The Landscape Green Infrastructure Design (L-GrID) Model

Metropolitan Planning Council
Calumet Stormwater Collaborative
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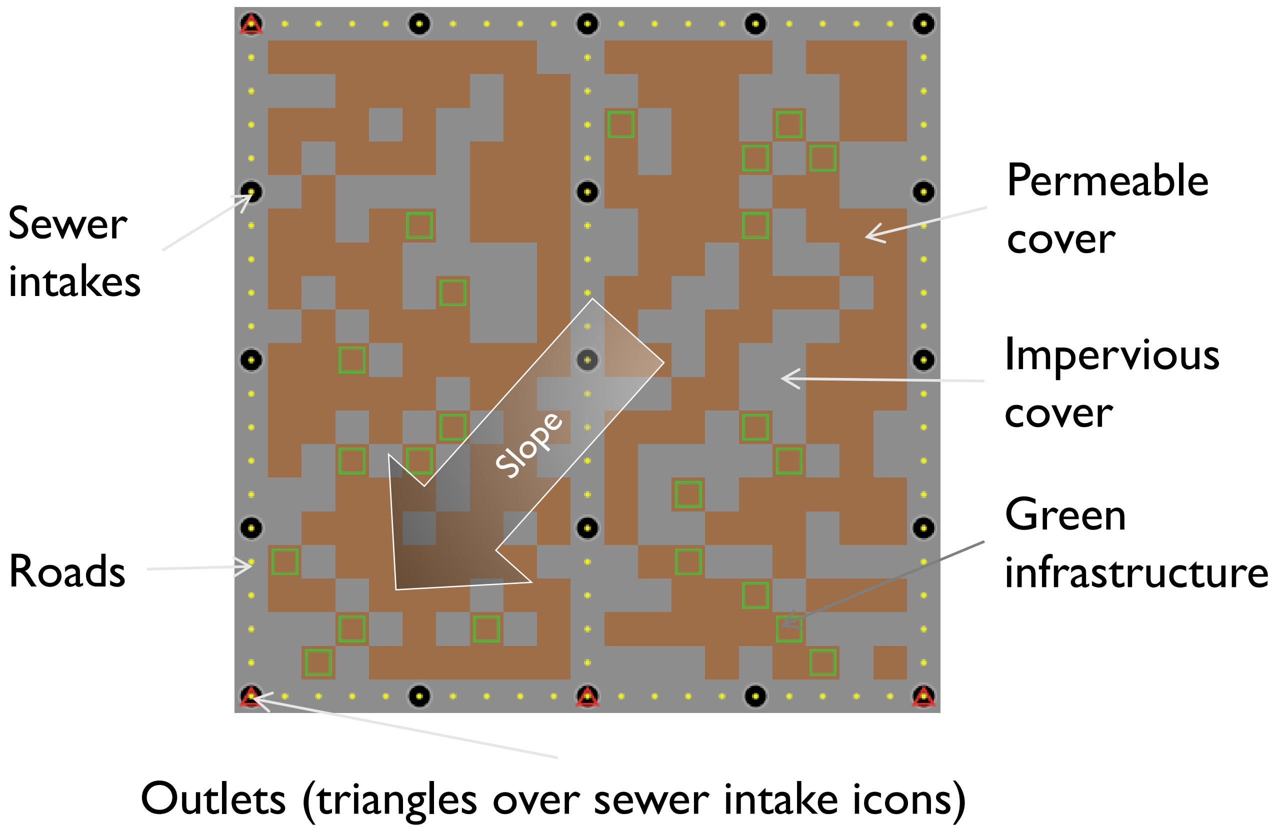
L-GrID Background

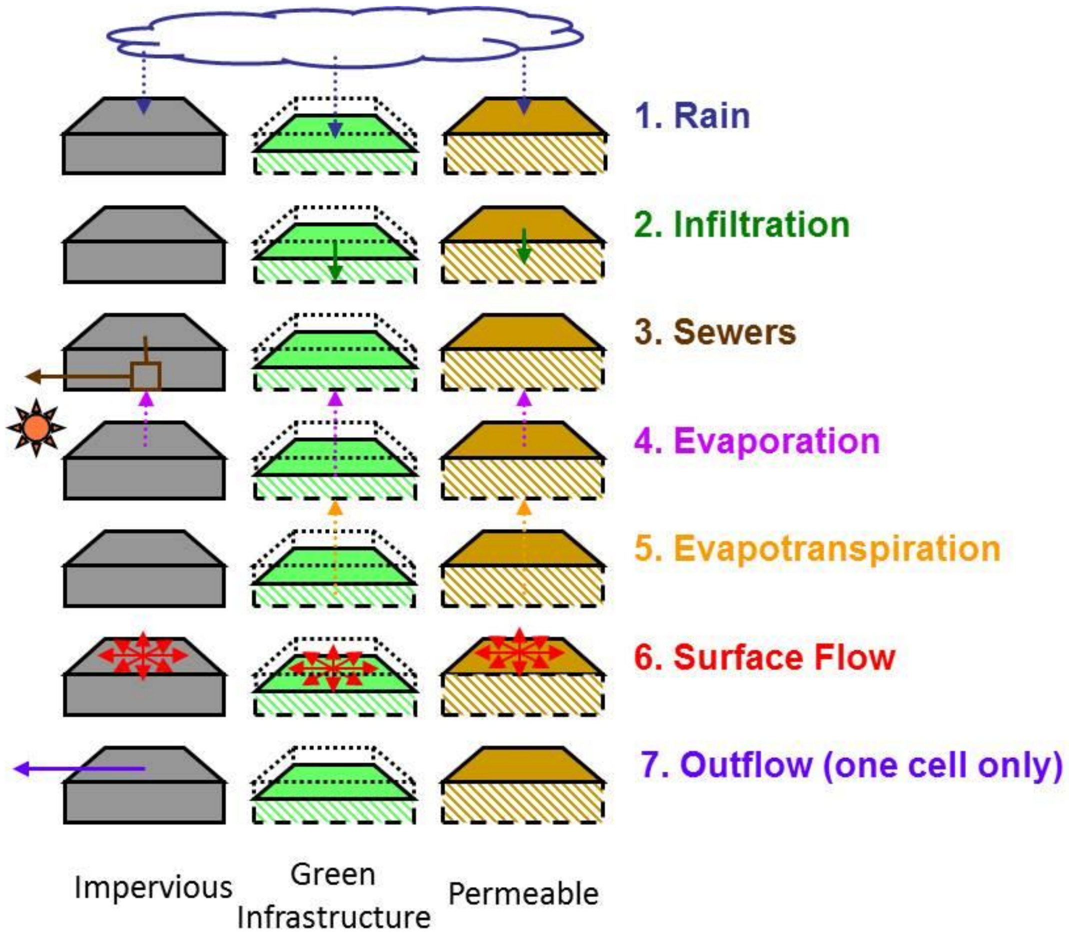
Motivations and questions

- IEPA 2009 – 2010
- Landscape design principles
  - How much?
  - Where?
- Publication:
  - Zellner, M.; Massey, D.; Minor, E.; Gonzalez-Meler, M. (2016). "Exploring the Effects of Green Infrastructure Placement on Neighborhood-Level Flooding via Spatially Explicit Simulations". *Computers, Environment and Urban Systems*, 59 (2016): 116-128

