Land Use Methods & Metrics Development and Land Use Options Evaluation Combined Outcome Management Strategy

2015–2025, v.3

Photo by Will Parson / Chesapeake Bay Program

I. Introduction

To minimize the extent and mitigate the negative effects of land conversion to development, local decision-makers and the land conservation community need to be informed about: 1) land use and land cover changes that affect stream and watershed health, wildlife, and human communities; and 2) policy options, incentives, and tools that reduce the rate and magnitude of land conversion. This strategy addresses both objectives by integrating the goals of the Land Use Methods and Metrics (LUMM) Development and Land Use Options Evaluation (LUOE) outcomes outlined in the 2014 Chesapeake Bay Agreement. This strategy addresses the first need through monitoring and reporting on the rates of farmland, forest and wetland conversion as well as the rate of impervious surface change at a scale relevant to county-level decisionmakers. These data will help inform outreach efforts and products developed as part of the LUOE outcome to reduce the rate of land conversion.

Preventing the loss of forests and wetlands by minimizing the amount of natural lands converted to new development is the best method for retaining the natural hydrology and pollution control that these lands provide to streams and the Chesapeake Bay. Although farms alter hydrology and add nutrients and sediment to the watershed, conserving farmland is an important local, state and federal priority for a variety of reasons including food production and capacity and rural economic development. Preventing the conversion of all remaining natural and rural lands while accommodating future population growth is not possible but if growth is better managed, land conversion can be lessened which both protects the Bay and preserves future land management options. The population of the watershed is expected to grow by ~1.9 million people, or the equivalent to 840,000 households by 2035. The conversion of natural and rural land to development is dependent on the amount of land each new home or business consumes. For example, if each new household consumes two acres, rural and natural lands could decrease by over 1.7 million acres, but if they consume one-quarter acre, ~200,000 acres could be converted. Although traditional land conservation techniques- land purchase, preservation easements - are indispensable for protecting high-value lands, additional land use "policy options, incentives and planning tools" as called for in the LUOE outcome are needed to "reduce the rate of conversion of agricultural lands, forest and wetlands". Achieving these outcomes requires protection of our most valued rural and natural lands while managing growth and improving the quality of life within our rural towns, cities and suburban areas.

The LUMM outcome provides the data needed to raise awareness of the causes and consequences of land conversion on the rates at which land conversion is occurring down to the neighborhood or community scale. The LUOE outcome provides policy guidance, web tools and applications, and outreach to facilitate land use decisions that accommodate growth while protecting important resources and preserving local character. These data and tools will only be effective, however, if they are communicated to decision makers by trusted sources, at the time decision options are being debated, and in formats that are easily understood and perceived to be relevant.

II. Goal, Outcome and Baseline

This management strategy identifies approaches for achieving the following goal and outcomes:

Land Conservation Goal

Conserve landscapes treasured by citizens in order to maintain water quality and habitat; sustain working forests, farms and maritime communities; and conserve lands of cultural, indigenous and community value.

Land Use Methods and Metrics Development Outcome

Continually improve our knowledge of land conversion and the associated impacts throughout the watershed. By December 2021, develop a watershed-wide methodology and local-level metrics for characterizing the rate of farmland, forest and wetland conversion, measuring the extent and rate of change in impervious surface coverage and quantifying the potential impacts of land conversion to water quality, healthy watersheds and communities. Launch a public awareness campaign to share this information with local governments, elected officials and stakeholders.

Land Use Options Evaluation Outcome

By the end of 2017, with the direct involvement of local governments or their representatives, evaluate policy options, incentives and planning tools that could assist them in continually improving their capacity to reduce the rate of conversion of agricultural lands, forests and wetlands as well as the rate of changing landscapes from more natural lands that soak up pollutants to those that are paved over, hardscaped or otherwise impervious. Strategies should be developed for supporting local governments and others' efforts in reducing these rates by 2025 and beyond.

