Reflections on Teaching Landscape Performance in an Interdisciplinary Graduate Seminar Course

Reid Coffman, PhD
Associate Professor
Kent State University, College of Architecture and Environmental Design
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Course Background

The graduate seminar course entitled *Urban Ecological Systems* is a required course in the professional curriculum in landscape architecture and a recommended course in architecture and urban design curricula. It investigates how novel ecosystems can provide environmental benefits for urban societies. It combines the design and science disciplines to address urban conditions. Fundamentals from the fields of ecology and design are used to inform the conceptualization of design proposals embedded with ecologically oriented hypotheses. A focus of the course is the conceptualization of urban infrastructure projects which deliver an ecological return on investment through the coupling and bundling of ecological services. Having synonymous goals with landscape performance agendas, it was anticipated that grant content would be easily integrated. For the spring 2015 term, 15 students (5 LA, 5 Arch, 5 urban design) were enrolled in the course. Students engaged the material through independent and team investigations where they isolated ecological performance and then re-combined three major performance goals to examine landscape performance and trade-offs.

Goals

1| Develop a working knowledge of the *ecosystem services theory* through the creation of proposals improving the ecological productivity, biological diversity, regulation of water and nutrients in urban sites.
2| Develop skills of identifying, communicating, and quantifying the inputs, outputs, and feedback of contrived ecological systems through diagraming, collage, and calculation.
3| Learn to optimize for an ecological return on investment by selecting for compatible ecological functions through the methods of coupling, bundling and stacking.
4| Advance your knowledge of ecological theory, concepts, and terminology.

Process

The course offers the opportunity to estimate the ecological (landscape) performance of a design proposal. Thus, the students learn the introductory ecological structure and function relationships created in built ecosystems. They are exposed to productivity (energy), nutrients (biogeochemistry), hydrologic cycles, biological diversity, human wellness and ecological narrative. They investigate and teach one another basic ecological concepts ranging from biogeochemical cycles to biological concepts such as ecological niche and social-ecological concepts such as biophilia. Concurrently, in three successive projects, they assess existing performance of a site and estimate performance of one; two and then three services for a proposed design. Each is measured with quantitative methods introduced in class or researched by the student. They use web calculators, calculations, ratios and study findings to estimate performance. For example, they estimate stormwater runoff quantity, then later add nutrient assessment (runoff quality) and lastly add human wellness. Each of those stages is a submittal and presentation. The focus of the class is explaining the methods and defending the validity of their estimations. They practice openness, clarity and objectivity to increase the validity of their estimations. The students work as individuals, in pairs and groups. Evaluation is made through project submittals and presentations.

Reflections

- Overall, students were able to craft and propose ideas that offered co-benefits of landscape performance. At first they had difficulty isolating one ecosystem function from the others to assess its performance. Once that was achieved they realized they could pick and choose a combination of ecological benefits in which to design for. They struggled with designing with the abstract idea of performance and were continually designing for the imagined clients (users) human factors. Through repeated questioning about the structure and function of the designed ecosystem and estimation of the performance variable they began to focus on the combining of ecological benefits. Giving them time to try out different performance benefits during the selection process was essential to learning.
- LAF *Landscape Performance Series (LPS)* material assisted decision making. The web portal of the LAF LPS offered our students both an introductory and in many cases advanced knowledge on the selection and estimation of landscape performance benefits. The breadth was great and the depth was adequate. They did, however, need to be reminded to return to it as a launching point. In the future, I would consider adding a course assignment in which students created literature reviews that could be added to the LAF materials.
- Web-based calculators were the most popular way to develop estimation. The prevalence of web calculators for stormwater, nutrients, and energy (green infrastructure) made it easy for students to estimate performance variables. Less common was the use of peer reviewed scientific literature to support and inform particular performance estimates. Commonly selected calculators were the national tree benefit calculator, green roof calculators, and green infrastructure calculators. Less commonly were i-tree and GIS-

based calculators due a required operational base knowledge. The building architecture graduate students appeared to be comfortable calculating using general mathematic summation and/or formulaic approaches learned in prior course work.

- Students employed a positivist approach and were less inclined to think critically about the trade-offs created by their design proposal. As a result, optimization of a return on investment was not necessarily achieved in the student's work. This could be due mainly to the time required to comprehend the new material, suggesting sequential coursework might be required for more critical thinking.
- Guest lectures enhanced the credibility of the science content. The students in this year's class, as well as years past, responded positively to learning directly from hydrologists, biologists, and biogeochemists about the environment. Several guests are invited to join graduate project and thesis committees.
- The poster, paper, video format was a challenging and enlightening method of tiered communication. The students strongly benefitted by developing a scientific/academic poster or paper in this course. The poster and paper were formatted and themed to be objective estimations of performance. This approach was unusual in their educational background and routine reminders of objectivity were needed.
- The requirement of an interdisciplinary approach was apparent. Disciplinary respect was developed across all design disciplines and to the sciences. Those in the building architecture program tended to share leadership with urban design and landscape architecture students. Landscape architects did assume roles addressing the use and selection of vegetation more commonly, while building architecture tended towards energy and material use and selection. Urban designers varied the most in topical pursuits.

Considerations

- *Use the* LAF *Landscape Performance Series* website*:* The grant materials of landscape performance were easily integrated into the course already based on ecosystem services. The terms 'ecological services' and 'landscape performance' can be used synonymously without confusion. The interdisciplinary nature of the course provided an improved exposure to evidence-based landscape principles. "Performance" as a concept drew non-landscape architects towards landscape content and solidified LA students more deeply in landscape architecture working knowledge. The LAF materials were critical in helping interpret scientific findings into a design student's mode of thinking. They do not easily search peer-reviewed academic literature on applied science, but they did follow the summaries and case studies of the *Landscape Performance Series* website. They were introduced early on to the LAF materials. Looping back to the LAF materials later in the semester during the major project would have improved usage and application. One suggestion is to require one precedent from the site be used in the precedent studies.
- *Emphasize basic ecological principles:* Teaching first year MLA students and advanced graduate architecture students ecological principles allowed for a relatively level playing field. The LA students volunteered for leadership and spoke in class less frequently than other disciplines. This was especially clear during site assessment and design proposal

discussions and team tasking occur. However, when discussion focused on basic ecological principles, they were more active in the course. The occasional switch to' landscape performance' terminology did not create more leadership and engagement in the LA students. Oddly, they retracted a bit. It appeared that building architects and urban designers respectfully waited for LA students to initiate thinking about the 'landscape' content. But when they failed to do so, the other design disciplines initiated the content development. This was unexpected. To provide an even platform in interdisciplinary coursework, I suggest using ecological services language as the guiding pedagogical approach that is further advanced in landscape performance. This provides foundational interdisciplinary knowledge while demonstrating landscape architectures' commitment to knowledge and practice advancement.

- *Introduction and Application:* Critical thinking and discussion were hard to reach in this introduction course. Even though it was at the graduate level, students were still grasping the breadth and depth of ecological knowledge for evidence based design. They did not fully grasp the idea of 'trade-offs,' where some performances outweigh, or even supplant, others, due to incompatibility, context, or stewardship limitations. After teaching this course a number of times, I may try to adjust the content slightly to include 'tradeoffs' as a more important concept without sacrificing introduction and applications of landscape performance. Because it was successful at focusing on estimating performance across design disciplines, emphasizing the knowledge and understanding of why and how ecological services are created should remain the priority of the course. Advanced critical thinking can be advanced in studio and independent research activities.

