CIIX Symposium – November 2014 - Ottawa

Unleashing the Capital for a More Sustainable World

Marty Janowitz
VP, Discipline Leader
Sustainable Development

John F. Williams, II
Chairman & CEO

John C. Parker
Chief Economist

Emma Stewart
Head of Sustainability
Solutions

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Project Managers, Engineers & Architects – First In, Last Out

- AEC professionals are the ones who know the project, its risks and benefits.

- They are generating and storing information in the feasibility, planning and design stages and the throughout the building life cycle. The information generated is supporting cost and risk management, construction, and facility operation.

- They are using a sustainability rating system and valuation framework to design-in and make the case for sustainable infrastructure.

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Tools Being Used Now That Can Inform the CIIX and Build Trust for ESG Investors

- Building Information Modeling (BIM)
- Envision™ Rating System
- AutoCASE

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BIM – Virtual Construction to Reduce Uncertainty, Simulate and Analyze Impacts

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BIM - Optimize Design

Courtesy of Multiconsult

BIM - Manage Complexity & Risk

TimeLiner

Tasks | Data Sources | Configure | Simulate

Tasks: Filter by Status | Column Set | Show Hierarchy | Rules...

Gantt Chart: Show | Display Dates: Planned vs Actual | Zoom:

Active	Name	Status	Planned Start	Planned End	Actual Start	Ac
☑	LcTlLinkRoot		30/07/2001	25/09/2001	31/07/2001	19/09
☑			30/07/2001	01/08/2001	31/07/2001	02/08
☑	S_A393_REIN_DEEP_E30		02/08/2001	03/08/2001	01/08/2001	02/08

July 2001 | August 2001

W31 | W32 | W33

Courtesy of VTN Consulting

BIM - Engage Stakeholders

Courtesy of Doyle Drive Project Team

Envision™ – A Standard for Sustainable Infrastructure

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Envision™ – A Standard for Sustainable Infrastructure

- ISI was founded by the American Council of Engineering Companies (ACEC), the American Public Works Association (APWA), and the American Society of Civil Engineers (ASCE).
- Provides a holistic framework for evaluating and rating the community, environmental, and economic benefits of all types and sizes of infrastructure projects.
- It evaluates, grades, and gives recognition to sustainable infrastructure projects.

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Tools to Plan, Manage & Verify are Rapidly Evolving

INSTITUTE FOR SUSTAINABLE INFRASTRUCTURE
I S I

ZOFNASS PROGRAM
FOR SUSTAINABLE INFRASTRUCTURE
Graduate School of Design
Harvard University

APWA Your Comprehensive Public Works Resource
ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS
ACEC American Council of Engineering Companies 100 Years of Excellence

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Subcategories of Infrastructure

energy

geothermal

hydroelectric

nuclear

coal

natural gas

oil/refinery

wind

solar

biomass

water

potable water distribution

capture/storage

water reuse

stormwater management

flood control

waste

solid waste

recycling

hazardous waste

collection & transfer

transport

airports

roads

highways

bikes

pedestrians

railways

public transit

ports

waterways

landscape

public realm

parks

ecosystem services

information

telecommunications

internet

phones

satellites

data centers

sensors

BIM is used to plan, design, construct, operate and maintain water, wastewater, electricity, gas, refuse and communication utilities to roads, bridges and ports, from houses, apartments, schools and shops to offices, factories, warehouses, prisons, etc.

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Integrated Sustainable Design Elements

QUALITY OF LIFE	Purpose, Community, Wellbeing
LEADERSHIP	Collaboration, Management, Plans
RESOURCE ALLOCATION	Materials, Energy, Water
NATURAL WORLD	Siting, Land & Water, Biodiversity
CLIMATE AND RISK	Emission, Resilience

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AutoCASE Example – Tucson & Pima County Flood Control Stormwater Management

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Project Background

- Collaboration between the City of Tucson, Pima County, Impact Infrastructure, Stantec, and Autodesk

- AutoCASE® for Stormwater:
  - On a commercial site
  - On a road project

- Automates TBL using:
  - Monte Carlo risk analysis
  - Multiple Account CBA
  - Linked to Envision
  - Embedded in planning & design process