Baseline and Current Condition

The temporal baselines for the LUMM outcome are the years 2013 (New York, Pennsylvania, District of Columbia, Delaware, and Maryland) and 2014 (Virginia, and West Virginia) for which 1-meter resolution land cover and land use data exist for all counties located within the Bay watershed. The economy, consumer preferences and public investments influence the decisions of private developers and businesses which in turn influence the migration of people seeking jobs and amenities resulting in both commercial and residential growth. These factors, however, can be unpredictable and volatile as witnessed in the steep decline in new housing over the period of 2006-2009 following a boom and the rise of remote workplaces in response to the global COVID pandemic starting in 2020. Therefore, measured rates of land conversion need to be interpreted in context relative to measures of economic activity such as population, employment growth, episodic large-scale infrastructure projects, and other phenomena.

The LUMM outcome is on course with tremendous progress made including the finalization of a 1-meter resolution, 54-class land use/land cover (LULC) dataset for all counties within and adjacent to the Chesapeake Bay watershed for 2013/14 and 2017/18. These data are now informing the Bay watershed model (CAST-21), Chesapeake Healthy Watershed Assessment, Chesapeake Data Dashboard, the Community Tree Cover Indicator, Impervious Surface Indicator, and County Tree Cover Fact Sheets. The 1-meter LULC data are viewable and downloadable on the web. These data will be used to inform additional indicators developed as part of this outcome over the coming year including metrics on the rates of land conversion (i.e., forest, wetland, and productive lands converted to development), riparian forest extent and change, and effective impervious cover extent and change. These metrics and the associated high-resolution LULC data will also inform ten other outcomes outlined in the 2014 Chesapeake Bay Agreement.

Progress on the LUOE outcome has also been significant with the development of a Conservation Land Use Policy Toolkit and the Healthy Watersheds Forest Retention Project in 2017. These efforts occurred in the absence of measures produced by the LUMM outcome. Now that such measures are being produced and the CBP Partners have adopted a strategic local engagement strategy, there is an opportunity to develop a new approach to informing and incentivizing better land use decisions. A new land use strategy needs to be inclusive of land conservation, public access/recreation, land use planning, climate resiliency, and environmental equity and justice. It should be very explicit about defining the value-added role of the CBP Partnership in managing growth given that land use change is a phenomenon driven by the interplay of economics, cultural preferences, episodic events, and a wide range of policies that cannot all be controlled.

A new land use strategy integrated across multiple CBP workgroups and GITs, with the direct involvement of locals is needed that focuses on: 1) incentivizing infill and redevelopment, particularly in underserved minority communities; 2) facilitating public outdoor recreation and environmental education through land conservation; 3) maintaining ecosystem services and healthy watersheds, 4) minimizing climate impacts on infrastructure; and 5) addressing local concerns (that may only be tangential to CBP concerns).

III. Participating Partners

The following partners have pledged to help implement this strategy:

- Chesapeake Bay Commission
- Land Use Workgroup
- Local Government Advisory Committee
- Local Leadership Workgroup
- Water Quality Goal Implementation Team
- Habitat Goal Implementation Team
- Healthy Watersheds Goal Implementation Team
- Maryland Department of Planning
- Pennsylvania Department of Community and Economic Development
- U.S. Geological Survey
- USGS National Geospatial Program
- The Chesapeake Conservancy

Local Engagement

To assist in quantifying impacts on communities, the Land Use Workgroup will work with the Local Government Advisory Committee (LGAC), Citizens Advisory Committee, Diversity Workgroup, Local Leadership Workgroup and the CBP Strategic Engagement Team to identify local governments interested in better understanding local rates of, and impacts from, land conversion and in better managing the rates and impacts from land conversion. Local government stakeholders are needed to advise the Chesapeake Bay Program on the local relevance of land change and impact metrics (i.e., are the metrics adequate to inform land use planning activities at the county level) and on the utility of related tools and applications.

The LUOE specifically calls for the direct involvement of local governments. In most cases, land use decisions are local government decisions and therefore the success of LUOE depends largely on local governments adopting and implementing policy options, incentives, and planning tools to better manage growth. Local governments should be consulted in developing strategies to support their efforts to reduce the rate of conversion. In addition, the advice, guidance, and direct assistance of LGAC, LLWG and others will be needed throughout the process of implementing this management strategy.

