Response to Request for Information
USDA-ARS Long-term Agro-Ecosystem Research (LTAR) Network

Lower Chesapeake Bay LTAR

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Introduction and Rationale

- *The gradient from urban to agriculture land use present in the Lower Chesapeake Bay region (Fig. 1) provides numerous opportunities to examine challenges not typically faced in largely-rural inland regions and to develop adaptive management strategies*
- *Results and outcomes of research conducted in this urban-agriculture LTAR would greatly benefit the national LTAR network and serve as an example to other US coastal urban-agricultural regions.*

The Chesapeake Bay is the largest estuary in North America and is located in the mid-Atlantic region of the US. The watershed area includes six states from New York to Virginia and is nearly 167,000 km^2 with more than 150 rivers and streams entering the 300-km Bay main stem. Forested and agricultural lands make up 58 and 22 percent of the land use, respectively; nearly 9 percent is urban and suburban use (NWF, 2013). Urban area expansion continues to change the landscape of the Bay watershed which is home to over 17 million people and is expected to be 19 million by 2025 (Claggett et al., 2012).

The health of the Chesapeake Bay ecosystem has been declining for several decades, and in 2009, a Presidential Executive Order tasked federal agencies “to contribute significantly to improving the health of the Chesapeake Bay” (Executive Order 13508, 2009). The US Environmental Protection Agency (USEPA) rated water quality in over 50% of the Bay's streams as poor or very poor (USEPA, 2010) and, in 2010, established a total maximum daily load (TMDL) for nutrients and sediment for the entire Bay watershed. Most recently, USEPA declared over 70% of the Bay tidal segments fully or partially impaired due to the presence of toxic contaminants (USEPA, 2012a). Air quality in the region is also impaired by ozone and particulate matter of less than 2.5 μm ($PM_{2.5}$) (USEPA, 2012b).

Climate change is another serious threat to the Chesapeake Bay (Naijar et al., 2010; Pyke et al., 2012; George et al., 2007). Increases in sea level combined with more intense precipitation during large storms events will lead to losses of coastal wetlands and erosion thereby exacerbating existing water quality problems. Higher temperatures will increase hypoxia problems in waterways and increase the rate of ground-level ozone formation in the region. Comprehensive and long-term research efforts are required to examine the effects of climate change on agricultural production in the region and to adapt production systems effectively.

Agriculture production contributes significant loads of nutrients, sediment, and other pollutants like pesticides into the Bay waterways (USEPA, 2010). However, well-managed, contiguous agricultural lands provide ecosystem services such as wildlife habitat, refugia for insect pollinators and biocontrol agents, stream buffers, carbon sequestration, and open green spaces in the landscape to off-set pressures of urbanization (NRCS, 2011). Better information on the services provided by agricultural lands is needed to support future efforts to preserve the continuity and integrity of these lands. Improved farming systems and conservation practices are needed to reduce off-site movement of pollutants while maintaining production efficiency.

Structure of Lower Chesapeake Bay LTAR

The Lower Chesapeake Bay LTAR (LCB-LTAR) will encompass areas of the Chesapeake Bay watershed south of the Susquehanna River basin (Fig. 1). ARS research activities are distributed across several research locations including the Henry A. Wallace Beltsville Area Research Center (BARC), the US National Arboretum, and the Choptank River Watershed. It will include partner organizations and long term research network sites such as the Baltimore Ecosystem Study and the Smithsonian Environmental Research Center (SERC) which participates in the National Ecological Observatory Network (NEON). Through this collaboration, the team will explore linkages between agriculture, urban and forest land use areas, bringing together expertise in air, water, and soil quality research, ecological assessment, and advanced remote sensing technology.

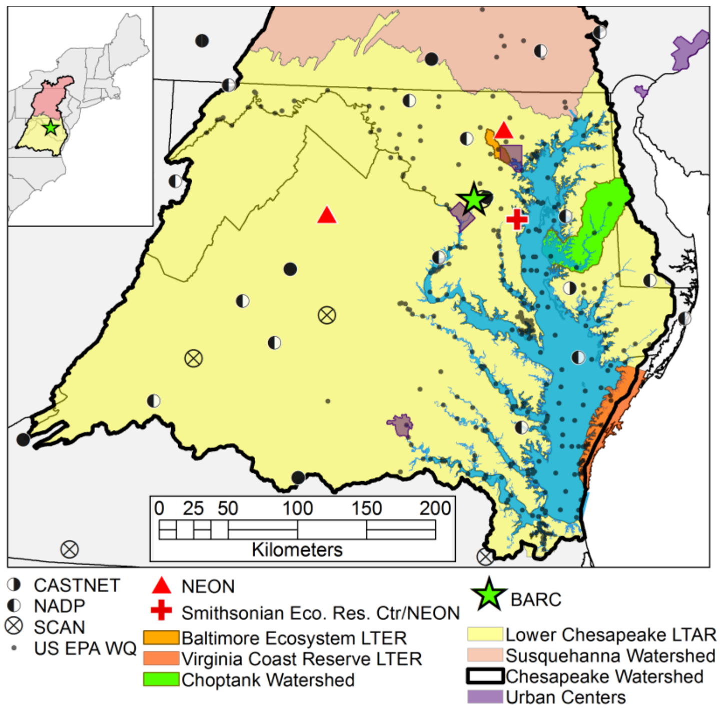

Figure 1. Map of the proposed Lower Chesapeake LTAR with existing ARS long term experiment sites and other long term environmental research and monitoring networks.

The Lower Chesapeake Bay LTAR Working Group has been formed and currently includes 26 BARC scientists. Scientists from each partner entity will be added if the LCB-LTAR is approved. Research planning and organizational meetings will be held annually with all scientists; committee meetings will be held more frequently for specific experiments/projects. A network of customer groups will be continually developed, and outreach activities such as field demonstrations and presentations at conferences, workshops and producer events will be supplemented by virtual outreach using webinars, YouTube videos, and other social media tools. A web portal will be established to provide information on projects and scientist bios, a bibliography of publications and other products, access to datasets, and links to partner sites.

Implementation of Vision and Goals

Our goals have been designed to leverage existing natural resource research programs and long-term experiments on-going at BARC and at partner sites in order ***to address critical research needs of the region***. These goals will also encourage development of new multi-disciplinary teams to meet specific research objectives.

Our overall approach involves a combination of fundamental and applied research experiments carried out at different scales with new discoveries being utilized as feedback to facilitate improvements and advances in the linked experiments.

Field-plot and small watershed-scale experiments will be used to conduct detailed, high-resolution investigations of the fundamental processes governing chemical behavior and crop growth. Smaller-scale experiments will also be used for direct comparison of production systems; for initial testing of new measurement technologies; and for the validation of process-based models and geo-spatial tools prior to testing at larger scales.

Vision

The Lower Chesapeake Bay LTAR site will provide a unique opportunity to address the effects of urbanization and climate change on agricultural ecosystems in coastal regions.

Goals

1. Provide a venue to explore beneficial opportunities and to minimize the negative aspects of the agriculture-urban interface.
2. Enhance the ecological benefits and services provided by agricultural lands in the protection and restoration of the Chesapeake Bay watershed.
3. Develop adaptive strategies for agricultural production systems in response to changes in climate within this vulnerable coastal region.
4. Develop decision-support tools to implement effective, efficient, and economically-viable agricultural systems, land and water resource management, and conservation practices.
5. Build upon existing partnerships with agencies, universities and non-governmental organizations to achieve programmatic goals.
6. Establish and maintain standardized laboratory and data management systems for critical analyses to ensure consistency and availability of long-term data records.

Large watershed-scale studies will examine the influence of landscape metrics on the effectiveness of conservation practices in protecting ecosystem health. These experiments will draw on the findings of smaller watershed and field scale observations, experimental results, and predicted outcomes. They will be used as a means to develop and to test decision-support tools for resource managers. Research conducted at the larger watershed scale will facilitate testing of improved conservation practices and interaction with producers, extension, and USDA action agencies such as the Natural Resource Conservation Service (NRCS). BARC scientists and partners conducting watershed experiments will also work cooperatively throughout the region to examine gradients across the agriculture-urban interface.

Infrastructure Capacity, Data Richness, and Productivity

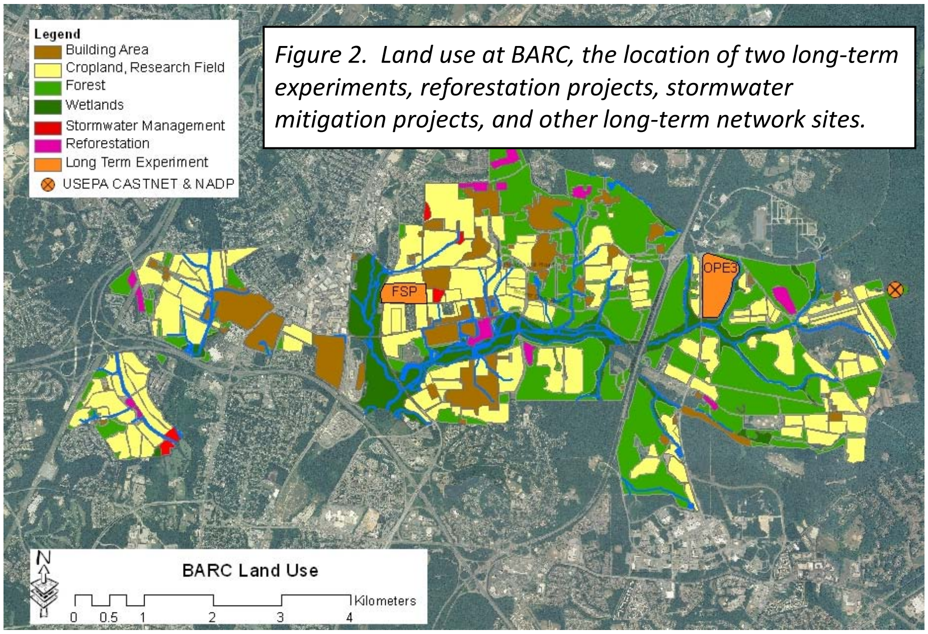

Figure 2. Land use at BARC, the location of two long-term experiments, reforestation projects, stormwater mitigation projects, and other long-term network sites.

BARC Overview. Established over 100 years ago, BARC is the world's largest agricultural research complex. It is located on 2600 ha of federal lands within the Anacostia River watershed, a highly-impaired Chesapeake Bay tributary. BARC adjoins the even larger 4800-ha Patuxent Wildlife Refuge, and both are part of 10,500 ha of contiguous federally-owned land containing a large complex of forests and wetlands commonly referred to as the Green Wedge. This valuable space is located within the Washington-Baltimore corridor which is undergoing rapid urbanization. Land use at BARC includes a working dairy, a compost center, >400 ha of production fields used for animal feed, and 135 ha of sensitive species forests and wetlands, including a number of rare upland bogs (Fig. 2). BARC hosts several long-term networks: Greenhouse gas Reduction through Agricultural Carbon Enhancement network (GRACEnet), Clean Air Status and Trends Network (CASTNET BEL116), National Atmospheric Deposition Program (NADP MD99), and Soil Climate Analysis Network (SCAN 2049).

