reports/ and bibliography at https://www.vims.edu/research/units/programs/sav/_pubs/sav_biblio.

(28) *If applicable:* Are the sampling, analytical and data processing procedures accepted as scientifically and technically valid? N/A

(29) *If applicable:* What documentation describes the sampling and analytical procedures used? N/A

(30) *If applicable:* To what extent are procedures for quality assurance and quality control of the data documented and accessible? N/A

(31) Are descriptions of the study design clear, complete and sufficient to enable the study to be reproduced? Yes, see answer to question 24.

(32) Were the sampling, analytical and data processing procedures performed consistently throughout the data record?

Some technical improvements (e.g., photo-interpretation tools) were made over the 30 years of the annual SAV survey in Chesapeake Bay. Surveyors and analysts have carefully evaluated the effect of methodological changes along the way and made corrections to adjust for any known effects. Some areas in the 2018 - 2024 reports were surveyed using satellite imagery. In some areas, this resulted in a loss of detail that may have a slight impact on the area calculations, particularly where the SAV cover was very sparse. Quality assurance project plan for the EPA grant to the Virginia Institute of Marine Sciences describes data collection, analysis, and management methods. This is on file at the U. S. Environmental Protection Agency Chesapeake Bay Program Office and available on the VIMS web site at http://mobjack.vims.edu/sav/VIMS_SAV_QAPP_2021.pdf. Metadata are included with the data set at the VIMS web site https://www.vims.edu/research/units/programs/sav/reports.

(33) If data sets from two or more sources have been merged, are the sampling designs, methods and results comparable? If not, what are the limitations? N/A

(34) Are levels of uncertainty available for the indicator and/or the underlying data set? If so, do the uncertainty and variability impact the conclusions drawn from the data or the utility of the indicator?

Yes, levels of uncertainty are available. See the QAPP referenced in question 32 for more details. Metadata are included with the data set posted at the VIMS web site https://www.vims.edu/research/units/programs/sav/reports.

No, the uncertainty and variability do not impact the conclusions. Some technical improvements (e.g., photo-interpretation tools) were made over the decades of the annual SAV survey in Chesapeake Bay. Surveyors and analysts have carefully evaluated the effect of methodological changes along the way and made corrections to adjust for any known effects. Quality assurance project plan for the EPA grant to the Virginia Institute of Marine Sciences describes data collection, analysis, and management methods. For more information, refer to the QAPP referenced in question 32.

(35) For chemical data reporting: How are data below the MDL reported (i.e., reported as 0, censored, or as < MDL)? If parameter substitutions are made (e.g., using orthophosphate instead of total phosphorus), how are data normalized? How does this impact the indicator? N/A

(36) Are there noteworthy limitations or gaps in the data record?

Spatial gaps occurred in 1984 and 1986, primarily due to flight restrictions around Patuxent Naval Air Station and Aberdeen Proving Grounds. Estimates of acreage in the non-surveyed areas, primarily based on prior and subsequent year surveys, were developed for those years (1984 and 1986).

Due to funding constraints, there were partial surveys in the years 1979-1983 and no survey in 1988. Spatial gaps in 1999 occurred due to hurricane disturbance and subsequent inability to reliably photograph SAV. Spatial gaps in 2001 occurred due to post-nine-eleven flight restrictions near Washington D.C. Spatial gaps in 2003 occurred due to adverse weather in the spring and summer and Hurricane Isabel in the fall. Spatial gaps in 2011 occurred due to adverse weather in the summer. Spatial gaps occurred in 2016 due to flight restrictions over military air space and adverse weather conditions.

Spatial gaps occurred in 2018 due to adverse weather conditions leading to highly turbid water and flight restrictions over military air space. Satellite imagery was acquired to address these gaps but was not sufficient to cover the entire missing area.

Spatial gaps occurred in 2021 due to adverse weather conditions. Satellite imagery was acquired to address these gaps but was not sufficient to cover the missing area.

Spatial gaps occurred in 2023 due to adverse weather conditions and access restrictions. Satellite imagery was acquired to address these gaps but was not sufficient to cover the missing area.

Estimates of acreage in the non-surveyed areas, based on prior year surveys, were developed for those years (1999, 2001, 2003, 2011, 2016, 2018, and 2021, 2023).

Refer to section H for additional details.

H. Additional Information (*Optional)*

(37) Please provide any further information you believe is necessary to aid in communication and prevent any potential misrepresentation of this indicator.

While the data presented here are geographically focused on the Chesapeake Bay, the data provider also collects information about SAV in Maryland's Coastal Bays, available at https://www.vims.edu/research/units/programs/sav/access/tables/segment_area_state.

2023: For 2023, 32,259 hectares (79,716 acres) of SAV were mapped in Chesapeake Bay and its tributaries. However, security restrictions prevented timely acquisition of imagery for a portion of the Potomac River. The area that was not fully mapped in 2023 supported 1,498 hectares of SAV in 2022 (3,703 acres, 4.8% of the Bay total).

2021: For 2021, 27,304 hectares (67,470 acres) of SAV were mapped in Chesapeake Bay and its tributaries. However, weather conditions prevented acquisition of useable

imagery for a portion of the Mattaponi and Pamunkey rivers. The area that was not fully mapped in 2021 supported 27 ha of SAV in 2020 (66 acres, 0.1% of the 2020 Bay total).