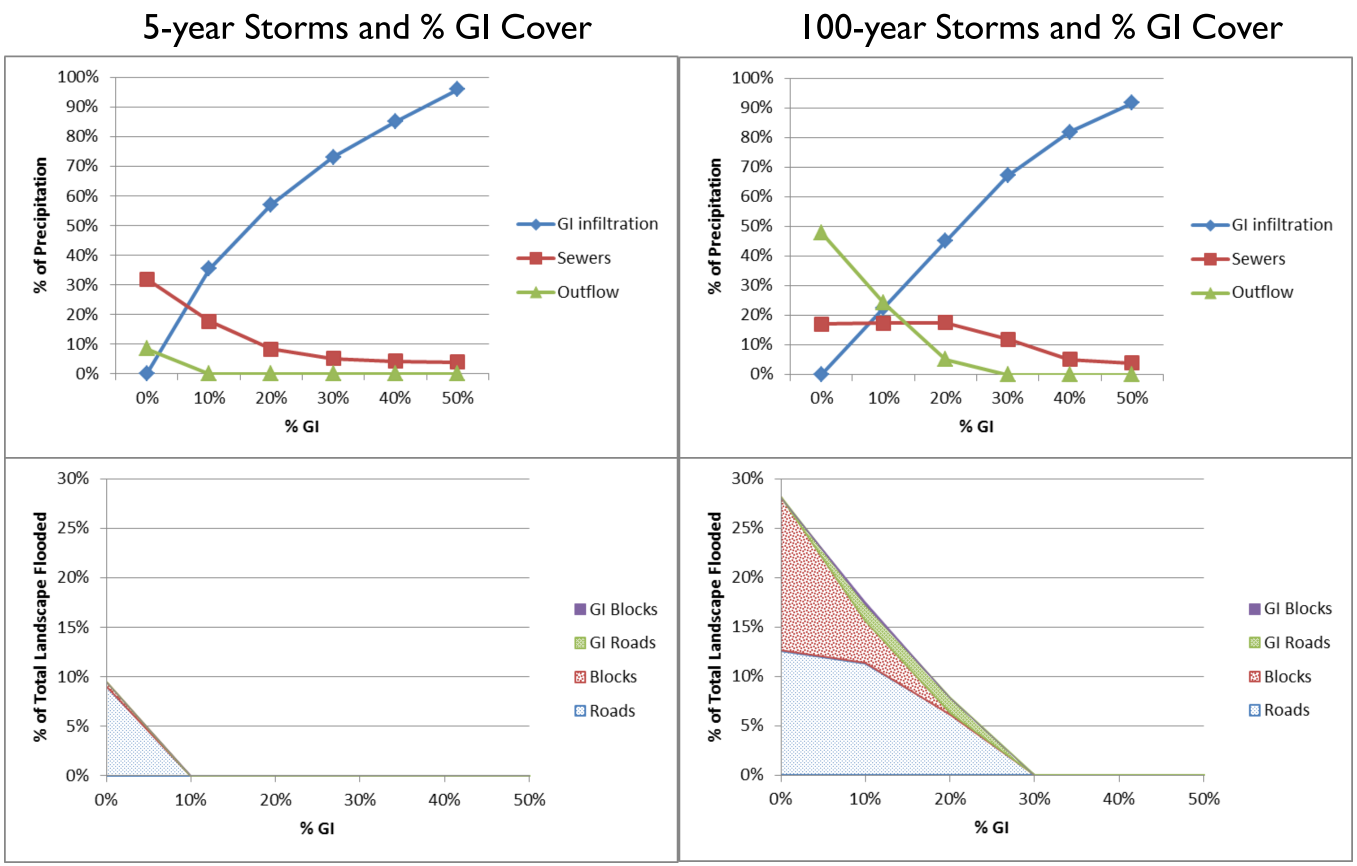
Landscape Green Infrastructure Design (L-GrID)