Urban Ecological Systems

The services of novel ecosystems
LARC 60602 & UD 65632

Instructor	Reid Coffman	Office	Monday 10-11am, or by appt.
Location	Cleveland Class room	E-mail	rcoffma4@kent.edu
Times	W 8:45-11:45 am	Phone	405-443-6497

Description

This course investigates how novel ecosystems can provide environmental benefits for urban societies. It combines the design and science disciplines to address urban conditions. Fundamentals from the fields of ecology and design are used to inform the conceptualization of design proposals embedded with ecologically oriented hypotheses. A focus of the course is the conceptualization of urban infrastructure projects which deliver an ecological return on investment through the coupling and bundling of ecological services.

Guiding Questions

- Why should we design 'nature' in the city?
- How a can we estimate the contribution of 'urban nature'?
- How can we represent and communicate those contributions across disciplines?

Goals

1| You will develop a working knowledge the of *ecosystem services theory* through the creation of proposals improving the ecological productivity, biological diversity, regulation of water and nutrients in urban sites.
2| You will develop skills of identifying, communicating, and quantifying the inputs, outputs, and feedbacks of contrived ecological systems through diagraming, collage, and calculation.
3| You will learn to optimize for an ecological return on investment by selecting for compatible ecological functions through the methods of coupling, bundling and stacking.
4| You will advance your knowledge of ecological theory, concepts, and terminology.

Qualifications

All students must have CAED graduate status and be proficient in 2-3D visual representation, graphic communication and the design process.

Requirements

Class attendance and completion of all assignments, projects and exams is required. It is expected that you will expand on the class material for the completion of work. The course will have weekly tasks, six major assignments, one term assignments and three exams. Each of the major assignments will require a combination of individual and team work with peers.

- Module 1: Identify our current and impending socio-environmental problems.
- Module 2: Calculating Ecological Services in microcosm

- 101 The Fundamentals of Ecology - present a fundamental ecological concept to your peers. Reading and Presentation

Term Projects:

Participate in the separating and recombination of site elements to provided intentional ecological services. The student team will use assessment, literature review, and design proposal to engage coupling and bundling the following flows and effects.

  - Calculating energy flows
  - Calculating the hydrology flows
  - Calculating the nutrient flows
  - Calculating biological diversity flows.
  - Calculating human health and wellness effects

Three Study locations

- Small Commercial (Happy Dog)
- Civic Park (Canal Basin Park)
- Large Industrial (CIIC)

Products

- P1: Poster: Develop from foundational analysis, a site graphic and schematic proposal for offering discrete services using site issues, calculators and peer reviewed literature on urban ecological performance.
- P2: Paper: Author a technically oriented design proposal paper that conveys the details of your schematic proposal.
- P3 : Video: Author a synoptic video that educates and illustrates how ecosystem services can be returned to the urban condition, using your proposal as an example.

Coordination efforts

The class will coordinate with various external groups including Landscape Architecture Foundation (LAF) Performance Series, Cleveland Metroparks, Northeast Ohio Regional Sewer District (NEORSD) and the Ohio & US EPA. Also, the course will coordinate when applicable with Novel Ecology Design Lab (NEDLAB), Robotics Lab and CAED materials lab through on-going projects .

Resources

Course folders in Dropbox (email invitation will be provided by instructor).

Required Text

Ecology: Theory and Application Peter Stiling 4th edition. 2002 Prentice Hall Publishing
Projective Ecologies C. Reed & Nina-Marie Lister 2014 Harvard Press,
The Professional Design Guide to Green Roofs K. Dakin, L.L. Benjamin and M. Pantiel 2013 Timber Press

Recommended

Living Systems: Innovative Materials and Technologies for Landscape Architecture L. Margolis and A. Robinson 2007 Birkhauser

Websites

Millennium Ecosystem Assessment http://www.millenniumassessment.org/en/index.html
Landscape Performance Series http://landscapeperformance.org/

ASLA Sustainable Landscapes http://www.asla.org/sustainablelandscapes/index.html
Sustainable Site Initiative http://www.sustainablesites.org/
Center for Low Impact Development http://www.lid-stormwater.net/
Landscape Machines Laboratory http://landscapemachines.com/about/

Web based Documents
Re-Imaging A More Sustainable Cleveland
https://docs.google.com/file/d/0B9gEzUmYRccJMTZkMGMwNDAtZDVjOS00NGVlLWJjMDgtZDFiNWZiNTlkOWRh/edit?hl=en_US&pli=1

Evaluation
Overall, students will be evaluated on the quality of information provided within their work and their professionalism within the course. Each assignment will possess its discrete criteria.

Module 1	5%
Module 2	10%
P1: Poster	20%
P2: Paper	20%
P3: Video	20%
101 Fundamentals	10%
Presentation/Review	10%
Professionalism	5%

Class meetings
University scheduled meeting time includes lectures, seminars, group and individual meetings - these times may be augmented with additional lectures, and field trips.

Building Hours
Students are required to comply with the university established building hours of operation.

Building and Equipment Maintenance
Students are required to maintain the studio and class areas in conformance with fire safety, health regulations and codes and to maintain a "professional working environment". These requirements include: not overloading electrical circuits, not accumulating waste materials and not blocking exit access pathways. It is critical that doors not be propped open circumventing the security system established for your safety.

School Policy
As a reminder, the classrooms, studio, offices and hallways are non-smoking areas and the use of radios/TV/CD/DVD, etc…at any time is discouraged and permitted only at the faculty's discretion and only when using headphones. Clarify the use of the above with the individual studio faculty. *Refrigerators, microwaves, coffeemakers, personal lounge furniture (couches etc…) are not allowed in the studio. Alcohol and drugs are strictly prohibited in studios. See studio policy.*

Computer System Policies, Rules and Responsibilities

See CAED website. The CAED does not condone or support the use of unlicensed/illegal software.

Course Accessibility

In accordance with University policy, Regarding Students with Disabilities (Revised 6/01/07) University policy 3342-3-01.3 requires that students with disabilities be provided reasonable accommodations to ensure their equal access to course content. If you have a documented disability and require accommodations, please contact the instructor at the beginning of the semester to make arrangements for necessary classroom adjustments. Please note, you must first verify your eligibility for these through Student Accessibility Services (contact 330-672-3391 or visit www.kent.edu/sas for more information on registration procedures).

Course Schedule (see attached)

Urban Ecological Systems

The services of novel ecosystems

Reading List

Urban Problems and Conditions

Millennium Ecosystem Assessment 2003 'Urban Systems', Chapter 12, p795-825

Ecosystem Services

Millennium Ecosystem Assessment 2003 'Conceptual Framework', Chapter 1, p1-12

De Groot, R. S., Wilson, M. A., & Boumans, R. M. (2002). 'A typology for the classification, description and valuation of ecosystem functions, goods and services'. *Ecological economics*, *41*(3), 393-408.

Urban Ecology and Landscape(isms)

Corner, J. 2006 'Terra Fluxus', The Landscaper Urbanism Reader, Princeton Arch Press, pg 21-33

Roncken, P. A., Stremke, S., & Paulissen, M. P. (2011). Landscape machines: productive nature and the future sublime. *Journal of Landscape Architecture*, *6*(1), 68-81.

