Chesapeake Bay Program | Indicator Analysis and Methods Document
Reducing Pollution Indicators | Updated May 2018

Indicator Title: Reducing Pollution

Relevant Outcome(s): 2017 Watershed Implementation Plans (WIP) Outcome (practices in place to achieve 60% of load reductions compared to 2009 levels); 2025 WIP Outcome

Relevant Goal(s): Water Quality

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?

Progress is measured by using the most up-to-date wastewater discharge data and tracking data reported to Chesapeake Bay Program (CBP) by Bay watershed jurisdictions. The CBP uses Phase 5.3.2 of the Watershed Model and wastewater discharge data reported by the Bay jurisdictions to estimate the amount of nitrogen, phosphorus and sediment delivered to the Bay. The CBP Watershed Model relies on actual wastewater discharge data, which is influenced by annual weather conditions, to estimate wastewater pollution. The Model estimates pollution from other sources including agricultural runoff and discharges, urban and suburban runoff, septic tank discharges, and air deposition based on average weather conditions. Data are used for tracking, research, long-term monitoring, and monitoring TMDL progress.

(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: Annual jurisdictional submissions of both monitored and estimated wastewater effluent concentrations and flows as well as best management practice (BMP) data for other sources of pollution tracked by jurisdictions and reported to CBP. The Phase 5.3.2 Watershed Model and Scenario Builder version 2.4 use many types of data from sources too numerous to describe here. Please see http://ches.communitymodeling.org/models/CBPhase5/index.php for the most recent Watershed Model documentation (December 2010). For the most recent Scenario Builder documentation, please see http://www.chesapeakebay.net/documents/SB_Documentation_V24_01_04_2013.pdf (January 2013).
- Custodians:
    - Wastewater: Ning Zhou, Wastewater Data Manager, Virginia Polytechnic Institute and State University, Chesapeake Bay Program Office
    - Best Management Practice and Watershed Model information: Matt Johnston, Nonpoint Source Data Analyst, University of Maryland College Park, Chesapeake Bay Program Office.

- Chesapeake Bay Program Contacts (name, email address, phone number): Ning Zhou (wastewater) zhou.ning@epa.gov and Matt Johnston (all other sources) mjohnston@chesapeakebay.net

(3) Please provide a link to the location of the data set. Are metadata, data-dictionaries and embedded definitions included? Yes. See link to Phase 5 and Scenario Builder sites in question 2 above.

B. Temporal Considerations

(4) Data collection date(s): 1985, 2009, 2014, 2015, 2016, 2017

(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: March 2019

C. Spatial Considerations

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

Wastewater: Data can be aggregated to Hydrologic Units (HUC8 and HUC11), counties/cities (FIPS), "state-segments" (the intersection of state boundaries and Phase 5.3.2 Watershed Model river segments), jurisdictional portions of major basins, major basins, jurisdictions, and the Chesapeake Bay watershed as a whole.

Agriculture, Urban/Suburban and Septic, Air: BMP implementation data to reduce pollution from these sources are aggregated to "state-segments", or the intersection of state boundaries and Phase 5.3.2 Watershed Model river segments, jurisdictional portions of major basins, major basins, major tributaries, jurisdictions, and the Chesapeake Bay watershed as a whole.

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

Wastewater: mostly point

Agriculture, Urban/Suburban and Septic, Air: Depending on the practice and jurisdiction, data for other sources of pollution are tracked and reported at the following spatial scales:

- State
- River Segment
- State-Segment – intersection of jurisdictional boundary and Watershed Model river segment
- Major Basin
- State-Basin – intersection of jurisdictional boundary and Major Basin

- County
- County-Segment – intersection of county boundary and Watershed Model river segment

(9) Are there geographic areas that are missing data? If so, list the areas.
Wastewater: Depending on the jurisdiction, effluent flows and concentrations may not be tracked and reported for some small non-significant facilities.

