THE OHIO STATE UNIVERSITY

University Panel on Ecosystem Services Report

May 2018

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I. Executive Summary

Introduction and Focus

Our landscapes, natural and human influenced, are the source of many benefits to us. These benefits are referred to as ecosystem services. As a major land owner and operator, The Ohio State University manages a wide range of landscapes with a primary focus of supporting learning, teaching, and discovery.

In December 2017, Jay Kasey, Administration & Planning Senior Vice President, and Kate Bartter, Office of Energy and Environment Director, jointly issued a charge to establish a University Panel on Ecosystem Services to develop a strategic plan for advancing the university's sustainability goals through ecosystem services. From January through May 2018, 15 members participated in the panel including two students, one municipal representative, and 12 faculty and staff.

The panel focused on defining ecosystem services for the university and outlining a framework needed to incorporate and enhance ecosystem services on campus. The panel approached its work with a deliberate "university-centric" viewpoint, with maximum focus on how our landscapes can benefit the campus community at large. It was noted, however, that the most impactful strides in sustainability will be made where the university can positively impact both people and the environment. It will also be important to leverage existing "iconic landscapes" to create new areas that advance overall campus sustainability.

Three important benefit types were identified as those that:

1. Support learning, teaching, and discovery utilizing campus as a living lab.
2. Enhance the quality of life for students, faculty, staff, and the community.
3. Reduce resource consumption.

The following Mission Statement, Objectives, and Recommendations will help advance the university's role as a leader in sustainability and set forth an agenda which will have a positive, transformative effect on the long-term health, function, and aesthetic appeal of the university's campus landscapes.

Mission Statement

Advance a culture promoting ecosystem services through Learning, Innovation, and Engagement.

Learning ***Innovation*** ***Engagement***

Figure 1: Ohio State University students learn by utilizing the natural campus (left), Howlett Hall green roof (middle), Ohio State University students planting trees on campus as part of service event (right).

Objectives

The panel developed two interdependent Objectives from the Mission Statement:

Figure 2: Two Objectives were developed that support each other and encourage ecosystem service learning, innovation, and project implementation.

Recommendations

Based on the Mission Statement and Objectives, the panel developed these Recommendations:

Revise Goal 7d Language: *Establish Living Labs Program, Landscape Management Plans, and evidence-based ecosystem targets to increase human and environmental benefits for University campuses, by 2025.*
Establish a Living Labs Program
Conduct an Assessment and Evaluation to define Preliminary Ecosystem Service Metrics
Incorporate an Ecosystem Services Assessment into the University's Green Build and Energy Policy
Create Campus Landscape Management Plans
Conduct a Cultural Values Survey
Create Heritage Tree Policy
Conduct Periodic BioBlitz Events

Figure 3: Overview of the Recommendations from this report.

With regards to the recommendation to establish preliminary ecosystem service metrics, the panel expects the university to continue ongoing work to increase the university's tree canopy, implement green infrastructure to manage storm water, and maintain its open space.

Conclusion

The approach detailed in this report positions the university for long-term leadership on topics related to ecosystem service management through the integration of the university's academic mission and desire for a more sustainable campus landscape.

As directed in the Panel Charge, this report is respectfully submitted to the President and Provost's Council on Sustainability for additional feedback and implementation guidance.

Sincerely,

Dr. Maria Conroy, Panel Chair

II. Introduction

In November 2015, university leaders accepted a comprehensive set of sustainability goals developed by the President and Provost's Council on Sustainability (PPCS). One of the goals called for the university to "Double the acreage that provides at least two ecosystem services, by 2025." In December of 2017, Jay Kasey, Senior Vice President of Administration and Planning and Kate Bartter, Director of the Office of Energy and Environment, jointly issued a Charge to Establish a University Panel on Ecosystem Services, in order to develop a strategic plan to realize this goal and provide a bold vision for initiatives that can have a positive transformative effect on the long-term health, function, and aesthetic appeal of the university's campuses.

Fifteen members participated in the Panel including two students, one municipal representative, and twelve faculty and staff. The faculty and staff members represented a wide range of departments including City and Regional Planning in the Knowlton School, the School of Environment and Natural Resources, Planning and Real Estate, the Department of Agricultural, Environmental, and Development Economics, The Office of Outreach and Engagement, The Office of Student Life, The Office of Energy and Environment, the Initiative for Food and Agricultural Transformation, and Facilities Operations Development. The Panel convened four times between January and May 2018.

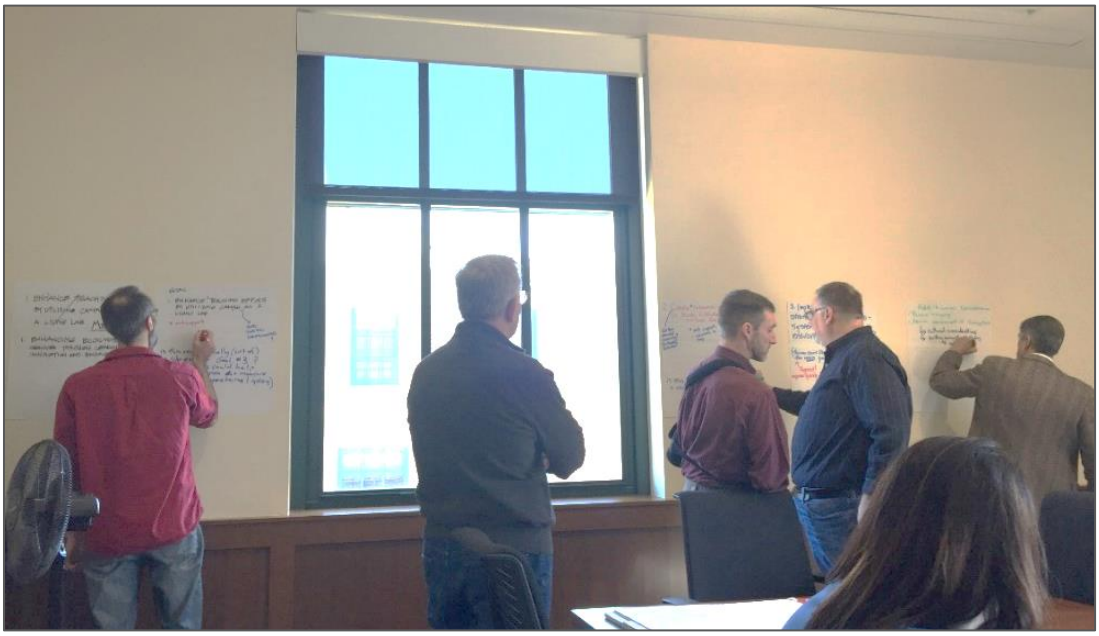

Figure 4: Panel members submit feedback on ecosystem services goals for the University. March 23, 2018.

