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Net Present Value of Low Impact Development Retrofits in Edmonton, AB



TRIECA Conference

March 21st, 2018

**Olivia Sparrow, P.Eng., ENV SP
Water Resource Engineer, EOR**

**Eric Bill, M. Econ, MBA
Vice President, Impact Infrastructure**

Introductions

A collaborative group of environmental and design professionals passionate about protecting our waters, restoring healthy ecosystems, and enhancing our community's unique sense of place.

www.eorinc.com



w a t e r

watersheds and water resources



e c o l o g y

ecosystem restoration



c o m m u n i t y

civil eng. & landscape arch.

Autocase SITES

A leader in economic analysis whose expert economists bring a \$50 billion track record of assessing projects across all sectors, and have built the market-leading cloud-based automated triple bottom line cost benefit analysis (TBL-CBA) software, Autocase. Our primary goal is to create a standardized suite of business case analysis tools to promote the development of more sustainable and resilient infrastructure. www.autocase.com

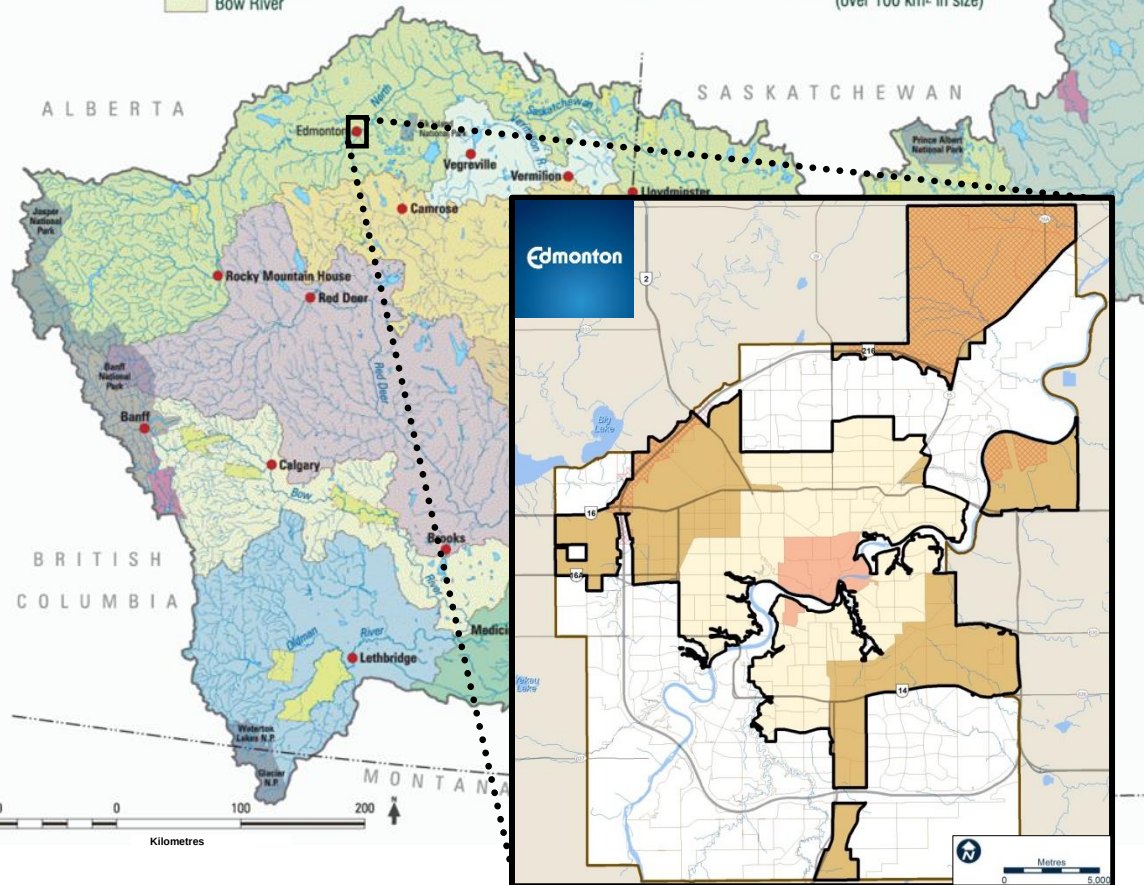


Study Area

Saskatchewan River Basin

Saskatchewan River Watersheds

Battle River	Oldman River	Vermilion River	First Nations Reserve (over 100 km ² in size)
Sounding Creek	South Saskatchewan River	Eagle Creek	Provincial Park (over 100 km ² in size)
Red Deer River	North Saskatchewan River	Saskatchewan River	
Bow River			



Case Study:

- 3,200 ha (7,900 ac.)
- Urban (all developed)
- Clay soils
- Nutrient levels (local & basin)
- Combined sewer overflow
- Flooding

Project Purpose:

Evaluate how many LID retrofits are needed to meet pollutant reduction targets by:

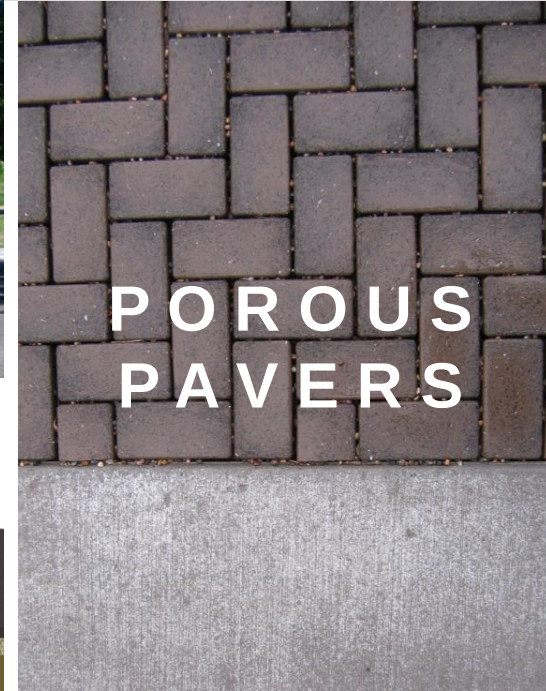
- Siting urban LID retrofits
- Estimating costs and benefits