Over 50 diverse and highly-productive BARC scientists and their support staff conduct long-term research in natural resources and sustainable agriculture (Fig. 3). Frequently, these scientists collaborate with other BARC researchers in animal and plant sciences. Laboratories are equipped with state-of-the-art analytical instrumentation, and researchers have access to computer-controlled greenhouses, growth chambers, and experimental field plots with sophisticated sampling and measurement equipment. BARC has strong ties with the Central Maryland Research and Education Center, a 115-ha facility (Hayden Farm) on BARC property managed by Maryland Agricultural Experiment Station, which is used for basic and applied agronomic research.

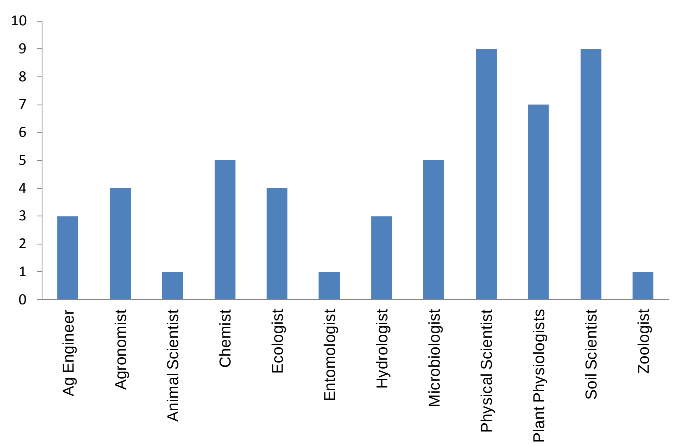

Figure 3. Distribution of natural resource and sustainable agriculture scientists.

We propose to ***utilize BARC as a testing and demonstration area*** for improved conservation practices, ecosystem services assessments of agricultural lands, and beneficial ag-urban partnerships. The LCB-LTAR will build upon existing partnerships such as the Baltimore Washington Partners for Forest Stewardship which promotes preservation and enhancement of ecological benefits of green infrastructure. BARC has established water quality and reforestation projects with the Metropolitan Council of Governments and with the Maryland State Highway Administration, Intercounty Connector Highway Project; the latter has led to the planting of over 9000 trees and installation of three new storm water runoff mitigation structures.

The BARC compost facility, open since 1997, is used to conduct research on combining agricultural and urban waste streams, leading to products for urban landscaping and reducing offsite impacts on the Chesapeake Bay. BARC scientists also conduct experiments at the US National Arboretum, a 185-ha facility located along the Anacostia River in the District of Columbia and a resource unique to the LCB-LTAR. The Arboretum mission includes the study and development of ornamental plants for gardening and landscaping to enhance the urban environment. The Student Discovery Garden at BARC is an outreach tool created by BARC scientists and others to inform students about agricultural research and related careers.

ARS Long-term Experiments

The **Choptank River Watershed Project,** a larger scale watershed experiment initiated in 2004, is a long-term project **designed to assess the effectiveness of conservation programs** at watershed scales and is an ARS Benchmark Watershed located on the Delmarva Peninsula of the Chesapeake Bay watershed (Fig. 1). Specific objectives include: 1) Improving our understanding of the aggregate effects of conservation practices at the watershed scale; 2) Improving our ability to select and place conservation practices on the landscape for maximum effectiveness; 3) Improving conservation practices to better protect water, air, and soil resources; and 4) Maintaining the effectiveness of conservation practices under changing climate and land use. This project benefits from data collected from other long-term networks (Fig. 4): US EPA Chesapeake Bay Program Water Quality Monitoring network, Maryland Department of Natural Resources, CASTNET (BWR139), NADP (MD-R-83), US Geological Survey stream flow (Tuckahoe, Greensboro), and NOAA National Buoy Center.

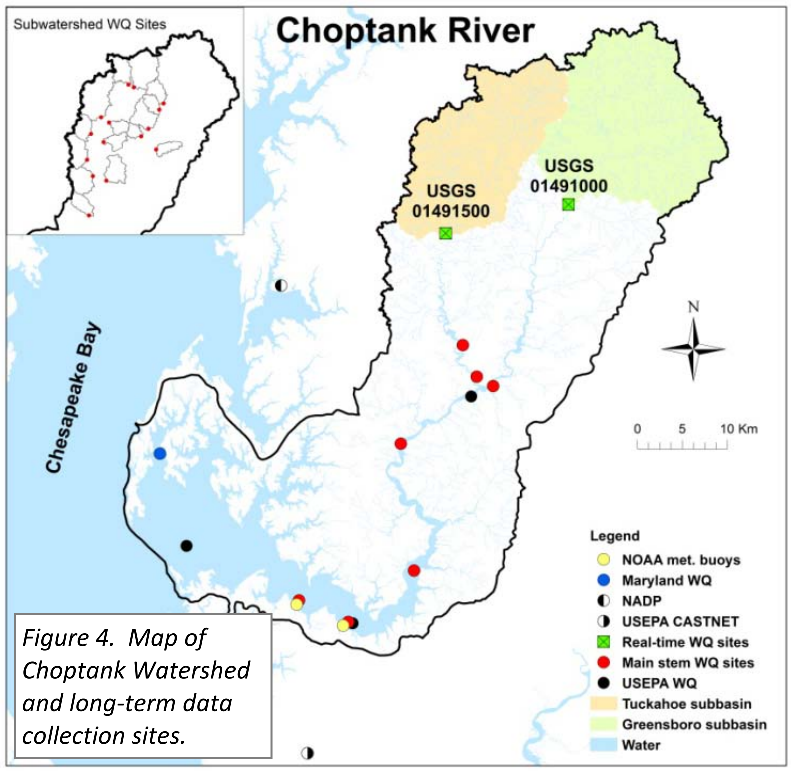

Figure 4. Map of Choptank Watershed and long-term data collection sites.

The Choptank River is located in the Atlantic coastal plain on the eastern shore of the Chesapeake Bay and portions of the watershed have been identified as “impaired waters” due to high levels of nutrients and sediments (McCarty et al., 2008). The watershed is 1756 km^2 with land-use being dominated by agriculture (58%) and forest (33%), with only 9% urban. The most common crop rotations include corn, soybean, and winter wheat double cropped with soybeans. In addition to winter small grains, non-harvest winter vegetation cover is encouraged by a conservation program from the state of Maryland to enhance water quality.

The Choptank River basin has shallow unconfined aquifers. The majority of the watershed is underlain by the Columbia surficial aquifer with the lower portion of the watershed underlain by the confined Chesapeake Group aquifer. Recharge to the Columbia aquifer is from local precipitation, and the groundwater flow paths are short, generally < 2 km. The water table in most of the region lies between 0 and 3 m below the land surface. The soils in Choptank are defined by the superposition of upper-delta-plain sands and gravel on marine-inner-shelf sands. Local soil types under cropland production include the Othello series (fine-silty, mixed, active, mesic typic aquolls) which are poorly-drained with moderately low-permeability, and the Mattapex series (fine-silty, mixed, active, mesic aquic hapludults) which are moderately well-drained with moderate or moderately-low permeability.

Experimental Design. The approach utilized for the core experiment involves a nested monitoring strategy. Paired subbasins formed in the headwater areas for the Tuckahoe Creek and Upper Choptank River (Fig. 4) are gauged by USGS for water discharge permitting accurate flux measurements of nutrient and pesticides. Additionally, 15 subwatersheds, mostly nested within these subbasins, (Fig.4 insert) are sampled on an approximately monthly basis under base flow conditions for determination of nutrient and pesticide concentration. These data are analyzed in the context of detailed land-use and digital elevation maps including the location of conservation practice installations. Differences in land use, soil types, and hydrology between subwatersheds allow assessment of the influence of landscape characteristics on conservation practice effectiveness. The nested design provides accurate flux measurements for assessing conservation practice effectiveness within the larger subbasin context. The overall influence of agriculture in the watershed on estuarine chemistry is provided by periodic transect sampling of the Choptank River mainstem.

Detailed land use and digital elevation maps aid in the understanding water quality status in the two monitored subbasins. High resolution satellite images (SPOT, 10-m resolution) covering ~ 4000 km^2 are acquired 4 times annually to assess cropping patterns and winter cover crop implementation. Winter cover crop biomass samples are collected on 30 diverse, production fields in the watershed during December and March to calibrate satellite data for cover crop nutrient uptake. Hyperspectral data have been collected in early spring conditions to measure spectral characteristics of ground surface containing crop residues and bare soils. Satellite-based radar and aircraft-based Light Detection And Ranging (LiDAR) data have been acquired for selected areas in the watershed to assess surface hydrology and detailed topography with a focus on examining wetland function. Samples are collected from accessible public areas, from producer cooperator farms, and from protected areas like the Nature Conservancy Crescent Preserve. Groundwater monitoring wells have also been installed in the Tuckahoe subbasin to support the wetland assessment objective. New air quality and climate change research efforts are being launched in Spring 2013. The effectiveness of multi-layer vegetative environmental buffers around poultry operations to mitigate emissions of ammonia, VOCs, and PM is being evaluated. A full-featured eddy covariance flux tower installed in the Tuckahoe subbasin will assess exchange of energy, water, and CO_2 between the land surface and atmosphere.

Productivity. Results from this long-term project and studies in other Chesapeake Bay watersheds have yielded important information on the processes controlling nutrient and pesticide fate. Earlier studies revealed that herbicides and their degradation products were widespread and persistent in tributaries and the main stem (Liu et al., 2001; McConnell et al., 2004; McConnell et al., 2007). Measurements of atmospheric deposition of pesticides to the Choptank indicated that wet deposition fluxes of highly soluble corn and soybean herbicides could be predicted from using weekly corn-planting progress and the number of rain events without regard to the total amount of rainfall (Kuang et al., 2003; Goel et al., 2005).

The Choptank Watershed Project began a more comprehensive examination of agricultural contaminants. Examination of landscape metrics, water quality data, and hydrologic analysis revealed that nitrate and pesticide concentrations were lowest in subwatersheds located in the poorly drained upland (PDU) area, reflecting increased denitrification and reduced agricultural land use intensity (Hively et al., 2011a). Findings also suggested that forested riparian buffers may provide an additional delivery mechanism to streams whereby volatilized herbicides are captured by the riparian forest canopy and subsequently washed off during rainfall as seen previously in a smaller scale at OPE3 (see below). Experiments carried out at OPE3 also suggested that the degradation product of the herbicide metolachlor, MESA, was formed in the soil column and delivered to the first-order stream via shallow groundwater. Measurements in the Chester River, a tributary adjacent to the Choptank, indicated that MESA was conserved in the estuary (McConnell et al., 2007). Using the combined measurements of nutrients and pesticides in the Choptank watershed (Whitall et al., 2010), the team discovered that MESA can be used as a tracer for agricultural nitrate-N. This finding is significant as it allows for the examination of the role of nitrate-N in the eutrophication of the estuary.