III. The Charge

The Panel was asked to develop ambitious ideas that would promote sustainability at the university through the incorporation and enhancement of ecosystem services on campus. The Panel was specifically charged with:

- Developing a strategic plan to implement an ecosystem services goal.
- Clarifying terms and providing overall clarity on an ecosystem services goal.
- Reviewing acceptable metrics for tracking and monitoring ecosystem services.
- Establishing baselines of ecosystem services at the university.
- Developing an inclusive system of governance for implementation of a strategic plan.
- Incorporating ideas for using this initiative as a larger educational component at Ohio State campuses.
- Identifying potential barriers and costs to meeting an ecosystem services goal.
- Creating a suggested timeline for action.

The first task that the Panel addressed was clarifying the goal language "Double the acreage that provides at least two ecosystem services, by 2025." After some debate it became clear that this existing goal language is not suitable for the university. The language, while providing a simplified and singular metric (acreage), is problematic in that it is insufficient to support the intended ecosystem improvement outcomes and not tailored to the university's characteristics. Additionally, the goal did not define an appropriate degree of multi-functionality that would require balance between different categories of services. Therefore, the panel focused on refining the goal and interpreting ecosystem services for the university, such that it becomes more relevant and operational.

With this increased focus on refining the goal and interpreting ecosystem services for the university, it became clear that the Panel could not address every aspect of the charge in the timeframe provided. Of real concern to the Panel was identifying metrics, setting baselines, and specifying project goals without compiling data and conducting research on a system or campus-wide basis. The Panel concluded that research was needed involving university faculty and students in order to understand the amounts and values of the ecosystem services currently provided, the potential trade-offs between services, and the priority ecosystem services given the mission of the university and future land use changes. Therefore, the Panel undertook a phased approach to the charge to set a solid foundation and steps for near term implementation.

This report represents the findings of the Panel and creates a framework from which future work on ecosystem services should be based. The Mission, Objectives and Strategies, and Recommendations set forth in this document promote the use of adaptive management practices. This allows new research, innovation, and technology to guide the university in its ecosystem services work.

Careful attention was paid to aligning this report with the university's overarching mission, vision, core goals, and key discovery themes. Many of the principles and strategies here

were developed in accordance with *The Ohio State University Sustainability Plan: Volume III – Technical Detail* (Mithun, 2011). The ideas laid out in this report respect and harmonize with development and growth needs for the university and our recommendations add value to future development plans such as Framework 2.0.

IV. Ecosystem Services at the University

The Panel reviewed a variety of ecosystem services definitions and recommends using that provided by the 2005 Millennium Ecosystem Assessment which has been widely cited: "Ecosystem services are the benefits people obtain from ecosystems. These include **provisioning services** such as food, water, timber, and fiber; **regulating services** that affect climate, floods, disease, wastes, and water quality; **cultural services** that provide recreational, aesthetic, and spiritual benefits; and **supporting services** such as soil formation, photosynthesis, and nutrient cycling" (Millenium Ecosystem Assessment, 2005). While this definition provides a solid foundation, the Panel recognized that this definition is broad and needs to be translated and adapted to a specific context, such as a college campus. With this in mind the Panel recommends creating a university-specific ecosystem services sub goal within its Resource Stewardship goal. This involves identifying what services are most important to the university community and prioritizing them at the landscape scale. These can range from natural landscapes where direct human-use is minimized to urban areas where human activities dominate the landscape (Millenium Ecosystem Assessment, 2005). Three important questions guide this process:

1. Who benefits from the ecosystem service?
2. What are the benefits from the ecosystem service?
3. How do we increase and enhance the provision of ecosystem services?

Ecosystems are inherently multifunctional and the ecosystem service types listed above as provisioning, regulating, cultural, and supporting are not mutually exclusive. An ecosystem could potentially provide benefits from each service type. It is important to recognize that we will not target all types of ecosystem services that campus lands could potentially provide. Our approach is deliberately "university-centric" with a focus on benefits to local people from the local environment. This approach, at its core, is about strengthening the relationship between people and the land; an ethical approach which includes a moral responsibility to the natural world (The Aldo Leopold Foundation, 2018). This means we will prioritize services that we feel are important to our campus community, particularly through design and protection of natural landscapes that can define the institution through unique characteristics. We will make the most strides in sustainability when landscapes are managed to positively impact both people and the environment.

Also, while we recognize the importance of the environment for food production, this ecosystem service will be addressed separately as part of the university's Food Sustainability Panel, whose tasks include determining how to achieve 40% local and sustainable food

procurement for the University, including an increase in the production of food on campus. The Initiative for Food and Agricultural Transformation (InFACT) is a co-chair of that university Panel and Brian Snyder, Executive Director of InFACT, was a member of this Ecosystem Services Panel and gave input on this decision. The Ecosystem Services Panel expects the university to continue collaborative efforts between the provision of food and the wider set of ecosystem services from campus lands.

Who benefits?