IV. Factors Influencing Success

The following are natural and human factors that influence the ability of the Chesapeake Bay Program (CBP) to attain these land use outcomes:

Technical Challenges

- Development of separate metrics: The CBP Management Board has interpreted the Outcome language as calling for the development of separate metrics for forest, farm, and wetland conversion in addition to measuring the rate of impervious surface change. For example, addressing this Outcome requires metrics that account for conversion from forests to farms and from farms to forests, in addition to conversions of both forests and farms to development.
- Sustainability of long-term monitoring: This factor is a question of political will more than technological capabilities. Continued monitoring of high-res land use change through the year 2034 is needed to support the achievement of multiple outcomes and the Phase 7 model. There remains a need to monitor land use change for an additional 5 years and meet the following objectives:
    - Adapt to changes in technology and CBP needs while ensuring consistency over time.
    - Couple monthly satellite imagery with more periodic aerial imagery.
    - Leverage advances in computational power and artificial intelligence.
    - Address the needs to monitor wetland change for black ducks, anadromous fish, and climate resiliency.
    - Evaluate effectiveness of the data for BMP verification.

- Methodology for assessing landscape change with high-resolution data with sufficient precision to inform county-level decisions: Techniques to separate actual change in land cover from false change. Change detection methods are rapidly advancing but are not sufficiently established to make this a non-issue. To accurately track change, updates to existing high-resolution land cover and land use datasets will be required during each four-year remapping phase. This will ensure that the data for 2013/14 are consistent with and directly comparable to the data for 2017/18 and those for 2021/22 and beyond.
- Methodology to quantify impacts to communities and the environment: The quantification of impacts from land conversion to communities and the environment need to be explored in more detail and with input from local governments. Quantification of impacts without sufficient context for interpreting those impacts may lead to false conclusions. Local governments need better information on the variety of benefits of land conservation and smart growth, such as source water protection, fiscal benefits, public health, and helping to meet regulatory responsibilities under the Chesapeake Bay TMDL. In addition, concentrating development can require changes to local government development codes and plans, such as reducing the number of parking spaces required, and encouraging two-story schools, libraries and other public buildings. Local governments must consider many diverse factors when regulating land use, including affordability of housing, property rights, and the adequacy of surrounding infrastructure. Local economic development objectives, especially in areas where there is high unemployment, also are of concern to local governments. Some local governments might need technical assistance to harmonize (through the comprehensive planning process) economic development objectives with environmental objectives. Governments most in need of such assistance sometimes are those that are just beginning to experience significant development pressure. There also is a need to ensure that open space

areas set aside by local governments are not rezoned and then lost to future development.

Political and Educational Challenges

- Reducing land conversion rates presents both a political and educational challenge. Growth pressure can impact political decisions for where and whether growth should be concentrated; legislative authority to shape growth patterns, for example, through conservation zoning, might be difficult to obtain. Also, efforts to minimize impacts from future land change within the watershed are sometimes neglected given the significant effort needed to reduce existing impacts from existing land conversion. There are many nongovernmental organizations focused on minimizing impacts from future land change, including approximately 180 local land trusts within the watershed, as well as smart growth advocacy organizations. Some existing policy drivers, such as the Chesapeake Bay Executive Order, TMDL, and the Bipartisan Infrastructure Law are influencing federal efforts to mitigate future land change impacts to the Bay.

Sustaining the Agricultural and Forestry Industries

- The loss of forest and farmland can be slowed by strengthening the agricultural and forestry industries in the watershed. Two areas of concern include: ensuring the continued profitability of working forests and farmland so they can continue to be managed as working lands and facilitating the transfer of those lands from those currently working them (often an aging population) to the next generation of farmers and foresters.

Ability to Engage Local Governments: Strategy Development

- A major task in achieving these outcomes will be engaging local governments and interest groups. To do so, the Bay Program needs a strategy with local governments and groups throughout the watershed. This strategy on how to involve locals should build off the existing Local Engagement Strategy and include a plan to provide data, resources and information related to land use change in a more efficient and effective manner.

DEIJ and Climate:

- Diversity, Equity, Inclusion and Justice (DEIJ) and climate considerations are not well accounted for in these outcomes. The way land is utilized for recreation, housing, infrastructure or industrial purposes can have a profound effect on the residents that make up a community. While resources related to policies, incentives, and planning tools to reduce land conversion have been compiled, there have not been any assessments completed to determine how underserved communities would be helped or hindered. It is vital that any policies, incentives or planning tools related to land conversion also support healthy communities in an equitable way.