Agriculture, Urban/Suburban and Septic, Air: Depending on the jurisdiction, BMP implementation data may be over-reported or not be tracked and reported, particularly for voluntary practices that are not cost-shared.

(10) Please submit any appropriate examples of how this information has been mapped or otherwise portrayed geographically in the past.
Acres of BMPs are most commonly reported as occurring on acres in a specific county.

D. Communicating the Data

(11) What is the goal, target, threshold or expected outcome for this indicator? How was it established?
In December 2010, the Environmental Protection Agency established a pollution diet for the Chesapeake Bay, formally known as a Total Maximum Daily Load (TMDL). The TMDL is designed to ensure that all nitrogen, phosphorus and sediment pollution control efforts needed to fully restore the Bay and its tidal rivers are in place by 2025, with controls, practices and actions in place by 2017 that would achieve at least 60% of the reductions from 2009 necessary to meet the TMDL. The TMDL sets pollution limits (allocations) necessary to meet applicable water quality standards in the Bay and its tidal rivers. Specifically, the TMDL allocations are 201.63 million pounds of nitrogen, 12.54 million pounds of phosphorus, and 6,453.61 million pounds of sediment per year (note: the nitrogen allocation included a 15.7 million pound allocation for atmospheric deposition of nitrogen to tidal waters).
As a result of this new Bay-wide "pollution diet," Bay Program partners are implementing and refining Watershed Implementation Plans (WIPs) and improving the accounting of their efforts to reduce nitrogen, phosphorus and sediment pollution. The WIPs developed by Delaware, the District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia identify how the Bay jurisdictions are putting measures in place by 2025 that are needed to restore the Bay, and by 2017 to achieve at least 60 percent of the necessary nitrogen, phosphorus and sediment reductions compared to 2009. Much of this work already is being implemented by the jurisdictions consistent with their Phase I and Phase II WIP commitments, building on 30 years of Bay restoration efforts.

Planning targets were established to assist jurisdictions in developing their Phase II WIPs. Specifically, the Phase II WIP planning targets were reductions of 207.27 million pounds of nitrogen, 14.55 million pounds of phosphorus, and 7,341 million pounds of sediment per year (note: the planning target for nitrogen included a 15.7 million pound allocation for atmospheric deposition of nitrogen to tidal waters). These planning targets, while slightly higher than the

allocations published in the December 2010 TMDL, represent the actions, assumptions, and "level of effort" necessary to meet the TMDL allocations.
In 2013, the CBP partners agreed to some post-Phase II WIP adjustments to the nitrogen and phosphorus targets based on nitrogen/phosphorus exchanges and exchanges between New York's nitrogen target and EPA's target for atmospheric deposition of nitrogen to tidal waters. The revised planning targets are 207.57 million pounds of nitrogen and 14.46 million pounds of phosphorus per year (note: the planning target for nitrogen includes a 15.2 million pound allocation for atmospheric deposition of nitrogen to tidal waters).

(12) What is the current status in relation to the goal, target, threshold or expected outcome?

The current goals for these indicators are as follows:

- Reduce computer-simulated nitrogen loads to the Bay by 75.09 million pounds, from 282.66 million in 2009, to 207.57 million by 2025.*
- Reduce computer-simulated phosphorus loads to the Bay by 4.77 million pounds, from 19.23 million in 2009, to 14.46 million by 2025.*
- Reduce computer-simulated sediment loads to the Bay by 1.335 billion pounds, from 8.675 billion in 2009, to 7.341 billion by 2025.*

Computer simulations show that pollution controls put in place by watershed jurisdictions between 2009 and 2017 have reduced nitrogen, phosphorus and sediment loads to the Bay by 11%, 21%, and 10%, respectively. Practices are currently in place to achieve 40 percent of the nitrogen reductions, 87 percent of the phosphorus reductions and 67 percent of the sediment reductions necessary to attain applicable water quality standards as compared to 2009, the year before the U.S. Environmental Protection Agency (EPA) established the Bay TMDL.