LID Types

RAINGARDENS



POROUS PAVERS



GREEN STREETS



GREEN ROOFS





Site Suitability

- Planimetric
- Impervious
- Land Use
- Topography & Hydrology
- Landscape Position
- Land Slope
- Distance to Buildings
- Distance to Trees
- Bioretention Suitability
- Bioretention Initial Screening
- Bioretention Final Screening
- High Slope Areas

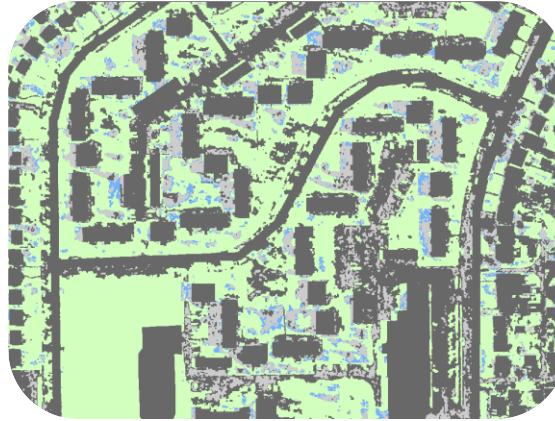
Siting LID Retrofits

Start Point



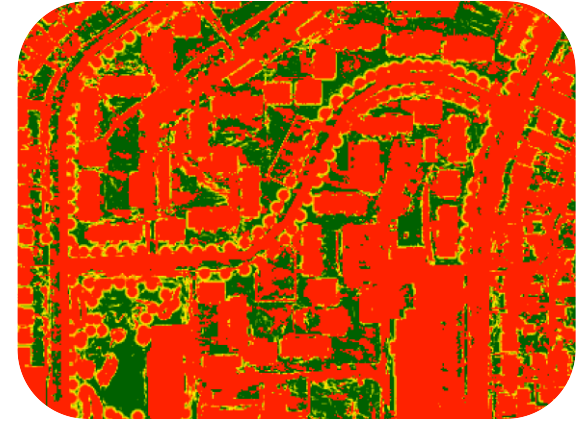
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Impervious



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Buffer Zones

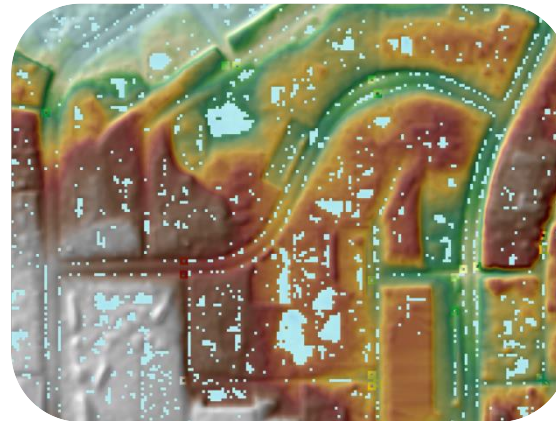


Bioretention Footprint



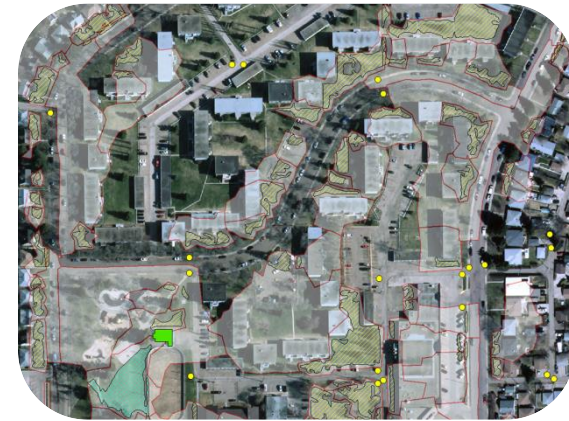
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Catchment Delineation