In order to determine what ecosystem services should be prioritized, the Panel first asked for whom the services should benefit. As a land grant institute of higher education, priority must first be placed on benefits to students, then faculty and staff, and lastly our larger community (adjacent neighborhoods, the cities, and regions). These benefits should be obtained through a thoughtful, ethical approach to landscape management that provides win-wins for human and other beneficial species. The existing ecosystem services goal language, which required at least two provisionary services, indirectly acknowledged the beneficiary by promoting diverse interests. Since any particular land area may provide a variety of ecosystem services (e.g., carbon sequestration, habitat provision, stormwater infiltration, aesthetic appreciation), the value of a service is best assessed in light of a selected beneficiary. So trees providing carbon sequestration can also have a value in terms of public health cost savings or habitat provision equivalence to avian species, for example. In this scenario the university will be most interested in the public health value for the campus community. The habitat provision for avian species is an indirect benefit. This direct acknowledgment of a beneficiary will guide how the university plans for ecosystem services.

What are the benefits?

While the Panel recognized the plethora of benefits ecosystems provide through their various services, the focus of our discussions was to identify which benefits the university should value the most, given the land grant mission. Three types of benefits were identified as important for ecosystem service provision and sustainability at Ohio State. These benefits are not mutually exclusive, and are in fact mutually reinforcing.

Living Labs

The first type of benefits aligns with the university's mission and supports learning, teaching, and discovery. This is encompassed by the concept of living labs. A living lab is a concept employed by universities to leverage learning and action on campuses. Students and faculty conduct research and experiments around campus, expand knowledge, and provide insights useful for a university to advance sustainable practices and technologies. For Ohio State, living labs will focus on using campus ecosystems as test beds for solving real world problems and teaching ethical landscape management approaches. Interdisciplinary research will be emphasized with a focus on sustainability and environmental and public health. The Panel has recognized that living labs will be a cornerstone for the university as it addresses sustainability and resource stewardship in the future. Therefore, we have recommended a Living Labs Program be created to promote and manage the campus as a living lab. Many other universities have formal Living Lab programs (Figure 2). The Association for the Advancement

of Sustainability in Higher Education (AASHE) also has a guide entitled: [A Guide For Applied Sustainability Learning Projects: Advancing Sustainability Outcomes On Campus And In The Community](#) (Beaudoin & Brundiers, 2017).

Figure 5: Three examples of Living Lab Programs. Harvard (top) - (Harvard University, 2018). Princeton (middle) - (Princeton University, 2018). Penn State (bottom) - (The Pennsylvania State University, 2018)

Enhancing Quality of Life

The second type of benefits is those that enhance the quality of life for students, faculty and staff, and the community. There is an increasing amount of literature that shows the correlation between green space and public health, in part due to increased opportunities for recreation and cleaner air (see Appendix). There is also a consensus among the Panel that we must protect, enhance, and create green space for cultural and recreational uses on campus. As our city and region continue to develop we must provide a healthy, balanced environment for our students to thrive. As a leading university with a broad reach and a high profile brand we should be a model for others in advancing sustainability through ecosystem services.

Reducing Operational Costs

The third type of benefits that is important to the university are benefits which can reduce our operational costs/resources or provide extra benefits (to people or the environment) at the same cost/resource. For instance if we can implement green infrastructure (i.e. rain gardens or bioswales) instead of grey infrastructure (i.e. underground water tanks and pipes) we may be able to provide the same benefit of storm water control while also adding other benefits such as aesthetic beauty, recreational or cultural opportunities, or increased habitat for a similar, or reduced, cost. These multifunctional landscape should be considered valuable to the university.

How to Increase and Enhance Ecosystem Services?

The third guiding question of the Panel stems from the consideration of benefits and beneficiaries and serves as the overall impetus for this report. The Panel recommends the three types of benefits identified should be prioritized across the university's main Columbus campus, its regional campuses (Lima, Mansfield, Marion, Newark, and Wooster), its Columbus golf course, airport and Hospital East as they are all relevant to our focus beneficiaries. Because these areas differ greatly in their characteristics, strategies for managing ecosystems will differ between them. However, the ethos set forth in this report should apply to all. The following sections lay out a Mission Statement, Objectives and Strategies for maximizing the benefits that our ecosystems provide us. Finally, we provide Recommendations for the university to realize its ecosystem services goal.

V. Mission Statement: *Advance a culture promoting ecosystem services through Learning, Innovation, and Engagement.*

Ecosystem services are an integral part of the university landscape and characterize the relationship the university has with natural processes. This relationship has historically been characterized by dominance (e.g., river straightening or channelization) or disregard (e.g., tree clearance, construction on greenspace). Furthermore, there has been a lack of comprehensive green space planning at the campus level. As the university embarked on the Framework Plan and other sustainability focused actions, the awareness of, and respect for,

ecosystem services became more prominent. This new perspective provides an opportunity to view the campus as a connected landscape and not as a number of disjointed building sites. Planning with this in mind will help maximize the benefits our landscapes provide. The Panel supports the adoption of a mission reflecting the shift in ethos that focuses on the intentional promotion and integration of ecosystem services on campus. Such efforts are expected in and out of the classroom as part of a living lab, as well as through campus based research and outreach.

