University of Maryland Green Roof Research Program

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The Driving Issue - Combined Sewer Outlets

DETAILS OF OUTLET SEWERS AT NIAGARA FALLS, ONT.
Chas. H. Mitchell, Town Engineer.

LEED Credits Associated with Green Roofs

Sustainable Sites

5.1: Site Development: *Protect or Restore Habitat* addresses using vegetation on green roofs for restoring habitat **using native or adapted plants.**

5.2: Site Development: *counts green roofs as open* space.

6.1: Stormwater Design: *Quantity Control lists green* roofs as a strategy to minimize stormwater runoff.

6.2: Stormwater Design: *Quality Control encourages* the use of green roofs to promote infiltration.

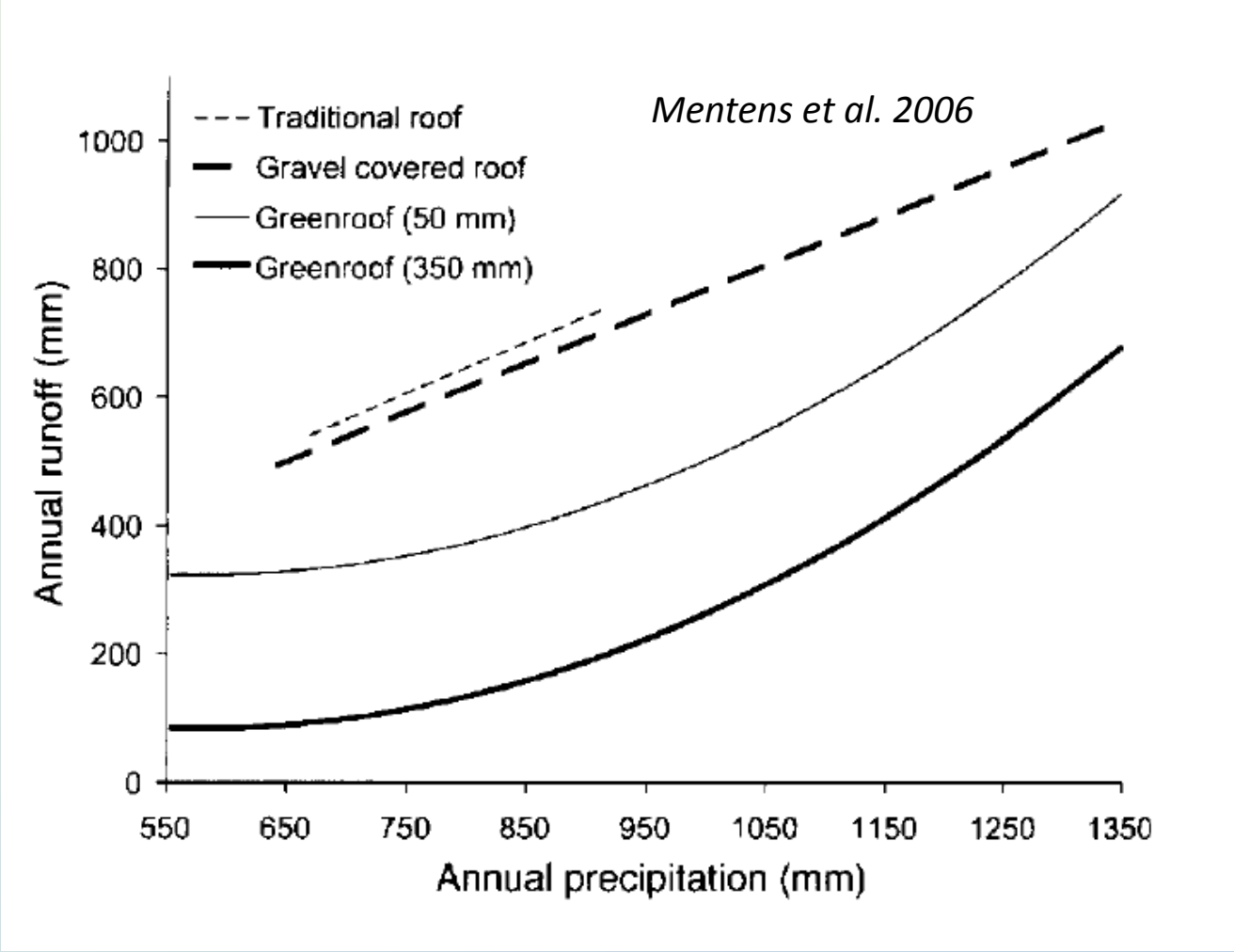
7.1: Heat Island Effect: *Non-Roof states that a green* roof can be used as a potential strategy for the replacement of constructed surfaces (roof, roads, sidewalks).