=

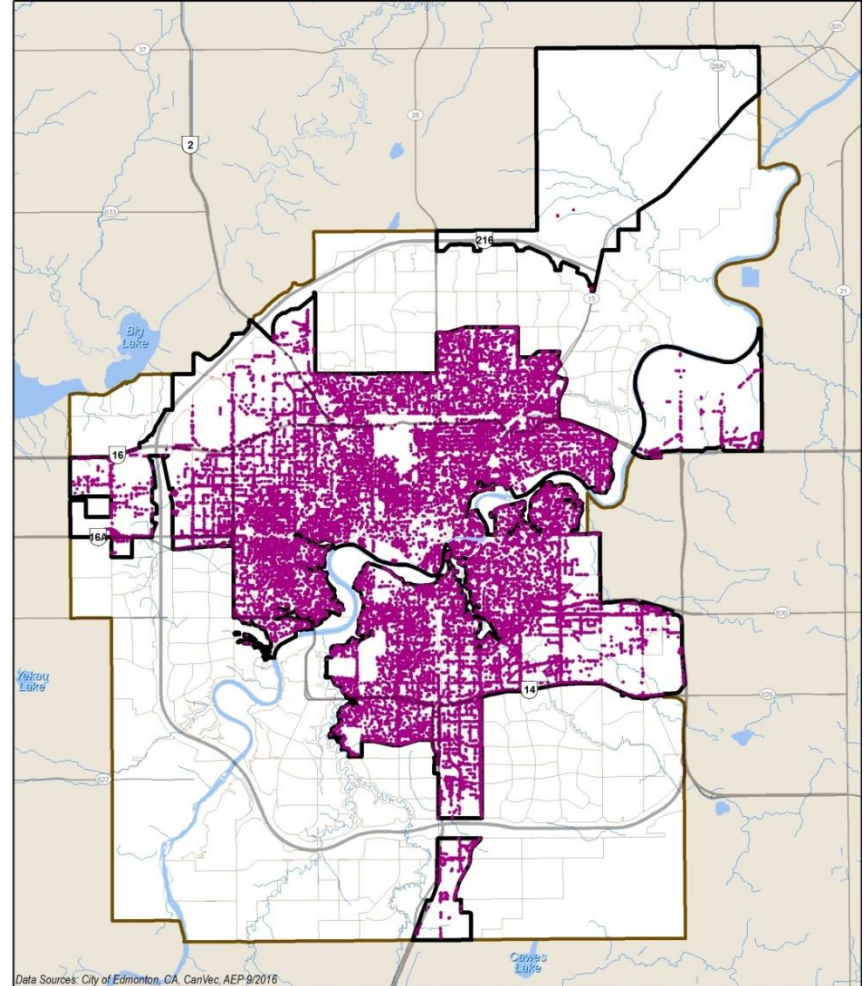
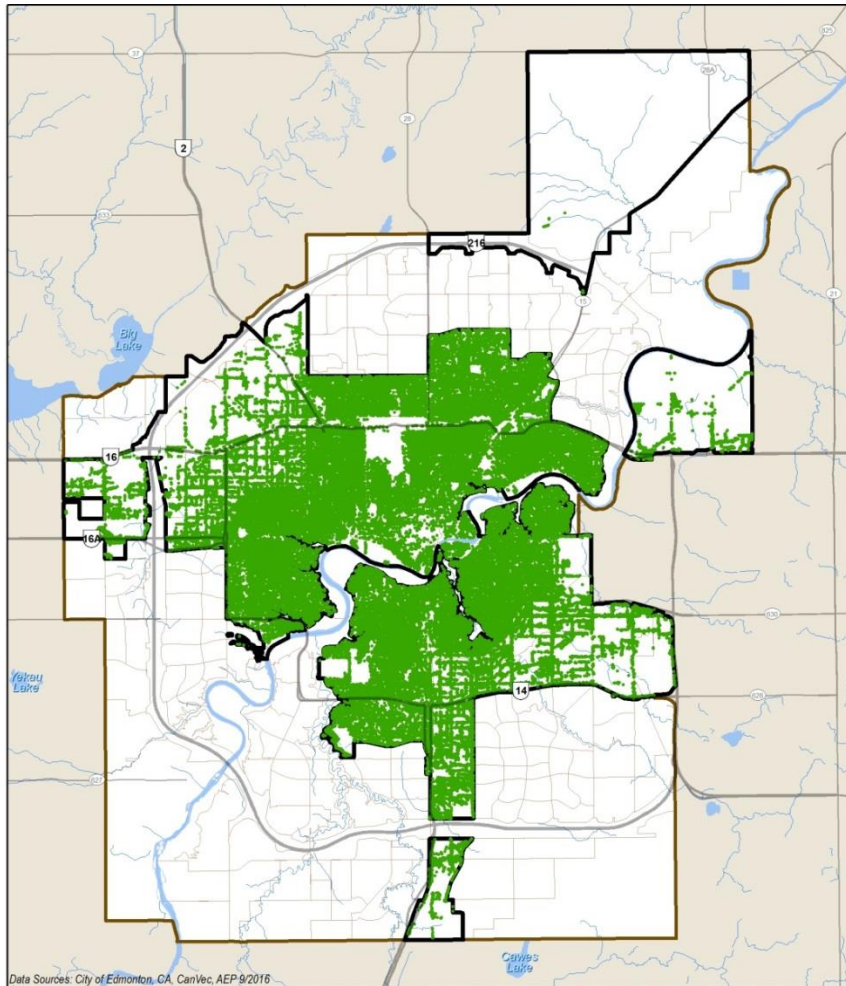
Final LID Retrofits



LID Retrofit Opportunities

Over 85,000 LID Retrofit Opportunities

(Over 33,000 on Public Land)



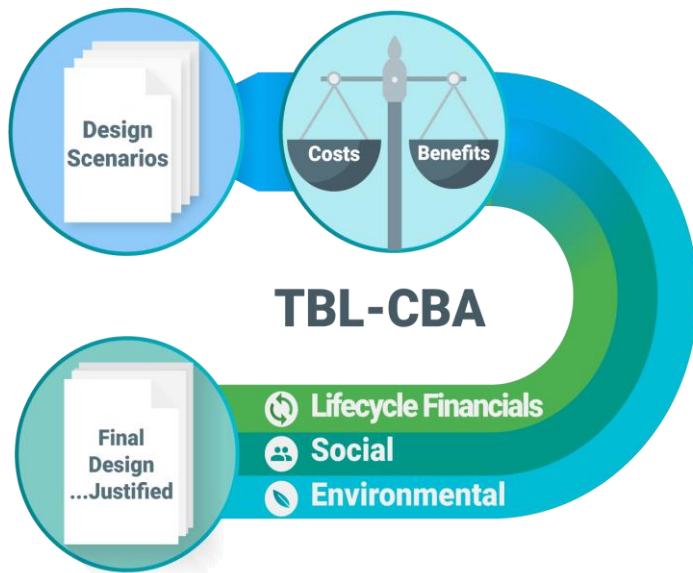
Analyzing Grey & Green Options



Methods

- **Financial:**
Capital + O&M Costs
- **Environmental Performance:**
Runoff + Pollutant Control
- **Cost-to-Benefit Ratios**
- **Triple Bottom Line:**
Economic + Environment + Social
- **Relative vs. Absolute**
- **NEW:**
Sustainable Return on Investment

S-NPV Analysis of LID



Edmonton LID Location Study

- 33,000 Public LID Retrofits
- Holistic Valuation of LID
- Absolute Analysis
- Time Span = 63 years
- Tool: Autocase for Sites
- New Batch Run Functionality