Hight, C. 2014 'Designing Ecologies' in Projective Ecologies Harvard GSD pg 84-105

Green Infrastructure

Coffman R. and Strosnider, K. 2009 "Public rain gardens for water quality in extreme environments." *Land and Water Magazine,* Nov-December pgs 37-40

Living Architecture

Oberndorfer, E., Lundholm, J., Bass, B., Connelly, M., Coffman, R., Doshi, H., Dunnett, N., Gaffin, S., Köhler, Liu, K., Rowe, B. 2007 'Green Roofs as Urban Ecosystems: Ecological Structures, Functions, and Services' *Bioscience*, Vol. 57 , issue. 10, Nov (cover and feature article)

Succession and Time

Waldheim, C 2006 'Landscape as Urbanism', The Landscaper Urbanism Reader, Princeton Arch Press, pg 35-52

Resiliency and Adaptation

Holling C.S. and Goldberg, MA 1971 'Ecology and Planning' reprint in Projective Ecologies Harvard GSD pg 106-123

Wu J and Wu T 2013 'Ecological Resilience as a Foundation for Urban Design and Sustainability' in Resilience in Ecology and Urban Design Spinger pgs 211-229

Urban Ecological Systems

The services of novel ecosystems

Nested Ecologies

Botkin D. 1990 'Within the Mooses Stomach: Nature as the Biosphere' originally in *Discordant harmonies*, reprinted in *Projective Ecologies*, Harvard GSD p 152-167

Hydrology

Shaw D. and Schmidt R. 2003 *Plants for Stormwater Design: Species Selection for the Upper Midwest.* Minnesota Pollution Control Agency 369pg

Nutrients

Read, J., Fletcher, T. D., Wevill, T., & Deletic, A. (2009). 'Plant traits that enhance pollutant removal from stormwater in biofiltration systems.' *International journal of phytoremediation*, *12*(1), 34-53.

Human Health and Well Being

Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kaźmierczak, A., Niemela, J., & James, P. (2007). 'Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review'. *Landscape and urban planning*, *81*(3), 167-178.

WEBSITES

Millennium Ecosystem Assessment http://www.millenniumassessment.org/en/index.html

Landscape Performance Series http://landscapeperformance.org/

ASLA Sustainable Landscapes http://www.asla.org/sustainablelandscapes/index.html

Sustainable Site Initiative http://www.sustainablesites.org/

Center for Low Impact Development http://www.lid-stormwater.net/

Landscape Machines Laboratory http://landscapemachines.com/about/

Re-Imaging A More Sustainable Cleveland
https://docs.google.com/file/d/0B9gEzUmYRccJMTZkMGMwNDAtZDVjOS00NGVlLWJjMDgtZDFiNWZiNTlkOWRh/edit?hl=en_US&pli=1

Ecoregions map of North America http://www.epa.gov/wed/pages/ecoregions.htm

CALCULATORS

Green infrastructure Calculator
http://greenvalues.cnt.org/calculator/calculator.php

Milwaukee Green Infrastructure Calculator
http://www.h2ocapture.com/Calculate.aspx

National Tree Benefit calculator
http://www.treebenefits.com/calculator/

Arbor Day Tree Calculator
https://www.arborday.org/calculator/

USFS itree
http://www.itreetools.org/index.php

Green roof- Green Save Calculator
http://www.greenroofs.org/index.php/resources/greensavecalculator

NedLab Green Roof calculator (in M2 folder)

SUMMARIZED LITERATURE

LAF Fast Fact (annotated bibliography)
http://www.lafoundation.org/research/landscape-performance-series/fast-facts/

ASLA Sustainable Design Resource Guides http://www.asla.org/guidesandtoolkit.aspx

By topic

Hydrology

USFS http://www.fs.fed.us/psw/programs/uesd/uep/research/water.shtml
Center of Urban Forest Research http://www.fs.fed.us/psw/programs/uesd/uep/
Calculators Sustainable Cities Institute
http://www.sustainablecitiesinstitute.org/view/page.basic/calculator/tag.topic/water
Storm Water Calculator http://www.epa.gov/nrmrl/wswrd/wq/models/swc/
Water Cycle Basics
http://www.youtube.com/watch?v=5LQ1tbZCQ94
http://www.youtube.com/watch?v=nkcI5xcO1Nw
Kyle Drefus-Wells and Susannah Drake Video http://www.cudc.kent.edu/blog/?p=2138
Cuyahoga River water Quality Report
http://www.epa.ohio.gov/portals/35/documents/cuyvol1.pdf
Cuyahoga Wetlands Assessment Report
http://www.epa.ohio.gov/portals/35/wetlands/CuyReportFinal_08Sept2007.pdf

Cuyahoga River Biological Assessment NEORSD 2006
http://www.cuyahogariverrap.org/Symposium_2006/b_Session%201/6_John%20Rhoades/061018%20Cuyahoga%20River%20Biological%20Assessment.pdf

Northeast Ohio Regional Sewer District- Project Clean Lake
http://www.neorsd.org/cso.php

Northeast Ohio Regional Sewer District- what is a watershed?
http://www.neorsd.org/whatisawatershed.php

Low Impact Development
http://www.lowimpactdevelopment.org/
this site provides information on reducing runoff, while use rainfall as a local resource.

LID Design Tools
http://www.lid-stormwater.net/
Very crude, but demonstrates basic concepts.

L-Thia for Low Impact Development
https://engineering.purdue.edu/mapserve/LTHIA7/lthianew/lidIntro.php
This site is used to proof data that is gathered, or used to augment data mining exercise. Lacks context specific proposal options.

CNT Greenvalues Neighborhood Stormwater Management Calculator
http://greenvalues.cnt.org/national/calculator.php

Nutrients

USFS Trees and Climate http://www.fs.fed.us/ccrc/topics/urban-forests/

See many water related

Productivity/Biodiversity

USFS Urban and Community Forestry Website http://www.fs.fed.us/ucf/
Center of Urban Forest Research http://www.fs.fed.us/psw/programs/uesd/uep/
Ebird http://ebird.org/content/ebird/
USFWS Endangered Species Ohio
http://www.fws.gov/midwest/endangered/lists/ohio-cty.html
Center for Biological Diversity
http://www.biologicaldiversity.org/programs/biodiversity/species_agreement/map.html
Trophic Cascades Program
http://www.cof.orst.edu/rangecontractions/maps.php
Tree Shrubs and Vines for Attracting Birds
http://books.google.com/books?id=H3Cx1hB-TeQC&pg=PR9&lpg=PR9&dq=Trees,+Shrubs,+and+Vines+for+Attracting+Birds+by+DeGraaf&source=bl&ots=ybbTcoaxty&sig=Z9URku54SU9V_Asgb1rM96IDZUM&hl=en&sa=X&ei=xCY_U4GqKvLJsATRr4CQDw&ved=0CH8Q6AEwBA#v=onepage&q=Birch&f=false
Butterfly Attracting Plants- Ohio
http://ohioline.osu.edu/w-fact/0012.html
Forest types of Ohio
http://ohioline.osu.edu/forests/forst_5.html

Humans and Values

Articles of Human Health and Well being at University of Illinois
http://lhhl.illinois.edu/all.scientific.articles.htm
Biophila mini-literature review https://blebeau2014.wordpress.com/literature-review-on-biophilia/

GI and Human Health - a literature review
http://www.sciencedirect.com/science/article/pii/S0169204607000503

Green Infrastructure/Ecological Values ($)

American Rivers the Value of Green infrastructure
http://www.americanrivers.org/newsroom/resources/the-value-of-green-infrastructure/

US Governmental Service Administration *The Benefits and Challenges of Green Roofs on Public and Commercial Buildings*
http://www.gsa.gov/portal/mediaId/158783/fileName/The_Benefits_and_Challenges_of_Green_Roofs_on_Public_and_Commercial_Buildings.action
John Cromptons Green space and economics
http://agrilife.org/cromptonrpts/selected-books-articles-and-presentations/selected-articles/
Wildlands as "economic engines" http://dirt.asla.org/2012/06/11/what-homeowners-want-wildlife-refuges/
Ohio Tree Value
http://oardc.osu.edu/7050/Ohio-State-Research-Shows-Dollar-Value-of-Urban-Trees-Benefits-NE-Ohio-City.htm

Urban Ecological Systems

The services of novel ecosystems

M1: Identifying our human induced environmental problems

What are the socio-ecological problems of Cities?