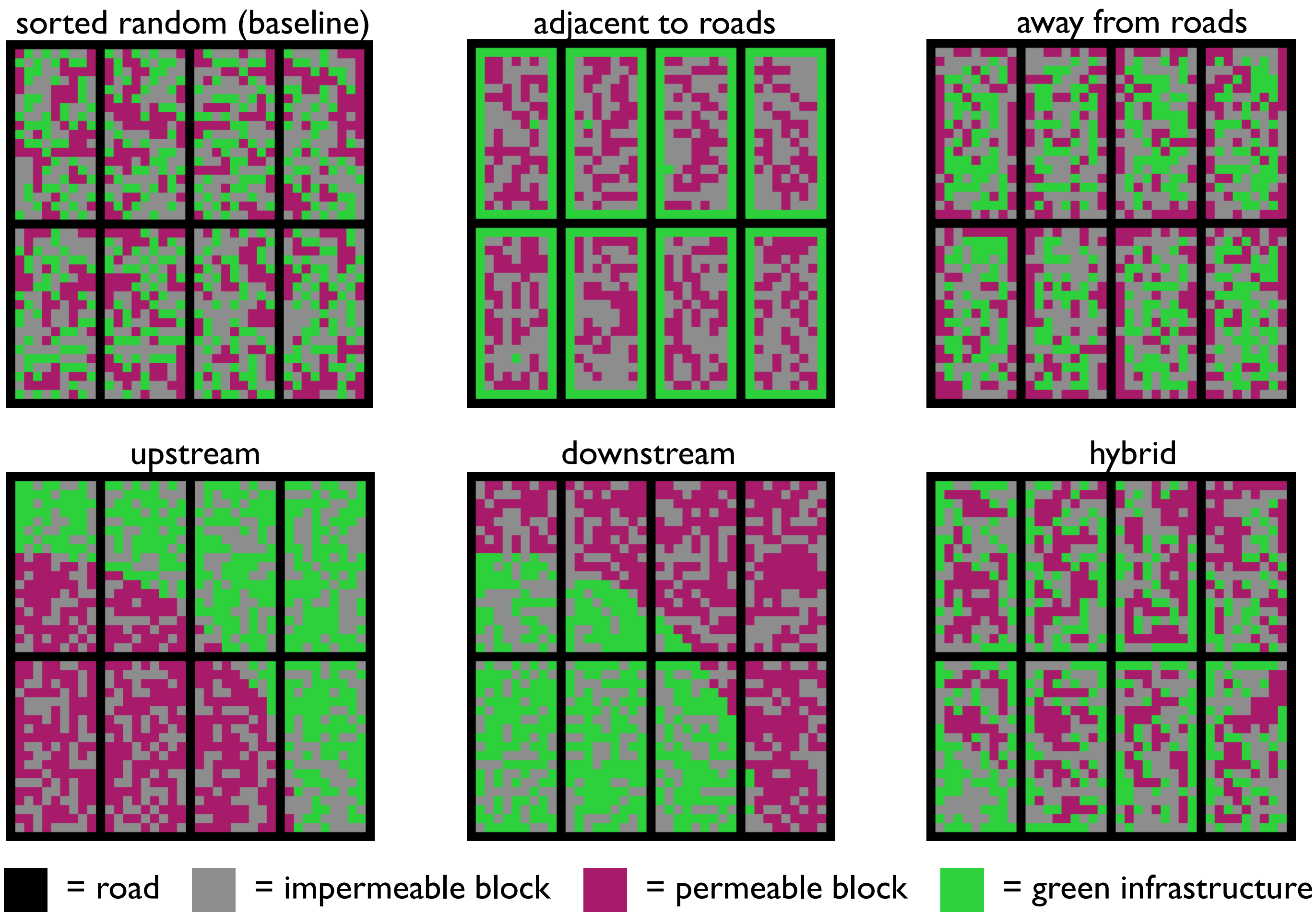
L-GrID Processes



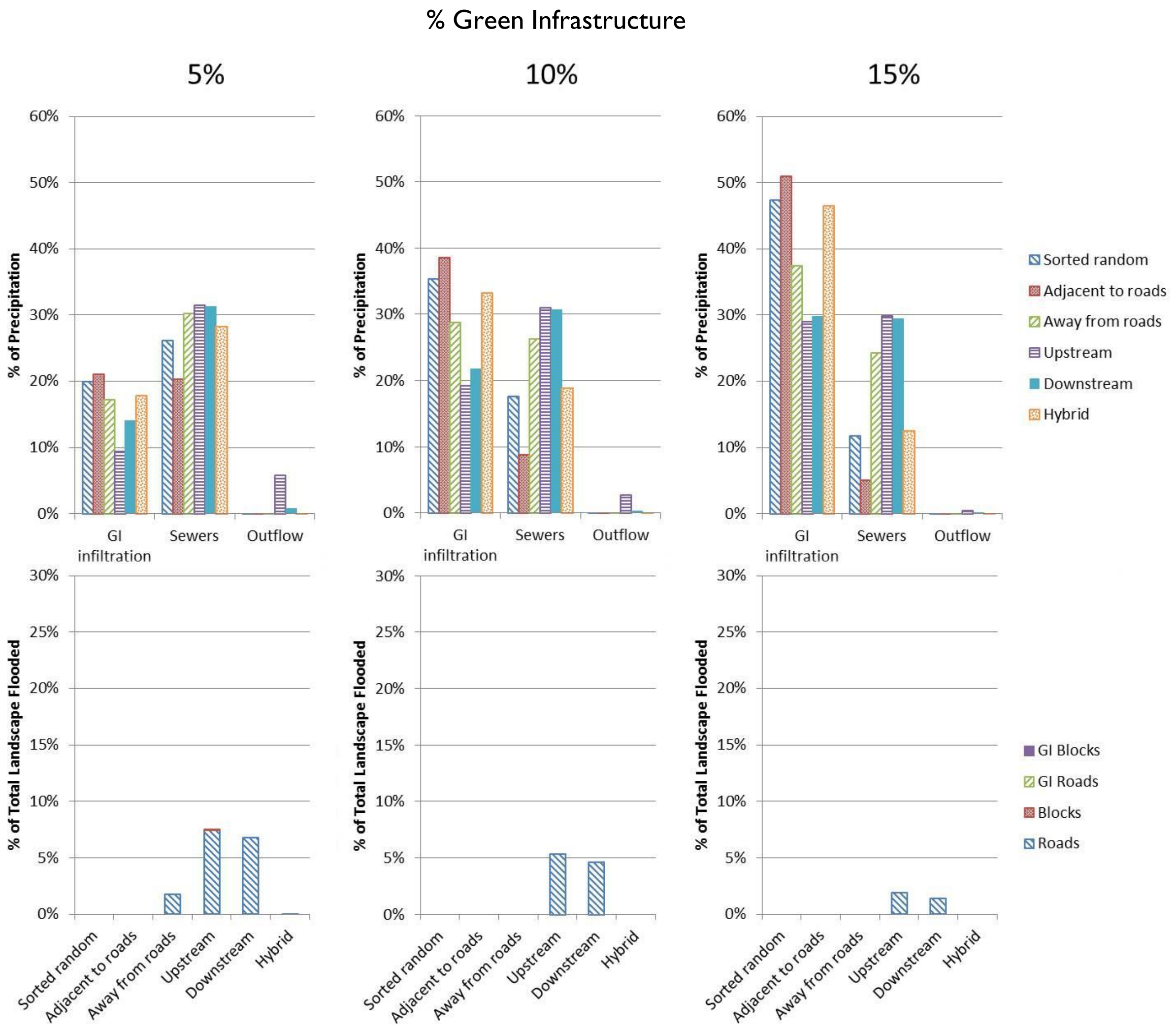
How much?


5-year Storms and % GI Cover
100-year Storms and % GI Cover
% of Precipitation
% GI
GI infiltration
Sewers
Outflow
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% of Total Landscape Flooded
GI Blocks
GI Roads
Blocks
Roads
25%
15%
5%

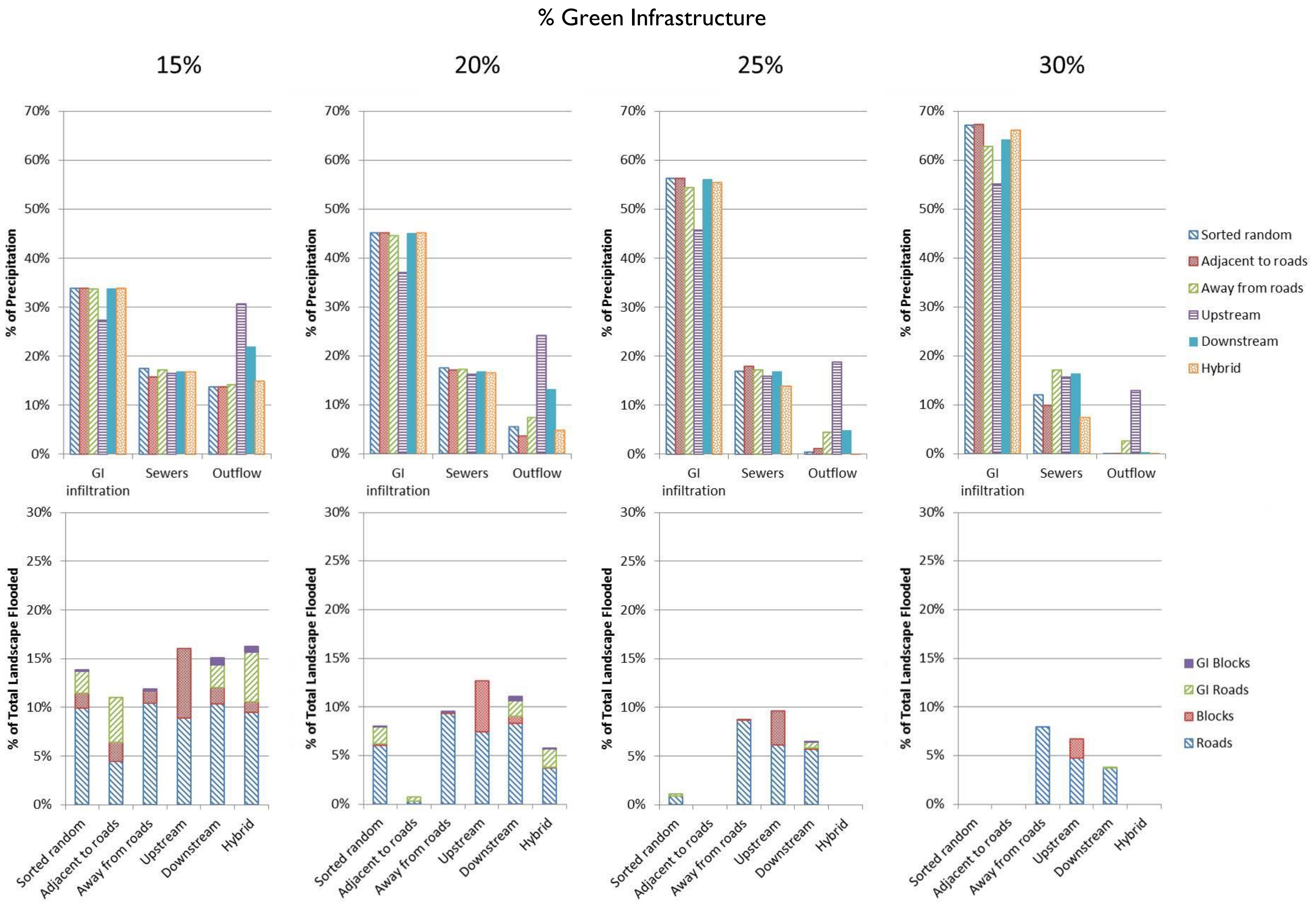
Where?


sorted random (baseline)
adjacent to roads
away from roads
upstream
downstream
hybrid
= road
= impermeable block
= permeable block
= green infrastructure