Components of Autocase

- **(Capital Expenditures)**
- **(Operations & Maintenance)**
- **(Replacement Costs)**
- + Irrigation Savings
- + Mowing Savings
- + Residual Value of Assets
- + Avoided Grey Infrastructure Costs

Financial

- + Flood Risk Mitigation
- + Property Value
- + Heat Island Effect Mitigation

Social

- + Water Quality Improvements
- + Carbon Sequestration by Vegetation
- + Air Pollution Reduction

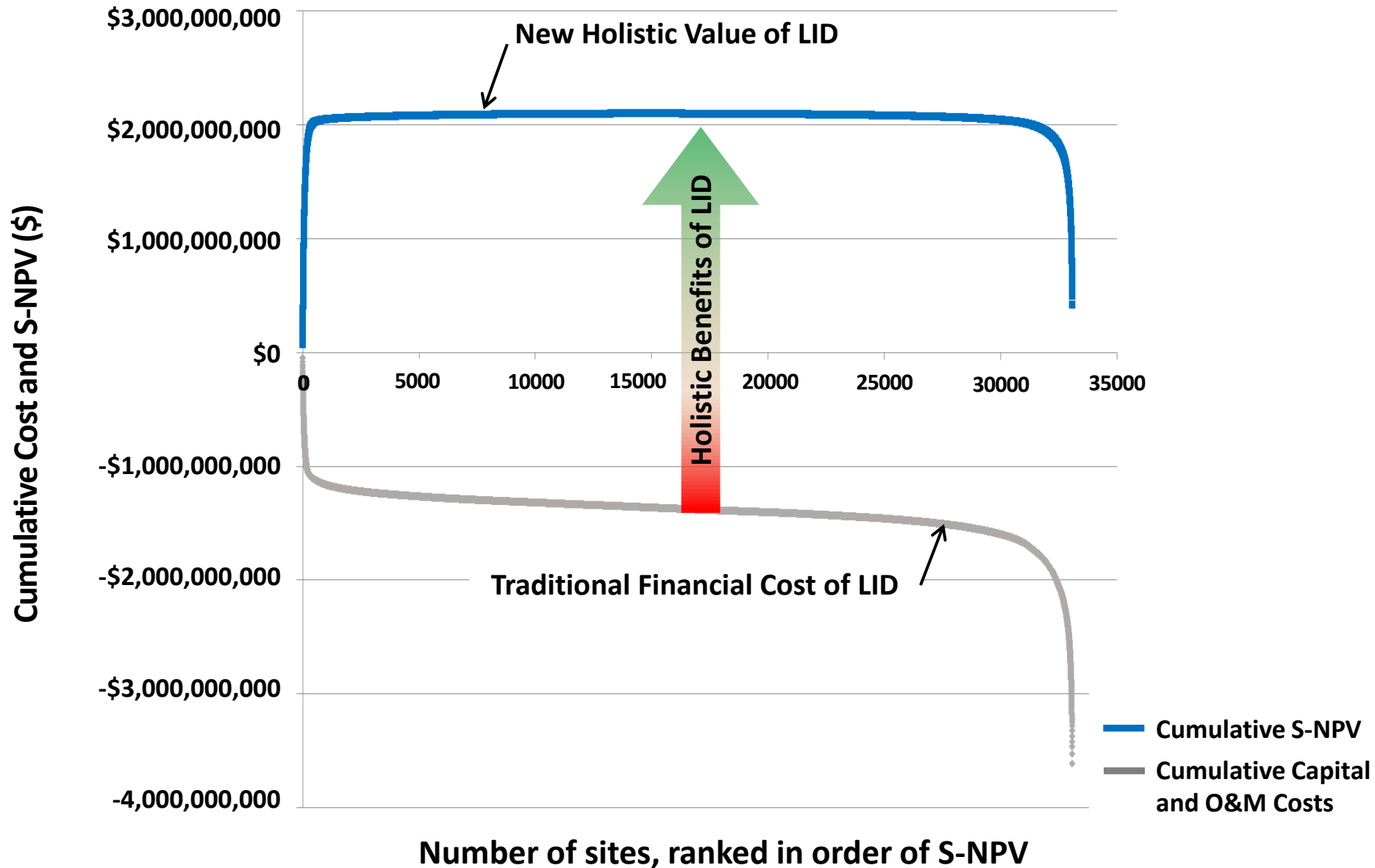
Environmental

Triple Bottom Line: Net Present Value

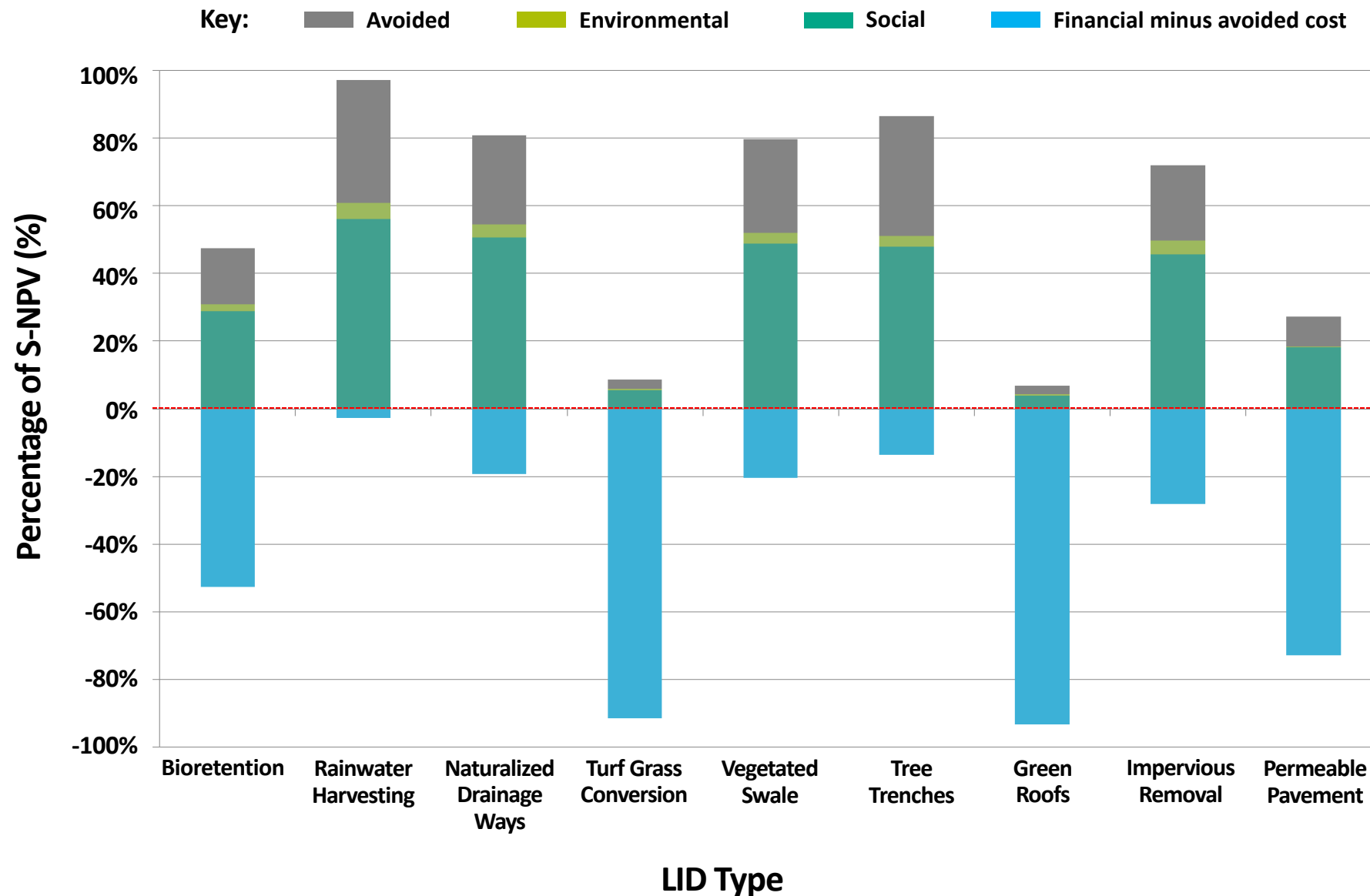
Example Output for Rain Garden

Impact Type	Cost/Benefit	Value	95% Confidence Interval
Financial	Other Benefits	\$521	\$521 to \$521
Financial	Residual Value of Assets	\$58	\$18 to \$156
Financial	Replacement Costs	-\$911	-\$1,973 to -\$349
Financial	Capital Expenditures	-\$1,256	-\$2,626 to -\$486
Financial	Operations and Maintenance	-\$10,897	-\$21,628 to -\$2,147
Social	Flood Risk	\$1,457	\$651 to \$8,238
Social	Property Value	\$475	\$302 to \$634
Social	Heat Island Effect	\$83	\$51 to \$121
Environmental	Air Pollution Reduced by Vegetation	\$360	\$259 to \$489
Environmental	Water Quality	\$173	\$173 to \$173
Environmental	Carbon Reduction by Vegetation	\$14	\$6 to \$28
Financial	Social	Environmental	Triple Bottom Line (before Avoided Costs)
-\$12,485	\$2,015	\$547	-\$9,922