7.2: Heat Island Effect: *Roof promotes the use of a* vegetated roof for at least 50% of the roof area. Cooler air above the roof can allow the HVAC system to be scaled back to save energy.

Innovation in Design points may be earned if 100% of the roof surface is vegetated. Innovation in Design is an extra section in addition to the main sections of credits that allots extra points for designs that go above and beyond credit requirements.

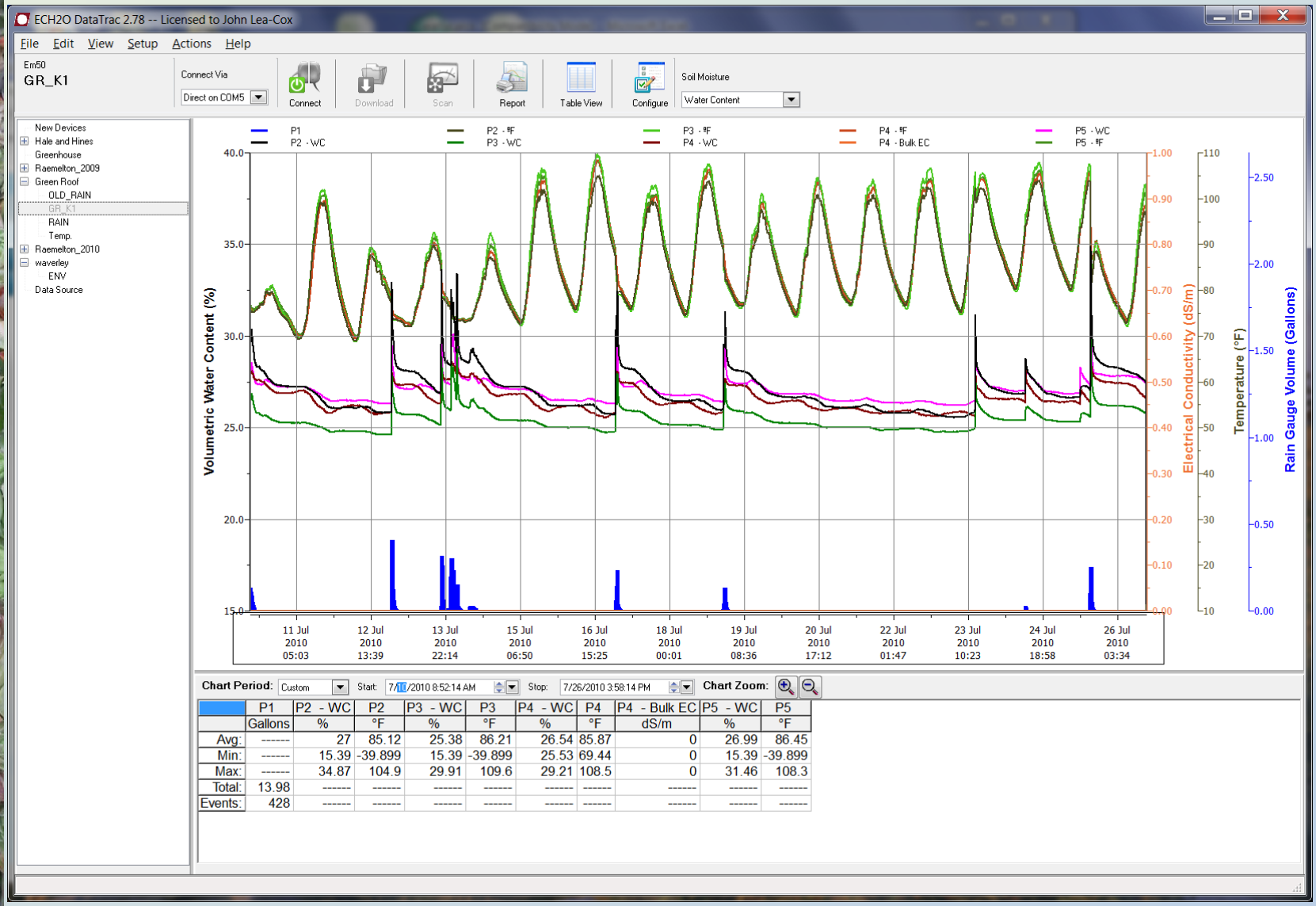
Q: How much stormwater is retained by a green roof?