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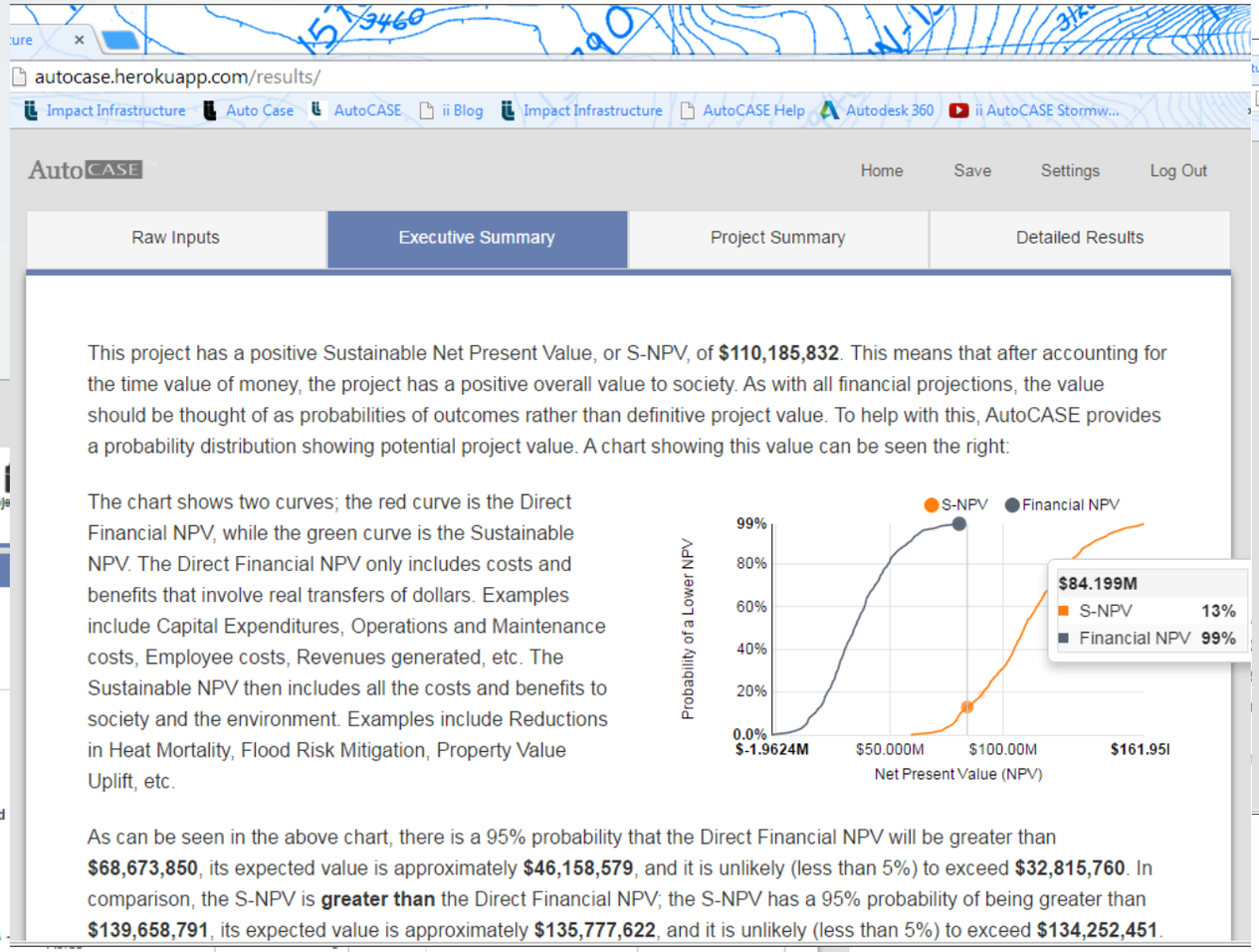
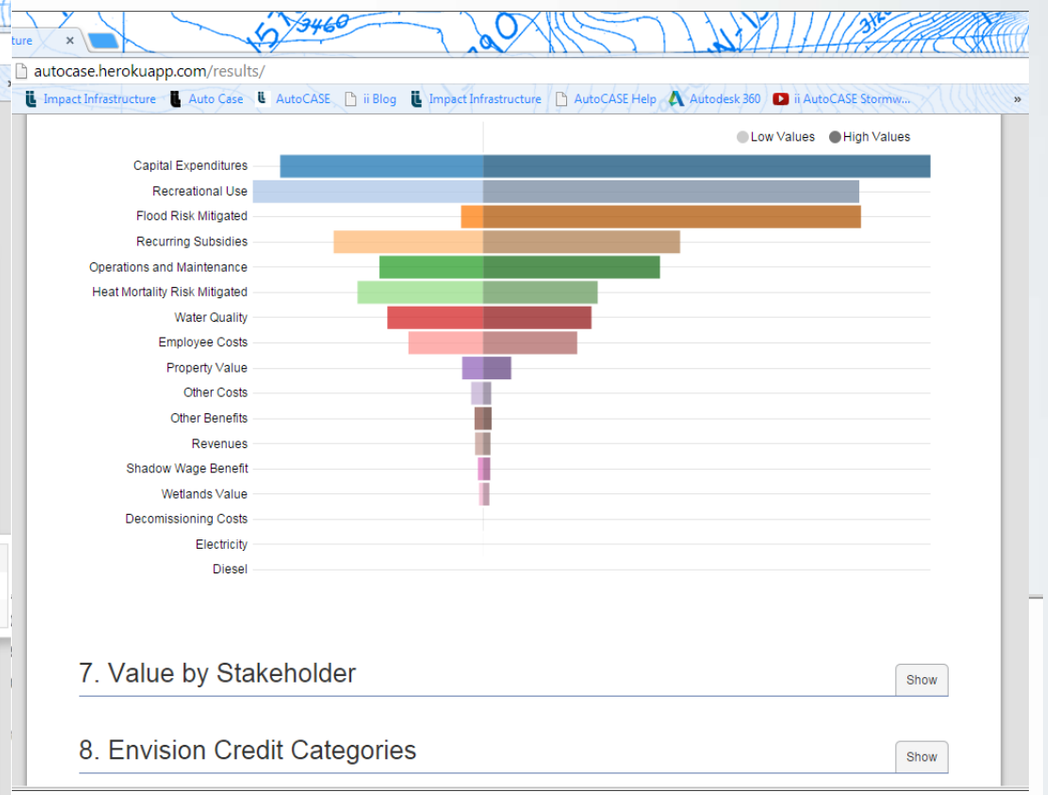