V. Current Efforts and Gaps

The term “land cover” refers to the classification of land surface characteristics into categories such as impervious surfaces and tree canopy. Land cover classifications are derived from aerial and satellite spectral imagery collected from passive sensors (e.g. photography, thermal, infrared). These classifications can be enhanced by incorporating data from active sensors (e.g., LiDAR). Since the late 1990’s, the CBP has relied on 30-meter resolution Landsat satellite-derived land use/land cover data to provide a spatially consistent representation of Chesapeake Bay watershed conditions to inform the suite of models used for management purposes and for tracking changes on the landscape. The U.S.

Geological Survey (USGS) has recently produced annual 30-meter resolution, 9-class (e.g., impervious, tree canopy) land cover data derived from Landsat imagery for the conterminous United States for the period 1985 – 2021 (https://www.usgs.gov/land-resources/eros/lcmap). In addition, the USGS has continued to produced their 16-class land use/land cover datasets for the years 1984, 1992, 2001, 2004, 2006, 2008, 2011, 2013, 2016, and 2019 (https://www.mrlc.gov/data). While these data are invaluable for quantifying temporal trends in land conditions over decadal time scales and have an overall accuracy around 80%, they underestimate impervious cover by over 40% throughout the watershed due to the under detection of small and narrow features. This fact combined with local-scale inaccuracies make them insufficient for monitoring change at a scale relevant to county-level decisions as called for in the LUMM outcome.

Since the early 2000's, counties, states, and the United States Department of Agriculture Farm Service Agency (FSA) have acquired high-resolution (under two meter) imagery to inform transportation, public works and natural resource decisions. Initially, these data were acquired as natural color images and used as pictures, rather than analyzed as data. This practice has gradually evolved through the development of object-based feature extraction software, such as Feature Analyst, ENVI, and eCognition as well as the acquisition of imagery with a near-infrared spectral band in addition to the three visible bands. The near-infrared band enhances the ability to distinguish vegetation from non-vegetated areas.

At present, the FSA collects four-band leaf-on one-meter resolution ortho-imagery for each state as part of their National Agriculture Imagery Program (NAIP) every 1-3 years. Collection dates are cyclic and vary due to the availability of state cost-share funds and other factors. In addition, the Virginia Institute of Marine Science (VIMS) collects and manually classifies black and white aerial photographs along the near-shore areas of the Chesapeake Bay and its tidal tributaries to support their annual inventory of submerged aquatic vegetation (SAV) extent and density. Some states and localities acquire sub-meter leaf-off imagery every 3-5 years to support transportation and planning needs. Leaf-on imagery is better for detecting vegetation and leaf-off imagery is better for detecting impervious surfaces and water features which may be obscured by the canopy during the growing season. Leaf-off imagery is mostly collected during the spring, but the collection years often vary by state.