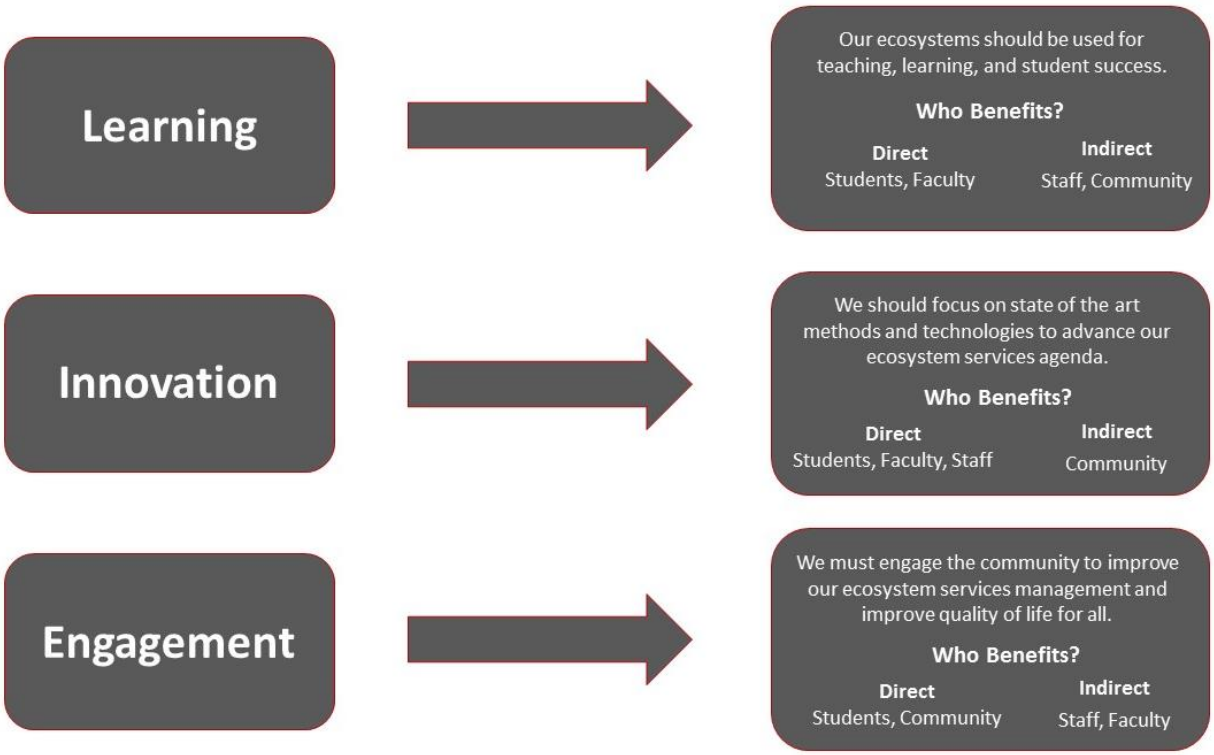

Figure 6: Three core values were identified by the Panel which closely match the values of the university. These will drive how we view ecosystem services for the university.

VI. Objectives and Strategies

The Panel developed two primary objectives from the mission statement. These objectives encompass the mission's intent while providing direction for actionable strategies. The objectives are interdependent and set out a research foundation using the campus environment that informs and validates ecosystem services metrics to be used to assess the university's progress toward sustainability.

Objective 1. Support learning, student success, and research innovation by utilizing campus as a living lab for ecosystem services.

Beneficiaries: Primarily students, as well as faculty and staff by expanding opportunities for knowledge generation and access to the university campus environment.

Strategy: Protect and create opportunities for outdoor living labs.

Strategy: Engage students, faculty, and staff to identify priority ecosystem services research topics.

Example: Studying the Fifth Ave Dam Removal

Ohio State scientists are studying the effects of a lowhead dam removal on the Olentangy River. Active scientific research on campus will drive our ecosystem services goal.

(The Ohio State University, 2014)

Figure 7: An example of Ohio State faculty and students using campus lands as a place for research and learning.

Example: Saving the Sycamores on John H. Herrick

A grassroots effort by staff, faculty and students in 2010 saved two Sycamore trees from removal by construction. Thought to be 250 to 300 years old, the trees marked an Underground Railroad trail along an old stream linking Mirror Lake to the Olentangy River. Protecting and preserving these trees adds value to the university.

(The Ohio State University, 2017)

Figure 8: An example of the Ohio State community recognizing the importance of ecosystem services provided by campus lands.

Objective 2. Implement operational strategies and policies to enhance ecosystem services, improving environmental and public health and quality of life for students, faculty, staff, and the community.

Beneficiaries: Students, faculty and staff, and the community will benefit from enhanced ecosystem services on campus lands.

Strategy: Establish land use and development decision guidelines that integrate the value of ecosystem services for the OSU community at large.

Strategy: Develop and validate metrics for ecosystem services monitoring and evaluation.

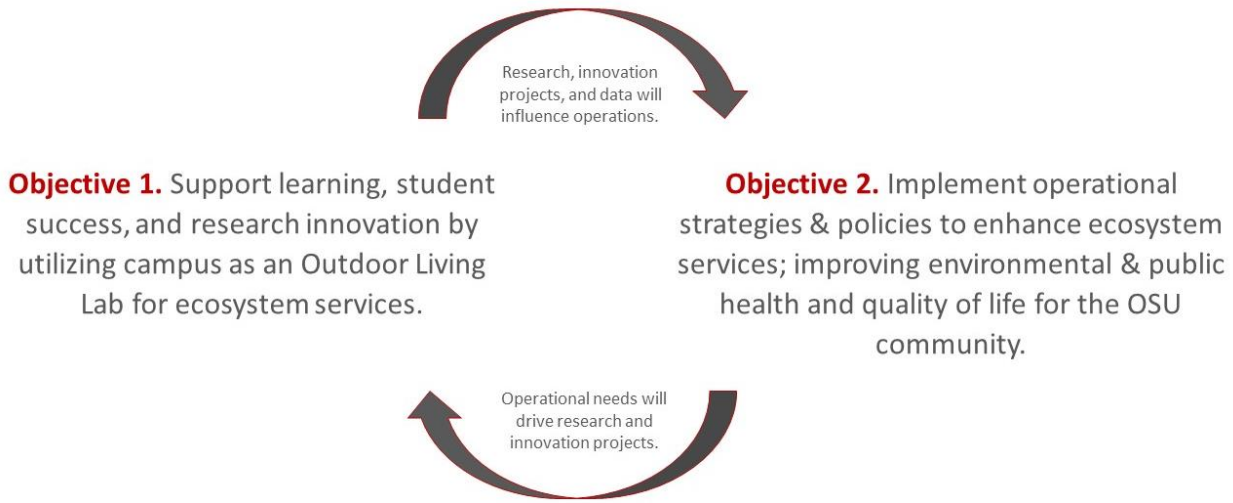

Figure 9: Two objectives were developed by the Panel. These objectives feed into each other and form a loop to encourage ecosystem services learning, innovation, and project implementation.