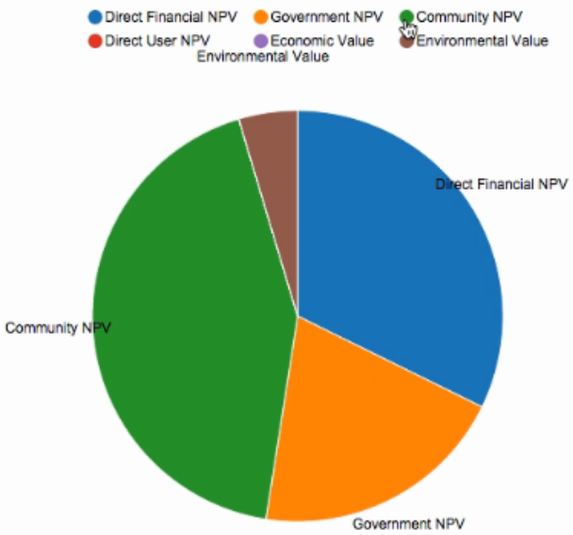
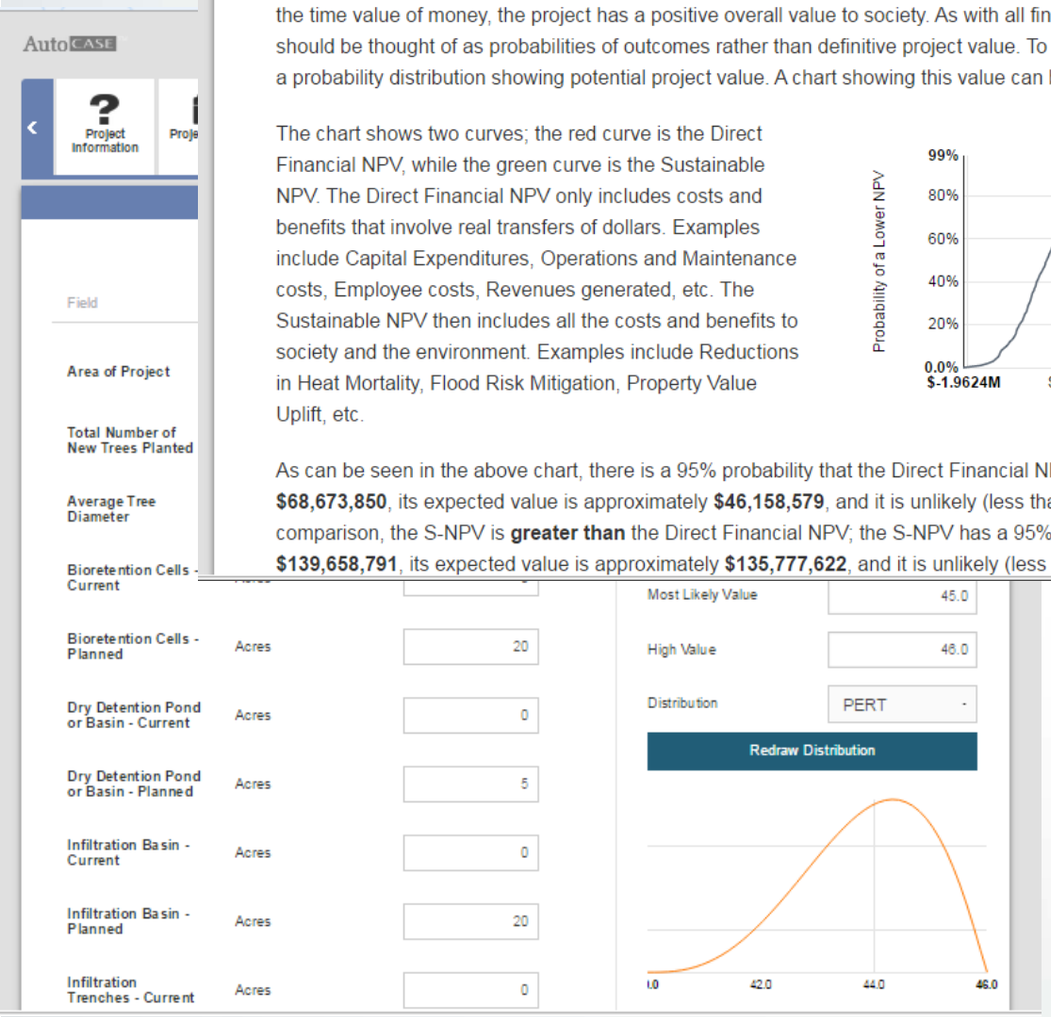
Cloud-Based Feasibility/Early Planning