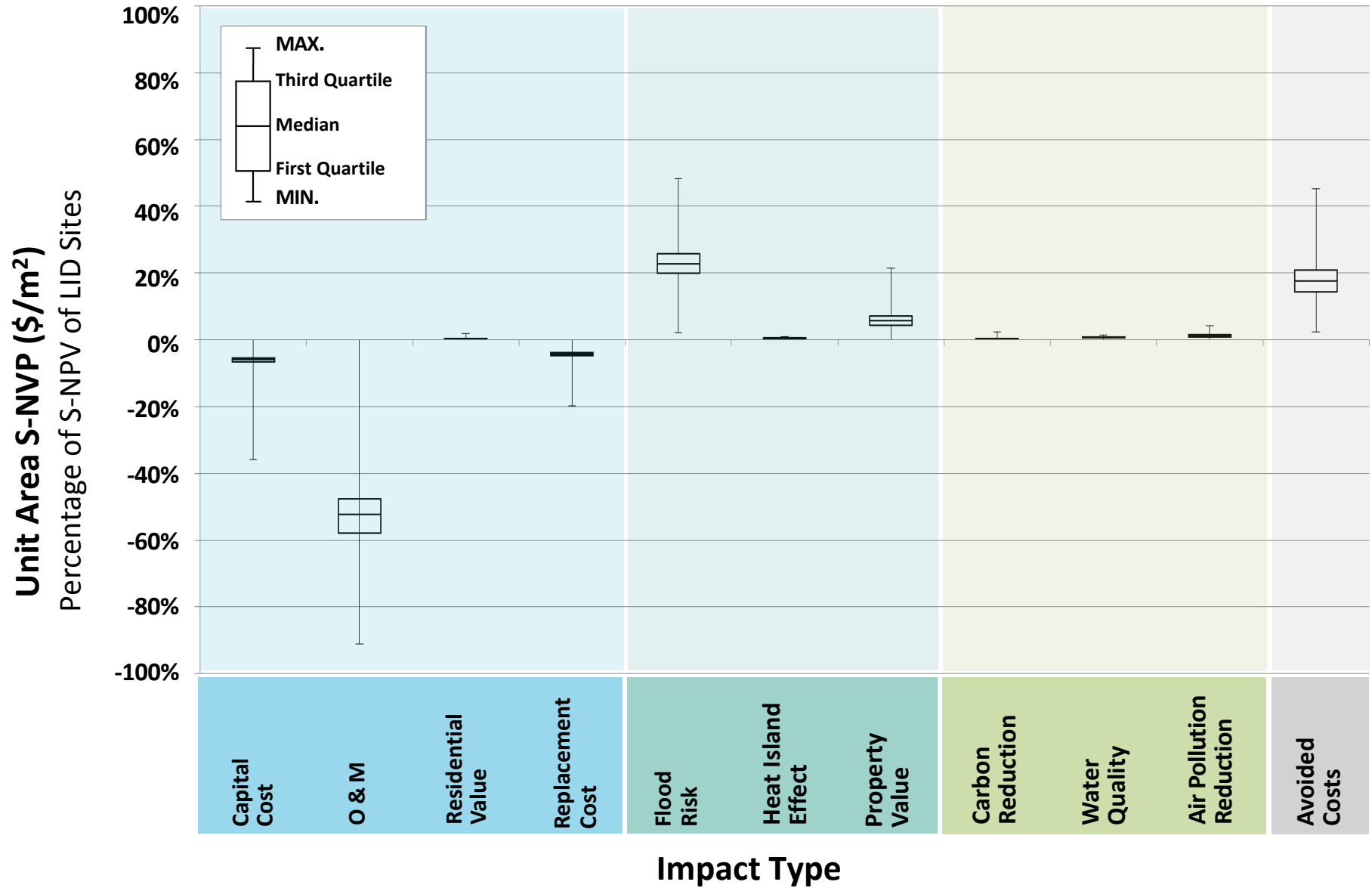
Cumulative Financial & S-NPV



What's contributing to triple bottom line?



Impact Types



Limitations



- Inputs for tree trenches and turf/pavement conversion
- Modifications for irrigation and mowing savings
- Research & data needed for valuing:
 - *social cost of water*
 - *ecosystem health*
 - *biodiversity*
 - *aesthetics*
- Base outputs from Autocase to troubleshoot and validate
- Confidence intervals for batch runs
- Planning-level analysis focused on LID

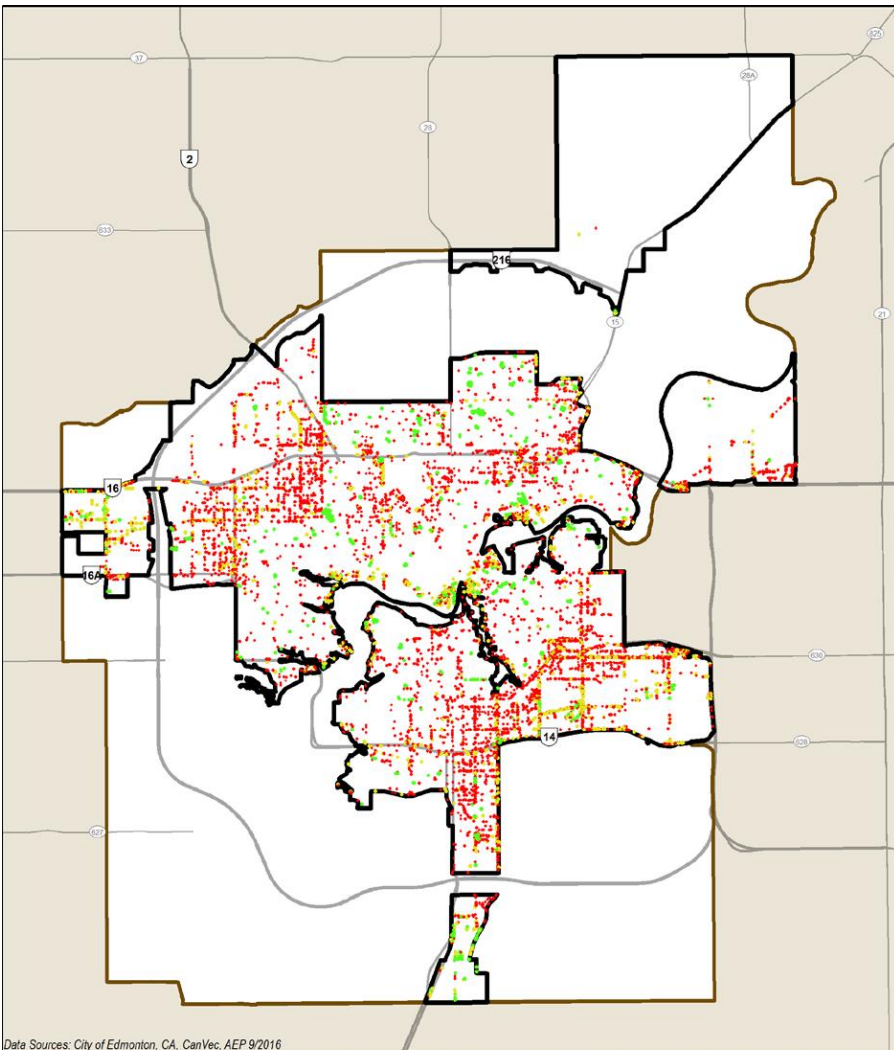
Conclusions



- **Public LID retrofits offer:**
 - ~ \$420 mil. in cumulative holistic value
 - ~ half of sites have benefits > costs
 - Exceed City's short & medium term TSS and TP targets to NSR
- **Results ready to prioritize LID implementation:**
 - Sustainable NPV
 - Runoff & pollutant reductions
 - TBL scores
 - Locations (flooding area or prime for redevelopment)
- **More information, research, and detail will address S-NPV limitations**

Study Results

- 85,000 retrofits sited total
- 33,000 public retrofits sited
- Ranked by cost-benefit ratios and S-NPV
- Scale of implementation needed for achieving load reduction targets