Step 1: Begin with your intuition and frame a "hunch" or two about socio-ecological problems in the built environment. Use the class materials and the web to examine the importance and truth of your hunch. Let this lead you to explore why we should have nature in cities by defining the socio-environmental problems related to cities and urbanization by identifying the pressing socio-environmental problems facing our world.

Just a few topics for consideration

Overpopulation
Freshwater scarcity
Water pollution
Global warming/climate change
Loss of biological diversity
Access to food or nutrition
Production of food
Human physical health
Greenhouse Gas Emissions
Human psychological health
Desertification

Step 2: Write each topic on sticky note (Large enough to read from a 6' distance), bring separate information to support and explain your position in class, determine relatedness of topical categories. Place sticky notes under categories and discuss.

Be prepared to discuss these questions: Why do you consider this a socio-environmental problem? Who says so? How is that determined? How do we as designers contribute to this problem?

Supporting your "Hunch" with facts and stories. Use organizations and agency information. Give rankings and be able to verbally cite studies and reports.

- What are the rankings for the world, the country, Ohio and Cleveland? (global to local scales)
- What are the units of measure for these problems? (What are the parameters?)
  FOR EXAMPLE: water quality can be measured by nutrients in the water, listed impaired stream lengths in miles, beach closures, warnings per year. Biodiversity can be measured by area (sq miles) of habitat loss, or species listed as of concern, threatened, or endangered. Use conventional parameters.
- How do we as designers contribute to this problematic condition? Are we ignoring it?
- Advice : Be prepared to use a combination of quick take-away facts and stories that dig deeper and contextualize *For example. "Ohio is ranked fifth in the US in (Stream habitat loss) by (US wildlife fund) " And "land area from the (Ohio Department of Natural Resources) shows a decline*

in (stream amphibians and other stream organisms) and "human health consequences are created by this can be… people experience less stress when living near urban green spaces." (a continuing decline of water quality and increase frequency of dangers like toxic algae)"

Tools: pencil and paper

Organization: Individuals

Tools: Computer with Web server and software,

Resources: your brain, google, Millennium Ecosystem Assessment (MEA), etc.

- Millennium Ecosystem Assessment http://www.millenniumassessment.org/en/index.html
- Assessments by topic from the MEA http://www.millenniumassessment.org/en/Condition.html
- MEA synthesis reports. http://www.millenniumassessment.org/en/Synthesis.html
- Re-Imaging A More Sustainable Cleveland (emphasizing the first few pages) https://docs.google.com/file/d/0B9gEzUmYRccJMTZkMGMwNDAtZDVjOS00NGVlLWJjMDgtZDFiNWZiNTlkOWRh/edit?hl=en_US&pli=1
- Cuyahoga Wetlands Report
- Northeast Ohio's combined Sewers http://www.neorsd.org/cso.php

Submittal format:

- 3 sticky notes
- 1-3 numeric or quantitative facts about each problem with key points, citation and references
- 1- 3 images (8.5 x 11) print outs with visual descriptions and/or quantitative data for graphic communication-- Images, Graphs, charts, and photos

Due: Next class period

Evaluation Criteria: Crossing scales (global to local), Clear Opinions (hunch), Factual Data support, Story, Relevance, Professionalism,

Urban Ecological Systems

The services of novel ecosystems

M2: Assessing the ecological services of a green infrastructure project

Unstacking ecological services

You will schematically represent and calculate the ecological services of a site. In a group of 4-5 students assess the site elements to create a report that calculates the ecological services of the site.

Part 1

Step 1: Use a systems diagram: diagram the inputs, outputs and interactions of the study site. Identify calculators and calculate 1-2 ES

Create a systems diagram, Calculate the roof contributions, identify the calculators for the rest of the site.

Tools: power point, in design, or program of choice, NedLab calculator

Due: Wednesday 1.28 **In class:** present system diagram and calculators being used

Submittal format: power point ppt, 3-5 slides 30 min prior to class place in M2 submittal folder (title file: all last names _ M2 ex. *Coates-Jones_ Smith_Harris _M part 1)*

Part 2

Step 2: Create an exploded axonometric with stacked layers representing the various services.

Tools: Autocad or equivalent, illustrator, power point, pdf creator, other

Step 4: Calculate the ecological services using the

Tools: VRS ecological calculator

Step 5: Create image charts describing the services provided by such as proposal

Tools: Autocad or equivalent, illustrator, power point, excel, pdf creator, other

Due: Wednesday 2.4 A powerpoint presentation. 30 min prior to class place in M2 submittal folder (title file: all last names _ M2 ex. *Coates-Jones_ Smith_Harris _M2)*

Due: Monday 2.4 In class:

Submittal format: power point ppt, slides covering the following, 5 minute presentation

Urban Ecological Systems

The services of novel ecosystems

- Overview introducing the problem, intent of the proposal, and outcome.
- Clarify and define the socio-environmental problems- global local, site
- A systems diagram of existing and proposed (existing fading to proposed), In a side column list details (animate as needed).
- A ecosystem service schematic existing and proposed (existing fading to proposed), In a side column list details and techniques used, (animate as needed).
- Images charts or bar graphs of ecological services

Evaluation Criteria: Rational/argument, Systems diagram, explanation of calculators, presentation of ES via axonometric schematics, professionalism




Unstacking Ecological Services– M2 Part 2

Nykamp, Shaw, Milius, Alosimi, Killen

Calculator Review

Green roofs help to reduce the amount of runoff from rooftops by holding stormwater in the plantings and growing media. The calculator shows how much water can be saved by a green roof and to calculate the reduced energy use.

Green Roof

Property Type

Commercial

Size (sq. ft.):

600

Calculate

Energy Use (equiv. kWh/year)	9.3
CO2 reduction (kg/year)	13.3
# Days Car Removed from Roadway	1
Median Runoff Reduction (%/year)	60%
Recharge obtained / year (k-gal)	7.7
TSS Removed (lbs/year)	6.5
Total Capital Costs	$19,080.00
Total Cost/gallon	$0.10
Maintenance Costs / year	$246.00

Porous pavement helps to reduce stormwater runoff by allowing the water to infiltrate into its open pore space. The calculator tool below can help you determine how much water porous pavement can hold and how much pollution it prevents from entering into area waterways.