Quantification of water and nutrient fluxes from subwatersheds has been used to calibrate distributed water quality models such as SWAT (Soil & Water Assessment Tool) which are vital for assessing conservation practice effectiveness at watershed scales. SWAT model streamflow prediction capability was improved using Next Generation Radar (NEXRAD) precipitation as input (Sexton et al., 2010; Beeson et al., 2011). The SWAT simulations showed combinations of rain gauge data and NEXRAD data provided superior results, even when the watershed included good spatial distribution of rain gauges. This improvement in precipitation inputs to the SWAT model will be important for future regional and global modeling.

Data collected in the watershed has led to significant progress in the use of remote sensing to assess nutrient uptake by cover crops. Eight years of field work has supported the development and implementation of geospatial adaptive management tools for cover crop management (Hively et al., 2009). Developed in collaboration with USGS and the Maryland Department of Agriculture, the tools combine field-specific conservation program enrollment data with satellite imagery analysis for rapid quantification, verification, and certification of cover crop performance. Maryland is currently beta-testing geospatial cover crop management toolkits at the Talbot County, Maryland Soil Conservation District. This work is expected to improve the effectiveness of winter cover crop nutrient uptake in the Chesapeake Bay Region substantially.

Research conducted on Nature Conservancy lands within the Choptank watershed has led to novel information regarding wetland-stream connectivity in coastal plain landscapes. Connectivity between wetlands and streams effects the ecological function and the regulatory status of wetlands. However, connectivity is difficult to assess using existing measurement techniques. We investigated the utility of airborne LiDAR measurements and derived digital elevation models for improved mapping of stream channels and a better assessment of wetland/stream connectivity. The LiDAR observations lead to a substantial improvement in the accuracy of stream maps compared to standard stream map products based on lower resolution elevation data. Assessments of wetland connectivity were greatly altered by this improved accuracy and a general increase in estimated connectivity was found. The geospatial and remote sensing tools developed in this research could improve our ability to effectively manage and conserve wetlands within agricultural landscapes (Lang et al., 2009; 2012).

On-farm research in the watershed has demonstrated the utility of unmanned aircraft for crop status data acquisition for within-crop management allowing to be monitored during precise stages of crop development. A low cost sensor was developed using a common commercial camera modified to be sensitive to near infrared light which, when used in conjunction with a red blocking filter, creates a NIR-green-blue digital camera. This camera was mounted on an unmanned aircraft and used to remotely sense the spatial distribution of leaf area index in small grain fields on the Choptank watershed (Hunt et al., 2010). Other on-farm research using five diverse field locations in the watershed demonstrated the utility of hyperspectral imagery to map soil properties. The aircraft-based hyperspectral data provided accurate maps of important soil properties such as carbon, aluminum, iron, and silt and sand in agricultural fields within the Choptank watershed. Application of this technology will greatly improve site specific management of agricultural lands and provide an accurate assessment of the spatial distribution of soil texture, fertility, and carbon storage within agricultural fields (Hively et al., 2011b).

Table 1. Datasets from the Choptank River Watershed and other long-term network sites.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	# sites
Choptank River																		
Stream Nutrients and Pesticides								x	x	x	x	x	x	x	x	x	x	15 streams
Water Quality at Headwaters														x	x	x	x	2 stations
Cover Crop performance											x	x	x	x	x	x	x	> 30 fields
Wetlands Assessment											x	x	x	x	x	x	x	> 30 fields
Main Channel Nutrients/Metals/Pesticides	x			x					x	x	x	x	x	x	x	x	x	7 stations
Eddy Covariance data																	x	1 location
Pesticides/Pollutants in Air and Rain						x	x	x	x									
Other Long Term Networks																		
Ches. Bay WQ Database (USEPA)	x (1984)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	4 stations
Clean Air Status and Trends Site (USEPA)	x (1995)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1 site
Gaging Stn Greensboro (USGS)	x (1948)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1 station
Gaging Stn Tuckahoe Creek (MD DNR)											x	x	x	x	x	x	x	1 station
National Atmos. Deposition Program								x	x	x	x	x	x	x	x	x	x	1 site
Nat'l Buoy Data Center (NOAA)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1 station
Vertical WQ Profiler (MD DNR)																x	x	1 station

The **<u>Optimizing Production Inputs for Economic and Environmental Enhancement (OPE3) site</u>,** initiated in 1998**,** is located in a small headwater catchment on BARC and consists of a highly instrumented 22-ha production field and adjacent riparian area (Fig. 5). The **primary goal is to discover and examine processes** for modeling and measuring chemical behavior and crop growth at the field-scale. Objectives are: 1) Determine atmospheric, surface, and subsurface watershed-scale fluxes of water, nutrients, and pesticides; 2) Examine the behavior and environmental effects of chemical inputs on the associated wooded riparian wetland and first-order stream; and 3) Develop remotely sensed data products and decision support tools for measuring and managing the spatial variability of crops and soils.

The OPE3 site is typical of many agricultural areas in the Lower Chesapeake Bay watershed system where production fields are located adjacent to streams and rivers. This site also provides an opportunity to examine the processes governing the atmospheric, surface, and sub-surface transport of contaminants into waterways. The use of riparian buffers to protect water quality is a widely-used conservation practice in the Chesapeake Bay region, and this experimental site allows for examination of riparian buffer function. Results from this highly instrumented watershed have provided critical new knowledge regarding the processes which control the fate and transport of water, greenhouse gases, nutrients, and pesticides. This information is required to improve and validate process-based models which are needed to improve planning and implementation of conservation practices at larger scales to achieve improvements in ecosystem health.

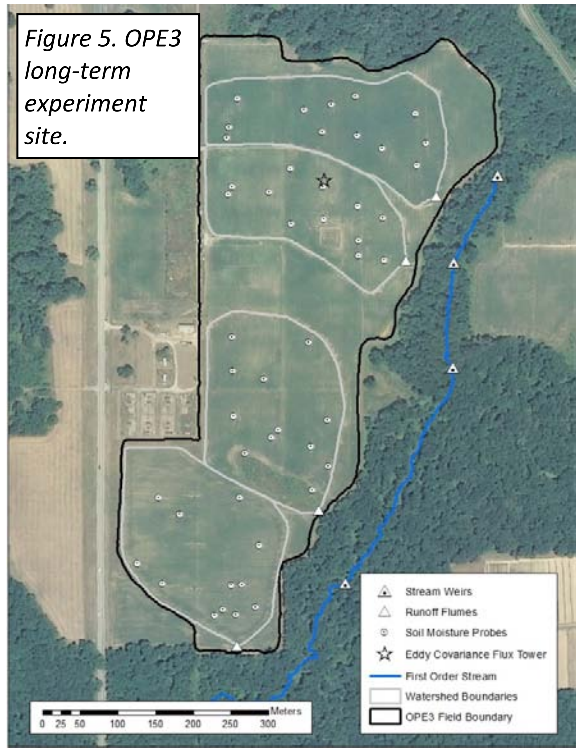

Figure 5. OPE3 long-term experiment site.

Experimental Design. While the OPE3 catchment is relatively small compared to most watersheds, the density of instrumentation is unique. An intensive network of capacitance sensors for soil moisture measurements in the top 2 m of soil has been established. Detailed soil surveys have been conducted and include over 40 km of ground-penetrating radar (GPR) to map subsurface stratigraphy and its effects on subsurface hydrology. Observation wells and runoff flumes in the production area and weirs in the first-order stream have been installed. An eddy-covariance meteorological station and an NRCS SCAN site are located at OPE3 for estimating the surface energy balance and for calculating turbulent fluxes of water and CO_2.

Productivity. Research at OPE3 has generated unique datasets (Table 2). Turbulent fluxes of pesticides have been measured for over 12 years. Proximal and remotely sensed datasets at OPE3 have been generated from ground and hand held sensors, towers, truck mounted active and passive microwave sensors, aircraft, and satellites sensors. Investigations of subsurface preferential flow pathways and water quality modeling at the field-scale have been conducted in collaboration with the US Nuclear Regulatory Commission (Chinkuyu, et al., 2007; Pachepsky et al., 2011). NASA collaborators use the site extensively to evaluate advanced remote sensing instruments.

Multi-year investigations have been conducted to examine the effects of soil conditions and local meteorology on herbicide volatilization. Metolachlor volatility ranged from 5 to 25% of that applied, and this variance was associated with local climatic variables (Prueger et al., 2005) as well as soil moisture (Gish et al., 2009). Herbicide volatilization relative to surface runoff losses was evaluated over an 8-year period, and on average, 25 times more atrazine and metolachor was volatilized than was lost from the field via runoff (Gish et al., 2011b). A better understanding of underlining processes will lead to more-useful predictive models.

Table 2. Dataset available from long-term experiments at OPE3 and BARC.

	1993-95	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	# sites
OPE3 (Production fields)																				
Soil moisture[a]				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	48 stations
Yield maps				x	x	x	x	x		x	x	x	x	x	x		x			4 fields
Meteorological data				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1 station
Eddy covariance data							x	x	x	x	x	x	x	x	x	x	x	x	x	1 station
Groundwater[b]							x	x	x	x	x	x	x	x	x	x	x	x	x	34 wells
Runoff						x	x	x	x	x	x	x	x							4 fields
Pesticide soil				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	20 sites
Pesticide air[c]				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2 sites
Remotely sensed Images				x	x	x	x	x	x			x	x		x	x	x	x		
Plant characteristics[e]				x	x	x	x	x	x		x	x	x	x	x	x	x	x		
OPE3 (Riparian Area)																				
Stream flow				x	x	x	x	x	x	x	x					x	x	x	x	2 to 4 weirs
Groundwater				x	x	x	x	x	x	x	x									120 wells
BARC-wide Data																				
Meteorlogical data including precip								x	x	x	x	x	x	x	x	x	x	x	x	7 stations
Other Long Term Networks																				
Soil Climate Analysis Network (NRCS)							x	x	x	x	x	x	x	x	x	x	x	x	x	1 site
Clean Air Status and Trends (USEPA)	x (1988)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1 site
National Atmospheric Deposition Program										x	x	x	x	x	x	x	x	x	x	1 site

[a] 256 sensors distributed among 48 monitoring locations over 22 ha, data recorded every 10 min.
[b] Shallow groundwater wells, 3 m in depth, nitrate & pesticides.
[c] From 2004 on, two -- 2m pesticide flux towers were deployed.
[d] Remotely sensed images includes multispectral/hyperspectral images
[e] LAI and chlorophyll

Advancements have been made in the measurement and understanding of surface and subsurface water flow interactions (Gish et al., 2007; Guber et al., 2008; Chinkuyu, et al., 2007; Pachepsky, et al., 2011) and this knowledge has been used to improve N management. By understanding the subsurface hydrology a variable rate field received 34% less N than the uniform rate field, yet there were no significant differences in grain yields (Gish et al., 2011a).