(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, the methodology has not changed.

(15) What is the long-term data trend (since the start of data collection)?
Computer simulations of pollution controls implemented between July 1985 and June 2017, calibrated using monitoring data, indicate that:

- nitrogen loads would have decreased 117.27 million pounds from 369.78 million pounds/yr in 1985 to 252.51 million pounds/yr in 2017*.
- phosphorus loads would have decreased 10.52 million pounds from 25.62 million pounds/yr in 1985 to 15.10 million pounds/yr in 2017*.
- sediment loads would have decreased 3.011 billion pounds from 10.798 billion pounds/yr in 1985 to 7.787 billion pounds/yr in 2017*.

Given that the Chesapeake Bay TMDL was established in 2010 (see 9a), the baseline year for these indicators is 2009. Computer simulations of pollution controls implemented between July 2009 and June 2017, calibrated using monitoring data, indicate that

- nitrogen loads to the Bay would have decreased 75.09 million pounds from 282.66 million pounds/yr in 2009 to 252.51 million pounds/yr in 2017*.
- phosphorus loads to the Bay would have decreased 4.13 million pounds from 19.23 million pounds/yr in 2009 to 15.10 million pounds/yr in 2017*.
- sediment loads to the Bay would have decreased 1.335 billion pounds from 8.675 billion pounds/yr in 2009 to 7.787 billion pounds/yr in 2017*.

(16) What change(s) does the most recent data show compared to the last reporting period? To what do you attribute the change? Is this actual cause or educated speculation?

Computer simulations show that between 2016 and 2017:

Nitrogen loads fell 0.3 percent, from 258 million pounds to 253 million pounds.
Phosphorus loads fell 1.7 percent from 15.37 million pounds to 15.1 million pounds.
Sediment loads fell 1 percent, from 7.920 billion pounds to 7.787 billion pounds.

Model assessments with, in part, jurisdictions' BMP data attribute the estimated drop in nitrogen pollution loads mostly to upgrades to wastewater treatment plants. BMP implementation in the agriculture sector also contributed to the nitrogen load reductions. For phosphorus and sediment, it is estimated that only agriculture BMPs contributed to load reductions. Increased phosphorus and sediment loads from urban growth were primarily responsible for offsetting or reducing the overall load benefits of reported agricultural BMPs.

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

- Excess nitrogen and phosphorous are two of the leading causes of the Chesapeake Bay's poor health. When nitrogen and phosphorus enter rivers, streams and the Bay, they fuel the growth of algae blooms that lead to low-oxygen "dead zones" that are harmful to fish, shellfish and other aquatic life. In general, nitrogen and phosphorus reach the Bay through three sources: wastewater treatment plants; urban, suburban and agricultural runoff; and air pollution. The Total Maximum Daily Load (TMDL) limits the amount of nutrients that can enter the Bay if it is to achieve water quality standards.

- Excess sediment is another one of the leading causes of the Chesapeake Bay's poor health. While loose particles of sand, silt and clay are natural parts of the environment, too much sediment can cloud the waters of the Bay and its tributaries, harming underwater grasses, fish and shellfish. Sediment enters the Bay when land, stream banks and shorelines erode. Erosion increases when land is cleared for agriculture and development. The Total Maximum Daily Load (TMDL) limits the amount of sediment that can enter the Bay if it is to achieve water quality standards.

E. Adaptive Management

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

The Phase 5.3.2 Model takes into account many of the factors influencing progress, including BMP implementation and verification, reporting levels from non-significant facilities, and changes in technology that enable greater progress in the wastewater sector. Permit limit and funding availability are two major factors influencing the wastewater progress.