Retention by greenroofs varies according to storm size



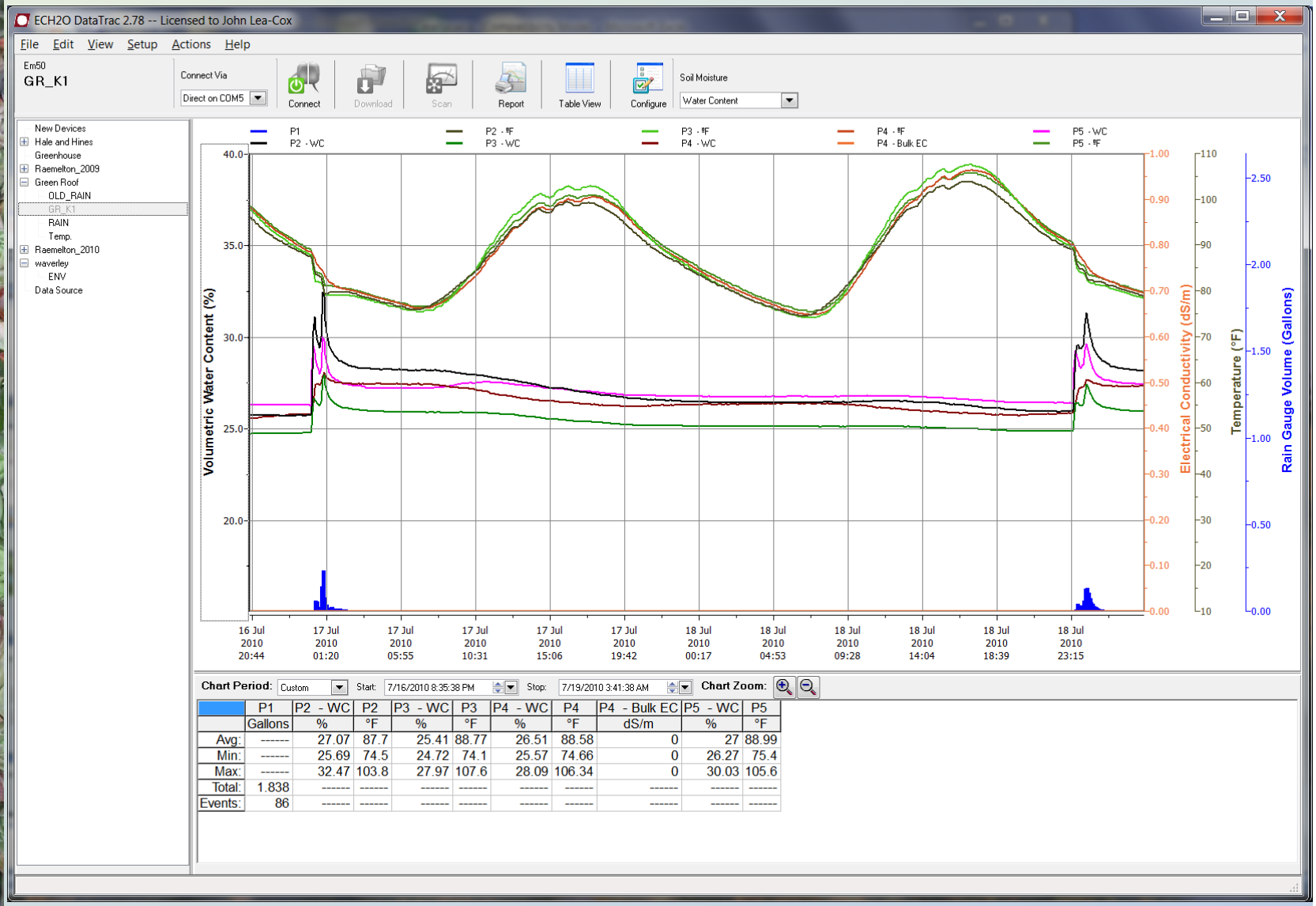
Green Roof Research Site:

Green Roof and Environmental Monitoring Data:



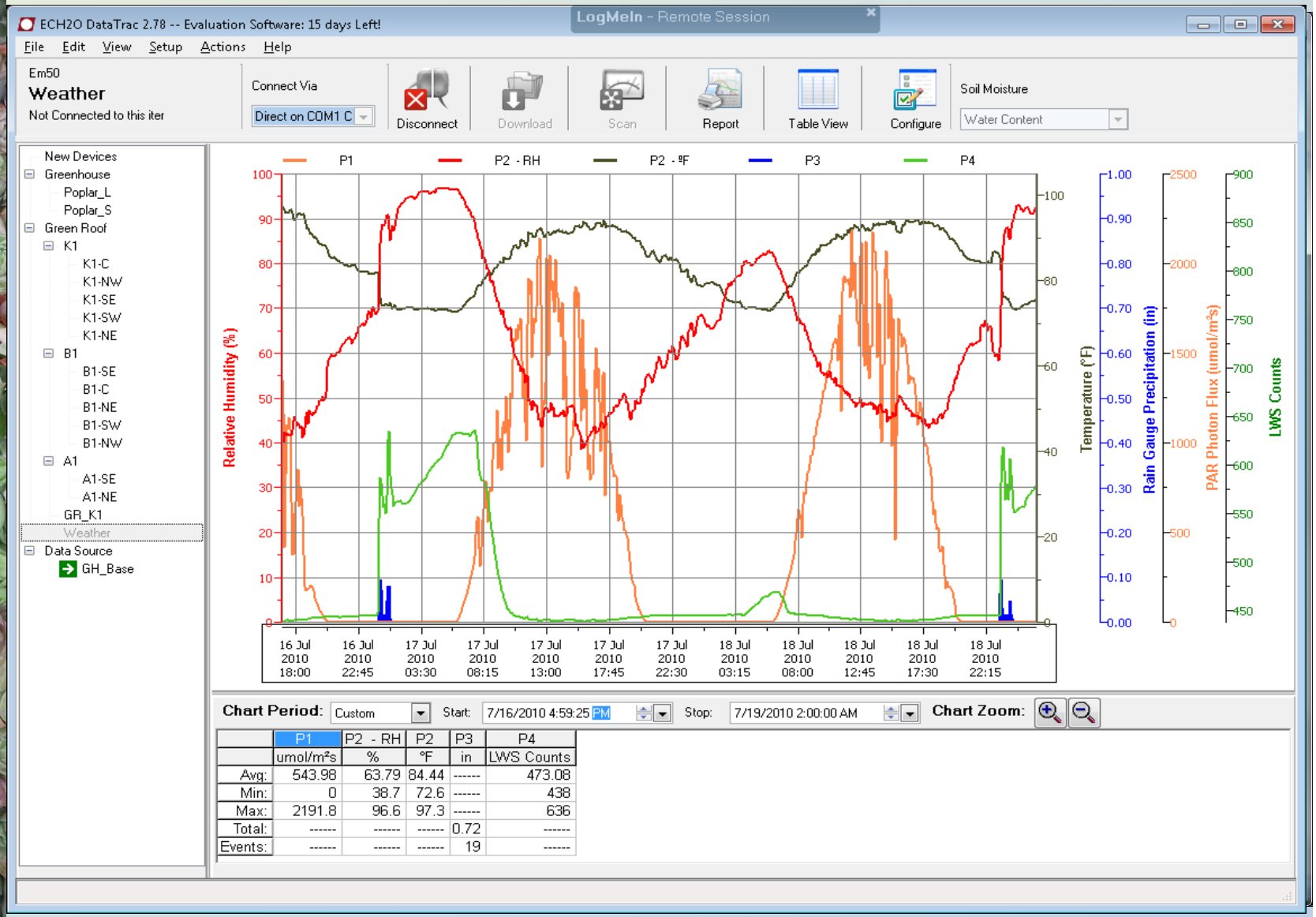
	P1	P2 - WC	P2	P3 - WC	P3	P4 - WC	P4	P4 - Bulk EC	P5 - WC	P5
	Gallons	%	°F	%	°F	%	°F	dS/m	%	°F
Avg:	------	27	85.12	25.38	86.21	26.54	85.87	0	26.99	86.45
Min:	------	15.39	-39.899	15.39	-39.899	25.53	69.44	0	15.39	-39.899
Max:	------	34.87	104.9	29.91	109.6	29.21	108.5	0	31.46	108.3
Total:	13.98	------	------	------	------	------	------	------	------	------
Events:	428	------	------	------	------	------	------	------	------	------

Green Roof and Environmental Monitoring Data:



	P1	P2 - WC	P2	P3 - WC	P3	P4 - WC	P4	P4 - Bulk EC	P5 - WC	P5
	Gallons	%	°F	%	°F	%	°F	dS/m	%	°F
Avg:	------	27.07	87.7	25.41	88.77	26.51	88.58	0	27	88.99
Min:	------	25.69	74.5	24.72	74.1	25.57	74.66	0	26.27	75.4
Max:	------	32.47	103.8	27.97	107.6	28.09	106.34	0	30.03	105.6
Total:	1.838	------	------	------	------	------	------	------	------	------
Events:	86	------	------	------	------	------	------	------	------	------

Green Roof and Environmental Monitoring Data:



	P1	P2 - RH	P2	P3	P4
	umol/m²s	%	°F	in	LWS Counts
Avg:	543.98	63.79	84.44	------	473.08
Min:	0	38.7	72.6	------	438
Max:	2191.8	96.6	97.3	------	636
Total:	------	------	------	0.72	------
Events:	------	------	------	19	------

Stormwater Modeling; Role of Plants in the System:

Olyssa Starry

We hypothesize that **plants enhance water storage** by greenroofs; the magnitude of this contribution will be affected by plant **physiology** as well as **climate**.