Effective N management depends on assessing crop needs and applying the necessary amount of N at the appropriate location and time. Research at the OPE3 site has led to advances in remote sensing technologies. Variations in soil reflectance and leaf area index often confound assessment of leaf N by remote sensing techniques. Numerous spectral vegetation indices for assessing leaf chlorophyll concentrations were evaluated using simulated and measured corn canopy reflectance data (Houborg, et al., 2009). Aerial multispectral imagery analysis showed consistent patterns of leaf chlorophyll concentrations. Remotely sensed maps of the spatial variability of crop growth and leaf chlorophyll should provide surrogate indicators for applying appropriate amounts of N fertilizer to optimize grain yields and minimize environmental impacts.

The extensive array of ground-based instrumentation at the OPE3 site has also been used for data assimilation studies aimed at developing techniques for improving root-zone (zero to 1-m depth) soil moisture estimates by utilizing remote sensing observations of land surface temperature and assimilating surface energy flux predictions from a thermal-based energy balance model (Crow et al., 2008). This analysis was extended (Li et al., 2010) to include the simultaneous assimilation of both root-zone soil moisture proxy information and direct retrievals of surface soil moisture, consistent with satellite-based microwave sensors.

The utility of remotely-sensed leaf chlorophyll estimates for quantifying leaf photosynthetic capacity and for constraining model simulations of water, energy and carbon fluxes was evaluated using the eddy covariance and thermal, visible and near-infrared remote sensing data (Houborg et al., 2011). A recently-developed soil evaporation/plant transpiration partitioning technique was employed using high frequency measurements of water vapor and carbon dioxide collected by the eddy covariance flux tower. This approach was shown to be essential for the appropriate calculation of canopy conductance, a key variable in many land surface and crop growth and yield models (Scanlon and Kustas, 2012).

Studies involving manure applications to the OPE3 production fields have provided data for development and testing of models for pathogen transport and fate in runoff. This resulted in the first field-scale, event-based model STWIR, linked to the USDA-ARS runoff and erosion model KINEROS2, to assess bacterial fluxes at the edge of manure applied fields. Experiments performed using the OPE3 first order stream have demonstrated that bottom sediments in the stream channel are an important source of microorganisms including *E. coli* which can become mobilized with storm events (Guber et al., 2011). These experiments revealed that wildlife such as geese and deer, are important sources of pathogenic bacteria found in stream sediment.

Detailed studies of movement and fate of agrochemicals in the riparian buffer demonstrated that naturally occurring preferential flow pathways in riparian wetlands can reduce ecosystem effectiveness for removing agricultural nitrate from exfiltrating groundwater (Angier et al., 2008). They also demonstrated the importance of tree canopy capture of volatilized field-applied pesticides as an important mechanism for delivering pesticides to the stream via canopy wash off. Subsequent work on the Choptank River Watershed provided evidence for importance of this delivery mechanism at larger scales of observation (Hively et al., 2011a).

The **Farming Systems Project (FSP)**, a field-scale experiment, was initiated in 1993 and is located on a ~9 ha field. The FSP is a long-term project with comparing two conventional and three organic systems designed 1) to identify and elucidate agroecological principles that drive the function of organic and conventional cropping systems and to quantify ecosystem services; and 2) to develop technologies and management strategies to improve productivity, enhance soil and water conservation, and improve of nutrient cycling efficiency on organic and conventional farms. **The five FSP production systems are examined for agroecological processes upon which farms rely** (nutrient, weed and soil organism dynamics) **for and system performance**: crop yields, economics, ecosystem services (e.g. soil carbon sequestration, nitrogen (N) retention) provided, and integrated analysis of system performance.

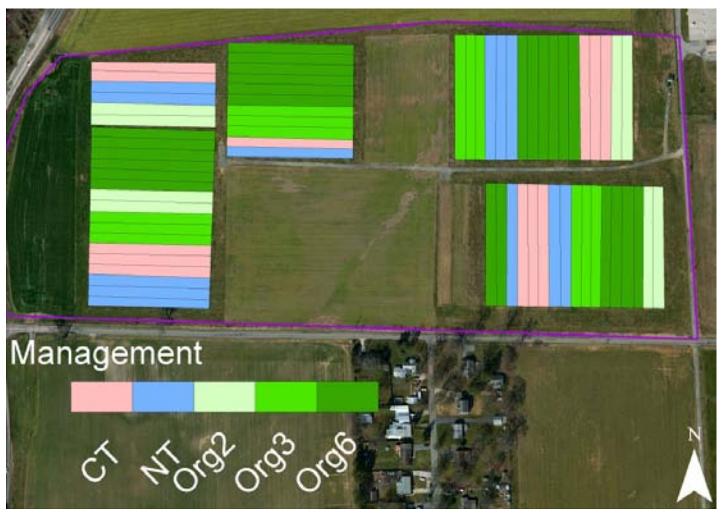

Figure 4. Farming systems project plots and treatments. CT – conventional tillage, NT – conventional no till, Org2, Org3, and Org6 are organic tilled systems with 2-, 3-, and 6-year crop rotations, respectively.

Shorter-term studies are designed to augment organic and conventional system performance by developing new 1) strategies for incorporating legumes into crop rotations to maximize nitrogen fixation, 2) strategies for beneficial and safe use of animal manures and composts, and 3) integrated agronomic systems for managing nutrients, weeds, and crop production. Results will lead to development of best management practices to improve the economic position of organic farmers, conservation potential of organic farms, and the ability of farmers to meet urban consumer demand for organic products and locally-grown foods. This research also contributes to improving the sustainability of conventional crop systems.

Experimental Design. The experiment uses a split-plot design with system as main plots and crop rotation as sub-plots. Each rotation entry point is present each year, resulting in 17 sub-plots in each of four replicated blocks (68 total sub-plots). Permanent 4.55 m x 9.1 m weedy (W) and weed-free (WF) microplots were established in 2009 in two rotation entry points in each cropping system. Weedy plots reflect natural weed populations. Weed-free plots are maintained during the corn and soybean phases by hand weeding when necessary to eliminate annual weed seed production and perennial weed propagules. These microplots are used to study weed-crop competition relationships, weed population dynamics, and crop yield potential.

A basic set of crop, soil, and weed data are collected from each FSP sub-plot on an annual basis (Table 3): 1) combine grain yield; 2) above-ground crop (including forage crop), cover crop, and weed biomass; 3) crop population at physiological maturity; 4) crop phenological development throughout the season; 5) leaf area during early exponential growth and at peak vegetative growth; 6) diagnostic nutrient sufficiency sampling (corn ear leaf chlorophyll and/or NDVI using canopy reflectance sensors at silking, soybean top leaf samples, whole wheat plants at soft dough stage); and 7) weed data; and soil fertility data (pH, P, K, Ca, Mg). Soil health data, using the Cornell Soil Health Assessment (Idowu et al., 2009), are collected every 5 years (2008, 2013, 2018) to assess changes in variables that may affect crop yield (aggregate stability, soil structure, available water capacity, field penetration resistance, organic matter, active carbon, potentially-mineralizable N, and root health assessment).

Table 3. Datasets available from the long-term Farming Systems Project.

Farming Systems Project[a]	1993-95[b]	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	# sites
Crop yields (corn, soybeans, wheat, forage)[c]	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	68 plots
Crop and cover crop biomass[c]	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	68 plots
Crop populations	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	68 plots
Crop characteristics[d]	x	x	x	x	x	x	x	x												Varies
Weed biomass[c], percent cover	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	40 plots
Soil fertility[c]	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	68 plots
Soil C and N[c]	x	x					x					x					x			68 plots
Soil health[e]														x					x	68 plots
Meteorological data	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1 site
Greenhouse gas emissions											x	x	x	x		x	x		x	27-68 plots
Management metadata	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	68 plots

a – Shorter-term projects conducted including N-fixation by soybeans, weed impacts on crop yields, N mineralization potential, soil aggregate stability, predicted soil erosion, impact of glyphosate on soil microbial communities, denitrifier community structure, glomalin analyses.

b - Site was managed as one no-till corn field; site uniformity data collected from 47 (soil texture, soil biological properties) to 298 (corn yield, nutrient uptake, soil C, N, chem.& phys.properties) .

c - Samples are stored in archive.

d - Nutrient content, 1996-2002 (archived samples available for further analyses); LAI intermittently.

e - Aggregate stability, available water capacity, field penetration resistance, organic matter, active carbon, potentially mineralizable nitrogen, root health assessment

Productivity. Recent results from this experiment show that increasing crop rotation length and complexity reduce production and other challenges in organic systems. Corn yield was 10 and 30% greater in a six-year corn-soybean-wheat-alfalfa rotation than in 3-year corn-soybean-wheat and 2-year corn-soybean rotations, respectively. Improvements were related to greater N availability and lesser weed competition as crop rotation complexity increased (Teasdale et al., 2004; Cavigelli et al., 2008; Teasdale and Cavigelli, 2010). Increasing crop rotation length and complexity also reduced predicted soil erosion, N_2O emissions, economic risk, animal manure inputs and soil P loading (Cavigelli et al., 2009b; Spargo et al., 2011; Cavigelli and Parkin 2012; youtube video Cavigelli et al., 2012).

Among 3-year crop rotations at FSP, predicted soil erosion was lower in organic than in conventional chisel-till system, but conventional no-till still provided considerable soil erosion control compared to organic management (Green et al., 2005). Results also indicate the organic cropping system has lower global warming potential (GWP) due to greater C sequestration and lower energy use than conventional systems (Cavigelli et al., 2009a). However, N_2O emissions in the organic system seem to be greater than in the conventional systems (Cavigelli et al., 2013). Thus, a need exists for improved management to increase ecosystem services.

An examination of soil microbial communities indicated that differences exist by cropping system, but that interactions are complex. Structural composition of bacterial communities (16S and 28S rDNA) and organisms harboring genes responsible for denitrification enzymes (nirK, nirS and nosZ) are different in organic and conventional systems (Maul et al., 2012). In addition, crop species (soybean versus wheat) and system interactions differentially affect microbial communities that produce and/or reduce N_2O (Maul et al., 2012).

Lessons learned from the FSP project are now being used on organic production farms on the Eastern Shore. BARC scientists have conducted on-farm trails with cooperating farmers in the Choptank Watershed and surrounding area. Initial results from on-farm research suggest that manure application rates on organic farms could be decreased while maintaining crop productivity (Cavigelli and Mirsky, 2012). FSP researchers also conduct joint outreach programs with the Queen Anne's County University of Maryland Extension Office.

Data Accessibility

Selected datasets from existing long-term projects are on-line, but are in different locations. Plans for the Lower Chesapeake Bay LTAR include a new web page on the BARC website that provides links to all available on-line datasets along with summaries of the long-term projects, publications, products, and links to partner sites. The new LCB LTAR working group will set priorities for additional datasets to be made available on-line based on requirements for the national LTAR project. Currently available datasets are as follows:

- Soil moisture, temperature, precipitation, wind and solar radiation data collected at the OPE3 from 2001 to present available at the NRCS National Water and Climate Center.
- Temperature, wind speed and direction, and precipitation from 5 weather stations located at BARC available in real time on the BARC website.
- Choptank River data available Sustaining the Earth's Watersheds (STEWARDS).