Paths/Porous Pavement

Property Type

Commercial

Size (sq. ft.):

20,000

Calculate

Energy Use (equiv. kWh/year)	387.1
CO2 reduction (kg/year)	554.4
# Days Car Removed from Roadway	34
Median Runoff Reduction (%/year)	75%
Recharge obtained / year (k-gal)	322.6
TSS Removed (lbs/year)	338.7
Total Capital Costs	$100,000.00
Total Cost/gallon	$0.02
Maintenance Costs / year	$4,600.00

scroll over for details

Rainwater harvesting includes rain barrels and cisterns. Rain barrels are water collection units that you can put on the outside of your home or garage that collect stormwater from your gutter system. Cisterns are similar to rain barrels in that they can collect water from the gutters on your roof and can also hold grey water from inside and outside of your home (shower water, laundry water, but not toilet water). Use the calculator tool below to help you determine the benefits of installing a rainwater harvesting system.

Cistern and Rain Barrels

Property Type

Commercial

Size (gallons)

2000

Calculate

Energy Use (equiv. kWh/year)	51.6
CO2 reduction (kg/year)	73.9
# Days Car Removed from Roadway	5
Median Runoff Reduction (%/year)	40%
Recharge obtained / year (k-gal)	43.0
TSS Removed (lbs/year)	24.1
Total Capital Costs	$5,080.00
Total Cost/gallon	$0.01
Maintenance Costs / year	$20.00

Green Values Stormwater Management Calculator

CALCULATOR

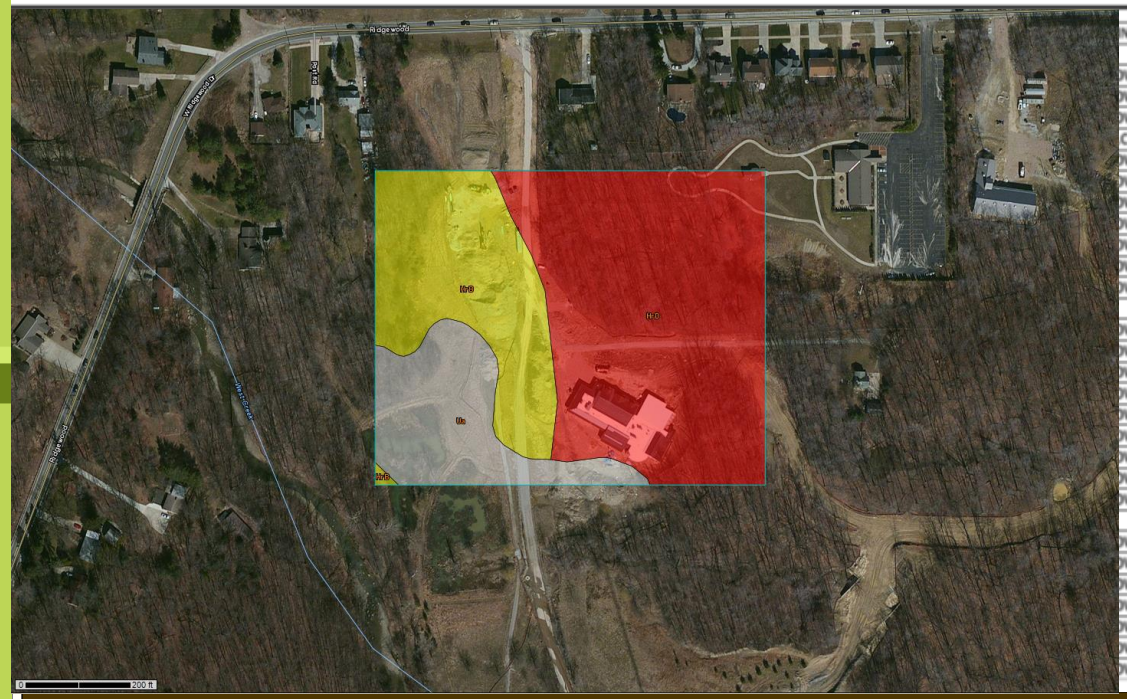
Green Interventions:

- Roof Drains to Raingardens at All Downspouts: ☑
- Half of Lawn Replaced by Garden with Native Landscaping: ☑
- Porous Pavement used on Driveway, Sidewalk and other non-street pavement: ☑
- Green Roofs: ☐
- Provide Tree Cover for an Additional 25% of Lot: ☑
- Use Drainage Swales instead of Stormwater Pipes: ☑

Site Statistics:

- Select a scenario: Custom
- Is this an existing site: (If clicked no construction costs included) ☑
- Total size of site: 1.35 acres
- Number of lots: 1
- Average Roof Size, including Garage: 8412 ft.²
- Average Number of Trees on Lot: 137
- Average Driveway Area: 10000 ft.²
- Average Impermeable patio, deck, alley or parking lot: 21150 ft.²
- Sidewalk Width: 5 ft.
- Average Street Width: 32 ft.
- Soil Type: C
- Average Slope: 3%
- Real Discount Rate: 3.1 %
- Life Cycle in Years: 100

Input



NG	TYPE	A77	A78	A79	A80	A81	A82	A83	A84	A85	A86	A87	A88
WN	Shade							3		1		3	
WN	Shade						3	6					
WN	Shade							3					
C	Ornamental										7		
WN	Ornamental								3	2			
WN	Ornamental						4		2		4	1	7
WN	Shade									2		4	
WN	Shade		1	1									
WN	Ornamental						4		5	24	5		
WN	Ornamental						1						
WN	Ornamental							9					
WN	Ornamental										2	2	
WN	Shade						2		2				
WN	Shade							3	3				
WN	Shade		1					1					
WN	Shade						3	3	2				2
WN	Ornamental						1			2		2	1
WN	Evergreen				9								
WN	Evergreen				9								
WN	Evergreen							4					5
WN	Shade							3					
WN	Shade					3		6					3
WN	Shade	1		1			3	4					2
WN	Shade					2							2
WN	Shade											2	
WN	Evergreen							7	3				14
WN	Shade									2			

Tables — Drainage (OH) — Summary By Map Unit

Summary by Map Unit — Cuyahoga County, Ohio (OH035)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
HrB	Hornell silt loam, 2 to 6 percent slopes	Somewhat limited	Hornell (85%)	Restricted permeability (0.94)	2.7	26.4%
				Depth to bedrock (0.11)		
				Slope (0.04)		
HrD	Hornell silt loam, 12 to 18 percent slopes	Very limited	Hornell (85%)	Slope (1.00)	5.8	56.1%
				Restricted permeability (0.94)		
				Depth to bedrock (0.11)		
Ua	Udorthents, loamy	Not rated	Udorthents (100%)		1.8	17.5%
Totals for Area of Interest					**10.4**	**100.0%**

Results

RESULTS

The difference between the conventional system and the green intervention(s) you chose increases the total 100 year life cycle costs and/or decreases benefits by a total of $212,166. This strategy reduces peak discharge by 39%.