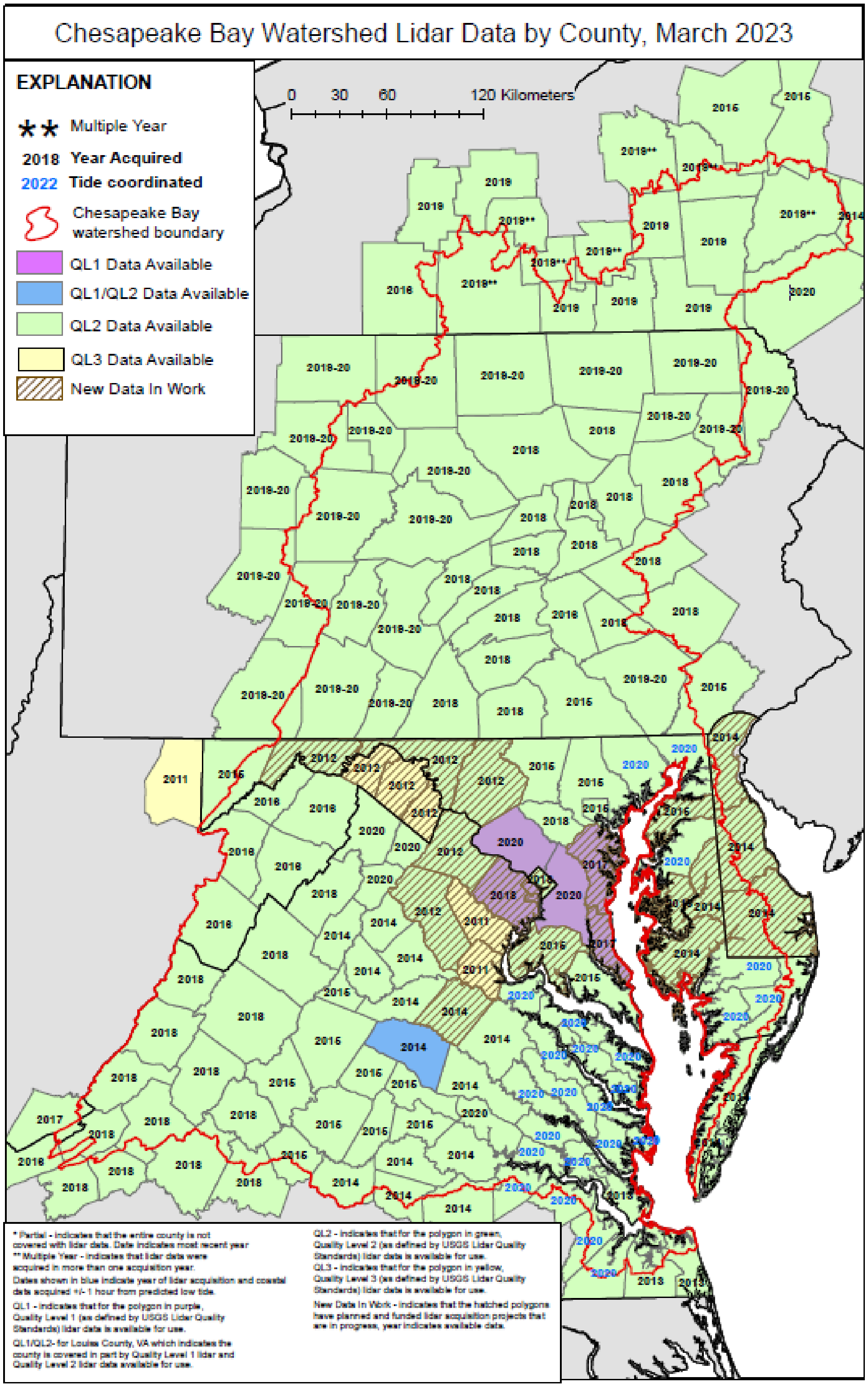

Figure 1. Status of LiDAR data acquisitions in 2023. QL1-3 refer to data Quality Levels that influence the spatial resolution and accuracy of the final product. For an updated status map, see: http://gis.chesapeakebay.net/lidarstatus/. For more information on LiDAR specifications, see: https://pubs.usgs.gov/tm/11b4/pdf/tm11-B4.pdf

LiDAR (Light Detection and Ranging) refers to a high-resolution (under two meter) active airborne sensor that emits pulses of light in near-infrared (topographic LiDAR) and/or blue-green (topo/bathymetric LiDAR) wavelengths. These pulses are directed towards the ground, reflect off surfaces (e.g., buildings, leaves, branches, pavement, dirt), and return to the sensor. The time it takes for the pulses to be detected is recorded and correlated with the travel distance or "range" of each pulse. Because the exact location of the airplane in three-dimensional space is known, travel distances can be converted to elevations revealing a wealth of information about vegetation height, structure, biomass, and ground surface characteristics. As of April 2023, LiDAR imagery with a quality level of 2 (1-meter resolution) or better has been collected on a county-by-county basis at least once (occasionally twice or three times) (Figure 1).