How might aspects of plant physiology affect water retention by green roofs?

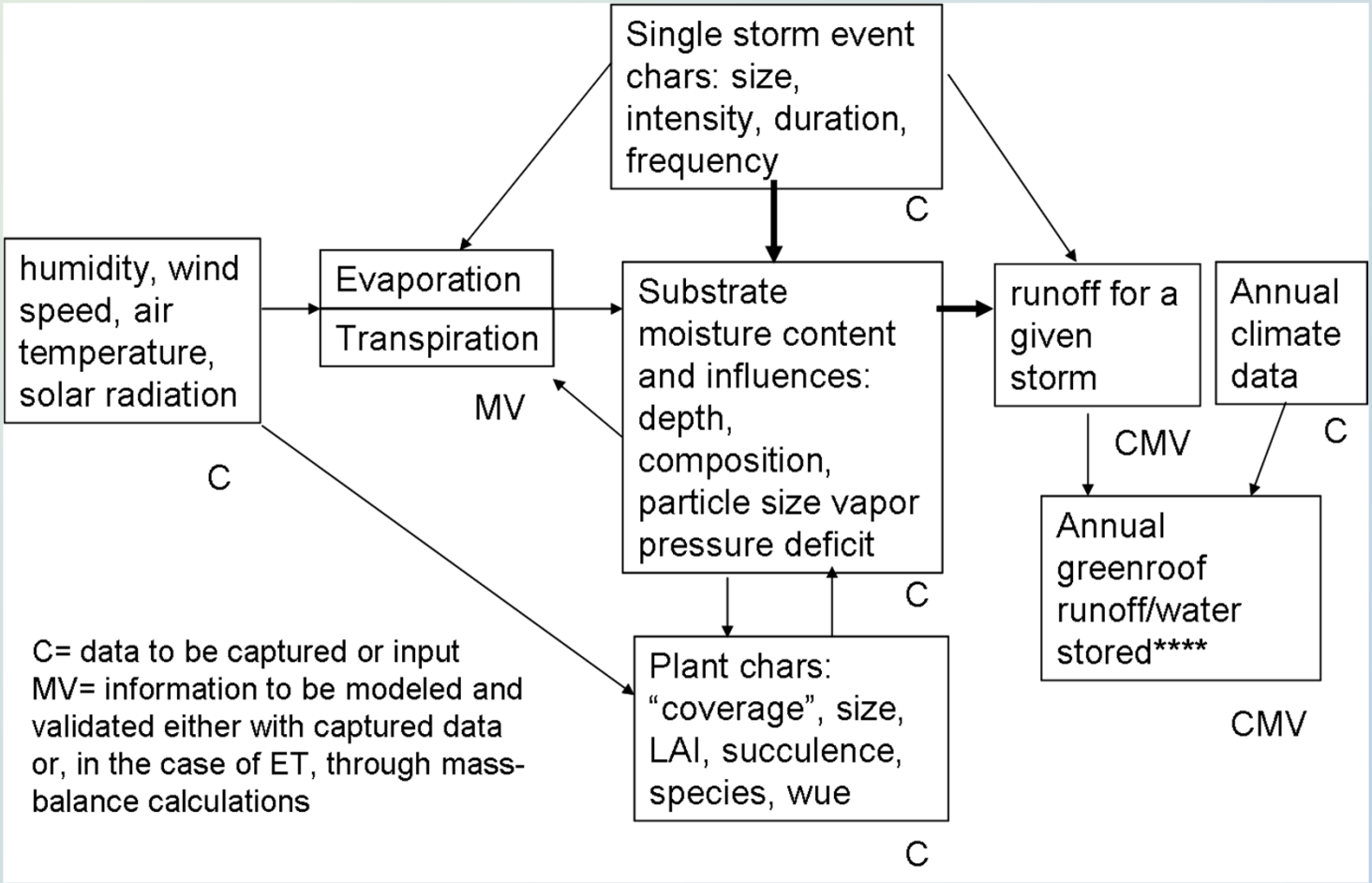
Sedum album
CAM cycler

Sedum sexangulare
likely CAM cycler

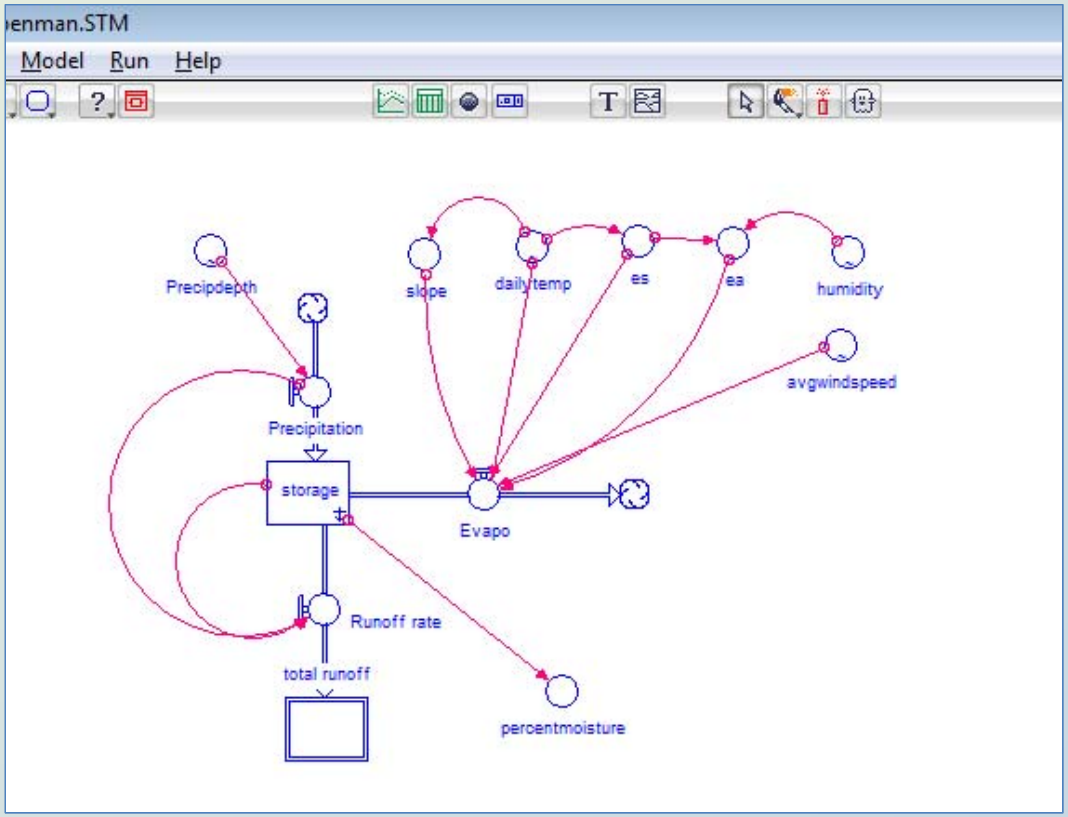
Sedum kamschaticum
suspected to be C3

How do green roofs function as systems?