Permanent link for this configuration

Hydrologic | Financial | Financial Detail | Scenario Detail

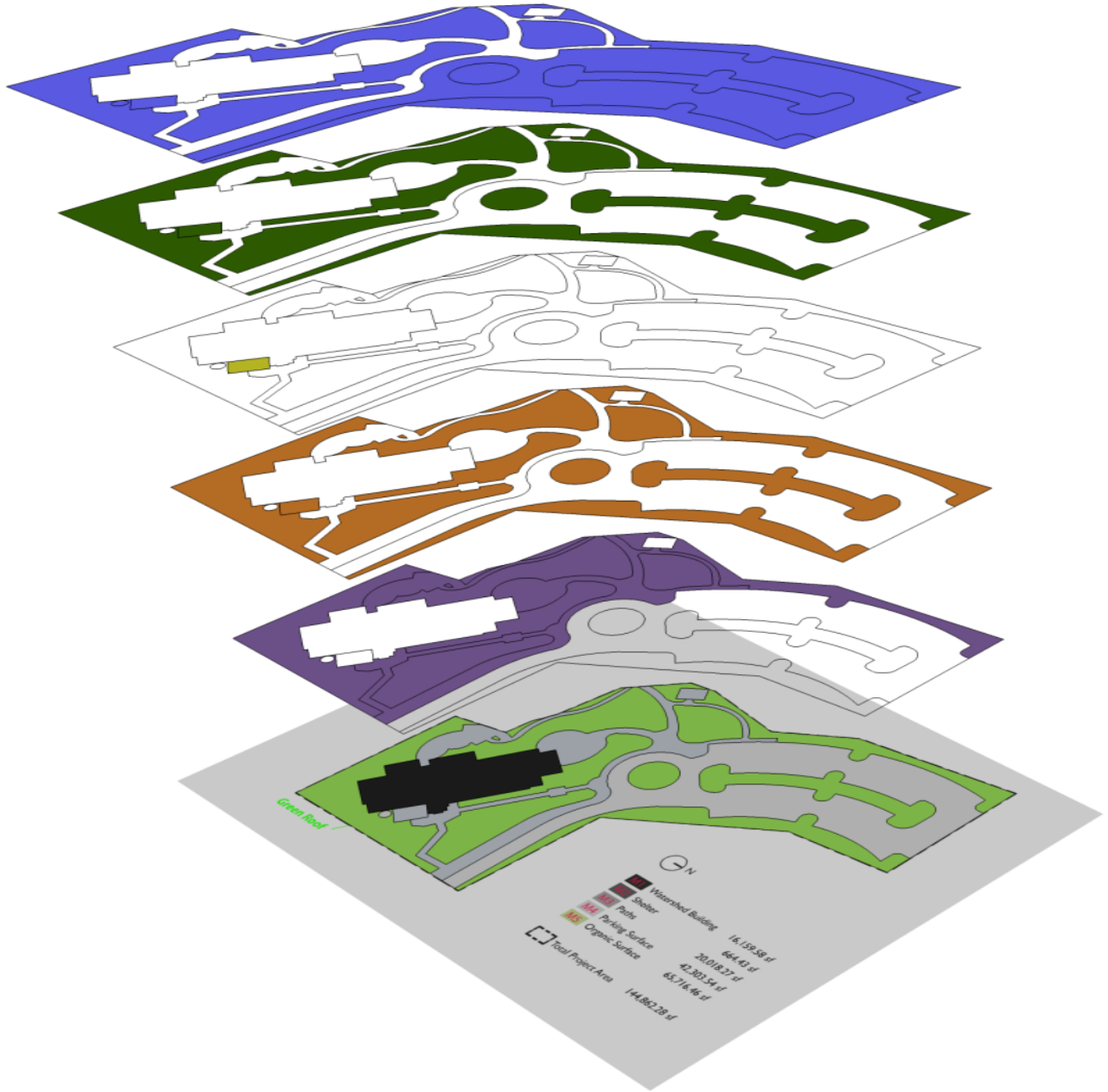
Hydrologic Results

Lot Level Improvements:	Conventional	Green	Reduction
Lot Discharge (cf)	3,770	506	86.6%
Lot Peak Discharge (cfs)	0.93	0.12	87.5%
Total Site Improvements:	**Conventional**	**Green**	**Reduction**
Total Peak Discharge (cfs)	1.49	0.90	39.3%
Detention Size Improvements:	**Conventional**	**Green**	**Reduction**
Total Detention Required (ft^3)	3,636	1,674	54%
Annual Discharge Improvements:	**Conventional:**	**Green:**	**Average Annual Ground Water Recharge Increase:**
Average Annual Discharge (acre ft)	1.13	0.69	0.28

http://greenvalues.cnt.org/calculator/calculator.php

VRS Calculator- Green Roof Only

- Rainfall Capture- 825.75 ft^3/yr
- Biodiversity – Species Richness of 38
- Ambient Urban Air Temperature- Production Estimate 19 sqft.
- Honey Production- 2 lbs/yr