Stormwater Management Example – Monte Carlo with Multiple Accounts









- http://youtu.be/JEtGnkC41Yw

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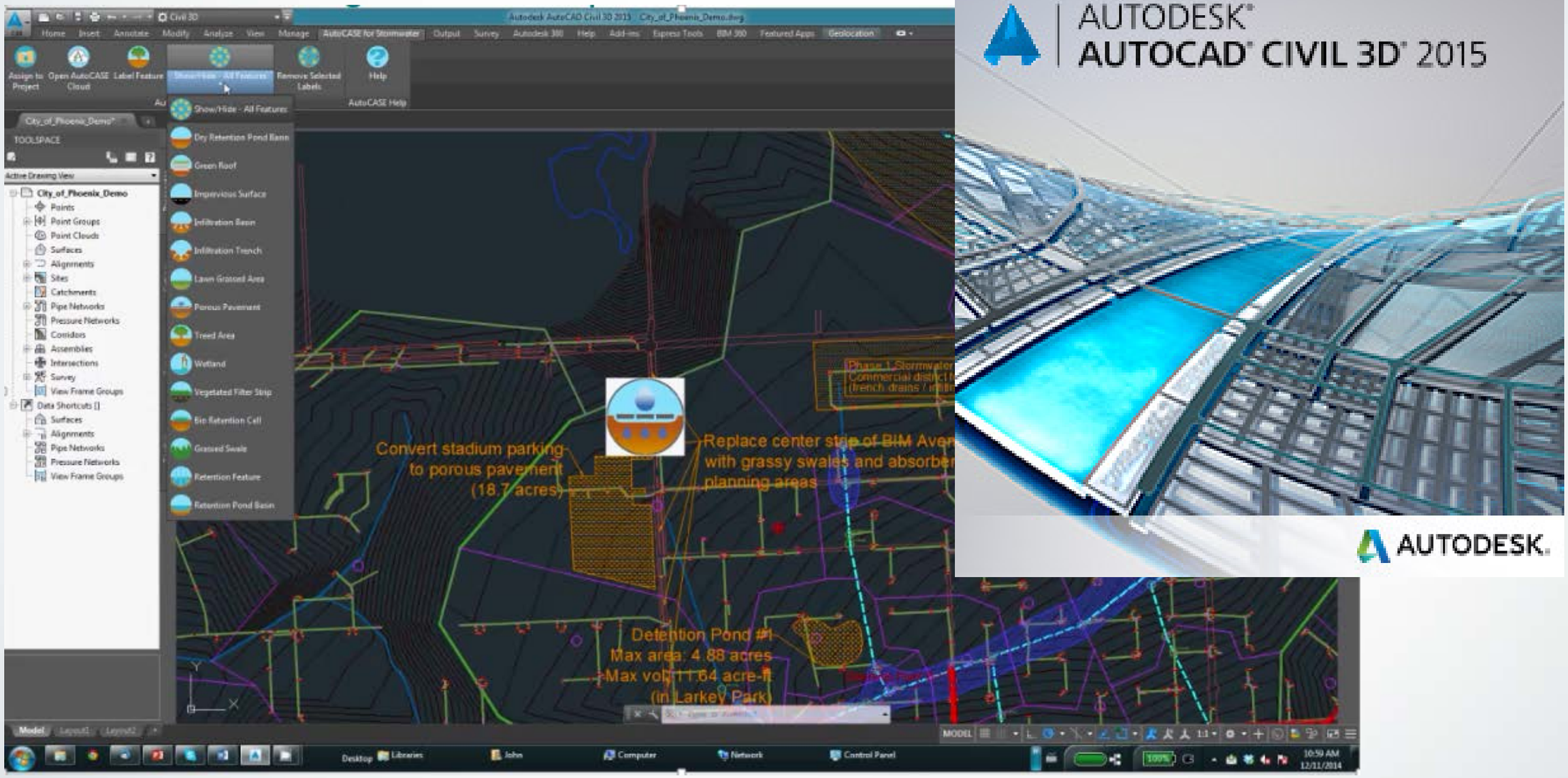
Plug-in Feature to Civil3D