Where? 5-year storms



Where? 100-year storms

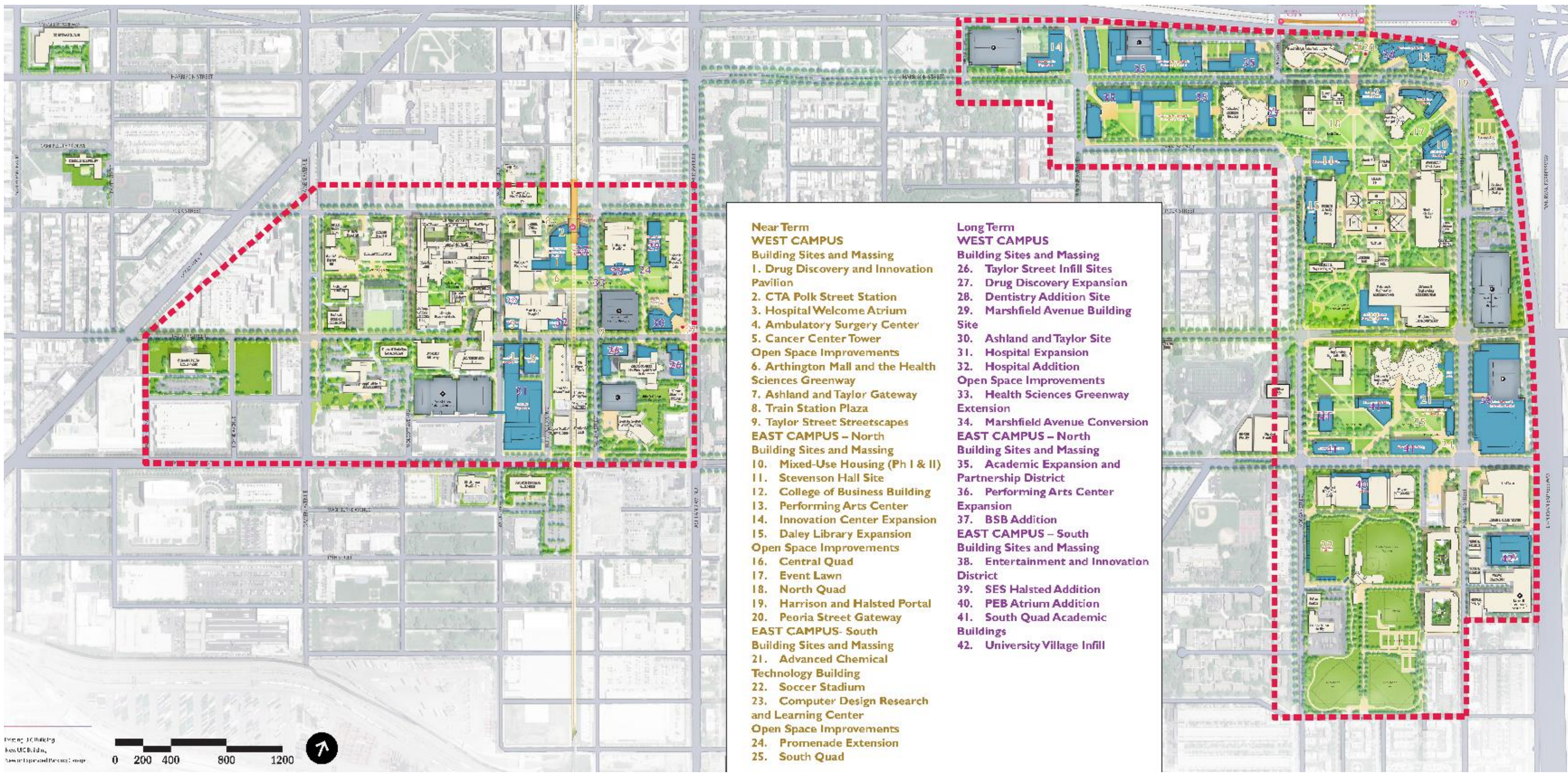


Design principles

- Thresholds
- Dispersed over clustered
- Advantage of curb cuts
  - Keep water in roads
  - Detention
  - Installation in public property and maintenance
- Hybrid in larger storms
  - Build on curb cut layout
- When all else fails, try random
- Other layouts?

UIC Campus Application

UIC capital plan



UIC West Campus

Baseline 1: (2-year, 6-hour storm)

Standing water levels during and immediately after the storm

Baseline 1: 2-year, 6-hour storm, 50% initial soil saturation, 70% initial sewer capacity, no CSOs

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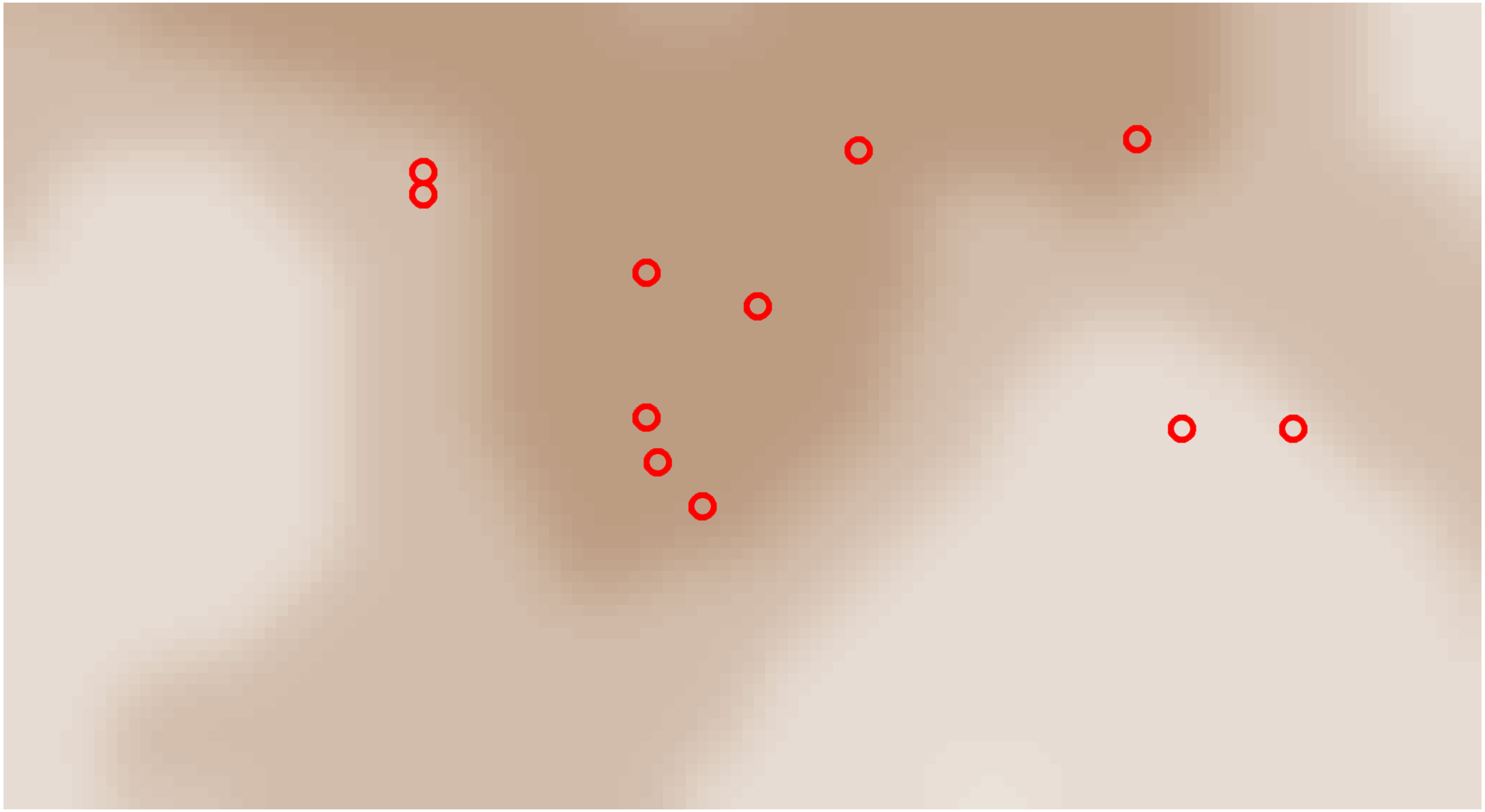
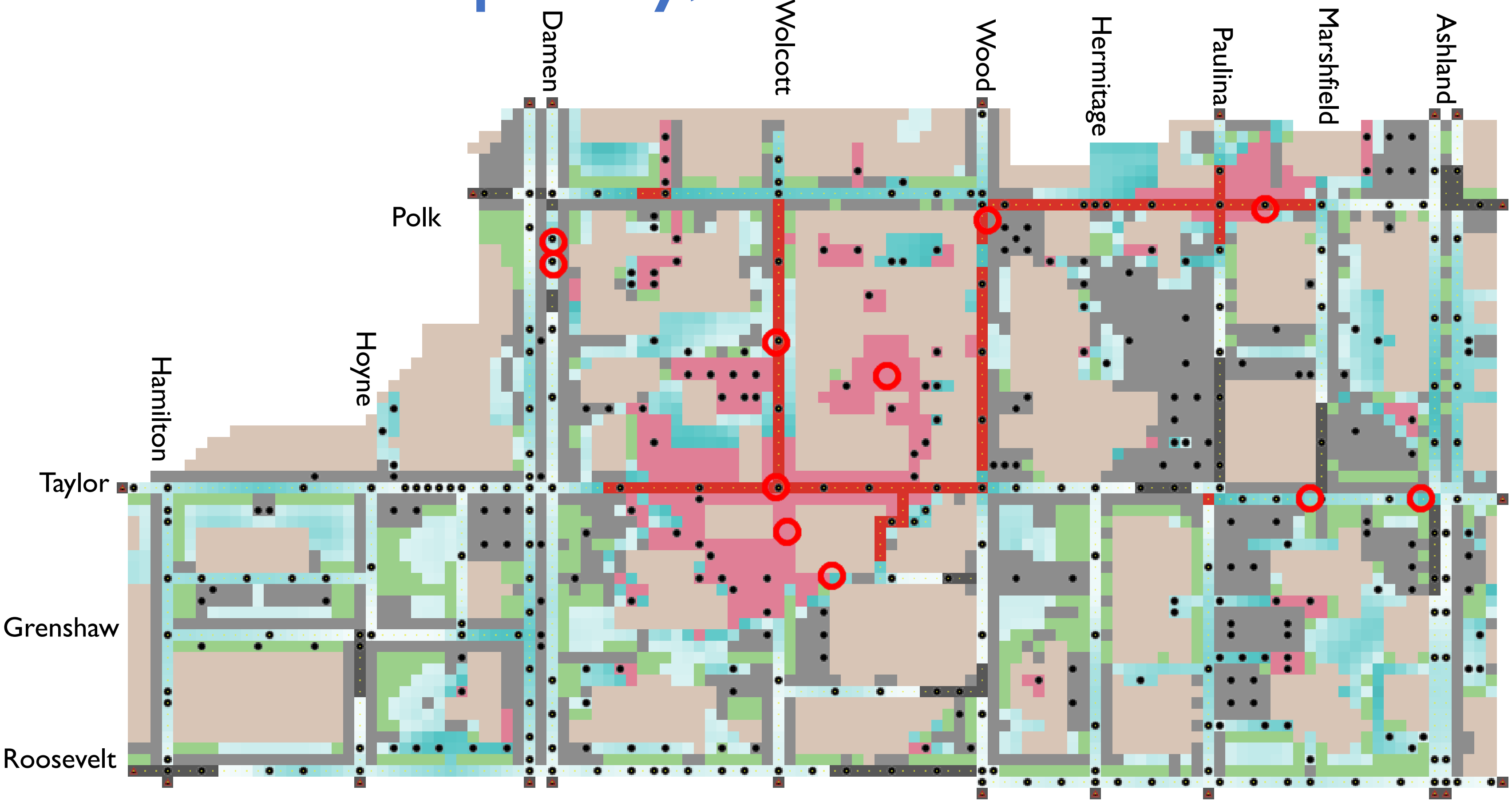
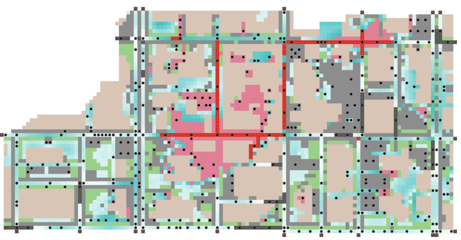