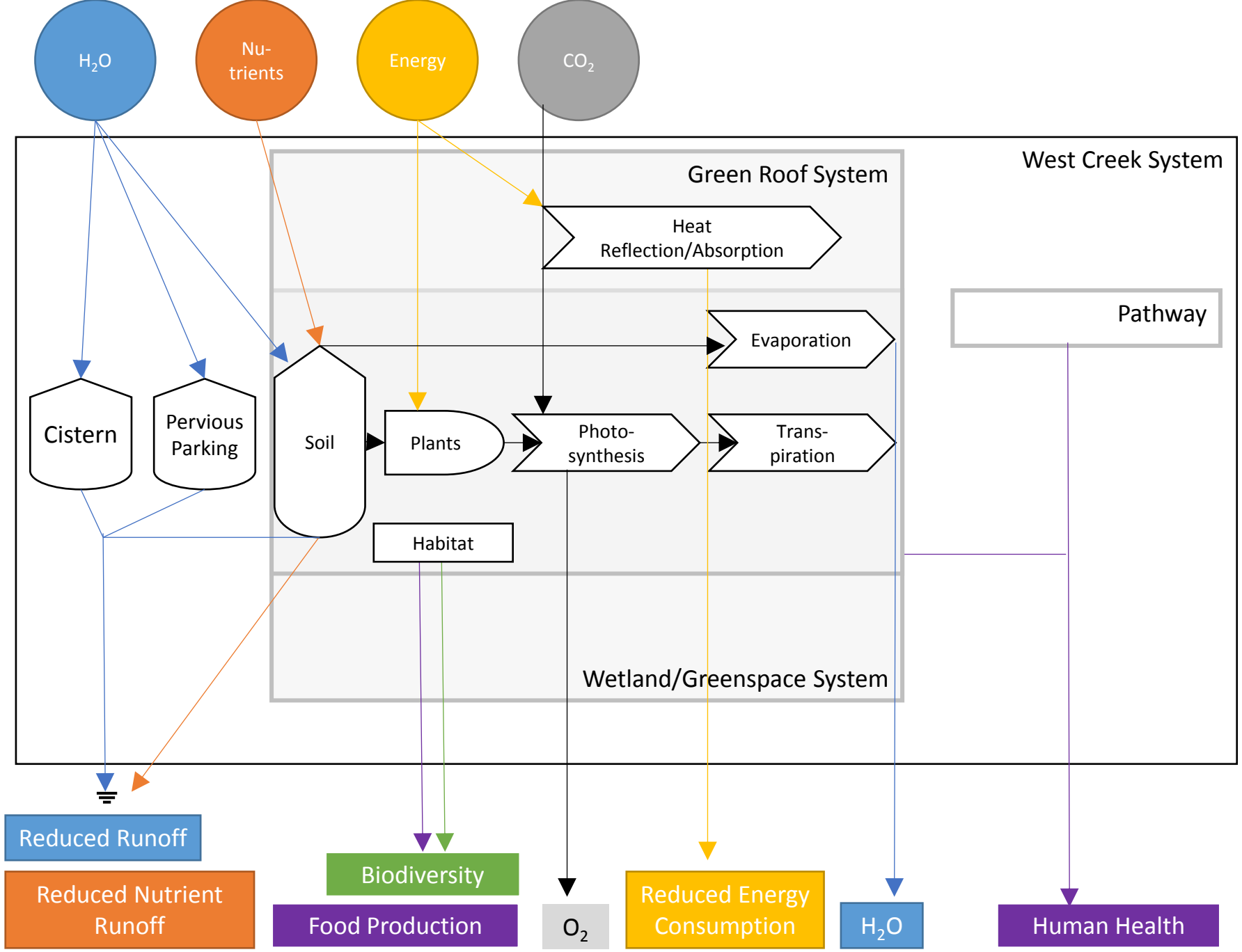
Water

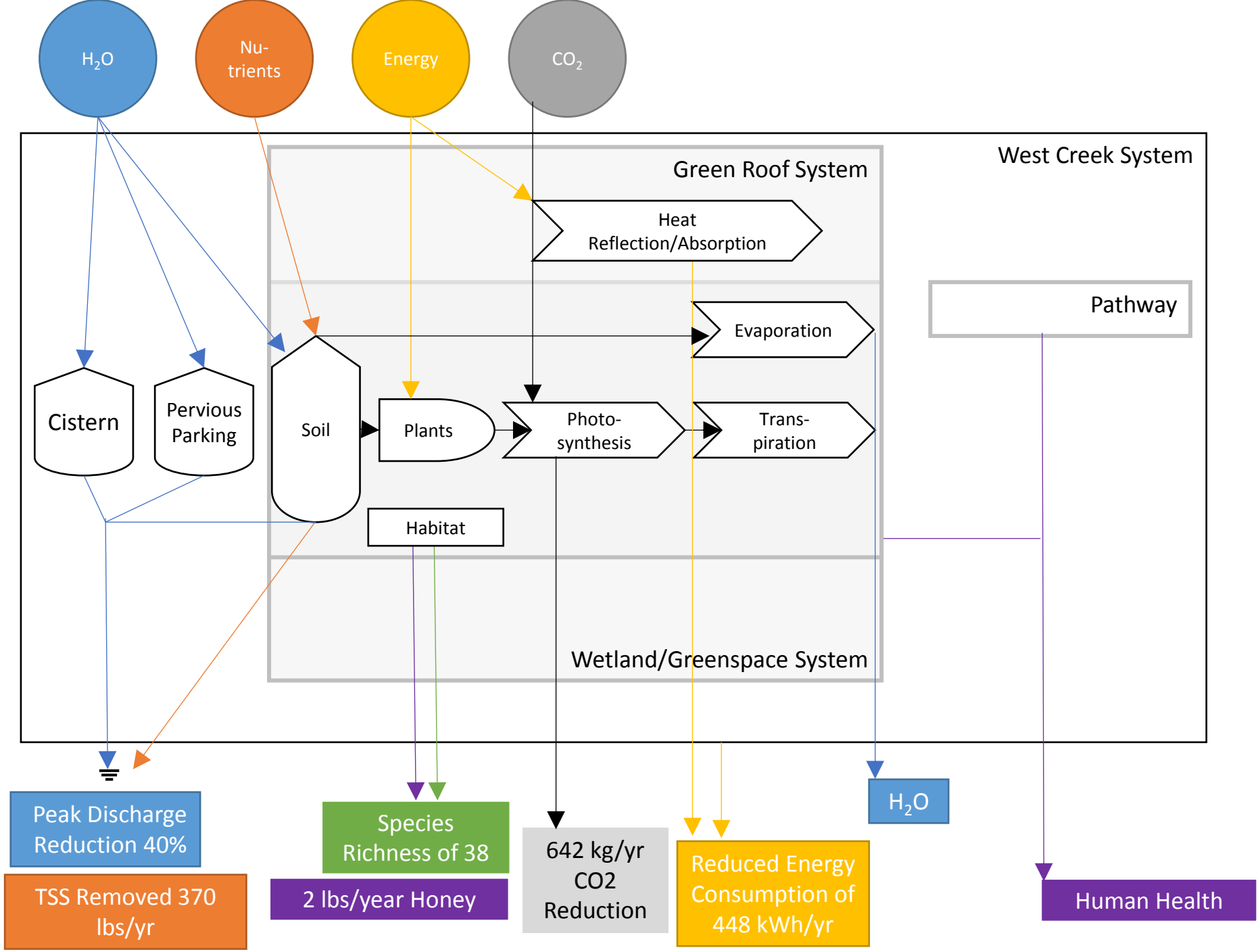
Biodiversity

Energy

Nutrients

Human Health


H_2O
Nu-trients
Energy
CO_2
West Creek System
Green Roof System
Heat Reflection/Absorption
Pathway
Evaporation
Cistern
Pervious Parking
Soil
Plants
Photo-synthesis
Trans-piration
Habitat
Wetland/Greenspace System
Reduced Runoff
Reduced Nutrient Runoff
Biodiversity
Food Production
O_2
Reduced Energy Consumption
H_2O
Human Health


H_2O
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Soil
Plants
Photo-synthesis
Trans-piration
Habitat
Wetland/Greenspace System
H_2O
Peak Discharge Reduction 40%
TSS Removed 370 lbs/yr
Species Richness of 38
2 lbs/year Honey
642 kg/yr CO2 Reduction
Reduced Energy Consumption of 448 kWh/yr
Human Health

P1-3: Bundling Urban Ecological Services

Bundling ecological services at the site level

Urban development reconfigures abiotic and biotic site elements to provide cultural and information services that inadvertently create ecological liabilities such as waste stream flows in the form of heat, energy, runoff, decreased biological diversity, etc.. Prioritizing these ecological services in the form of conservation reclaims lost services while excluding cultural and information services. To reconcile this dichotomy, you are asked to bundle ecological and cultural or information services in novel ways that make architecture and infrastructure into mutually productive urban ecologies.

Begin by assessing the ecological and cultural services of an existing site (Commercial, Industrial, and Civic) and create a re-design combining three ecological services in a new proposal of the site. The new proposal will "model", or estimate, ecological services performances to determine the ecological productivity of the site. You can redesign all items of landscape, infrastructure and architecture to accomplish these goals. Incorporating distinct forms of green infrastructure and living architecture will be helpful practices for repurposing architecture and infrastructure for ecological productivity. However, the selection and design of the practices should optimize the identified ecological services. These optimizations will drive creativity and novelty of the proposal.

It is recommended that you approach the three ecosystem services through a structure-function relationship and material systems-flow perspective. Understand the potentials of green infrastructure and living architecture to deliver ecological services before you begin optimization of performance. As you and your team mates call attention to these ecological services using simplified diagrammatic imagery and succinct language will assist across the various forms of communication that will be required.