(19) What are the current gaps in existing management efforts?
Quantitative differences between reported on-the-ground BMP implementation and BMP goals for both 2017 Progress and 2025 Watershed Implementation Plans defined by jurisdictions can be found at https://baytas.chesapeakebay.net/

(20)What are the current overlaps in existing management efforts?
There are no "overlaps" of existing management efforts with respect to BMP implementation. BMP implementation and control technologies that go beyond what was planned or anticipated would offset to some degree short-falls in implementation that was planned or anticipated.

(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?

The CBP partnership is committed to flexible, transparent, and adaptive approaches towards Bay restoration and will develop Phase III WIP planning targets in 2017 based on the Phase 6 suite of modeling tools. The partnership also conducted a midpoint assessment of the Bay TMDL to ensure that the seven Chesapeake Bay watershed jurisdictions are on track with meeting the Bay TMDL's 2025 goal of putting all practices in place to reduce pollution and, over time, restore the Chesapeake Bay. As part of the Bay TMDL's midpoint assessment, the CBP partnership enhanced the CBP partnership's decision support tools, such as the Watershed Model and Water Quality Sediment Transport Model. Many of the fundamental modeling processes have remained the same but have been improved with better, and more recent, input information such as the addition of simulation years, monitoring stations, updated BMP efficiencies, research on phosphorus-saturated soils, and the incorporation of the latest science on Conowingo and climate change. A critical piece of this was incorporating higher-resolution land cover data and local land use information into our tools so we have an improved accounting of actions being implemented on the ground at the local level.

Jurisdictions will develop Phase III WIPs in 2018 and 2019 to incorporate the new information brought to bear in the Bay TMDL midpoint assessment and address any needed modifications to ensure, by 2025, that controls, practices and actions are in place which would achieve full restoration of the Chesapeake Bay and its tidal tributaries to meet applicable water quality standards.

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.

Raw data are aggregated to various geographies larger than land-river segments by summing the individual datum.

(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, the method is accepted as scientifically sound. Information about the Chesapeake Bay Program Watershed Model can be found in Section 5 of the Bay TMDL (http://www.epa.gov/reg3wapd/pdf/pdf_chesbay/FinalBayTMDL/CBayFinalTMDLSection5_final.pdf). Additionally, please see http://ches.communitymodeling.org/models/CBPhase5/index.php for the most recent Watershed Model documentation (December, 2010). Updated Phase 5.3.2 documentation will be added when it is available. For the most recent Scenario Builder documentation, please see http://www.chesapeakebay.net/documents/SB_Documentation_V24_01_04_2013.pdf (January, 2013).

(24) How well does the indicator represent the environmental condition being assessed?

The CBP Phase 5.3.2 Watershed Model is the tool used to transform calculated wastewater discharge loads (generally, from monitored flow and concentration data) to nutrient loads delivered to Chesapeake Bay tidal waters, upon which the measure is based. Wastewater data are influenced by annual weather conditions.

The Phase 5.3.2 Watershed Model and Scenario Builder version 2.4 are also employed to integrate the BMP implementation data applied to other sources of pollution which is submitted by jurisdictions for a host of practices and programs, to changes in delivered nutrient and sediment loads as well as to assimilate the impacts of both wastewater and nonpoint source controls and practices.

The Watershed Model allows scientists to simulate changes in physical, chemical, and biological processes in a large and complex ecosystem due to changes in human and animal populations, land uses, or pollution management, so that technically sound environmental decisions can be made. Monitoring data provides observations in the past or the present, at discrete times, and at isolated locations while modeling scenarios can be used to represent the environment under different management regimes in different temporal and spatial scales.