How can annual stormwater retention by green roofs be better predicted by computer models?



Evapotranspiration Sensitivity Analysis



FAO Penman Monteith equation:

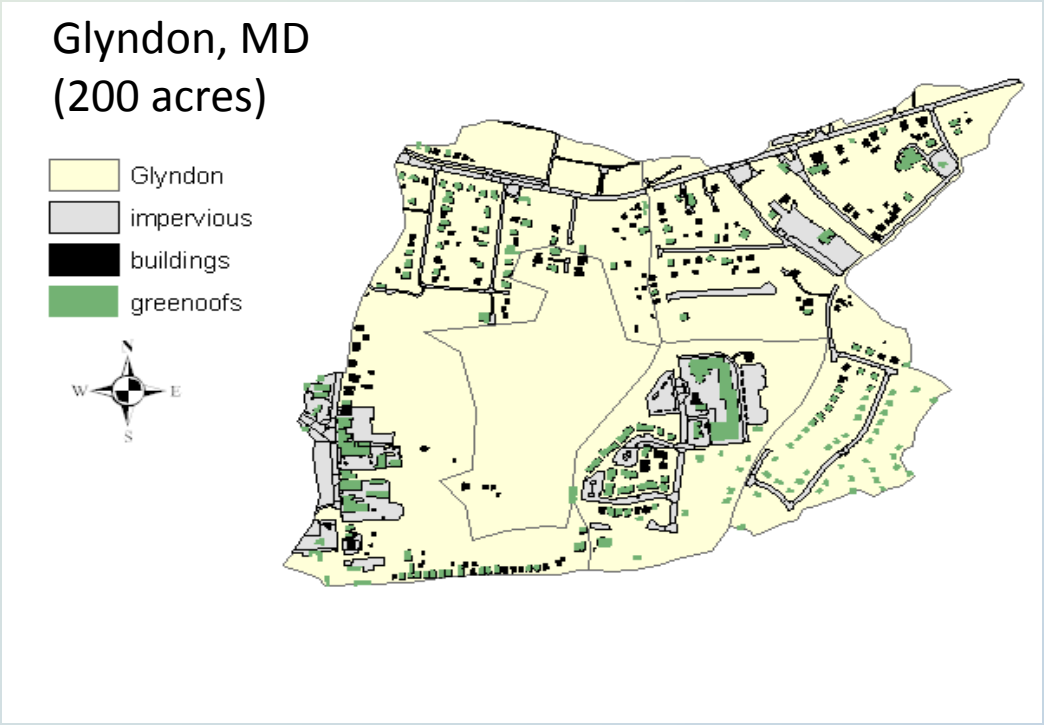
$$ET_o = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T+273} u_2 (e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)} \quad (6)$$