Geographic Coverage at Various Scales

The proposed LCB LTAR will address the Farm Resource region of the upper Southern Seaboard. Hydrologically, the LCB LTAR falls within the Chesapeake Bay watershed (HUC11), and is located within the Mid-Atlantic domain (D2) of the National Ecological Observatory Network (NEON). Research will range from field plot to watershed to regional assessments. The primary focus of this LTAR will be on assessing impacts of agricultural activities in the coastal plain on water, soil, and air quality. This will involve coordinated investigations across multiple scales. Thus, results will provide insight on the linkages between processes occurring at molecular, field, watershed and regional scales that affect agrichemicals fate and transport.

Partnerships

Many important local, state, national, and international partnerships have been established during the course of these long-term projects. Below are those that have specifically agreed to support the proposed LCB LTAR through continued and enhanced cooperative efforts.

Baltimore Ecosystem Study Long-Term Ecological Research (BES-LTER), established in 1997, provides a platform for integrated urban ecological and social research, education and outreach. With > 45 researchers, educators, and community specialists, the BES-LTER maintains an extensive network of water quantity/quality monitoring instrumentation in the Gwynne Falls watershed across a rural-urban gradient, complementing the monitoring and measurements occurring on the largely rural Choptank River Watershed. As part of the BES-LTER, the US Forest Service maintains an eddy flux tower (as an Ameriflux comparison site) documenting the influences of the urban/suburban environment and is complementary to the ARS flux towers at the BARC and in the Choptank River watershed.

Baltimore-Washington Partners for Forest Partnership supports efforts to conserve and to improve wildlife habitat, reduce nutrient and sediment pollution to the Chesapeake Bay.

Chesapeake Bay Foundation (CBF) is partnering with the Farming Systems Project, utilizing greenhouse gas data in the calibration/validation of region-specific model to estimate N_2O emissions from nutrient management practices.

District of Columbia Water and Sewer Authority (DCWater) is a long-standing partner with BARC scientists, collaborating on a number of projects concerning composting, biosolids contaminants, and VOC emissions from wastewaters and biosolids.

Howard University, Beltsville Center for Climate System Observation is a located adjacent to BARC and conducts complementary research on fundamental atmospheric processes.

Maryland Department of Agriculture (MDA) has established extensive partnerships with BARC scientists on improving cost-share programs, especially winter cover crops.

National Ecological Observatory Network (NEON) is a key partner in the National LTAR Network and will initially be participating in this LTAR via the NEON site at SERC

National Oceanographic and Atmospheric Administration (NOAA), Center for Coastal Monitoring and Assessment) and BARC scientists have partnered in the Choptank River watershed study since 2004 to examine the effects of agriculture on estuaries.

Patuxent Wildlife Research Center (PWRC), established in 1936, is a 4800-ha facility developing the scientific information needed to provide the biological foundation for conserving and managing the Nation's biological resources most effectively. The center leads in many areas of wildlife, population, community and ecosystem-related science. Major research areas include determining demographic parameters in population ecology, using adaptive management and decision support tools, developing, managing, and interpreting wildlife surveys, assessing effects of climate and land use change on wildlife populations. Collaboration in these areas can add greatly to the breadth of the LCB-LTAR.

Smithsonian Environmental Research Center (SERC), established in 1964, investigates human impacts on linked coastal ecosystems in six major areas: global change, toxic chemicals, nutrient pollution, fishing and estuarine food webs, and invasive species. SERC has the longest record of acid rain for the mid-Atlantic region and relates precipitation inputs to watershed discharges. SERC's global change research includes the world's longest running field experiment on the effect of increasing atmospheric carbon dioxide on plant communities. SERC is the home of the Smithsonian Institution Global Ecological Observatories program to assess carbon processing, responses to climate change, and ecology of temperate forests. SERC has built a 35-year database on species composition and populations dynamics of plants and animals in the Chesapeake Bay region. SERC research focuses human impacts on the Chesapeake Bay, with long-term analyses of the ecological regulation of plankton blooms, food web dynamics, blue crab ecology, fish population biology, host-parasite interactions, wetland functions, and estuarine indicators of water quality and habitat value.

TapRoots fosters soil science literacy by connecting youth to research institutions focused on soil conservation, microbial diversity and ecosystem structure and function. Together with BARC scientists, Taproots will facilitate long term monitoring of microclimates of five distinct urbanized ecosystems, and will conduct outreach programs on green roofs, rain gardens, public parks hosting community gardens, ecotones on BARC.

The Nature Conservancy (TNC) has worked with BARC and US Forest Service scientists examining wetland function and ecosystem services.

US Forest Service (USFS) and BARC scientists work collaboratively on forested wetland function and the development of remotely-sensed data to examine wetland-stream connectivity. USFS scientists also operate the Ameriflux tower at BES-LTER.

US Geological Survey (USGS) has a strong, long-term collaboration with BARC scientists concerning on water quality research on the Eastern Shore and the development of geospatial tools to determine nutrient uptake by winter cover crops.

University of Maryland (UMD) has been involved in extensive collaboration at numerous levels, including Department of Civil and Environmental Engineering; Earth System Science Interdisciplinary Center, researchers at Maryland Experiment Station; and Queen Anne's County, Univ. Maryland Extension. Many UMD graduate students are hosted at BARC to conduct collaborative research projects.

USDA-Natural Resource Conservation Service is a partner in the Choptank River watershed project, winter cover crop and wetland ecosystem services assessments, and in the effectiveness of vegetative environmental buffers for air quality improvements.

US Environmental Protection Agency, Chesapeake Bay Program Office (CBPO) has sought the collaboration and expertise of BARC scientists on the measurement of contaminants in Bay tributaries and watershed water quality modeling. BARC also hosts the Beltsville site in the Clean Air Status and Trends Network on air quality research.

Institutional Commitment

The Beltsville Area has a strong commitment to long-term agricultural research and fully supports this addition to the LTAR network. Large investments of funding and labor have been made to create these instrumented sites and to maintain long-term projects which have been incorporated into the research programs of numerous BARC and other ARS scientists.

Other Information

Just before the submission deadline, BARC scientists became aware of a separate proposal being developed for the Lower Chesapeake Bay region. The short timeframe did not allow for restructuring of proposals prior to the deadline. However, we welcome participation from the University of Maryland Eastern Shore group in this LTAR project.

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United States Department of Agriculture

Research, Education, and Economics
Agricultural Research Service

March 27, 2013

SUBJECT: Letter of Support for the Lower Chesapeake Bay LTAR

TO: Mark Walbridge, National Program Leader
Natural Resources and Sustainable Agricultural Systems

FROM: Joseph Spence
Area Director

I am pleased to offer the enthusiastic support for the Beltsville Agricultural Research Center (BARC) to participate in the Long Term Agro-Ecosystem Research (LTAR) Network. Over twenty BARC scientists from a diversity of disciplines have partnered with several universities, seven federal and state agencies, three long term ecosystem networks, and outreach and advocacy entities to create the Lower Chesapeake Bay LTAR. All scientists involved in this effort have an excellent record of scientific productivity and their productivity and problem solving capabilities is expected to continue. These partnerships are also expected to be sustained over the coming years.

The strategic location of BARC makes this team ideally suited to conduct research concerning the nexus of urban and agricultural land uses. Established over 100 years ago, BARC is the world's largest agricultural research complex. It is located on 2600 ha of federal lands is part of 10,500 ha of contiguous federally-owned land containing a large complex of forests and wetlands commonly referred to as the Green Wedge. This valuable space is located within a region Washington-Baltimore corridor which is undergoing rapid urbanization. Land use at BARC includes a working dairy, a compost center, and more than 400 ha of production fields.

BARC scientists have established several long term research sites to address critical research needs in the region and include the Choptank River Watershed Project, Optimizing Production Inputs for Economic and Environmental Enhancement site (OPE^3) and the Farming Systems Project (FSP). Establishment of the new LTAR will tie these important projects together more closely with each other and with other long-term research networks in the region. Together with their outreach partners, BARC scientists are providing improved conservation practices and decision support tools to farmers, producers, and natural resource managers. I am certain the Lower Chesapeake Bay LTAR and its consortium will be a strong and vibrant contributor to the LTAR network.

Cary Institute
of Ecosystem Studies

Steward T.A. Pickett, Ph.D.
Distinguished Senior Scientist
PickettS@ecostudies.org

March 27, 2013

Dr. William Kustas
USDA-ARS Hydrology & Remote Sensing Lab
10300 Baltimore Ave
Bldg 007 BARC-West
Beltsville MD 20705-2350

Dear Dr. Kustas:

I am writing in support of potential collaborative opportunities between the NSF-supported Baltimore Ecosystem Study Long-Term Ecological Research (LTER) site and your proposed USDA-ARS Lower Chesapeake Bay Long-Term Agro-Ecosystem Research (LTAR) site.

The BES LTER, founded in 1998, is composed of the Baltimore metropolitan area on the western shore of the Chesapeake Bay (Anne Arundel, Baltimore, Carroll, Harford, and Howard Counties and Baltimore City, Maryland), roughly coinciding with the HUC 8 Gunpowder-Patapsco watershed that drains to the Chesapeake Bay. The area contains an urban core as well as older urban and suburban residential areas, rapidly suburbanizing areas, and a suburban/rural fringe. Work to date has focused on delimiting the social, economic, and ecological patch structure of Baltimore, documenting how the patches interact, and how the patch structure has changed over time. Long-term data sets quantify the fluxes of water, carbon, and nutrients through the urban water cycle and terrain. The LTER is now in its 15th year, having been renewed in 2010 through 2015. University of Maryland Baltimore County hosts the BES LTER field headquarters.

The LTER supports a backbone of hydrologic instrumentation (stream gages, rain gages, CLIMDB meteorological stations, soil moisture and temperature sensors, riparian zone piezometers) in collaboration with USGS and USDA Forest Service. NSF WATERS Testbed Phases 1 and 2 have built on this (bedrock wells, a portable eddy covariance station, chemical sensors). In collaboration with the NSF-supported HydroNEXRAD project spatially distributed rainfall fields at a discretization of 1 km^2 have been estimated for the Baltimore region from rain gages coupled with radar reflectivity observations from the Sterling, Virginia WSR-88D radar (1998 – present) using algorithms that combine gage and radar observations. A tower with eddy covariance stations at multiple elevations is deployed at Cub Hill (north of Baltimore) to measure atmospheric parameters and to calculate meteorological flux of CO_2 and sensible and latent heat. Clusters of wireless soil moisture sensors are installed at Cub Hill. BES hydrologic observational resources have provided characterizations of urban impacts on regional climate, hydrology and hydraulics, and geomorphology.

Weekly stream chemistry data (Cl^-, NO_3^-, total N, PO_4^{3-}, total P, SO_4^{2-}) have been collected for over 14 years at 11 sites; time series are available at http://beslter.org. These data have been used to quantify urban biogeochemical budgets and cycles and increased salinization of streams in the northeastern US. Permanent biogeochemical study plots provide long-term data on vegetation, soil and hydrologic processes in key ecosystem types within the urban ecosystem. Plots are instrumented with lysimeters to sample soil solution chemistry, time domain reflectometry probes to measure soil moisture, and trace gas flux chambers.
Spatial data for geology, soils, land cover/land use, topography including LIDAR, and infrastructure layers (roads, storm sewers, sanitary sewers, building footprints) have been obtained for the region.