Major Phases

- **Assessment of Ecological Services**
- **Story of the site and proposal**
- **Schematic proposals of Ecological applications (GI and Living Architecture)**
- **Maximizing performance (Novel ecologies and new approaches)**
- **Communication and representation**

Organization

- **Teams of 3 students** (1 urban designer, 1 landscape architect, 1 architect)
- **All products are TEAM created** meaning that everyone collaborates to develop the materials of the project
- **All products, presentations, and reviews are advanced under a 1 leader and 2 supporters format** i.e. lead author and co-authors where the co-authors contribute key figures and sections of the paper and the lead author contributes equally and also directs and advances the comprehensive material into the end format. In a film a director will create materials and lead the film effort while film co-directors will provide materials, contribute and edit the content but have less responsibility over the packaging and presenting of the final
- **Instructor acts a main reviewer**
- **External review is from someone (expert) outside of class**
- **Communication and representation will be of professional quality in the various stages with external presentation and dissemination quality in the final product.**

Products and Milestones

- **1 paper** draft due March 11th, final due Apr 22nd
- **1 poster** draft due March 18th, final due Apr 29th
- **1 film** draft due Apr 22nd , final due May 6th
- **1 presentation** (Apr 2nd 5-8pm) **and review** (Apr 16th 5-8pm) **on Living architecture** to 3rd Architecture students

Resources

- **Web based calculators shown in class materials and discovered**
- **Web sites for ecosystem services, landscape performance, green infrastructure and living architecture**
- **Books and readings**
- **Base information packets**

COMMUNITY COOL

Brittany Ballish, Clarisse Gates and Jessie Hawkins
Urban Ecological Systems - Kent State University - Spring 2015

CHALLENGES

EXISTING

PROPOSED

ACOUSTICS

Local Sound Pollution Stressors


150 dB

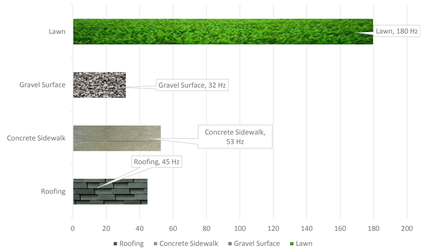

110 dB


85 dB


60 dB

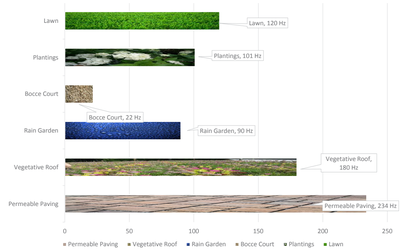
The selected site is currently being affected by sound pollution due to its proximity to a nearby airport, two industrial train lines, two highways, as well as busy local streets. These variables currently create noise pollution at levels above 90 decibels, which over time, will cause hearing impairment.

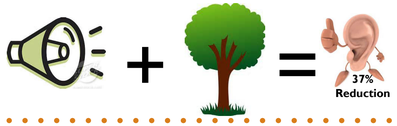
Existing Site Sound Absorption



In addition to being a nuisance, the EPA has also found that over time, psychological and physiological effects have been seen as a result of noise pollution. The increase of vegetation has conservatively raised the sound absorption coefficient to 746 Hz. This means that the overall sound pollution of the site is now being reduced by twenty-nine (29) decibels overall. This has reduced noise pollution by 20% overall. This reduction adds value to the property as well as improves the health of the residents of the neighborhood.

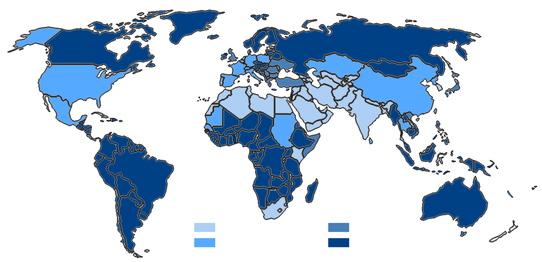
Proposed Site Sound Absorption





HYDROLOGY

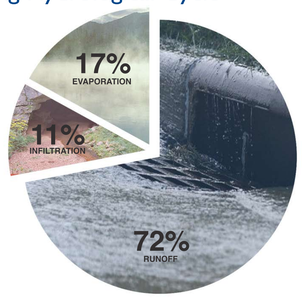
Global Water Pollution



Water Resource Stress

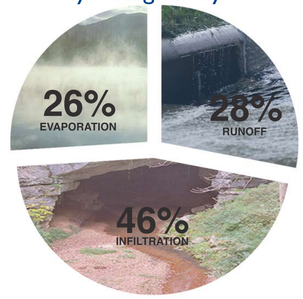
Fresh water stress is a major topic for discussion on an international scale regarding the problems posed by existing and future scarcity issues. With the projected population of the Great Lakes region to rise approximately 5,000,000 people over the next ten years by 2025 the population of the region will have increased by 10%. Based off of the assumption that the average person uses approximately 80 gallons of water per day this would mean that the Great Lakes region uses on average 4,442,000,000 gallons of water per day. By 2025, with projected population increases that number will rise to 4,854,250,000 gallons per day making the overall consumption of daily water usage within the Great Lakes region rise by 10% per day.

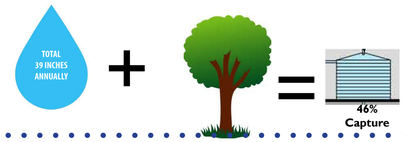
Existing Hydrological Cycle



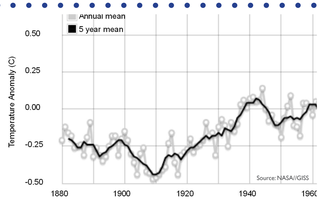
The site is being designed to have many low impact developments (LID) that help the site to collect water. To measure this, the EPA Stormwater Calculator was used. The site data was used to create a summary of the current site, and then to measure the runoff, infiltration, and evapotranspiration of projected inputs for the designed site. This project has chosen to increase water conservation through cistern storage and sizing. The cisterns will allow the reuse of greywater within Happy Dog and for irrigation on site. The proposal includes only 28% impermeable surfaces, resulting in an overall reduction of impermeability by 60%. The proposed materials were used to analyze the new hydrological flow on site. With the 39 inches of rain the site receives annually, 28% or 11 inches would go towards runoff, 26% or 10 inches would leave as evaporation and 46% or 18 inches would infiltrate the site.

Proposed Hydrological Cycle



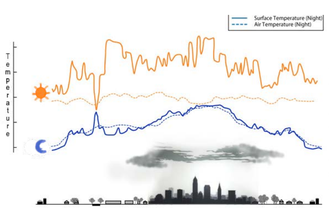


CLIMATE



Global Climate Change

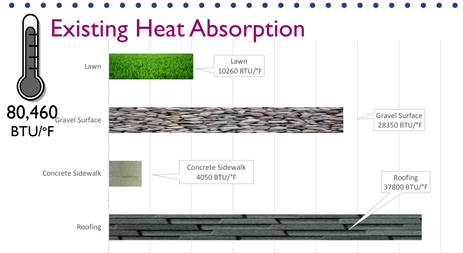
Globally, the climate is shifting. As early as 1995, the Intergovernmental Panel on Climate Change reported that there is a "discernible human influence on global climate." The warming trend has continued, with the year 2014 ranking as the warmest on record. (Source: NASA/GISS).



Urban Heat Island Effect

Exacerbating the issue is the effect of an urban heat island. The excessive absorption of the materials found in urban areas can cause surface temperatures to be 50–90°F hotter than the air (Source: EPA). The heat captured ends up radiating, thus increasing the ambient air temperature by as much as 22°F (Source: EPA). Surface urban heat islands, contribute to a host of problems, ultimately affecting a community's environment and quality of life.

Existing Heat Absorption



The use of materials with a high albedo, along with increasing plantings to aid in transpiration, can significantly reduce the impact of an urban heat island. To measure the mass heat absorption, the area of the materials were found, and then multiplied by its density and heat absorption coefficient. In treating heat island effect, it was found that heat island effect can raise the temperature of urban neighborhoods up to 22 °F. For this site, 17 °F was used as the maximum difference in temperature from urban neighborhoods to non-urban neighborhoods. Through site interventions, heat absorption was reduced by 43%, equivalent to a 7.5 °F reduction in ambient air temperature.

Proposed Heat Absorption