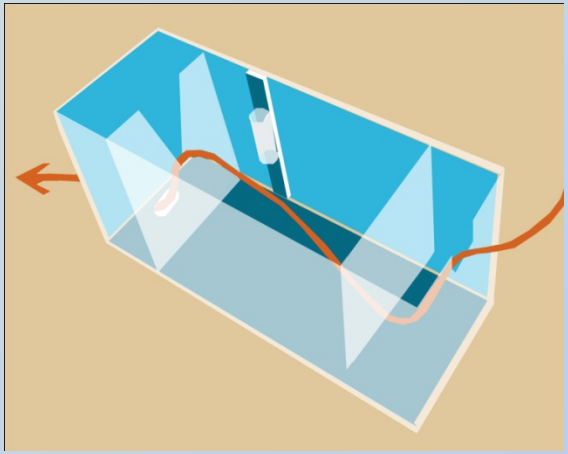
Hargreaves equation:

$ET = 0.023 * R(T_{ave} + 17.8) * (T_{max} - T_{min})^{0.5}$

Future directions:

- Model validation with roof-scale data
- Watershed scale models (swmm)





Summary:

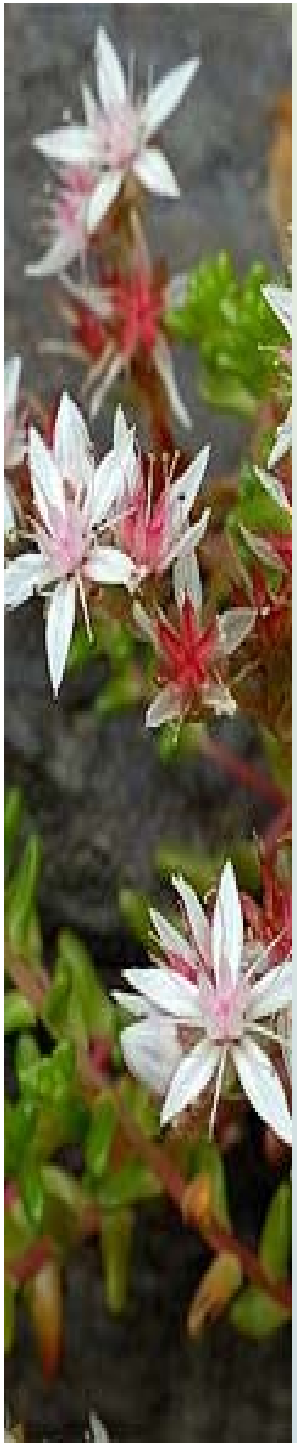
- ✓ Sensing individual green roofs is possible and economic
- ✓ Modeling stormwater runoff could be a powerful tool for providing site and watershed-specific data
- ✓ Better storm water modeling data could provide urban planners with cost/benefit analysis information

- ➢ This will enable LEED to Incorporate credits for performance and verification standards (for water management, energy fluxes)
- ➢ Benchmark Platinum Status

Media Research

Andrew Ristvey

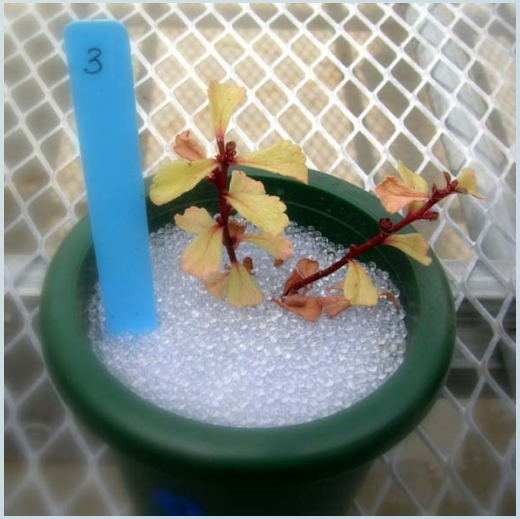
- Studying Crumb Rubber as a media component amendment
- Develop a Low-Carbon Impact Medium
- Model Performance on both micro (rooftop) and macro (watershed) scales