Data Sources: City of Edmonton, CA, CanVec, AEP 9/2016



CBA Stage
• Short
• Medium
• Long
• StudyArea
• City of Edmonton



LID Location Study

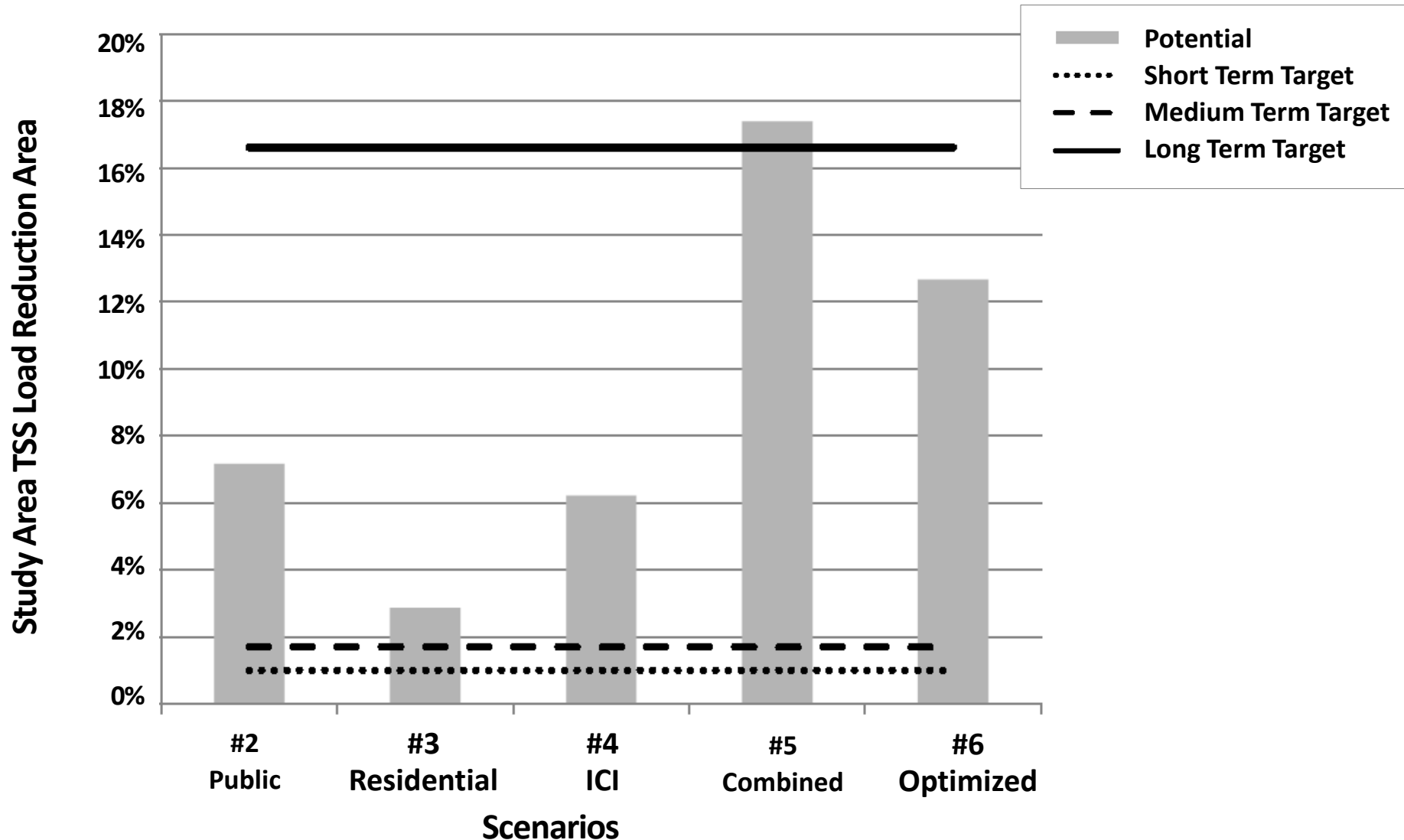
CBA Implementation Staging



Metres
0 5,000

Study Results

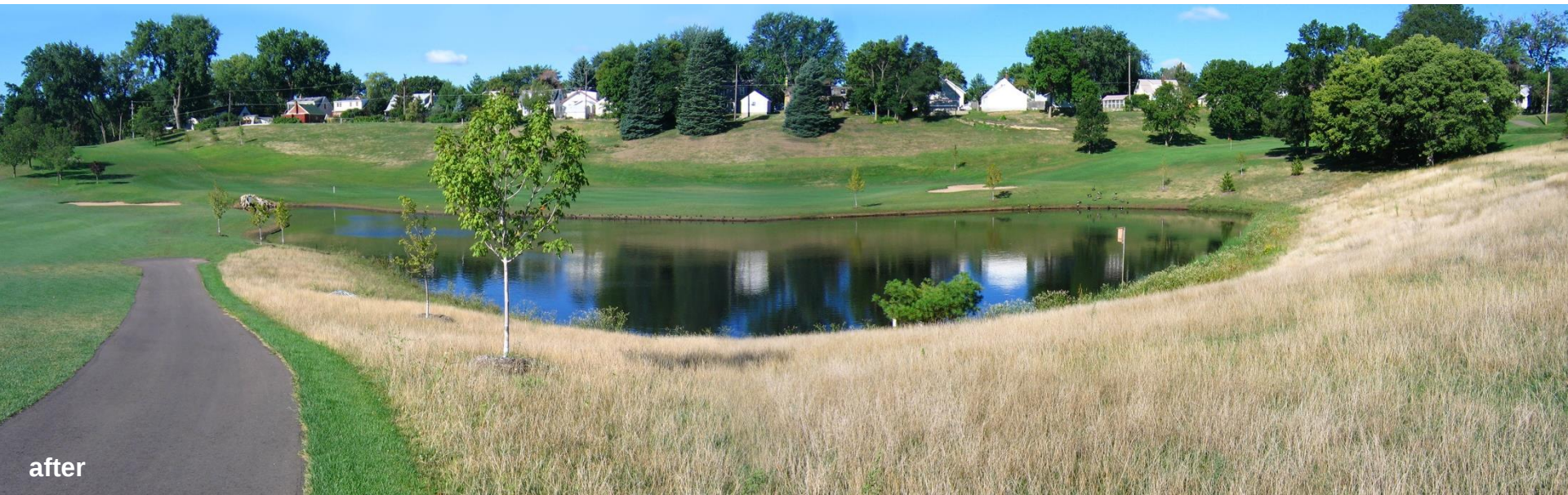
Comparison of Estimated TSS Load Reduction from LID Retrofits to Targets