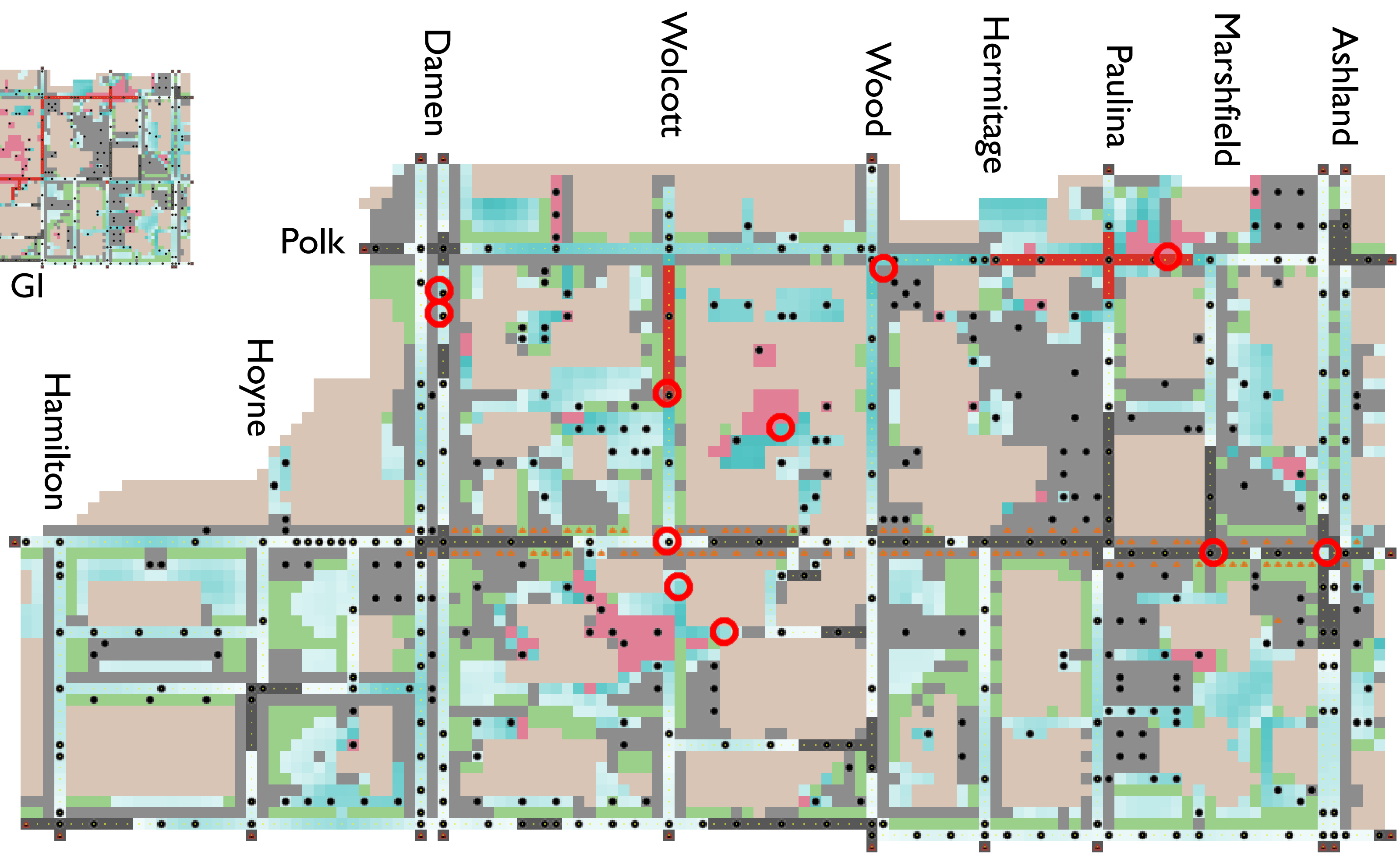
Baseline 1: 2-year, 6-hour storm, 50% initial soil saturation, 70% initial sewer capacity, no CSOs