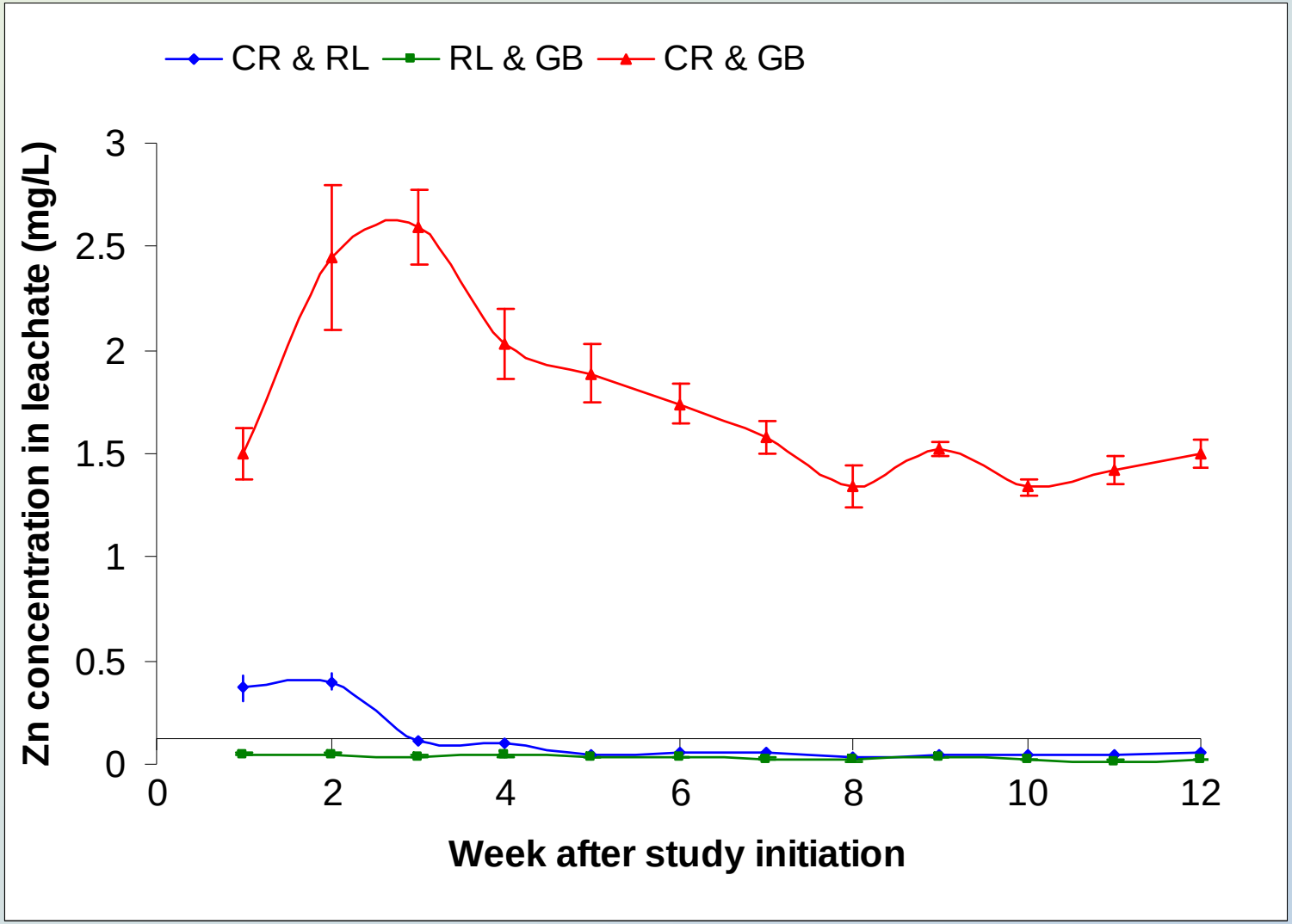


Media: Key Physical Component

- Retains stormwater to reduce peak flow
- Sustains plant life
- Capable of retaining pollutants

- Must have the right physical properties

	0.3 ppm	80 ppm	160 ppm
Rooflite™			
Glass Beads			



Zinc concentration in media leachates.

Extension Program

- Help the industry develop rigorous performance-based standards
- Mid-Atlantic Green Roof Research Conference
  - Bring research authorities together
  - August 2011

Websites, Blogs

1. Specialty Crops Research:
   (Sensor Networks, Model Development)
   http://smart-farms.net

2. UM Green Roof Program Website:
   (Under construction)
   http://greenroof.umd.edu

3. Olyssa Starry's Blogspot:
   http://urbansod.blogspot.com