Data used for policy analysis such as zoning, census, parcel boundaries, parcel sales transactions and ownership records, forest conversion requirements, open space requirements, preserved lands, and legacy areas have also been compiled. Detailed spatially explicit land histories of residential subdivision development have been compiled for two counties using platting documents available only from court records. High-resolution orthoimagery combined with LIDAR has been used to derive fine-grained land cover maps. Spatial data sets are archived at the Cary Institute and UMBC and maintained by a staff dedicated to this task. Links to data and metadata are provided on the BES web site http://beslter.org.

We look forward to possible opportunities to work with BARC staff in joint efforts of interest. Example kinds of topics that may be fruitful to pursue include:

- Quantifying the influence of land-cover and topography on locally-variable evapotranspiration in urban vs agricultural areas;
- Quantifying the impacts of stream restoration on reduction of nutrient concentrations in agricultural vs urban streams and in Coastal Plain and Piedmont settings.
- Comparison of SWAT (USDA) to RHESSyS and ParFlow (BES) model output.

We wish you the best for success of your proposal and look forward to working with you as opportunities become available.

Sincerely,

Steward T. A. Pickett, Ph.D.
Baltimore Ecosystem Study Project Director
Cary Institute of Ecosystem Studies

BWPFS | Baltimore - Washington Partners for Forest Stewardship

March 27, 2013

Mark R Walbridge
National Program Leader
Water Availability and Watershed Management
5601 Sunnyside Avenue
Beltsville, Maryland 20705

Dear Mr. Walbridge,

As Co-chairs of the Baltimore Washington Partners for Forest Stewardship (BWPFS), we are writing to affirm support for the Lower Chesapeake Bay Long-Term Agroecosystem Research (LCB-LTAR) project submitted by the Beltsville Agricultural Research Center (BARC). The BWPFS is a coalition of federal, state and local government landowners, joining with the Center for Chesapeake Communities, and the Maryland Department of Natural Resources, to support collaborative strategies for the stewardship, conservation, and restoration of common forested ecosystems and managed lands in the Baltimore Washington corridor. The BARC campus is a vital part of the extensive federal lands green infrastructure found the corridor and often referred to as the Green Wedge. BARC is home to large tracts of sensitive lands and a number of rare ecosystems. Exemplary land stewardship and state of the art conservation practice implementations can enhance the ecological value of federal lands and provide model systems to assess conservation practice effectiveness. The LCB-LTAR provides a framework for partnership interactions which can lead to synergies between implementation and assessment that advance our understanding of the impacts of land management on ecosystem stability and health of the environment.

BWPFS looks forward to partnering with LCB-LTAR with the goal of enhanced stewardship of federal lands.

Thank you,

Christine Conn

Christine Conn, Ph. D.
Director, Strategic Land Planning
Office for Sustainable Future
Maryland Department of Natural Resources
(410) 260-8785
cconn@dnr.state.md.us

Gary G. Allen

Gary G. Allen
Executive Director
Center for Chesapeake Communities
(410) 267-8595
gallenbay@aol.com

CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

March 28, 2013

Mark R. Walbridge
National Program Leader
Water Availability and Watershed Management
5601 Sunnyside Avenue
Beltsville, Maryland 20705

Dear Mr. Walbridge:

The Chesapeake Bay Foundation (CBF) is pleased to offer support for the Lower Chesapeake Bay Long-Term Agroecosystem Research (LCB-LTAR) project submitted by the Beltsville Agricultural Research Center (BARC). As the largest non-profit advocacy group dedicated to the protection and restoration of the Chesapeake Bay, CBF relies heavily on scientific research, like that conducted by BARC scientists, to help guide our policy initiatives. Furthermore, we also provide technical and financial assistance to the region's agricultural producers to help them implement conservation practices because we recognize the importance of sustainable farming to a restored Chesapeake watershed. In that regard, we are often bridging the gap between recent advances in scientific research and on-the-ground implementation.

The LCB-LTAR would provide a framework for partnership interactions between implementation and assessment that will advance our understanding of the impacts of land management on the Chesapeake Bay ecosystem and can help inform future policy decisions. To date, CBF has already had some collaborative relationships with BARC scientists. For example, Dr. Michel Cavigelli is a partner on a U.S. Department of Agriculture Conservation Innovation Grant that CBF received, via the greenhouse gas program, entitled: *Estimating Nitrous Oxide Reductions from Nutrient Management in the Chesapeake Watershed*. We are using the long-term data from the Farm Systems Project to calibrate and validate a soil processing model that we are using to estimate nitrous oxide benefits of enhance nutrient management approaches.

The LCB-LTAR will provide us the opportunity to strengthen and deepen these relationships in the future and we look forward to this opportunity.

If you have any questions, please don't hesitate to contact me at bmcgee@cbf.org or 443-482-2157.

Sincerely,

Beth McGee

Beth L. McGee, Ph.D.
Senior Water Quality Scientist

dc water is life

DISTRICT OF COLUMBIA WATER AND SEWER AUTHORITY | 5000 OVERLOOK AVENUE, SW | WASHINGTON, DC 20032

April 1, 2013

Mark R Walbridge
Office of National Programs
Water Availability and Watershed Management
5601 Sunnyside Avenue
Beltsville, Maryland 20705

Dear Dr. Walbridge,

The District of Columbia Water and Sewer Authority is a leader in the effort to improve water quality in the Potomac River and in the Chesapeake Bay through our implementation of new technologies to reduce nitrogen in our effluent. We also seek partnerships with the agricultural community to beneficially utilize nutrient and carbon-rich biosolids on production and pasture lands.

Establishment of the Lower Chesapeake Bay Long-term Agroecosystem Research project would provide an excellent venue to enhance the cooperative research efforts already on-going with between DCWater and BARC scientists and to accelerate improvements in the health of the Chesapeake Bay. BARC's location within the Anacostia River watershed makes this partnership all the more important since it provides an excellent location for the demonstration of new technologies and conservation practices to protect water quality and to reduce storm water runoff.

We look forward to participating as a partner in the LTAR and continuing mutually-beneficial research efforts in the future.

Thank you,

Mark Ramirez

Mark Ramirez
Process Engineer
DCWater

Maryland
Department of Agriculture

Agriculture | Maryland's Leading Industry

Office of Resource Conservation

Martin O'Malley, Governor
Anthony G. Brown, Lt. Governor
Earl F. Hance, Secretary
Mary Ellen Setting, Deputy Secretary

The Wayne A. Cawley, Jr. Building
50 Harry S. Truman Parkway
Annapolis, Maryland 21401

Internet: www.mda.state.md.us

410.841.5700 Baltimore/Washington
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410.841.5914 Fax
800.492.5590 Toll Free

March 25, 2013

Mark R Walbridge
National Program Leader
Water Availability and Watershed Management
5601 Sunnyside Avenue
Beltsville, Maryland 20705

Dear Dr. Walbridge,

I am pleased to affirm our support for the Lower Chesapeake Bay Long-Term Agroecosystem Research (LCB-LTAR) project submitted by the Beltsville Agricultural Research Center. The Maryland Department of Agriculture (MDA) has benefitted from a long-term collaboration with USDA-ARS on evaluation of conservation practices in the Choptank River Watershed. This research has resulted in innovative approaches that combine the use of remote sensing data with geospatial agronomic data gleamed from cover crop program implementation to accurately estimate cover crop performance at field to watershed scales. Efforts are underway to implement this evaluation tool state-wide leading to better adaptive management of the Maryland winter cover crop cost share program. MDA has also collaborated on ARS on evaluating utility of controlled drainage structures in ditches for reducing nitrate export from production fields. In part, this evaluation led to the inclusion of the controlled drainage practice in Maryland Agricultural Cost Share (MACS) program.

The MDA looks forward to continued productive collaborations within the LCB-LTAR framework with anticipation of enhanced partnership interactions resulting from this framework.

Thank you,

John C. Rhoderick

John Rhoderick
Administrator of Operations
Maryland Department of Agriculture
Office of Resource Conservation
50 Harry S. Truman Parkway
Annapolis, MD 21401

Dr. Gregory McCarty
USDA-ARS Hydrology & Remote Sensing Laboratory
Beltsville Agricultural Research Center
Beltsville MD 20705

March 26, 2013

LETTER OF SUPPORT FOR THE LOWER CHESAPEAKE BAY LTAR SITE

Dear Dr. McCarty:

I am writing in support of your proposal to the USDA for incorporating areas of the Chesapeake Bay watershed south of the Susquehanna River basin into the existing USDA Long-term Agro-ecosystem Research (LTAR) Network. The evolution of the LTAR is of considerable interest to the National Ecological Observatory Network (NEON), whose strategic interests are closely aligned with that of the USDA's.

Your proposed effort will clearly extend the footprint of the LTAR by addressing the effects of urbanization and climate change on agricultural ecosystems in coastal regions. Multiple stresses are already being experienced by coastal regions caused by human activities through land-use change and other large-scale forcings. Some of these effects will result in reduction or loss of ecosystem services, including potentially irreversible impacts. Deployment of sites as you propose across land-use types in an important watershed like the Chesapeake Bay will lend additional prognostic capability to the LTAR.

As you know, NEON plans to collect extensive observations across the United States. The goal is to understand the impacts of climate change, land use change, and invasive species on continental scale ecology, and to enable analyses and forecasts of ecosystem responses in biodiversity, biogeochemistry, ecohydrology, and infectious disease. NEON plans to establish observations at 60 terrestrial and 36 aquatic sites along with 10 stream experimental research sites. Relevant here, we will be collecting extensive data on vegetation structure and composition, plant diversity, productivity and biogeochemistry, soil moisture and biogeochemistry, including carbon flux, and soil microbial diversity and function among many other organismal data. Remote sensing capabilities and data resources will be used to extend data collected on the ground to regional and national scales. Hundreds of data products will be developed to support ecological forecasts.

NEON entered a five-year construction period during 2012. We anticipate completing construction of the observatory during 2017. Operations will begin as sites are constructed and commissioned in parallel with construction. As such, data will become available at selected sites prior to 2017. All NEON data and information will be made freely and openly available to anyone via the NEON data portal, which is currently in development.

NEON is in the process of establishing standardized procedures and protocols for vegetation and soils monitoring and welcomes the opportunity to contribute our knowledge, experience and approaches to the LTAR. NEON, in turn, will benefit from collaboration with the LTAR by ensuring relevance and applicability of our data and data products. This type of collaboration is also very much consistent with our developing and on-going collaborations with the Long Term Ecological Research (LTER) network here in the US, The Ecological Research Network (TERN) in Australia and the International Carbon Observatory Systems (ICOS) in the European Union.

I look forward to further discussions. Please do not hesitate to contact me for further information.