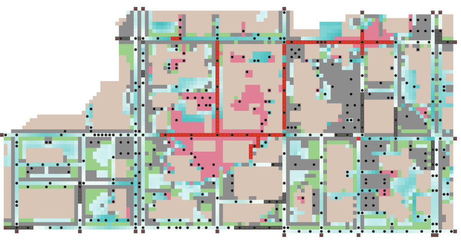
Scenario 1a: swales along Taylor Street



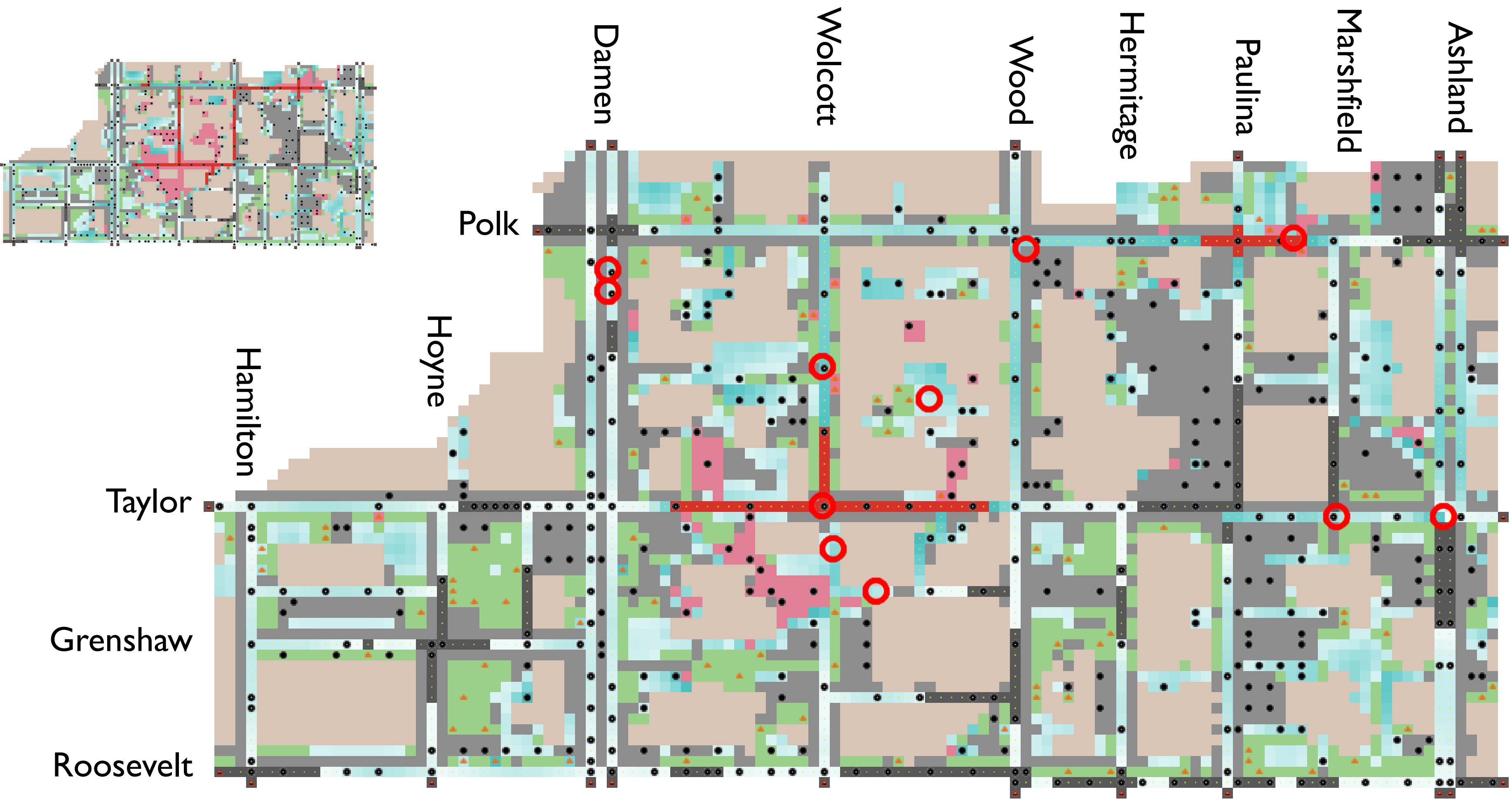
No GI



Scenario 1b: flow path



Scenario 1c: random



How well do scenarios perform?

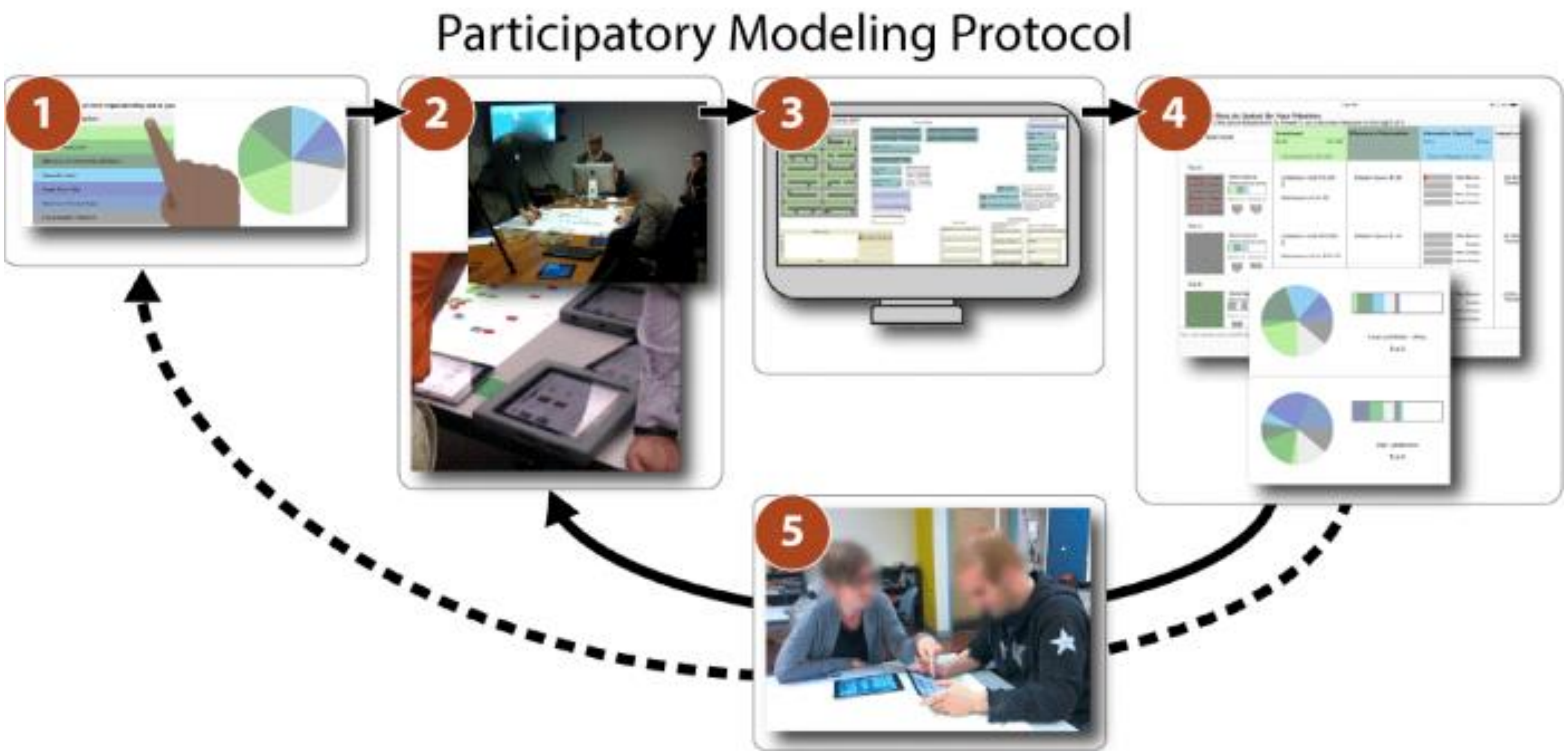
			For normalized values, 1 is worse, 0 is better							
			Baseline 1 (2yr, 6hr)		Scenario 1a: Taylot St		Scenario 1b: flowpath		Scenario 1c: random	
Ranking 1	**Ranking 2**	**Metric**	**Value**	**Normalized Value**	**Value**	**Normalized Value**	**Value**	**Normalized Value**	**Value**	**Normalized Value**
3	5	**Present value cost: installation + maintenance (20 years)**	NA	NA	$1,439,300	1.00	$1,439,300	1.00	$1,439,300	1.00
2	2	**$ per gallon runoff captured by GI**	NA	NA	$1.65	1.00	$1.23	0.00	$1.63	0.95
1	1	**GI capacity used**	NA	NA	67.94%	1.00	90.82%	0.00	68.84%	0.96
5	6	**Sewer capture (% of precipitation)**	84.28%	NA	79.04%	0.47	77.81%	0.00	80.42%	1.00
6	4	**Outflow to downstream area (% of precipitation)**	6.91%	NA	4.18%	1.00	2.56%	0.00	3.34%	0.48
4	3	**Area flooded (% of area ever flooded)**	7.88%	NA	2.47%	0.99	0.86%	0.00	2.48%	1.00
		SCORES								
		Ranking 1	NA		5%		81%		5%	
		Ranking 2	NA		3%		90%		10%	