The model simulations represent "what-if" management scenarios, providing comparisons among historic and current watershed conditions and a future condition that would restore water quality and living resources in the Chesapeake Bay. So that the comparisons are relevant, reported loads from the Watershed Model for sources of pollution other than wastewater treatment plants are estimates of what would occur under average weather conditions in a single year's watershed conditions (i.e., land uses, animal manure and chemical fertilizer inputs, human population, nonpoint source controls/practices, septic, and atmospheric deposition). Wastewater loads reflect measured discharges from tracked waste treatment and industrial facilities that are influenced by annual weather conditions, using the model to account for changes in nutrients as the pollutants move downstream. The influence of weather, rain and snowfall can be quite large and can influence wastewater loads more than the restoration efforts in any single year. However, the indicator does demonstrate long-term progress to reduce wastewater pollution. The Model estimates pollution from other sources such as agriculture or urban runoff using average weather conditions. This allows managers to understand trends in efforts to implement pollution reduction actions.

Pollutant loads to the Bay in any given year are influenced by changes in land-use activities and management practices, as well as the amount of water flowing to the Bay (hydrology). Annual rain and snowfall influence the amount of water in rivers flowing to the Bay. Other indicators track annual changes in river flow and population, which are important to understanding the context for the model results for a given year and over time.

There are two types of indicators that report different pollutant load amounts in a particular year. For example, in the Nitrogen Loads and River Flow indicator, the US Geological Survey reports the load of nitrogen reaching the Bay each year using data from different River Input Monitoring (RIM) stations around the watershed. The annual load to the Bay in 2009 was 235 million pounds of nitrogen, based on actual river flow during that year. In this Reducing Nitrogen Pollution indicator, the simulation of nitrogen loads in 2009 was 283 million pounds. This simulation does not represent how much nitrogen actually reached the Bay in 2009 since the loads from agriculture, urban runoff, septic, forest and atmospheric sources are based on long-term average hydrology rather than the actual amount of water flowing to the Bay in 2009. Conversely, the wastewater portion of the Reducing Nitrogen Pollution indicator shows actual loads reaching the Bay, but high- or low-flow years may confound progress associated with wastewater treatment upgrades. For more information on the Loads and River Flow indicators, please see the relevant Analysis & Method documentation here and the indicator page here.

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

(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)?

Both load and BMP implementation data can be extrapolated spatially and out in time to get a sense of future business-as-usual conditions. As with most projections, the greater the time period or spatial expanse from the baseline, the greater the uncertainty in the predictions. Changes in watershed conditions like animal and people populations; acres in agriculture, urban and forest settings; septic system growth; nutrient inputs to the land; etc. are extrapolated in time for what-if scenarios like the 2-year Milestones. Methods for performing the projections are appropriate and agreed to by Bay Program partners. By building in anticipated future conditions in model scenarios, changes in loads are accounted for that are associated with the changing conditions in the watershed. The BMP plans can then accommodate the effect of these changing condition. As an example, additional stormwater management would be needed to offset the growth in impervious surface as development occurs.

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 29-31.**

Procedures for compiling and managing wastewater discharge data at the Chesapeake Bay Program Office are documented in the following EPA-approved Quality Assurance Project Plan: "Standard Operating Procedures for Managing Point Source Data – Chesapeake Bay Program" on file for the EPA grant (contact: Quality Assurance Coordinator, Durga Ghosh, dghosh@usgs.gov).

Procedures at the Chesapeake Bay Program Office for acquiring and managing data from sources of pollution other than wastewater treatment plants are documented in the following EPA-approved Quality Assurance Project Plan: "Standard Operating Procedures for Managing Nonpoint Source Data – Chesapeake Bay Program" on file for the EPA grant (contact: Quality Assurance Coordinator, Durga Ghosh, dghosh@usgs.gov).

Jurisdictions providing wastewater effluent data and BMP data for other sources of pollution to the Chesapeake Bay Program Office have supplied documentation of their quality assurance and quality control policies, procedures, and specifications in the form of Quality Assurance Management Plans and Quality Assurance Project Plans. Jurisdictional documentation can be found under the CBP BMP Verification Committee's Projects and Resources at: http://www.chesapeakebay.net/groups/group/best_management_practices_bmp_verification_committee

(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?