Sincerely,

Brian Wee, Ph.D.
Chief of External Affairs
National Ecological Observatory Network (NEON), Inc.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE
CENTER FOR COASTAL MONITORING AND ASSESSMENT
1305 East West Highway N/SCI1, 9th Floor
Silver Spring, MD 20910

March 28, 2013

Mark R Walbridge
National Program Leader
Water Availability and Watershed Management
5601 Sunnyside Avenue
Beltsville, Maryland 20705

Dear Dr. Walbridge,

I am pleased to offer my support for the establishment of a Long-term Agroecosystem Research (LTAR) site in the Lower Chesapeake Bay Watershed as proposed by scientists at the Beltsville Agricultural Research Center. The National Centers for Coastal Ocean Science and BARC scientists have previously collaborated on useful projects in the Choptank River Watershed and Chesapeake Bay.

In the past, our agency has been able to provide boat support for sample collection, data analysis, and interpretation of results as viewed from a coastal waterways perspective. Several manuscripts have recently been published indicating that better conservation practices were needed in some subwatersheds. A recent collaborative discovery by NCCOS and BARC has revealed the nutrient uptake in the Choptank River mainstem may not involve nitrate-N as had been assumed. Plans are underway between NCCOS and BARC to develop additional projects concerning nutrient sources and their fate and transport using novel tracers within this watershed. The results here will also be used to enhance our modeling efforts in assessing eutrophication in coastal waters.

We look forward to continued mutually beneficial and productive collaboration with BARC scientists and with their partners involved in the Lower Chesapeake Bay Long Term Agroecosystem Research project.

Thank you,

Mary C Erickson

Mary Erickson, Acting Director

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Patuxent Wildlife Research Center
12100 Beech Forest Road, Suite 4039
Laurel, Maryland 20708-4039
(301) 497-5503 • fax: (301) 497-5505

Dr. Laura L. McConnell
USDA-ARS
10300 Baltimore Ave.
Bldg. 007 Rm. 225 BARC-W
Beltsville, Maryland 20705

Dear Dr. McConnell,

The USGS Patuxent Wildlife Research Center (PWRC) is very pleased to join USDA-ARS as a partner in the development of the Lower Chesapeake LTAR. The focus on the ecological role of agricultural lands in the lower Bay watershed is a very important one and we look forward to contributing to research that enables that role to be appreciated and enhanced.

As you know, PWRC has had a long history of work in the Chesapeake Bay, mostly in aquatic and shoreline habitats; we appreciate the importance and challenges of understanding and conserving the ecological services provided by the Bay watershed, specifically, PWRC has long undertaken research on the ecology of wintering waterfowl in the Bay. We have ongoing work now on back sucks that adds substantially to the President Obama's Chesapeake Bay initiative. We have also worked extensively on upland habitats in the watershed: surveys of breeding birds, investigations of avian nesting in various areas of woodlots, exposure of mammals and amphibians to contaminants and the resulting effects on life history, surveying native bee species are among the studies Patuxent has carried out.

PWRC has much expertise and many institutional capabilities that could be brought to bear on various projects in the LTAR, including an active group working on amphibian monitoring design, several scientists specializing in terrestrial wildlife toxicology, a growing capacity for visualization of large datasets of animal populations, among others. Most important, PWRC sits on the FWS Patuxent Research Refuge, a 12,000acre National Wildlife Refuge that is adjacent to the Henry A. Wallace Beltsville Area Research Center.

We look forward to collaborations in research in the Lower Chesapeake LTAR that enhance our understanding of this important landscape.

Sincerely,

John B. French Jr, Ph.D
Research Manager

UNIVERSITY OF MARYLAND EXTENSION

Solutions in your community

Queen Anne's County Office 505 Railroad Avenue - Suite 4 Centreville, Maryland 21617

March 25, 2013

Mark R Walbridge
National Program Leader
Water Availability and Watershed Management
5601 Sunnyside Avenue
Beltsville, Maryland 20705

Dear Dr. Walbridge,

I am pleased to affirm my support for the Lower Chesapeake Bay Long-Term Agroecosystem Research (LCB-LTAR) project submitted by the Beltsville Agricultural Research Center. The Queen Anne's County Office of the University of Maryland Extension has had long term collaboration with scientists involved with the Choptank River Watershed project concerning conservation practice implementation in the watershed including winter cover crops and wetland restorations.

We have also worked collaboratively with BARC scientists for eight years on outreach and on-farm research to support local organic farmers and others. Farmers in our area have benefitted greatly from research conducted by BARC scientists at the long-term Farming Systems Project and associated projects.

I forward to continued productive collaborations within the LCB-LTAR with anticipation of enhanced partnership interactions resulting from this effort.

Thank you,

Jennifer L Rhodes

Jennifer Rhodes
Extension Educator, Agriculture and Natural Resources

Smithsonian Environmental Research Center

Office of the Director

March 25, 2013

Mark R Walbridge
Office of National Programs
Water Availability and Watershed Management
5601 Sunnyside Avenue
Beltsville, Maryland 20705

Dear Dr. Walbridge,

The Smithsonian Environmental Research Center (SERC) is pleased to provide support for the establishment of a Long-term Agroecosystem Research (LTAR) location in the Lower Chesapeake Bay Watershed as proposed by scientists at the Beltsville Agricultural Research Center. Scientists at SERC have had long standing collaborations with BARC scientists concerning water quality issues and have actively participated in the Choptank River Watershed project.

SERC has very strong research infrastructure developed on 1,072 ha of non-federal land located in the Rhode River Watershed that include 110 ha of agricultural land, 360 ha under forest management and 26 km of shoreline on the Rhode River Estuary. The site serves as a natural laboratory for long-term ecological research on linkages between watersheds and estuaries. For over 35 years SERC has used automated samplers to monitor discharges from 8 sub-watersheds of the Rhode River. Automated sampling of two additional sub-watersheds and a tidal wetland will begin in 2013. These coastal plain watersheds are well suited for relating discharges to land use because they are perched on a layer of impervious clay that prevents exchanges of water with underlying aquifers and forces the locally infiltrated water to surface in streams within the watersheds.

The monitored watersheds range in size from a few ha up to 1,000 ha and include diverse deciduous forests across a range of successional stages (1-135 yr), agricultural fields, and wetlands. Most of the monitored watersheds include <10% agricultural land. One of the study watersheds includes riparian forest covering about one third of its area and has had continuous corn cultivation on most of its remaining area. This watershed has been the site of seminal research on uptake of agricultural nutrient discharges by adjacent riparian forest. The corn fields in this watershed are now being converted to experimental plots planted with various diversities of tree species. This will become one of the few such large-scale experiments in the world on the effects of tree biodiversity. Continued monitoring of this watershed will document the time course of change in nutrient discharges following cessation of crop fertilization.

In addition to the automated watershed monitors the SERC field site has extensive field instrumentation. Instruments for monitoring precipitation and solar radiation are mounted on a 40m tower. A separate 50m tower is instrumented for measuring micro-meteorological conditions in a forest canopy. This canopy tower will soon be moved to another location and replaced with a taller more heavily instrumented tower to be run by the NSF NEON program. In 2013, six additional towers will be deployed use for data telemetry throughout the SERC field sites. Extensive instrumentation in a SERC tidal wetland is being used for the running a long-term field experiment on effects of increasing atmospheric carbon dioxide.

Under the proposed LTAR framework, SERC looks forward to opportunities to strengthen collaborative research with BARC scientists. Research areas of joint interest include assessing air, soil, and water quality relative to health of the Lower Chesapeake Bay Watershed and sharing data from flux towers to better document surface-atmosphere exchanges for the principle land uses in the region.

Thank you,

Anson Hines, Ph.D.
Director

Smithsonian Environmental Research Center
PO Box 28, 647 Contees Wharf Road
Edgewater, MD 21037 USA
Tel: 443.482.2208 Email: hinesa@si.si.edu www.serc.si.edu

March 31, 2013

Mark R Walbridge
Office of National Programs
Water Availability and Watershed Management
5601 Sunnyside Avenue
Beltsville, Maryland 20705

As the Founder and Executive Director of TapRoots, I am writing to affirm support for the Lower Chesapeake Bay Long-Term Agroecosystem Research project submitted by the Beltsville Agricultural Research Center.

TapRoots aims to develop young ecological stewards through hands-on inquiry based learning and educational programs facilitated by University of Maryland students and faculty. We were founded in Greenbelt, MD in 2010. Our four programs are crafted to serve Northern Prince George's County middle schools: TapRoots in the Classroom (Spring), Young Ecological Stewards (Summer), Adventures in Soil Science (Fall) and Conversations with TapRoots (On-going). Respectively, our programs teach 7th grade students about urban ecology in their science classrooms and engage them in outdoor learning, mentor youth with gardening projects that invokes play and discovery in order to build curiosity for the natural environment, those curious minds then strengthen their understandings of urban ecosystems through the lens of soil science. To keep their appreciation for ecological sciences active, we personalize Science Technology Engineering Mathematics Fair mentoring programs with the help of University of Maryland educational and environmental-science students.

We are launching an ecological monitoring program for the urban-rural transect that links Beltsville, Greenbelt and College Park communities. The Young Ecological Stewards and Adventures in Soils Science programs will lead the way with installing and calibrating research instrumentation that will collect microclimate data on organic agricultural research fields, extensive and intensive vegetated roofs, a parking lot rain garden, and a community garden in a forested public park. This sensor network will allow our students to run controlled STEM fair experiments and help teachers integrate graphical analysis into classroom curricula.

The Lower Chesapeake Bay-LTAR is vital to our programming. The research generated from this project, coupled with citizen science initiatives under TapRoots, provides youth in Northern Prince George's County public schools with a unique opportunity to become engaged in real-world science that addresses environmental issues in their community.

TapRoots looks forward to partnering with LCB-LTAR with intent of enhancing citizen-science programs in local schools and fostering ecological stewardship among youth in the Lower Chesapeake Bay.

Yours sincerely,

Anthony Dimeglio
Founder and Executive Director
TapRoots

The Nature Conservancy
Protecting nature. Preserving life.™

The Nature Conservancy of Maryland/DC
5410 Grosvenor Lane, Ste. 100
Bethesda, MD 20815

tel (301) 897-8570
fax (301) 897-0858
nature.org

March 18, 2013

Re: Long Term Agroecosystem Research network proposal

I am writing in support of the Beltsville Agricultural Research Center's proposal to join the national Long Term Agroecosystem Research (LTAR) network. This work includes the wetland assessment on the Choptank River Watershed, which encompasses several of our preserves and focal areas. We have collaborated with the scientists involved in this project through their research on our preserves for many years, and have benefitted greatly from their work.

The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. The LTAR network would help us achieve this mission by addressing the effects of urbanization and climate change on agricultural ecosystems in our coastal regions.

Please accept this letter of support for the Lower Chesapeake Bay LTAR. I appreciate your consideration of Beltsville Agricultural Research Center's request.