There are different types of airborne LiDAR (e.g., waveform, discrete return, pulse width, and photon counting) which are not discussed here. The LiDAR data characteristics most relevant to the CBP needs are spatial accuracy, vertical accuracy, and penetration through water. Accuracies are influenced partly by the height and speed of the plane and frequency of pulses. The National Digital Elevation Program has developed a convention for characterizing the quality of elevation datasets. Most of the LiDAR elevation data currently available in the Chesapeake Bay watershed are classified as either Quality Level 2, "QL-2" (nominal pulse density of ≥ 2.0 pls/m^2; 10 cm vertical RMSEz) or "QL-3" (nominal pulse density of ≥ 0.5 pls/m^2; 20 cm vertical RMSEz). The QL-2 products have sufficient accuracy to produce a 1m resolution Digital Elevation Model (DEM) or Digital Surface Model (DSM) whereas the QL-3 products only support the production of a 2-3m resolution derivative products. Quality Level 1, "QL-1", data are now available for three jurisdictions and have nominal pulse density of ≥ 8.0 pls/m^2; 10 cm vertical RMSEz. These LiDAR products have mostly been collected using laser pulses with near-infrared wavelengths that cannot penetrate through water. Surface waters are depicted as flat, constant elevation surfaces similar to some building and pavement surfaces. Bathymetric and topo-bathy LiDAR instruments emit pulses in the blue-green wavelength that can penetrate water surfaces up to depths of 1- 10 meters depending on water clarity. Submerged surface elevations are also more accurate if the substrate is hardened (e.g., oyster bed) vs. soft (e.g., mud).

Coupling LiDAR data with high-resolution spectral imagery has proven very useful for improving the accuracy of semi-automated land cover classifications (e.g., differentiating buildings from parking lots and forests from scrub-shrub and herbaceous vegetation). The more data informing a classification (e.g., number of spectral bands, elevation and biomass data, parcels, and land use), the more automated the process can become to produce an accurate product. The costs of production are generally positively correlated with the degree of automation, yet all products require some level of manual editing to increase overall and individual class accuracies above 90%.

In 2015, 1-meter land cover data were produced for the entire Bay watershed (including all adjacent counties) using a combination of 2013/14 leaf-on NAIP imagery, available state or county leaf-off imagery and a normalized Digital Surface Model derived from LiDAR.[1] In 2016, the 12-class land cover data were translated into a 16-class land use dataset by the CBP GIS Team.[2]Translating land cover into a more categorically detailed land use/land cover dataset is essential to meet the needs of this and other CBP outcomes. For example, herbaceous vegetation (a land cover class) can either represent one of the most polluting land uses (corn) or one of the least polluting (lands undergoing natural succession). Moreover, a categorically detailed land use/land cover dataset can be used to qualify and understand

[1] https://chesapeakeconservancy.org/conservation-innovation-center/high-resolution-data/land-cover-data-project-2/
[2] https://chesapeakeconservancy.org/conservation-innovation-center/high-resolution-data/land-use-data-project/

the types of changes occurring on the land such as agricultural intensification, utility-scale solar field development, and highway lane expansions, all of which involve increases in impervious cover but have differing environmental consequences.

The LUMM outcome calls for "continually improving the knowledge of land conversion" which requires attention towards monitoring land change rather than just representing land conditions for a single point in time or periodically as resources allow. Assessing and mapping land use/landcover change from high-resolution imagery is challenging but holds great promise for meeting the objectives of this outcome. Changes in spectral surface-reflectance properties over multi-date images, however, introduce a lot of noise (i.e., misleading information) into interpretations of change. Sources of noise might include variations in sun-angle, atmospheric conditions, vegetation phenology and infrastructure materials. Image properties can also vary from one image tile to another and from one year to another. These problems present challenges but ones that can be overcome with proper preparation and curation of input imagery and ancillary datasets.

Efforts to date towards the LUOE include projects and studies aimed at determining the spectrum of existing land use "policy options, incentives and planning tools" being implemented at the local and state level. This work focused on efforts within the watershed, examples of successful efforts outside of the watershed, such as specific examples of cities and communities that have directly addressed the issue of land conversion, like Chicago, Illinois and Portland, Oregon. The results of these efforts were integrated in to various resources including the Watershed Data Dashboard, the Healthy Watersheds GIT homepage and integrated into communication resources including the Local Government Guide to the Chesapeake Bay, Module 5: Preserving Local Character and Landscapes. An approach is still needed, however, to improve transfer of knowledge on the costs, benefits and effectiveness of both local and state level land use policy options, incentives, and planning tools.

VI. Management Approaches

There are three elements to the LUMM Outcome:

1. Monitor the rates of impervious surface change and conversion of forests, wetlands and farmland.
2. Quantify the impacts of land conversion on:
    a. Water quality.
    b. Healthy watersheds.
    c. Communities
3. Communicate results to the public, elected officials and to the CBP.