Things to consider

- Simulations alone are not enough
  - Tradeoffs
  - Costs and distribution
  - Spatial constraints
  - Diverse stakeholder interests
- Solution-building AND compromise
- Awareness of preferences
  - Addressing diverse needs
    - metrics, evaluation, exploration

Participatory Modeling

Workshop structure



1: Concern profile

iPad 12:03 PM 100%

Sort the items based on how important they are to you

- Maximum Flooded Area
- Damage Reduction
- Efficiency of Intervention ($/Gallon)
- Capacity Used
- Water Flow Path
- Groundwater Infiltration
- Investment
- Impact on my Neighbors

Enter Username

Profile Unlocked / Profile Locked

Definitions

Investment: Cost to install and maintain new green infrastructure on both city and private property. Maintenece costs are in Present Value (PV) over 20 years, at 3% discount rate.

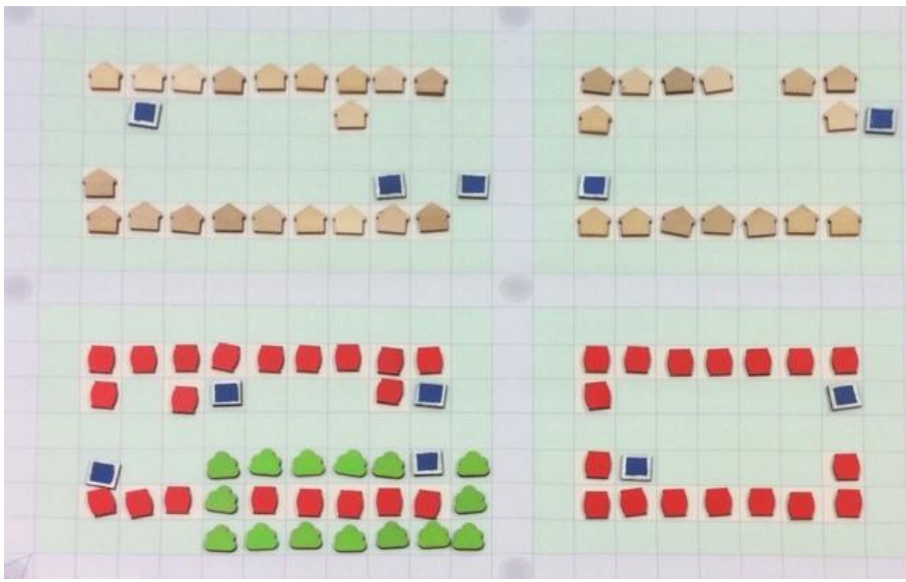
Damage Reduction: The amount of property damages reduced by the investment.

Efficiency of Intervention: ($/Gallon) The amount of money spent per gallon of rainwater stored or infiltrated by green infrastructure installations.

Capacity Used: The percentage of capacity used by interventions over their total avaiable capacity

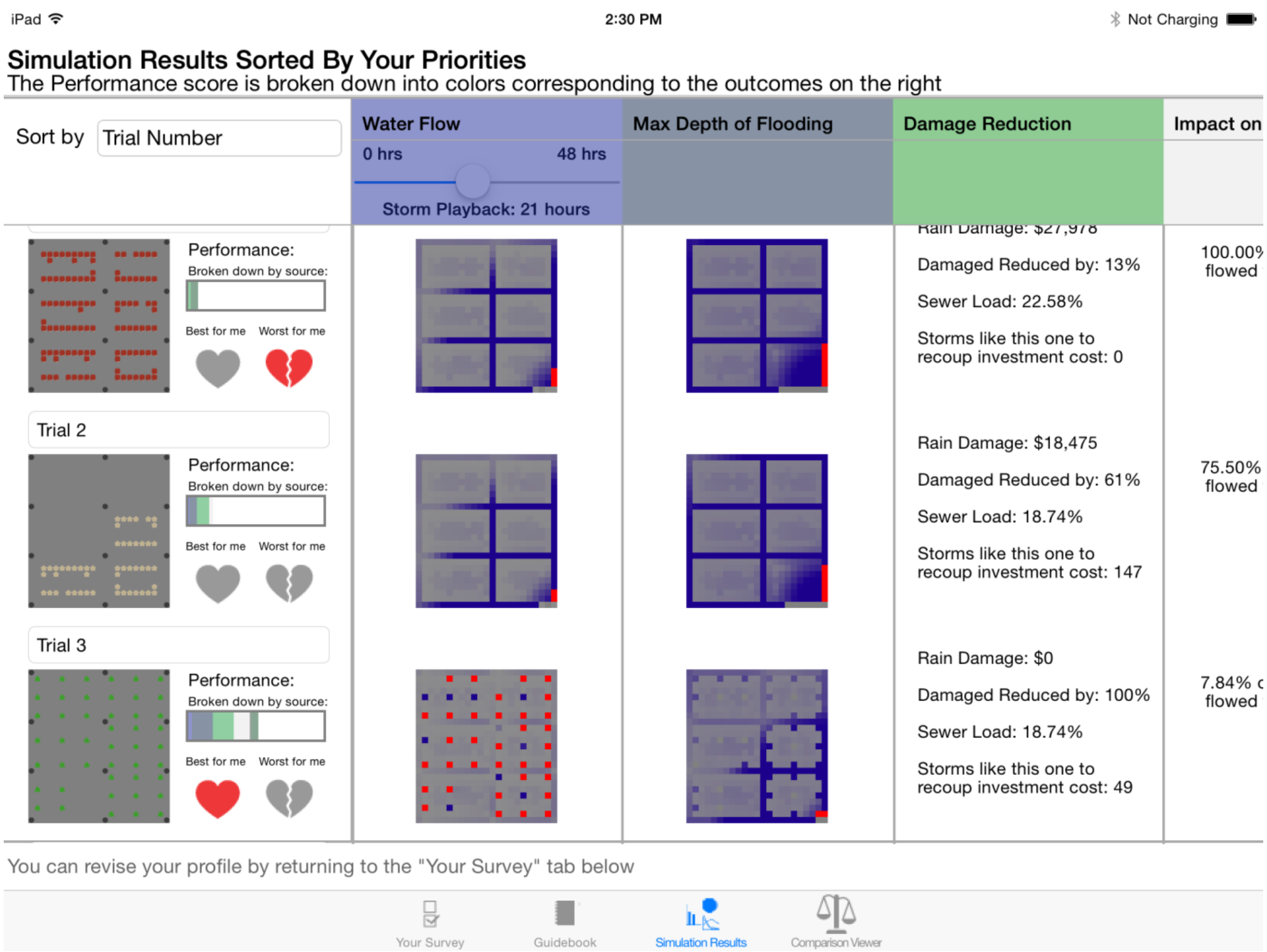
Your Survey | Guidebook | Simulation Results | Comparison Viewer