Sincerely,

Deborah Landau, Ph.D.
Conservation Ecologist

United States Department of Agriculture | Forest Service | Northern Research Station | 11 Campus Blvd., Suite 200
Newtown Square, PA 19073-3200

Date: March 26, 2013

Dr. William Kustas
USDA-ARS Hydrology and Remote Sensing Lab
Bldg 007 BARC-West
Beltsville, Maryland 20705

Dear Dr. Kustas,

I am pleased to provide this letter of support for the establishment of a Lower Chesapeake Bay - Long-Term Agroecosystem Research project as submitted by the Beltsville Agricultural Research Center. As a scientist with the Climate, Fire, and Carbon Cycle Sciences Program (formerly the Forest Service Northern Global Change Program), I have been engaged in understanding the impacts and interactions of climate change, land use and human activities on an urban-to-rural gradient of forested ecosystems. We currently operate an eddy covariance tower at the Cub Hill site located 14 km to the northeast of the Baltimore City center in collaboration with the Baltimore Ecosystem Study Long-Term Ecological Research (LTER) project. In addition to the Cub Hill tower, the USDA Forest Service has nearby carbon flux towers in more rural interfaces, such as Elk Neck State Forest (90 km north, in the Chesapeake Bay Watershed) and at the Silas Little Experimental Forest, NJ.

In collaboration with Dr. Nicanor Saliendra, USDA ARS (Mandan, ND), our analysis of the natural and maintained vegetation cover in urban/suburban/ rural forest stands is providing insights on the dynamics of land use on the water/energy/carbon exchange in this urban/suburban environment. With Dr. Yude Pan (USDA Forest Service, NRS), we have modeled the role of atmospheric deposition, climate change stressors, and loss of forested lands on the net primary productivity in the forested ecosystems of the Chesapeake Bay Watershed.

With your eddy flux towers in nearby long term agricultural field sites and our urban/suburban and rural towers, I feel that this would be a great opportunity for interagency collaboration as partners in the Lower Chesapeake Bay Long-term Agroecosystem Research project on energy/water/carbon exchange from urban, forest and agricultural landscapes.

I look forward to working with you in the future.

Regards,

John Hom, Ph.D.
Interdisciplinary Scientist
Climate, Fire, and Carbon Cycle Sciences Program
USDA Forest Service, Northern Research Station
11 Campus Blvd., Suite 200
Newtown Square, PA 19073-3294
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jhom@fs.fed.us

A. JAMES CLARK
SCHOOL OF ENGINEERING

OFFICE OF THE DEAN
3110 Jeong H. Kim Engineering Building
College Park, Maryland 20742-2831
(301) 405-3868 Fax (301) 314-5908

March 26, 2013

Mark R Walbridge
National Program Leader
Water Availability and Watershed Management
5601 Sunnyside Avenue
Beltsville, Maryland 20705

Dear Dr. Walbridge,

I am pleased to offer my support for the establishment of a Long-term Agroecosystem site in the Lower Chesapeake Bay Watershed as proposed by scientists at the Beltsville Agricultural Research Center.

The Department of Civil and Environmental Engineering at the University of Maryland, College Park, has a long, productive collaboration with BARC scientists on projects ranging from pollutant fate and transport in the Chesapeake Bay watershed, regional atmospheric transport and deposition, development of new novel measurement using rapid sensors technologies, modeling reactions and pollutant fate, and most recently assessing the effectiveness of conservation practices to mitigation agricultural emissions.

Over the past twenty years, more than 30 MS and PhD students have participated in joined projects resulting in over 75 publications. We do believe our proximity to ARS researchers and the establishment of the Agroecosystem site at the lower Chesapeake Bay watershed would benefit out faculty and students for years to come.

We look forward to continue mutually beneficial and productive collaboration with BARC scientists and with their partners involved in the Lower Chesapeake Bay Long Term Agroecosystem Research project.

Yours truly,

Darryll J. Pines

Darryll J. Pines
Farvardin Professor and Dean

UNIVERSITY OF MARYLAND

EARTH SYSTEM SCIENCE INTERDISCIPLINARY CENTER
Office of the Director

5825 University Research Court, Suite 4001
M Square Building
University of Maryland
College Park, Maryland 20740
TEL (301) 405-0050 FAX (301) 405-8468
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Mark R Walbridge
National Program Leader
Water Availability and Watershed Management
5601 Sunnyside Avenue
Beltsville, Maryland 20705

Dear Dr. Walbridge:

I am very pleased submit this letter supporting the proposal for a Lower Chesapeake Bay - Long-Term Agroecosystem Research (LCB-LTAR) project from the Beltsville Agricultural Research Center.

The Earth System Science Interdisciplinary Center (ESSIC) was created to facilitate projects that cut across the traditional boundaries of scientific disciplines to enhance our understanding of how the atmosphere, ocean, land and biosphere components of the Earth interact as coupled systems.

Our goals are well aligned with the goals of the LCB-LTAR. Particular areas of mutual interest are those related to impacts of climate change on function of agricultural ecosystems, and the influence of agricultural activity on the health of the Chesapeake Bay ecosystem.

We look forward to collaborating with the USDA-ARS and partners involved with the LCB-LTAR to find enhanced synergies to understand processes and interactions within complex coupled systems.

Sincerely,

Antonio J. Busalacchi

Antonio J. Busalacchi
Professor and Director
Earth System Science Interdisciplinary Center

UNIVERSITY OF
MARYLAND
COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

AGRICULTURAL EXPERIMENT STATION
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March 28, 2013

Mark R Walbridge
National Program Leader
Water Availability and Watershed Management
5601 Sunnyside Avenue
Beltsville, Maryland 20705

Dear Dr. Walbridge,

As the Associate Director of the Maryland Agricultural Experiment Station (MAES), I am writing to affirm support of the Lower Chesapeake Bay Long-Term Agroecosystem Research (LCB-LTAR) project submitted by the Beltsville Agricultural Research Center. The College of Agriculture and Natural Resources at the University of Maryland is one of the leading programs emphasizing the impact and relationship of the urban environment on agriculture and natural resources. With an ever expanding urban population, competition for land and resources has continually increased and we seek to find harmony between an expanding population and the need to maintain agricultural production and protect our natural resources. The goals of the LCB-LTAR outlined in this proposal are well aligned with the MAES research mission at the College of Agriculture and Natural Resources of the University of Maryland, and increased collaboration as part of this long-term effort will provide research and educational benefits for the University faculty and students.

The MAES has had a long-term collaboration with BARC in the operation of the Hayden Farm which is located on BARC campus. The Hayden Farm management has extensive interaction with BARC field crews in managing crop production at the joint facility. Continuing to increase the sustainability of these operations will be another benefit of our collaboration, and will contribute to the restoration of the Chesapeake Bay. The Lower Chesapeake Bay LTAR site will provide a unique opportunity to address the effects of urbanization and climate change on agricultural ecosystems in coastal regions we are committed to collaborate on related line of research and education.

MAES looks forward to productive collaborations with the LCB-LTAR as interactions between partner organizations are enhanced.

Sincerely,

A. Shirmohammadi

Adel Shirmohammadi
Professor, Assoc. Dean for Research & Assoc. Director of MAES

cc: Cheng-I Wei, Dean and Director, College of Agriculture and Natural Resources

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
339 Busch's Frontage Road, Suite 301
Annapolis, MD 21409

Phone: 410-757-0861
FAX: 410-757-0687
www.md.nrcs.usda.gov

MAR 28 2013

Mark R Walbridge
National Program Leader
Water Availability and Watershed Management
5601 Sunnyside Avenue
Beltsville, Maryland 20705

Dear Dr. Walbridge:

As State Conservationist in Maryland, I am happy to provide my support for the establishment of a Long-term Agroecosystem site in the Lower Chesapeake Bay Watershed as proposed by scientists at the Beltsville Agricultural Research Center. The Maryland Natural Resource Conservation Service has enjoyed a fruitful collaboration with BARC scientists.

The Choptank River Watershed began as an NRCS Special Emphasis Watershed within the Conservation Effectiveness Assessment Project. This project led to extensive assessments of land use and conservation practice and their effects on water quality in the watershed.

This collaboration has also led to advanced application of remote sensing techniques for assessment of winter cover crop performance and for assessment of ecosystem services provided by natural and restored wetlands.

We are also happy to support collaborations between BARC and the NRCS Plant Material Center in Beltsville to examine the effectiveness of vegetative environmental buffers at protecting air quality.

We look forward to continued productive collaborations to improve conservation practice implementation in Maryland by enhanced partnerships within the Lower Chesapeake Bay Long Term Agroecosystem Research project.

Thank you,

ROBERT MCAFEE
Acting State Conservationist

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

March 25, 2013

Dr. Mark R. Walbridge
National Program Leader
Water Availability and Watershed Management
5601 Sunnyside Avenue
Beltsville, Maryland 20705

Dear Dr. Walbridge,

As Director of USGS MD-DE-DC Water Science Center in Maryland, I am happy to express my support for the establishment of a Long-term Agroecosystem site in the Lower Chesapeake Bay Watershed as proposed by scientists at the Beltsville Agricultural Research Center.

The USGS Water Center has had long standing collaborations with BARC scientists concerning water quality issues on the Eastern Shore of Maryland going back several decades. In the past these included comparisons of regional water quality assessment findings of the USGS with field scale water quality patterns investigated by BARC scientists. More recent collaborations include detailed assessments of wetland hydrology in the Choptank River Watershed to understand how wetlands affect flow and water quality in agricultural landscapes. Current collaboration includes work on how to best use data from real time nitrate and sediment sensors for accurate assessment of nutrient fluxes from watersheds.

We look forward to continuing to partner with BARC scientists and other agricultural scientists in addressing water quality concerns in Maryland. We believe that such partnerships will be enhanced by the proposed Lower Chesapeake Bay Long Term Agroecosystem Research project.

Sincerely yours,

Robert J. Shedlock

Robert J. Shedlock, Director
MD-DE-DC Water Science Center
U.S. Geological Survey
5522 Research Park Drive
Baltimore Maryland 21228

HOWARD UNIVERSITY

College of Arts and Sciences
Department of Physics & Astronomy

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March 26, 2013

Dr. William Kustas
USDA-ARS hydrology and Remote Sensing lab
Bldg 007 BARC-West
Beltsville, Maryland 20705

Dear Dr. Kustas,

As Director and Principal Investigator of the Beltsville Center for Climate System Observation (BCCSO), I am pleased to provide this letter of support for the establishment of a Lower Chesapeake Bay - Long-Term Agroecosystem Research project as submitted by the Beltsville Agricultural Research Center.

Our center is a NASA University Research Center at Howard University engaged in fundamental atmospheric research. We currently operate an eddy covariance tower as well as a number of atmospheric sounders and profilers at the BCCSO facility which encompass three of the major land use types in this region, forest, urban and agriculture. With your eddy flux towers in nearby long term agricultural field sites, we see opportunities to collaborate with partners in the Lower Chesapeake Bay Long-term Agroecosystem Research project on energy/water/carbon exchange from urban, forest and agricultural landscapes.

Regards,

Sincerely,

Everette Joseph, Ph. D.
Professor, and
Director, Howard University
Program in Atmospheric Sciences;
Director, Beltsville Center for
Climate System Observation