Green-Roof at Sentara Williamsburg Regional Medical Center

Scott Morris

William and Mary

Dr. Randy Chambers

Sentara Williamsburg Regional Medical Center

- Sentara Hospital is the regional hospital for Williamsburg and James City County
- New building opened 2003
- Non-profit
- Has over one hundred forty-five beds, all in individual rooms
- Brand-new and state-of-the art, and they want to stay that way

Rationale for Green-Roof at Sentara

- Planetree Alliance
  - aesthetic pleasure for patients
- Environmental Stewardship
- Community Collaboration
  - scientists from William and Mary
  - mental health professionals from Social Services
  - financial support from wealthier members of the community
- Will be one of the first, if not the first, hospital to have a green-roof on premises

Goal

- Determine the environmental impact of a green-roof at Sentara Regional Medical Center on the surrounding area

Past Research

- Green-roofs are a fairly new idea in America
  - not much data exists on them
- Dearborn, Michigan Project, conducted by Michigan State University Faculty and students
  - Bradley Rowe, Associate Professor, Horticulture
  - Jeff Andresen, Associate Professor, Geography
  - John Lloyd, Professor, Mechanical Engineering
  - Tim Mrozowski, Professor, Planning, Design and Construction
  - Kristin Getter, Graduate Research Assistant, Horticulture
- They collected the first real data on green-roofs

Background on the Dearborn Project

- The Ford factory had an unused warehouse on the premises
- Michigan State suggested the company convert it to a green-roof
- Ford did and now Michigan State runs tests on it, as well as on their own, small scale, 'simulation' green-roofs

Photos from the Dearborn Ford Factory

Major Findings of Some of their Publications

- Green roofs have been shown to retain +60% of the storm water they receive, depending on the vegetation used
- Function as very good nutrient 'sinks'
- Guard against extreme fluctuations in heat

➔ All of these help to mimic natural storm water retention, and then release

Areas of Experimentation

- Water Retention Ability
  - run-off time to peak discharge
- Conductivity/pH
- Heat Retention Ability
- Concentration of Waterborne Nutrients
  - ammonium, nitrate/nitrite, phosphate

Water Retention Ability

- Target: roof should mimic the natural release of water into the streams and watershed
- Result of urbanization is flash flooding and erosion of stream beds
- The roof will function as a retention pond

Conductivity/pH

- Life depends on a delicate range of pH
  - if that range is altered, life processes will suffer, or if altered too heavily, simply stop
  - pH of approximately 6.5-8.5 is acceptable for most organisms
- Conductivity is a measure of the number of dissolved ions in the water
  - too many can harm organisms that depend on pristine water

Heat Retention Ability

- Temperature also has a range in which life processes are possible
  - aquatic systems are particularly sensitive to changes
- Colder water can hold more dissolved oxygen than warmer water
- No set range for temperature
  - yet streams generally are healthy around ~18-22 degrees C in the summer
  - ponds are generally average of ~28 C in summer

Concentration of Waterborne Nutrients

- Chemical concentrations have an optimal range for each organism
- Will test phosphate concentration, ammonium concentration, nitrate/nitrite concentration
- Too many of these compounds will stimulate algal blooms
  - which are harmful to the other organisms

  ➔ Again, no set concentration but generally, the more pristine systems have very little of each