Stormwater Management Example



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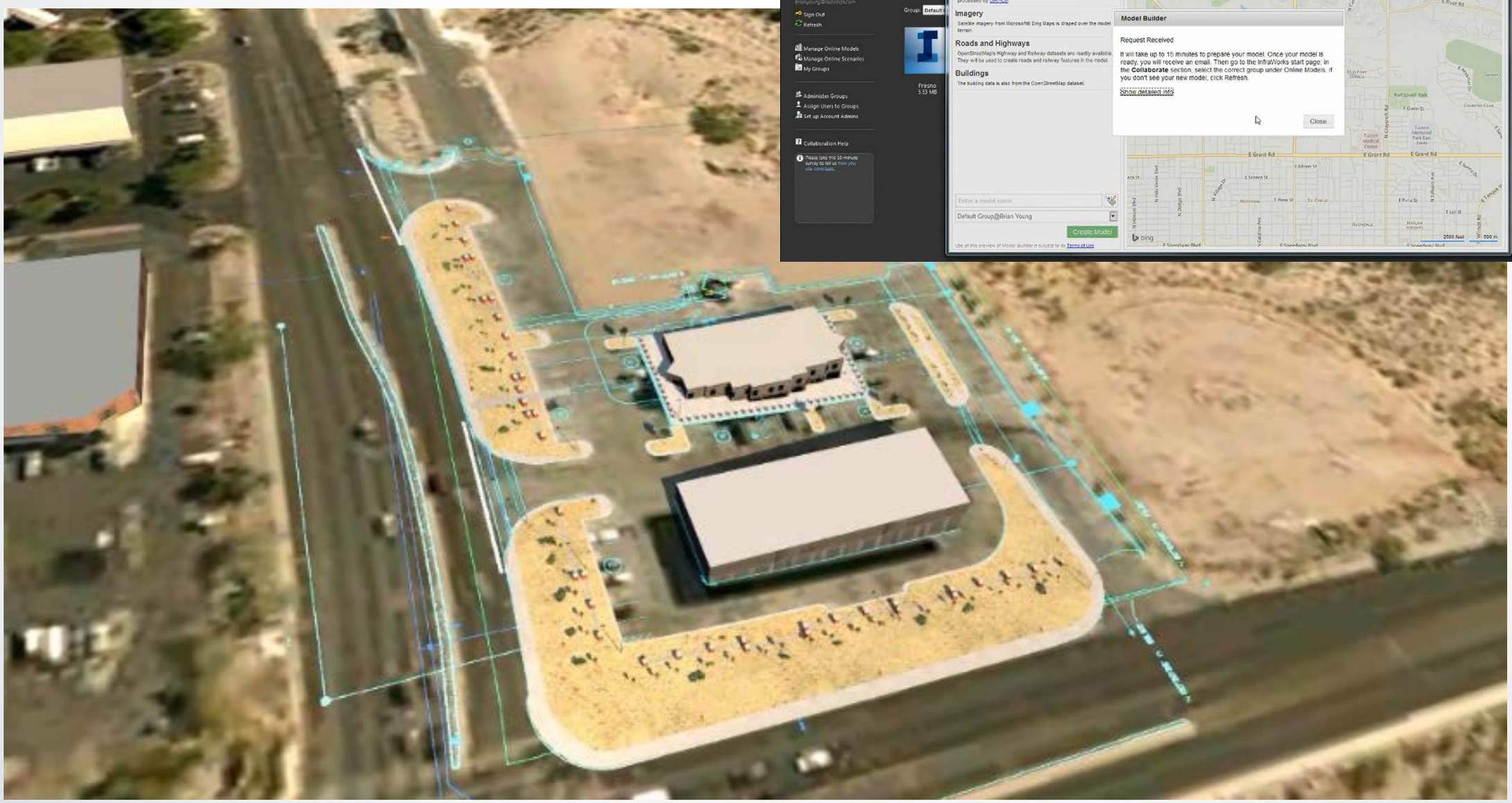
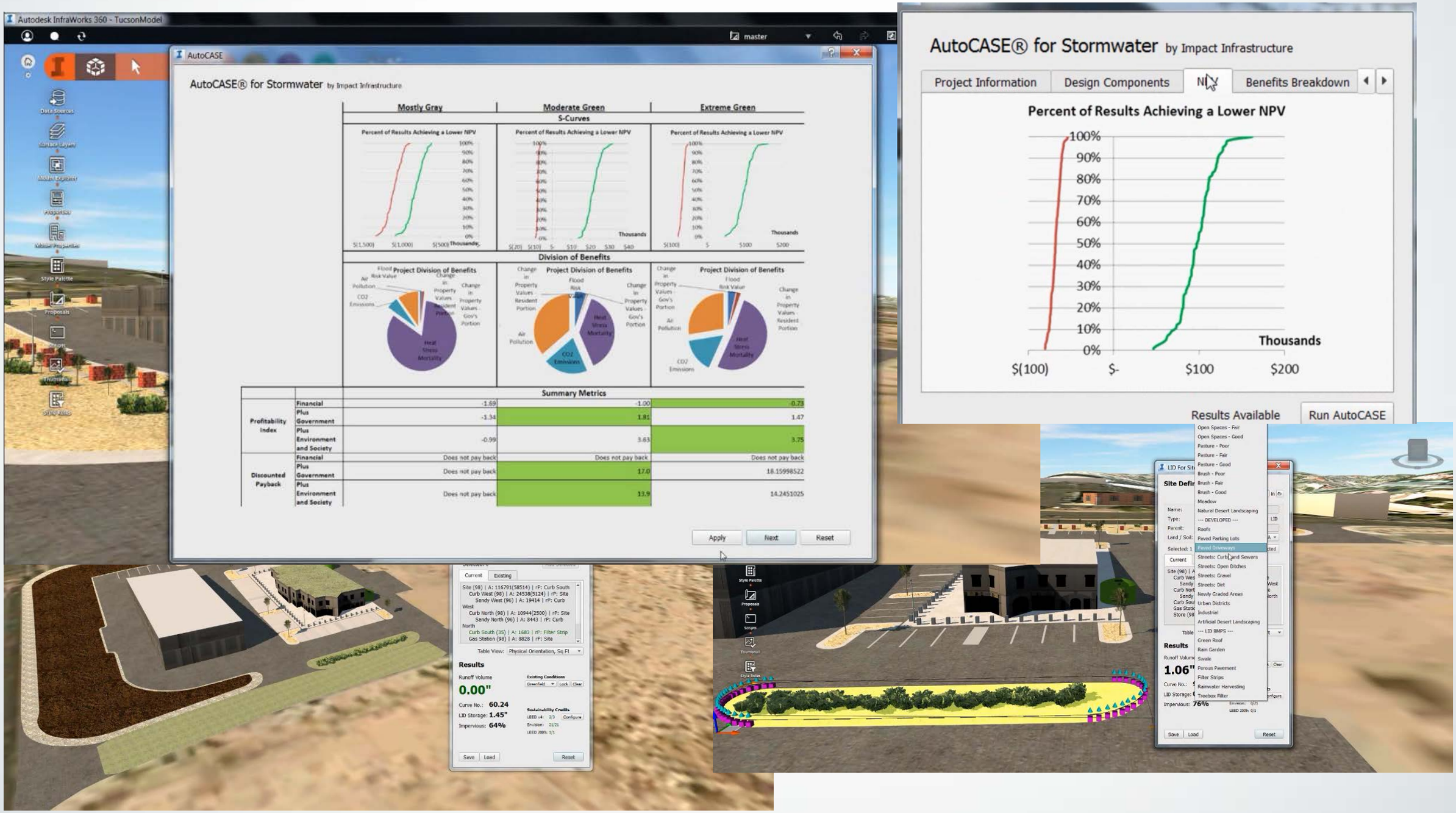
AutoCASE in 3D