Study Implications



- **Scale of LID implementation:
go beyond demonstrations/pilots**
- **Financial markets**
 - Municipal bond ratings
 - Flood Insurance
 - Stormwater credit market
- **Research needs**



after

Example Project: Green Medical Campus



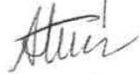
Example: User Perspective

11/8/16

Dear folks,

This is a much belated thanks for your wonderful work landscaping the grounds of Amery Regional Medical Center. I am a staff physician there and remain in constant awe every time I visit. It only improves with maturity. August brings a sea of butterflies. Spring & fall have their own peaks.

Thank you for such an incredible job so well done.

Sincerely,

Steve Riendl

"Dear folks,

11/8/16

This is a much belated thanks for your wonderful work landscaping the grounds of Amery Regional Medical Center. I am a staff physician there and remain in constant awe every time I visit. It only improves with maturity. August brings a sea of butterflies. Spring & Fall have their own peaks."

Thank you for such an incredible job
So well done.

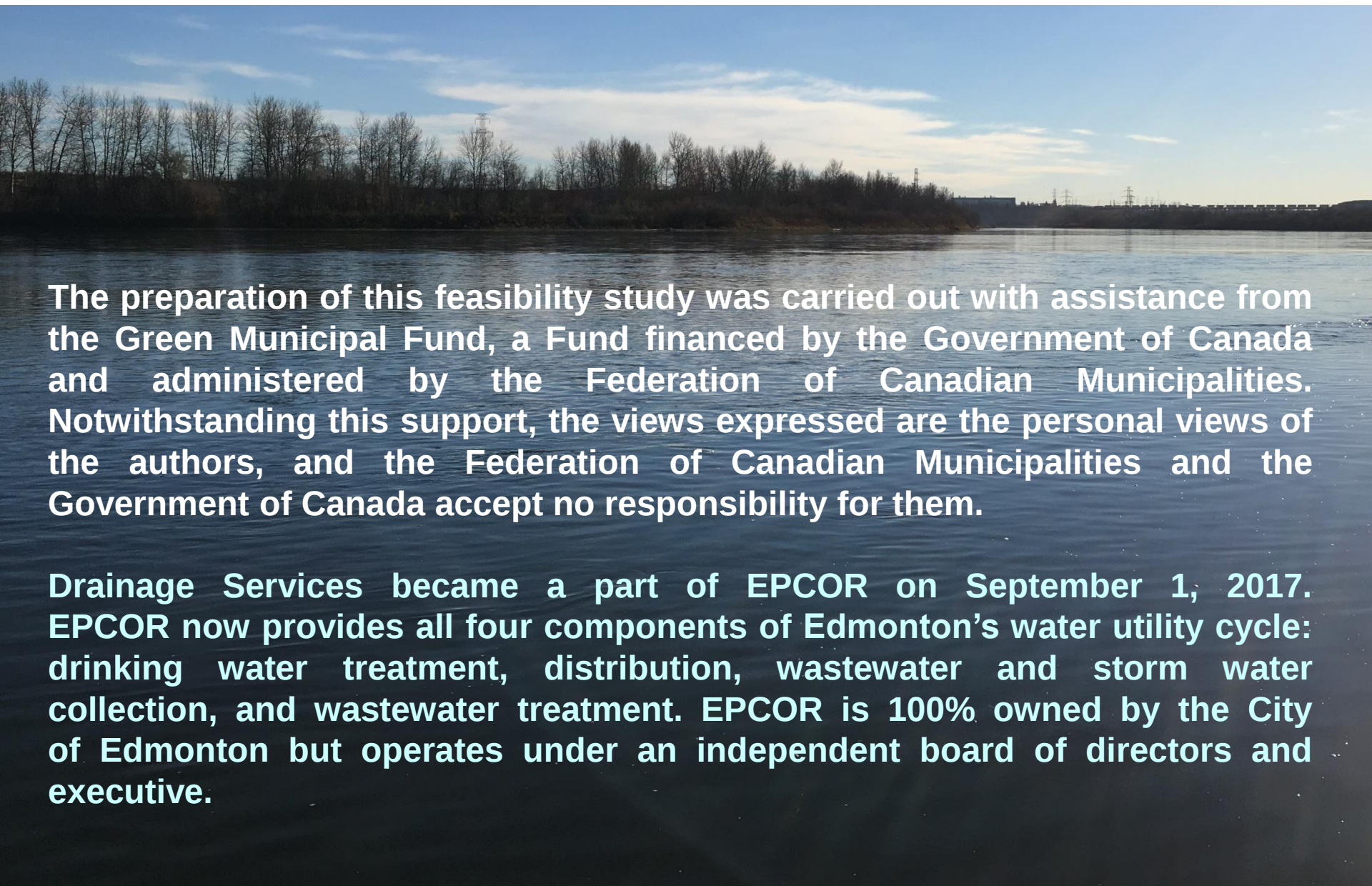
Sincerely,
Steve Riendl"

Acknowledgements

- City of Edmonton
- EPCOR
- Federation of Canadian Municipalities



Thank You



The preparation of this feasibility study was carried out with assistance from the Green Municipal Fund, a Fund financed by the Government of Canada and administered by the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

Drainage Services became a part of EPCOR on September 1, 2017. EPCOR now provides all four components of Edmonton's water utility cycle: drinking water treatment, distribution, wastewater and storm water collection, and wastewater treatment. EPCOR is 100% owned by the City of Edmonton but operates under an independent board of directors and executive.

Questions?



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