2: Interactive placement of tokens

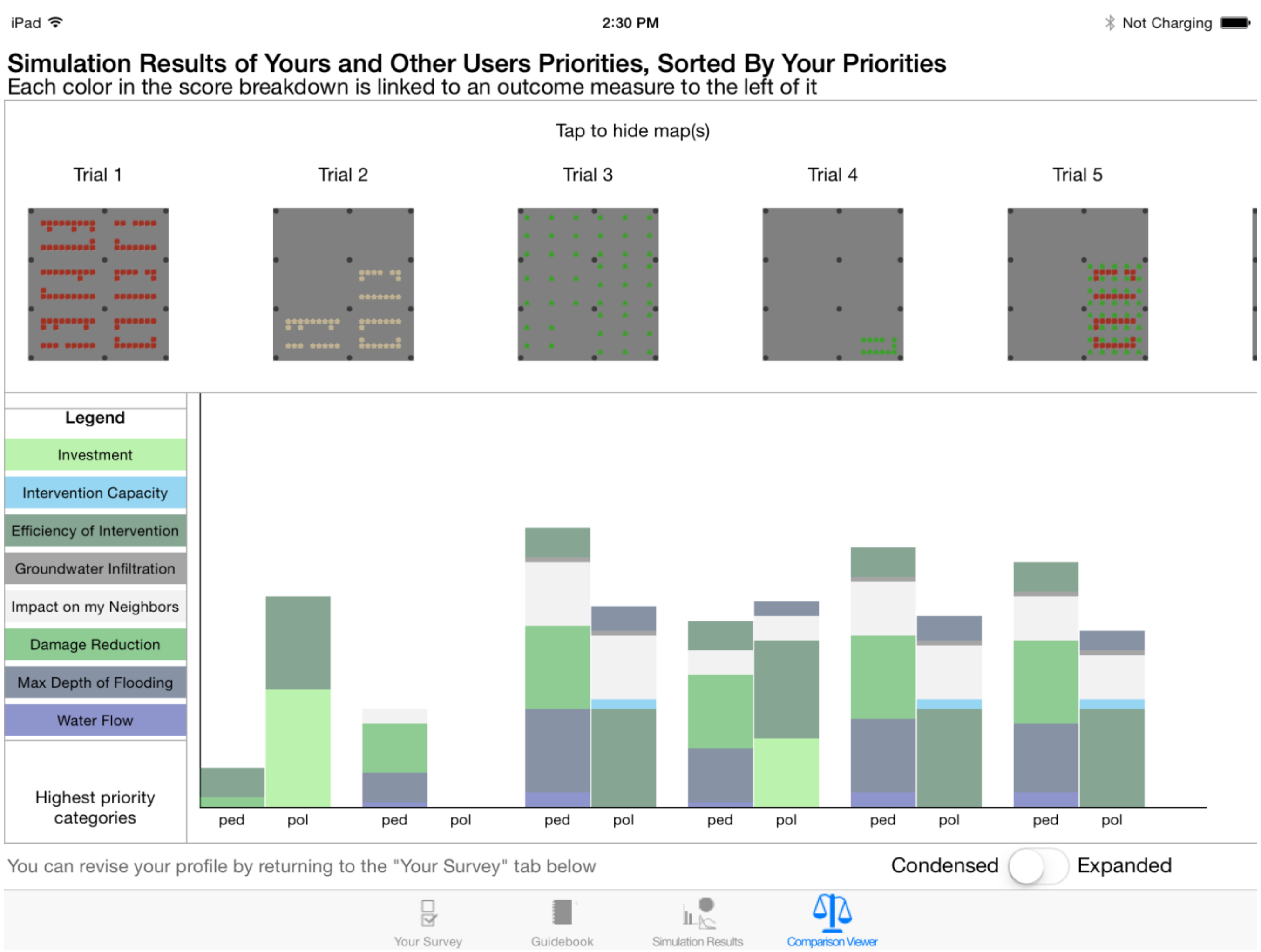
 

3: L-GrID Simulations

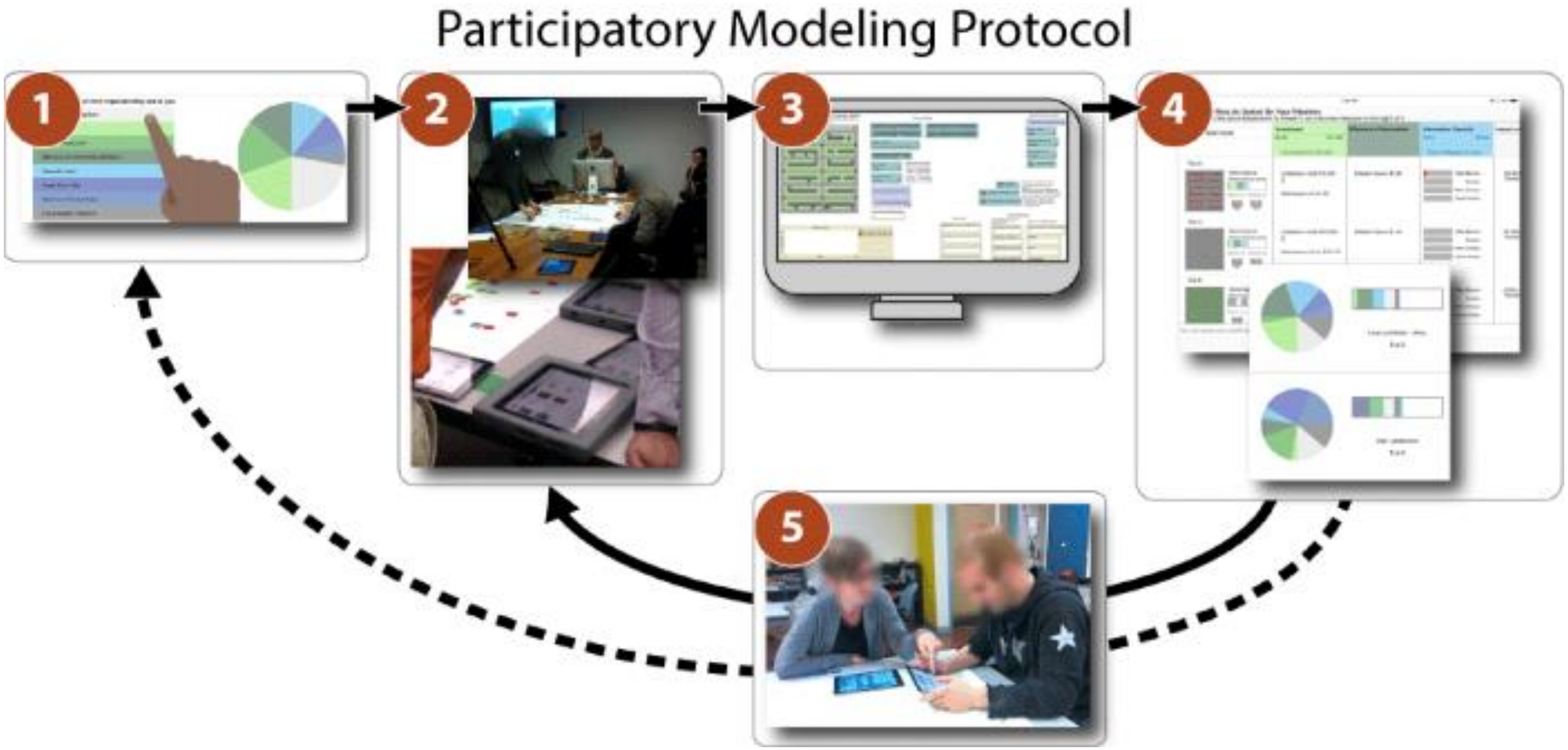
4: Sorted simulation results



5: Social viewer



Iterative structure



Learning, innovation, compromise

- Transparency of assumptions and tradeoffs
  Jo: "Oh wow, that's much better…for you."
  Nina: "I guess it matters what your priorities are!"
  Kevin: "Damage was reduced by 87%…but we were over budget by 1.2 million."
- Systematic exploration
  "Let's start by going crazy, putting a lot of stuff on here, and then pare back from there."
  "We can run multiple simulations, so let's run this one and then try that"
- Gesturing and mental modeling
  Following the flow
  Imagining different performance
- Green infrastructure cannot locally solve the problem
  "Perhaps we need to think of moving the houses out of there"
  Green AND gray infrastructure
  Coordination with other communities

Takeaways

- Collaborative design
- Facilitation for synthesis
- Consensus or compromise?
- Participatory modeling as a point of entry
  - to the problem,
  - to other tools,
  - to diverse interests
  - to other problems

- Zellner, ML, Lyons, L, Milz, D, Shelley, J, Hoch, C, Massey, D and Radinsky, J. n.d. "Participatory complex systems modeling for environmental planning: Opportunities and barriers to learning and policy innovation." In: Porter, WF, Zhao, J, Schmitt Olabisi, L and McNall, M (eds.), *Innovations in collaborative modeling*. East Lansing, USA: Michigan State University Press. In Press.

Thank you!

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