The CBP will coordinate and solicit input on user requirements and technical specifications for this outcome. There are three basic technical approaches for monitoring land conversion every 2-4 years: 1) coarse, 30-meter resolution watershed-wide mapping of land cover change from Landsat satellite imagery; 2) high-resolution (under five meter) watershed-wide mapping of land cover change from aerial or satellite imagery; and 3) high-resolution (under five meter) stratified random sampling. Each of these options has advantages and disadvantages related to cost, accuracy, spatial and temporal scale, flexibility for management use, adaptability to changing management objectives and educational value. These attributes were considered in developing recommendations for monitoring land change over time. Note that the above options are not necessarily mutually exclusive. For example, monitoring land change with Landsat satellite imagery can inform a stratified-sampling framework using high-resolution imagery. An area can be stratified into sections based on the amount of change detected by satellite imagery to ensure that all areas of high-change sections are included within a sample. Additional approaches, such as the use of artificial intelligence to classify high-resolution imagery, may emerge in the future given rapidly advancing technologies and techniques.

While measuring current rates of land conversion will require use of existing imagery and data which varies in spatial resolution, accuracy and acquisition year, significant improvements in derived metrics and cost savings to local, state and federal government agencies could be achieved through a coordinated effort to synchronize the acquisition of imagery and agree on a classification schema and change detection approach.

Quantifying the impacts of land conversion on water quality will be accomplished through close coordination with the CBP Modeling Workgroup and utilize the same sets of assumptions and data used to inform water quality decisions associated with the Chesapeake Bay Total Maximum Daily Load (TMDL). Quantifying impacts to healthy watersheds will be determined through close coordination with the Habitat and Healthy Watersheds Goal Implementation Teams (GITs) and may involve measures of vulnerability to urban development coupled with hydrologic impact measures associated with stream flow alteration. Assessing the impacts of land conversion to communities is one of the most complicated aspects of this outcome. Land conversion associated with residential and commercial development provides economic benefits to communities, but also involves costs that are not always evident at the time of development. Local participation will be sought to help identify and describe impacts to communities and to develop and implement the engagement strategy as described below.

Approaches Targeted to Local Participation

Local participation in developing impact methodologies, particularly those used to assess impacts to communities, are needed to ensure the data are useful for informing local-level decisions. The CBP Land Use Workgroup will work with LGAC, the Local Leadership Workgroup, Communications Workgroup, and others to help develop a local engagement strategy that seeks to target outreach efforts and integrate and disseminate products from this outcome and those from the LUOE outcome.

Cross-Outcome Collaboration and Multiple Benefits

Restoration and conservation efforts in the watershed will benefit from the availability of high-resolution land cover and elevation data produced every 2-4 years. The data will inform all goals and almost all the outcomes specified in the *Chesapeake Bay Watershed Agreement*—particularly the Vital Habitats, Healthy Watersheds and Land Conservation Outcomes. Specific benefits include:

- Characterizing, mapping, and tracking of wetlands, riparian forest buffers, forests and impervious surfaces;
- Characterizing, mapping, and tracking habitat conditions;
- Developing habitat suitability maps;
- Prioritizing and targeting restoration, conservation, education and public access efforts;
- Understanding the effects of management actions on water quality;
- Verifying riparian buffer and urban tree canopy best management practices (BMPs);
- Verifying the effects of land policy BMPs;
- Assessing the vulnerability of watersheds and stream restoration BMPs to altered flow regimes;

- Improving the accuracy of nutrient and sediment load estimates; and
- Educating people on the value and location of high-functioning landscapes.

VII. Monitoring Progress

N/A

VIII. Assessing Progress

Progress in developing the methods and metrics will be assessed quarterly by the Land Use Workgroup and will be based on the feasibility and accuracy of the derived metrics and impact measures. Following development and approval of the metrics, they will be reassessed every 2-4 years corresponding to the receipt of updated land cover information.

IX. Adaptively Manage

The utility of the metrics and impact assessments for informing CBP decisions will be evaluated at the end of each monitoring cycle and adjusted as needed to improve their utility for local decisions to accommodate changes in technology and programs.

X. Biennial Logic & Action Plan

Biennial logic and action plans for each management strategy will be updated to accompany this management strategy. The combined LUMM and LUOE Logic & Action Plan will update the following information:

- Key actions.
- Timeline for the action.
- Expected outcome.
- Partners responsible for each action.
- Estimated resources.