- http://youtu.be/-gQI1DPbrl4

Design and Analysis with AutoCASE

What's in it for me?



- http://youtu.be/Y52WUA66yMU

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CIIX – Standardized Valuation

- There is a standard that can be used (Multiple Account CBA with risk analysis) to provide standard metrics the impact investment community
- Automation of the standard can be done via BIM, Envision & AutoCASE
- Large scale deployment can be achieved through Autodesk
- Application of standard to projects can be done by professionals who know the project best – the AEC community

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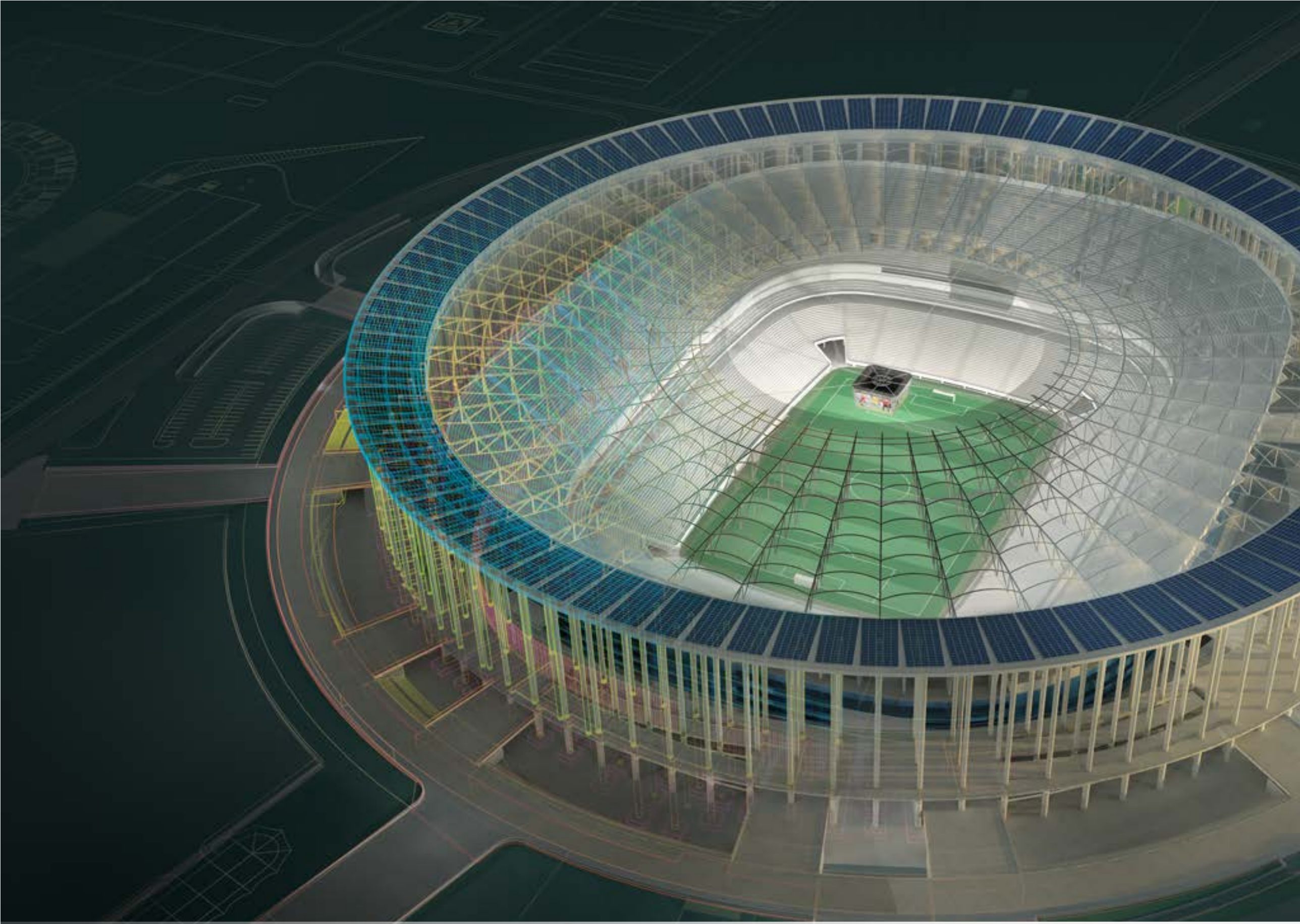