VII. Recommendations

Based on the objectives and strategies identified above, the Panel developed two sets of recommendations, one for the short term (0-2 years), and one for the medium term (3-5 years). By the end of September 2018, Panel members will develop a more specific work plan with identified university stakeholders to begin implementation for each of the following recommendations.

Short Term (0-2 years)

- **Revise Resource Stewardship Goal 7d** to read "Establish Living Labs Program, Landscape Management Plans, and evidence-based ecosystem targets to increase human and environmental benefits for University campuses, by 2025." This will enable the university to develop a science-based approach to manage its landscapes in a manner that maximizes the value provided by ecosystem services on available acreage.

- **Establish a Living Labs Program**. The Living Labs Program is intended to serve as the primary programmatic entity responsible for institutionalizing multi-disciplinary ecosystem service research at Ohio State. Program activities could focus on quantifying and valuing ecosystem services to students, faculty/staff, and extended campus communities. Such a program potentially addresses all key beneficiaries, and helps to clarify the types and amounts of ecosystem services on campus. While there are numerous logical units that could house this program, the Panel recommends it

initially reside within the combined Office of Energy and the Environment and Sustainable and Resilient Economy Discovery Theme. This recommendation is pending further dialog and input from University faculty and staff regarding the optimal, long-term home for such a program. The Program will be tasked to:

- Review, catalog, track, integrate, develop and administer learning and innovation projects involving university lands. These projects will provide valuable insight and data related to existing and potential ecosystem service metrics across campus. As the central entity for such projects, the Program will have the ability to solicit ideas from other university offices and departments for use by faculty and students, or connect researchers with appropriate entities.
- Advance tools and projects for conservation, restoration, and environmental enhancement of the university's lands.

- **Incorporate an Ecosystem Services Assessment (ESA) into the University's Green Build Policy.** Facilities, Operations and Development (FOD), which is currently responsible for the university's Green Build and Energy Policy, would require all new developments to conduct an ESA to best determine how to achieve development goals while ensuring no net loss, and ideally enhancement, of ecosystem services at the site or campus level. This further supports comprehensive green space planning and creates a means by which ecosystem services are continually put into decision-making rather than an annual ex post metric review. The Panel recommends using a third party evaluation system. While such systems, if done to a certification level, involve added costs that accompany their benefits, the actual assessment process is possible without pursuit of formal certification. The Panel recommends The Sustainable SITES Initiative certification at a minimum and the The Living Building Challenge (LBC), PETALS, as a high standard. SITES is a "sustainability-focused framework that ushers landscape architects, engineers and others toward practices that protect ecosystems and enhance the mosaic of benefits they continuously provide our communities, such as climate regulation, carbon storage and flood mitigation" (http://www.sustainablesites.org/certification-guide). An example SITES scorecard can be found in the Appendix of this report.

Example: Phipps Center for Sustainable Landscapes (CSL),

SITES and LBC certified

Place Petal – Built on a brownfield
Water Petal – Captured rainwater supplies water use, green infrastructure treats & stores storm water
Energy Petal – Net positive on energy
Materials Petal – Local, salvaged, & high quality, non-toxic materials used in design
Beauty Petal – Green roof blends the building into the surrounding gardens

Figure 10: An example of a sustainable building and landscape design.

- **Conduct a cultural values survey** of students, faculty, staff, alumni and community members to assess the cultural value of spaces on campus. This will "piggyback" off planned surveys from either The Office of Energy and the Environment (OEE) or The Office of Student Life. Questions targeting the cultural value of spaces on main and satellite campuses will be added to the survey with minimal additional cost or time. The insight gained from such a survey provides data on the cultural value of campus lands that currently have no quantitative or qualitative assessment

- **Conduct a BioBlitz for the university**. A BioBlitz is "an event that focuses on finding and identifying as many species as possible in a specific area over a short period of time" (National Geographic, 2018). This would involve university faculty, students, scientists from local environmental groups, alumni, families, and community members working together to obtain an overall count of the plants, animals, fungi, and other organisms that live on campus. This information will become a baseline for biodiversity on campus and, if performed on a recurring basis (every 2-5 years), can show trends of species distribution. New technology such as iNaturalist will allow a seamless integration with the Digital Flagship initiative. The Living Labs Program will plan and coordinate this effort around Time For Change Week.

- **Create a Landscape Management Plan** that harmonizes with the Framework 2.0 Plan. The plan will ensure the entirety of campus is treated as a connected ecosystem rather than fragmented sites. This implies that impacts are assessed not only at the site where development takes place, but across the campus. The advantage of this approach is that landscape effects (e.g., connectivity, fragmentation, edge effects, dispersal, etc.) are incorporated into the assessment of the impacts. The plan would be a resource for the Living Labs Program as they assess current and future lab areas as well as the Ecosystem Services Assessment process of the Green Build and Energy policy. The Plan would also identify current and future "iconic landscapes" on university campuses for protection and ecosystem service enhancement. This is foreseen as a collaboration between Planning and Real Estate, Facilities Operations and Development, City and Regional Planning – Knowlton School, and the School of Environmental and Natural Resources.

Example: Trees of Penn State Policy
"a method to identify, acknowledge, and protect irreplaceable trees" ***Designation Criteria:*** *Age* *Historic Significance* *Location/Setting* *Size/Habit* (The Pennsylvania State University)

Figure 11: Example of a university Tree Heritage Policy.

- **Establish a "Heritage Tree" policy** to protect old, large, and targeted species of trees on campus and the ecosystem services they provide. Heritage Tree Policies have been used by municipalities as well as universities across the United States. Pennsylvania State University, see sidebar, has an established policy which defines the criteria for a heritage tree or heritage grove, the process for designation, as well as the implications of the designation. The intent is to recognize and protect trees of significance through university established standards. Benefits of the Heritage Tree policy ensure an enviro-cultural connection

between trees and the campus community. The University's Tree Advisory Committee will oversee the establishment of this program.