Please see the response to question 23 for the locations of the most recent Watershed Model and Scenario Builder documentation.

Study/survey design procedures for both wastewater discharges and managing nonpoint source data can found in the QAPPs referenced in the response to question 27.

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

Wastewater:

- Monitored discharge data were generated from the EPA-approved standard sampling and analysis methods and documented in the Data Monthly Reports from facilities to jurisdictions.
- Discharge data back to the earlier years of the record are inadequate for many regions in the Bay watershed; however, the 1985 baseline is consistent throughout the indicator record.
- Facilities have been added to the point source database over the years either because they physically went on line, or because they were previously untracked. In addition, facilities have been turned inactive in the wastewater database over time because they went off line or combined with other facilities as new plants.
- Protocols of calculating discharges from measured or estimated flows and effluent concentrations have been adjusted throughout the data record to better reflect actual end-of-pipe loads.

Agriculture, Urban/Suburban and Septic, Air:

- For some BMPs and some jurisdictions, implementation levels reported for annual model assessments have increased or decreased significantly over the data record, not necessarily because of on-the-ground implementation, but because of the establishment of or changes to tracking mechanisms or because of new or revised resource assessments.
- Adjustments to BMP effectiveness and the methods of crediting BMP implementation have occurred over the period of the data record to better reflect conditions. There is an ongoing review program of BMP effectiveness by expert panels to establish the effectiveness of BMPs that have not historically been reported – as well as a fresh look at BMPs that are currently accounted for in the modeling tools. Once recommendations of expert panels have been approved through CBP workgroups and Goal Implementation Teams, they are introduced in the model simulation appropriately.
- Changes to data processing procedures by jurisdictions that report BMPs are documented in their Quality Assurance Project Plans.
- Changes to data processing procedures and databases used within the environmental tools such as Scenario Builder and the Watershed Model are reviewed and approved through the relevant Bay Program source workgroup and Watershed Technical Workgroup.

(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?

Wastewater: Data sets from seven jurisdictions are merged at the Chesapeake Bay Program Office. Continual peer-review of the thoroughness of discharge data and methods of managing the information by the Wastewater Treatment Workgroup promotes consistency and completeness of calculated end-of-pipe loads among the jurisdictions.

Agriculture, Urban/Suburban and Septic, Air:
Means of collecting and methods of analyzing BMP data vary among jurisdictions depending on the sophistication of their tracking mechanisms and resources devoted to managing the information. Jurisdictions providing BMP data to the Chesapeake Bay Program Office have supplied documentation of their quality assurance and quality control policies, procedures, and specifications in the form of Quality Assurance Management Plans and Quality Assurance Project Plans. This documentation can be obtained here or by contacting the Quality Assurance Coordinator, Durga Ghosh, dghosh@usgs.gov.

- BMP implementation data from seven jurisdictions are merged at the Chesapeake Bay Program Office. Continual peer-review of the data and methods of applying the data by Water Quality Goal Implementation Team workgroups promotes consistency and completeness among the jurisdictions. To improve uniformity in reporting BMPs among jurisdictions, summary and detailed information about the practices and reporting criteria are accessible through the Scenario Builder documentation (http://www.chesapeakebay.net/documents/SB_Documentation_V24_01_04_2013.pdf) and available for download via ChesapeakeProgress.

(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? No. Significant uncertainty and variability could be traced. Causes of the uncertainty and variability could be documented to limit its impact on the conclusion.

The CBP Watershed Model, employed to integrate wastewater technology controls and a large array of BMPs to reduce pollution from other sources, is best utilized when making comparisons among scenarios. For the Reducing Pollution indicators, these comparisons are among 1985, the 2009 Bay TMDL baseline, the yearly model assessments of loads, and the Phase II WIP planning targets.

By presenting trends and status at the large scale of the 64,000 square mile watershed over a 20-year period, yearly changes in data tracking mechanisms by particular jurisdictions and changes in methods of data analysis for particular wastewater plants and BMPs are somewhat masked.