2018: For 2018, 40,270 hectares (99,511 acres) of SAV were mapped in Chesapeake Bay and its tributaries. However, highly turbid water, weather conditions, and security restrictions in the DC area, over Patuxent Air Base and associated mid-Bay areas prevented acquisition of useable imagery for a portion of the tidal fresh and mesohaline Potomac River; the Bohemia, Choptank, and Mattaponi rivers. The area that was not fully mapped in 2018 supported 3,467 ha of SAV in 2017 (8,567 acres, 9% of the 2017 Bay total).

2016: For 2016, 97,668 acres of SAV were mapped in Chesapeake Bay and its tributaries. However, weather conditions and security restrictions in the DC area, over Patuxent Air Base and associated mid-Bay areas prevented acquisition of useable imagery for a portion of the tidal fresh and mesohaline Potomac River, including Piscataway Creek and St. Mary's River. A small portion of this area was covered by NAIP imagery under conditions that were appropriate for mapping SAV. The area that was not fully mapped in 2016 supported 1,951 acres of SAV in 2015, 2% of the 2015 Bay total. The full report located at https://www.vims.edu/research/units/programs/sav/reports/2016 will contain more details.

2011: Only 57,964 acres were mapped Bay-wide in 2011. It is estimated that an additional 5,119 acres may have been present (for an estimated Bay-wide total of 63,083), however, they could not be mapped since SAV signatures were masked by excess turbidity present months after the passage of Hurricane Irene and Tropical Storm Lee. The regions that were not mapped are contained within nine CBP segments, including the Middle, Upper and Western Branch of the Patuxent River; the Middle and Upper Potomac River; Piscataway Creek; and the Anacostia River. The estimated additional acreage is based on acreages mapped in those regions in 2010. Zone and density totals do NOT include estimated additional acreage.

2003: Only 61,695 acres were mapped Bay-wide in 2003. It is estimated that an additional 1,832 acres may have been present (for an estimated Bay-wide total of 63,527), however, they could not be mapped since some portions of the Bay were not flown due to adverse weather in the spring and summer and Hurricane Isabel in the fall. These regions, including Tavern and Swan creeks; lower Chester River; upper Wicomico River; Prentice, Dividing, and Ball Creeks; Dameron Marsh; and Great Wicomico River were not fully mapped in 2003. The estimated additional acreage is based on acreages mapped in those regions in 2002. Zone and density totals do NOT include estimated additional acreage.

2001: Only 77,889 acres were mapped Bay-wide in 2001. It is estimated that an additional 7,525 acres may have been present (for an estimated Bay-wide total of 85,415), however, they could not be surveyed due to flight restrictions following

September 11. The estimated additional acreage is based on acreages mapped in those regions in 2000. Zone and density totals do NOT include estimated additional acreage.

1999: Only 64,718 acres were mapped baywide in 1999. It is estimated that an additional 3,382 acres may have been present (for an estimated baywide total of 68,100), however, they could not be mapped due to the following: either flown too late in 1999, due to poor atmospheric conditions and severe storm events, or not flown until after an early seasonal die-back in freshwater SAV species, possibly a result of increased salinity during the drought and severe storm events. Those areas include Spesutie Narrows, the Bush, Gunpowder, upper Patuxent, lower Magothy, upper York and upper James rivers, and the Swan Point and Tavern Creek area. The estimated additional acreage is based on acreages mapped in those regions in 1998. Zone and density totals do NOT include estimated additional acreage.

1986: Only 47,414 acres were mapped Bay-wide in 1986. It is estimated that an additional 276 acres may have been present (for an estimated Bay-wide total of 47,690), however, they could not be mapped due to flight restrictions around Aberdeen Proving Grounds. Where available, the previous and subsequent year's data were averaged to generate estimated additional acreage. Please refer to "SAV Area Estimates for Missing 1984 and 1986 Quadrangles Technical Note 12/15/97" for details. Zone and density totals do NOT include estimated additional acreage.

1984: Only 38,228 acres were mapped Bay-wide in 1984. It is estimated that an additional 731 acres may have been present (for an estimated Bay-wide total of 38,958), however, they could not be mapped due to flight restrictions around Patuxent Naval Air, camera malfunction and missing digital files. Where available, the previous and subsequent year's data were averaged to generate estimated additional acreage. Please refer to "SAV Area Estimates for Missing 1984 and 1986 Quadrangles Technical Note 12/15/97" for details. Zone and density totals do NOT include estimated additional acreage.

[1]*Outlook:* Outlook is the forecasted trajectory for whether the Chesapeake Bay Program is on course to achieving the outcome. An outcome's outlook may be on course, off course, uncertain, or completed. This information will be incorporated into the outcome's progress page. An outcome's course outlook is reviewed and updated during the outcome's Strategy Review System (SRS) Quarterly Progress Meeting in addition to when recent progress is assessed.

[2]*Recent Progress:* Recent Progress describes the change in the indicator based on the most recent data collected since the last reporting period. The recent progress icon will reflect this change as an increase, decrease, no change, or completed, depending upon this progress. This information will be discussed at the outcome's Strategy Review System (SRS) Quarterly Progress Meeting.