- **Conduct an assessment and evaluation for four preliminary metrics.** In continuation of prior work we will refine the study and tracking of:
  - Tree Canopy Acreage. Tree canopy has a long established value to our noted beneficiaries. According to American Forests, "The greater the tree cover and the less the impervious surface, the more ecosystem services are produced in terms of reducing stormwater runoff, increasing air and water quality, storing and sequestering atmospheric carbon and reducing energy consumption due to direct shading of residential buildings" (American Forests). While there is additional information needed to quantify the particular benefits, the overall canopy acreage may be seen as a fundamental metric for which we have current data for the Columbus campus (Figure 12). Further work is needed to quantify canopy for regional campuses and other university lands.
  - Greenspace and Low-Maintenance Acreage. Understanding and characterizing Ohio State University greenspace, woodland, and low-maintenance properties as they currently existing and provide connectivity would provide a baseline knowledge of ecosystem services these properties provide from which to measure future enhancements across a university campus.
  - Runoff Curve Number. There is currently no direct measure of stormwater runoff on Ohio State University campuses. Stormwater is an operational cost to the university and has a potential negative impact on provisioning services due to temporary flooding and pollutant loads, for example. There is a relationship between the amount of impermeable surfaces (e.g., rooftops and paved areas) and the amount of stormwater runoff. Calculating and tracking the runoff curve number over time provides insight into management successes. This is especially relevant when coupled with the medium term green infrastructure recommendation below. The runoff curve number, developed by the USDA Natural Resources Conservation Service, is a widely used metric for estimating runoff and peak discharges in small watersheds (Natural Resources Conservation Service, 1986). Percent and amount of impervious surfaces on campus will be used to calculate this metric among other variables (Figure 12).
  - Provisioning Acreage (i.e. food, timber, fiber). While noted previously that the university's Food Sustainability Panel will study and track local and sustainable food procurement by the university, it should be noted that those efforts will be focused on food for human consumption. It is also important to study and track campus lands used for other provisioning services such as producing livestock feed, orchards used for research and seed stock, or woodlots used for timber. Understanding this acreage and land use will provide insight for enhancing these provisioning services as well as adding additional services to the land through best management practices. As a university with deep agricultural roots this acreage represents a large portion of campus lands and may provide many opportunities to enhance and increase ecosystem services. The university's Facilities Information and Technology Services will be used to track this acreage with collaboration from academic departments.

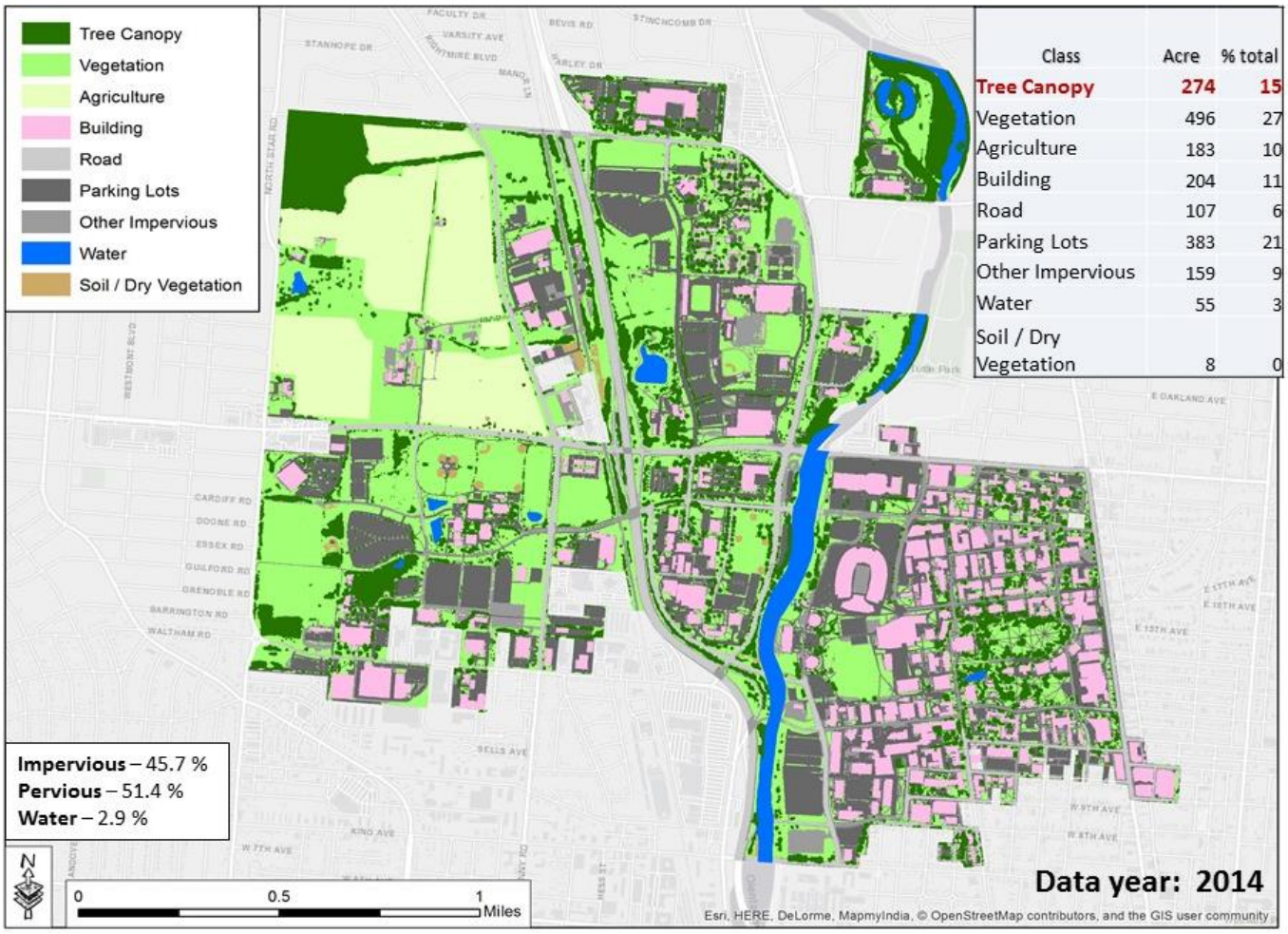

Figure 12: A land classification from 2014 is considered a baseline for tree canopy, as well as impervious surface. The university Geographic Information System (GIS) continues to update a campus landscape map and related data.