The indicator is designed 1) to depict, generally, the degree of progress over the long term toward the implementation goals and 2) to clearly identify pollutant sources where gaps are large and to what extent. The Reducing Pollution indicator connects efforts (pollutant controls) with results (loading reductions and subsequently, water quality and habitat health).

(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? N/A

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.
Loads to Bay were simulated using CBP phase 5.3.2 Watershed Model.
Atmospheric deposition simulated using the Chesapeake Bay Airshed Model (a combination of a regression model of wet deposition and a continental-scale air quality model of North America called the CMAQ for estimates of dry deposition).

Atmospheric deposition to the watershed that is EPA's responsibility to reduce under the federal Clean Air Act is calculated by subtracting watershed loads in 1985, 2009 and 2012 assuming that existing requirements under the Clean Air Act are fully implemented (known as "allocation air") from watershed loads and the actual atmospheric deposition that occurred in 1985, 2009 and 2012.

Urban Runoff and Septic loads typically increase with development unless offset by BMPs due to growth in impervious surfaces, turf, the number of septic systems, and their associated loads.

Forest loads will increase due to buffer and tree plantings, but this change lowers total loads since less pollution comes from an acre of forest than from agricultural or urban lands.

Data and methods used in the CBP Watershed Model as well as the simulation itself and loading outputs are continually under external and internal review. Internal review mostly involves the CBP Water Quality Goal Implementation Team and its workgroups; the Modeling Workgroup within the Scientific, Technical Assessment and Reporting (STAR) Team; and special task groups established particularly for peer review. Scopes and purposes of these groups and their extensive considerations of the Watershed Model as a planning tool can be found at http://www.chesapeakebay.net/groups/group/modeling_team.

An external review of the Bay Program's Phase 5 Watershed Model Hydrologic Calibration was completed in September 2008 and can be found at http://www.chesapeakebay.net/content/publications/cbp_51626.pdf.

In February, 2008, an external panel assembled by the Scientific and Technical Advisory Committee reviewed the CBP Phase 5 Watershed Model assessing (1) work to date, (2) the

model's suitability for making management decisions at the Bay Watershed and local scales, and (3) potential enhancements to improve the predictive ability of the next generation of the Chesapeake Bay Watershed Models. A report of the review, with specific recommendations, can be found at http://www.chesapeake.org/pubs/2ndphasevreportfinal.pdf
Another external review of Bay Program modeling efforts "Modeling in the Chesapeake Bay Program: 2010 and Beyond" completed January, 2006 is published by STAC at http://www.chesapeake.org/stac/Pubs/ModBay2010Report.pdf.

In June, 2005, another external review of the Watershed Model addressed the following broad questions: 1) Does the current phase of the model use the most appropriate protocols for simulation of watershed processes and management impacts, based on the current state of the art in the HSPF model development, and 2) Looking forward to the future refinement of the model, where should the Bay Program look to increase the utility of the watershed model? Details of this review and responses can be found at http://www.chesapeakebay.net/channel_files/16175/response_chesapeake_bay_watershed_modeling_effort_review_-_2005.pdf

* - Loads simulated using 5.3.2 version of Watershed Model and wastewater discharge data reported by the Bay jurisdictions. The Chesapeake Bay Program Watershed Model uses actual wastewater discharge data, which is influenced by annual weather conditions, to estimate wastewater pollution. The Model estimates pollution from other sources such as agriculture or urban runoff using average weather conditions using constant delivery factors and allocation air for jurisdictional loads. Loads include atmospheric deposition of nitrogen to tidal waters and the portion of atmospheric deposition to the watershed that is EPA's responsibility to reduce under the Clean Air Act. Planning targets, while slightly higher than limits published in the December 2010 TMDL, represent the actions, assumptions, and "level of effort" necessary to meet the TMDL.