Procedures

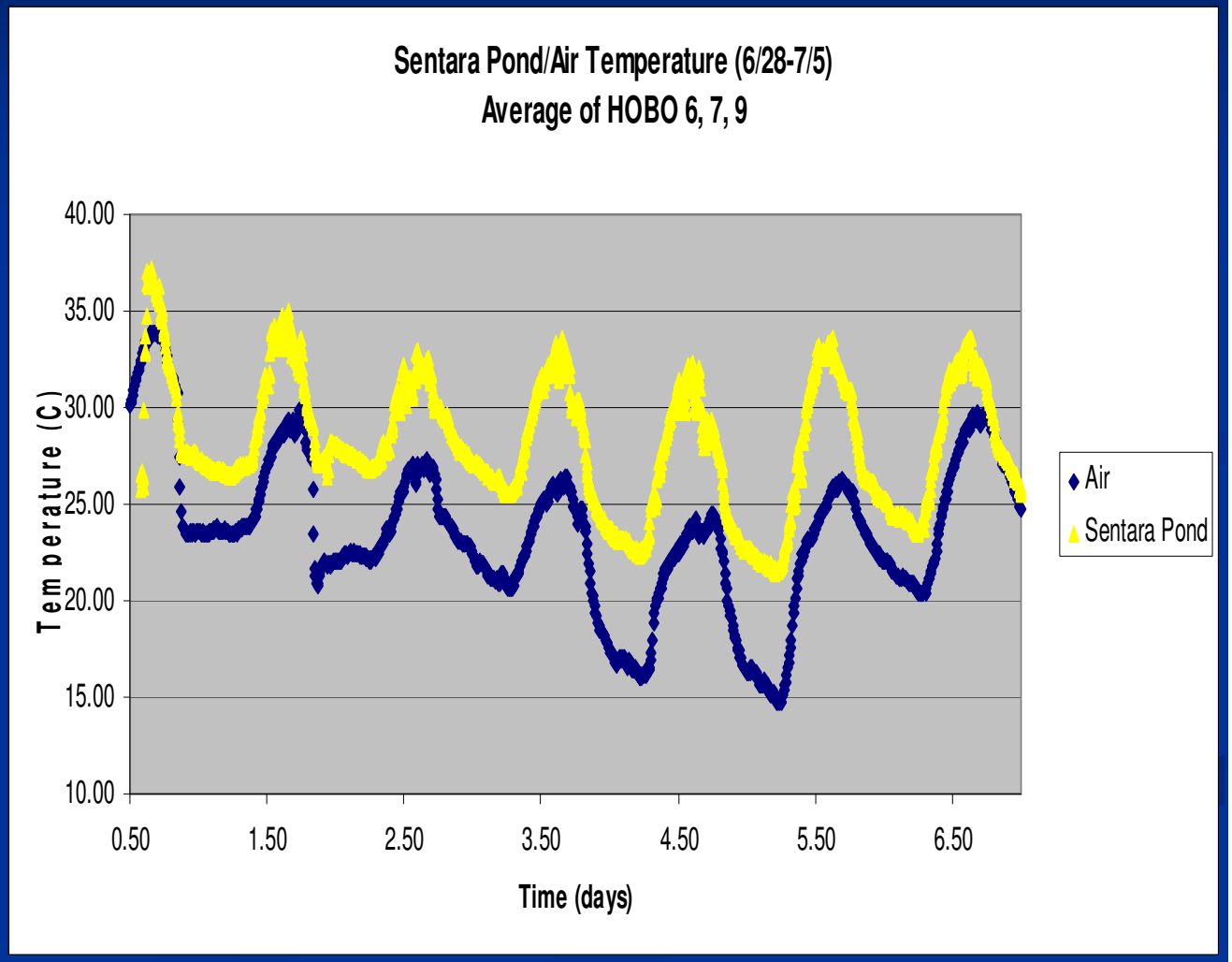
- Set up HOBO sensors to record temperature of rainfall
- Set up water collection devices during a storm event
- Set up a weather station to record constant data of roof temperature and other information

Timeline

- Summer/Fall 2007 (likely into 2008)
  - Collect preliminary data of pond and roof temperature, as well as roof run-off collection of water during a storm
- Summer 2009 (or post-construction)
  - Conduct the same tests as before and analyze the data for comparison purposes

Preliminary Data

- Temperature of the retention pond on Sentara property from June 28 to July 5
- Pond temperature is approximately 3-5 degrees C hotter than air temperature



Where to go from here?

- Meet with Don West of Facilities' Management at Sentara tomorrow to determine the best possible areas to collect rainwater
- Will set up the weather station for the Fall Semester at the end of August
- Will collect data during the school year

Sources for this Project

- www.greenroofs.org/img/grhc2004_ford1_medium.jpg (image)
- www.hrt.msu.edu/.../Rowe/101402%20FordRoof2.jpg (image)
- http://www.sentara.com/NR/rdonlyres/ECFA44D2-7D76-47A6-9E67-6609F3ED781D/0/williamsburg_small.jpg (image)
- Durhman, A.K., D.B. Rowe, and C.L. Rugh. 2007. Effect of substrate depth on initial growth, coverage, and survival of 25 succulent green roof plant taxa. HortScience 42(3):588-595.
- Getter, K.L. and D.B. Rowe. 2007. Effect of substrate depth and planting season on Sedum plug establishment for green roofs. J. Environ. Hort 25(2):95-99.
- Durhman, A.K., D.B. Rowe, and C.L. Rugh. 2006. Effect of watering regimen on chlorophyll fluorescence and growth of selected green roof plant taxa. HortScience 41(7):1623-1628.
- Getter, K.L. and D.B. Rowe. 2006. The role of green roofs in sustainable development. Hort Science 41(5):1276-1285.
- Rowe, D.B., M.A. Monterusso, and C.L. Rugh. 2006. Assessment of heat-expanded slate and fertility requirements in green roof substrates. HortTechnology 16(3):471-477.
- Monterusso, M.A., D.B. Rowe, and C.L. Rugh. 2005. Establishment and persistence of *Sedum* spp. and native taxa for green roof applications. HortScience 40(2):391-396.
- VanWoert, N.D, D.B. Rowe, J.A. Andresen, C.L. Rugh, R.T. Fernandez, and L. Xiao. 2005. Green roof stormwater retention: Effects of roof surface, slope, and media depth. J. Environ. Quality 34(3):1036-1044.
- VanWoert, N.D, D.B. Rowe, J.A. Andresen, C.L. Rugh, and L. Xiao. 2005. Watering regime and green roof substrate design affect *Sedum* plant growth. HortScience 40(3):659-664. College Creek Alliance Data
- Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in Pacific Northwest and Alaska. EPA #910/9-91-001. May, 1991.
- Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. Bjorann and Reiser, edited by William R. Meehan, American Fisheries Society Special Publication 19:83-138, 1991.