Medium Term (3-5 Years)

Three additional recommendations are proposed for the medium (3-5 year) planning horizon. These recommendations need additional time and/or policy adoption for their advancement.

- **Increase the campus tree canopy** with new plantings and share the value of the trees through interactive platforms. As noted in the short term recommendations, tree canopy acreage may be seen as a fundamental metric for ecosystem services. The university should continue to look for opportunities to increase its tree canopy on campus lands as well as in surrounding neighborhoods.

- **Supplement existing grey surface storm water management with green infrastructure projects.** Stormwater management needs to focus on releasing runoff to receiving waters in a way that supports stream stability and function, and maintains water quality

and viable water body ecosystems. Green infrastructure supports this goal by providing opportunities to treat and capture stormwater at the source rather than a regional basin. Additionally, green infrastructure has the potential to add additional value to the landscape such as aesthetic beauty, recreational opportunities, and increased habitat.

- **Reduce the amount of maintained acreage** on campus to decrease maintenance resources and to increase urban meadow habitat. Urban meadows are designated grassy areas where mowing has been reduced to a few times per year promoting natural regeneration of grasses and wildflowers. Urban meadows increase biodiversity by providing areas of pollination, feeding, and nesting for birds, bees, butterflies and other flora and fauna; improve air quality by sequestering carbon monoxide and reducing greenhouse gas emissions from mowing equipment; beautify and diversify the landscape; increase storm water retention as tall grasses and wildflowers trap and treat more water than mowed areas; and create learning opportunities for students (Yale University, 2013).
    - The Living Labs Program would facilitate an assessment of the condition of existing urban meadows on campus.
    - Implement operations (planting, invasive removal) to further restore these areas closer to native habitat.

Urban Meadows at Ohio State

More than 21 acres have transitioned from high-maintenance lawn to tall grass urban meadows that only need mowed annually at the Columbus campus. Studying these areas can help us enhance these ecosystems and the services they provide.

Figure 13: An example of using urban meadows as a sustainable landscape practice at Ohio State.

VIII. Conclusion

At times, the Ohio State University has demonstrated its willingness to manage its properties in a manner that enhances the ecosystem services provided by those properties. However, the university could leverage more social, environmental, and economic benefit through a more comprehensive strategy in protecting, restoring, and managing its property assets. Further, there is an incredible potential for these properties to provide more opportunities for student learning, faculty teaching, community engagement, and research innovation when integrated with the university's operational maintenance. With the initial recommendations provided here, the university is poised to provide leadership on these issues well into the future.

IX. Appendices

Panel Members:

- Maria Conroy, Panel Chair – City & Regional Planning, Knowlton School
- Matt Davies – School of Environment & Natural Resources
- Christianna Dyer – Student Representative, USG Sustainability Committee
- Greg Hitzhusen – School of Environment & Natural Resources
- Andrew Neil – Planning and Real Estate
- Daniela Miteva – Department of Agricultural, Environmental, and Development Economics
- Tina Mohn – City of Columbus
- Stephen Myers – Office of Outreach & Engagement
- Tom Reeves – Office of Student Life
- Mike Shelton – Office of Energy and Environment
- Brian Snyder – Initiative for Food and Agricultural Transformation
- Jimmy Uhland – Student Representative, EEDS Major
- Brenda VanCleave – Facilities Operations & Development
- Steve Volkmann – Planning and Real Estate
- Paul Walsh – Facilities Operations & Development

Panel Meeting Dates:

- January 19, 2018
- February 16, 2018
- March 23, 2018
- May 2, 2018

Sustainable SITES Initiative Scorecard:

Project Name: _____ Project ID#: _____ Date: _____

SITES v2 Scorecard Summary

YES	?	NO	1: SITE CONTEXT		Possible Points:	13
0	0	0				
Y			CONTEXT P1.1	Limit development on farmland		
Y			CONTEXT P1.2	Protect floodplain functions		
Y			CONTEXT P1.3	Conserve aquatic ecosystems		
Y			CONTEXT P1.4	Conserve habitats for threatened and endangered species		
			CONTEXT C1.5	Redevelop degraded sites		3 to 6
			CONTEXT C1.6	Locate projects within existing developed areas		4
			CONTEXT C1.7	Connect to multi-modal transit networks		2 to 3

0	0	0	2: PRE-DESIGN ASSESSMENT + PLANNING		Possible Points:	3
Y			PRE-DESIGN P2.1	Use an integrative design process		
Y			PRE-DESIGN P2.2	Conduct a pre-design site assessment		
Y			PRE-DESIGN P2.3	Designate and communicate VSPZs		
			PRE-DESIGN C2.4	Engage users and stakeholders		3

0	0	0	3: SITE DESIGN - WATER		Possible Points:	23
Y			WATER P3.1	Manage precipitation on site		
Y			WATER P3.2	Reduce water use for landscape irrigation		
			WATER C3.3	Manage precipitation beyond baseline		4 to 6
			WATER C3.4	Reduce outdoor water use		4 to 6
			WATER C3.5	Design functional stormwater features as amenities		4 to 5
			WATER C3.6	Restore aquatic ecosystems		4 to 6

0	0	0	4: SITE DESIGN - SOIL + VEGETATION		Possible Points:	40
Y			SOIL+VEG P4.1	Create and communicate a soil management plan		
Y			SOIL+VEG P4.2	Control and manage invasive plants		
Y			SOIL+VEG P4.3	Use appropriate plants		
			SOIL+VEG C4.4	Conserve healthy soils and appropriate vegetation		4 to 6
			SOIL+VEG C4.5	Conserve special status vegetation		4
			SOIL+VEG C4.6	Conserve and use native plants		3 to 6
			SOIL+VEG C4.7	Conserve and restore native plant communities		4 to 6
			SOIL+VEG C4.8	Optimize biomass		1 to 6
			SOIL+VEG C4.9	Reduce urban heat island effects		4
			SOIL+VEG C4.10	Use vegetation to minimize building energy use		1 to 4
			SOIL+VEG C4.11	Reduce the risk of catastrophic wildfire		4

0	0	0	5: SITE DESIGN - MATERIALS SELECTION		Possible Points:	41
Y			MATERIALS P5.1	Eliminate the use of wood from threatened tree species		
			MATERIALS C5.2	Maintain on-site structures and paving		2 to 4
			MATERIALS C5.3	Design for adaptability and disassembly		3 to 4
			MATERIALS C5.4	Use salvaged materials and plants		3 to 4
			MATERIALS C5.5	Use recycled content materials		3 to 4
			MATERIALS C5.6	Use regional materials		3 to 5
			MATERIALS C5.7	Support responsible extraction of raw materials		1 to 5
			MATERIALS C5.8	Support transparency and safer chemistry		1 to 5
			MATERIALS C5.9	Support sustainability in materials manufacturing		5
			MATERIALS C5.10	Support sustainability in plant production		1 to 5

YES	?	NO	6: SITE DESIGN - HUMAN HEALTH + WELL-BEING		Possible Points:	30
0	0	0				
			HHWB C6.1	Protect and maintain cultural and historic places		2 to 3
			HHWB C6.2	Provide optimum site accessibility, safety, and wayfinding		2
			HHWB C6.3	Promote equitable site use		2
			HHWB C6.4	Support mental restoration		2
			HHWB C6.5	Support physical activity		2
			HHWB C6.6	Support social connection		2
			HHWB C6.7	Provide on-site food production		3 to 4
			HHWB C6.8	Reduce light pollution		4
			HHWB C6.9	Encourage fuel efficient and multi-modal transportation		4
			HHWB C6.10	Minimize exposure to environmental tobacco smoke		1 to 2
			HHWB C6.11	Support local economy		3

0	0	0	7: CONSTRUCTION		Possible Points:	17
Y			CONSTRUCTION P7.1	Communicate and verify sustainable construction practices		
Y			CONSTRUCTION P7.2	Control and retain construction pollutants		
Y			CONSTRUCTION P7.3	Restore soils disturbed during construction		
			CONSTRUCTION C7.4	Restore soils disturbed by previous development		3 to 5
			CONSTRUCTION C7.5	Divert construction and demolition materials from disposal		3 to 4
			CONSTRUCTION C7.6	Divert reusable vegetation, rocks, and soil from disposal		3 to 4
			CONSTRUCTION C7.7	Protect air quality during construction		2 to 4

0	0	0	8. OPERATIONS + MAINTENANCE		Possible Points:	22
Y			O+M P8.1	Plan for sustainable site maintenance		
Y			O+M P8.2	Provide for storage and collection of recyclables		
			O+M C8.3	Recycle organic matter		3 to 5
			O+M C8.4	Minimize pesticide and fertilizer use		4 to 5
			O+M C8.5	Reduce outdoor energy consumption		2 to 4
			O+M C8.6	Use renewable sources for landscape electricity needs		3 to 4
			O+M C8.7	Protect air quality during landscape maintenance		2 to 4

0	0	0	9. EDUCATION + PERFORMANCE MONITORING		Possible Points:	11
			EDUCATION C9.1	Promote sustainability awareness and education		3 to 4
			EDUCATION C9.2	Develop and communicate a case study		3
			EDUCATION C9.3	Plan to monitor and report site performance		4

0	0	0	10. INNOVATION OR EXEMPLARY PERFORMANCE		Bonus Points:	9
			INNOVATION C10.1	Innovation or exemplary performance		3 to 9

YES	?	NO	TOTAL ESTIMATED POINTS	Total Possible Points:	200
0	0	0			

KEY		SITES Certification levels	Points
YES	Project confident points are achievable	CERTIFIED	70
?	Project striving to achieve points, not 100% confident	SILVER	85
NO	Project is unable to achieve these credit points	GOLD	100
		PLATINUM	135

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Figure 14: An example scorecard from the Sustainable SITES Initiative (Green Business Certification Inc., 2018).

X. Additional Figures

Urban Living Conditions	Health Effects
Homes within short distances of a green space	Annual prevalence rate for anxiety disorders and depression was lower for living environments having more green space within one kilometer; an increase of 1% of green space equals the effect of 1-year-lower age.[45] Presence of green space within 3 kilometers distance has a positive health effect.[38] The risk of type II diabetes mellitus is significantly lower in neighborhoods with 40% or greater green space.[46] Exposure to nearby green space and trees may have a positive effect on infant birth weight,[47] particularly for the lowest socioeconomic groups.[48] Homes more than 700 meters from urban green space were associated with increased risk of cardiovascular death after treatment for acute coronary syndromes.[49]
Gardens in urban areas	People in highly urban areas self-reported a higher risk of mental illness, while having a garden was a predictor for lower incidences of illness.[38]
Access to a garden or short distances to green space from home	Subjects experienced less stress and had a lower incidence of obesity, probably due to more outdoor activity and physically healthier modes of travel.[50]
Children and nearby natural settings	Greater exposure to natural settings correlate to lower impacts of stressful life events on psychological well-being.[51]
Minority groups living in high density housing with high exposure to drug misuse and various distances to quality green space	Those closer to green space had lower systolic blood pressure and lower rates of hypertension.[52]
Residents living in areas with loss of urban trees due to emerald ash borer infestation	Residents in areas infested by emerald ash borer suffered an additional 15,000 deaths from cardiovascular disease and 6,000 more deaths from lower respiratory disease compared to uninfected areas.[53]
Urban residents near long-term noise annoyances (such as nearby busy highways)	Having access to nearby green areas reduced noise-caused associated stress impacts.[54]
Coastal living	Good health is more prevalent the closer one lives to the coast. Positive effects may be greater among socio-economically deprived communities.[55] Positive judgment of restorative experiences is dependent on air and water quality.[56]

Figure 15: "Positive health outcomes associated with urban nearby nature experiences" downloaded from (Wolf, Krueger, & Rozance, 2014).

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