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Business Case Evaluator

ENVISION™ BUSINESS CASE EVALUATOR

Impact Infrastructure, LLC
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Introduction

The Business Case Evaluator (BCE) has been developed to enhance the Envision™ rating system, adding the ability for the Envision™ system to provide value-based and risk-adjusted analyses of infrastructure projects. The current iteration of the BCE tool is designed to be applied to stormwater management projects.

Model Inputs

It is important to remember that not all inputs in the BCE need to be filled out in order to run the model. For most projects, there will likely be several input categories that are not relevant. If the user does not have reliable information for a specific input, or if the input is perceived to be irrelevant to the project, it can be left blank. For example, "Expected Number of Full-time Employees During Operations Stage" may not be relevant to a small stormwater management project, therefore this set of inputs could be left blank. As a general rule, the more inputs that are filled out with accurate information, the more reliable the results will be in reflecting the true costs and benefits of the project.

Most of the inputs include the capability of indicating a low, expected, and high value for each variable. The ranges indicated by the user provide the basis for the risk assessment in the model, allowing the user to indicate uncertainty around values. If the user has a specific value for an input, they can simply enter a value for the "Expected Value", while leaving the low and high value boxes blank. In the case that the user has only low and expected values, the high value can be set as equal to the expected value. Similarly, if the user has only the expected and high values, the low value can be set as equal to the expected value.

Input Risk Ranges

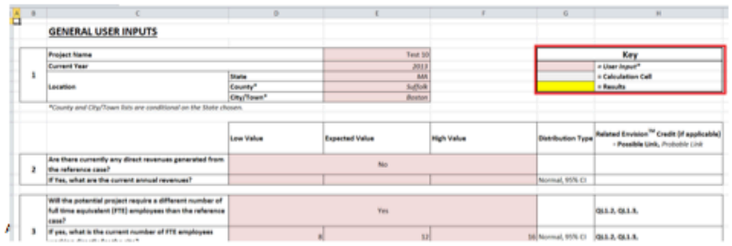
For each input that has the option of entering a range of values, the user can also indicate the "Distribution Type" around those values. The options in the BCE include "Normal, 95% CI", and "Beta" distribution.

The "Normal, 95% CI" option means that the model will interpret from the user's inputs that the Low and High values will surround a range contain
words, there will be a 2.5% probability that the value for that input will be lower than the Low value, and there will be a 2.5% probability that the v
distribution is useful if a range can be identified with high confidence but without certainty. The distribution that is fitted to the three inputs will be

The second distribution type is the "Beta" distribution. The beta distribution is best to use when the user does not expect that the value of the inpu
higher than the High value indicated. Essentially, the beta distribution ensures that the Low and High values are the extremes and it assumes a 0%
contained range. This distribution is useful if a range can be identified with certainty. This distribution can be, but need not be, symmetrical. If the v
skewed curve will be fitted.

Spreadsheet Conventions and Navigation

There is a color coding scheme to the model that runs throughout all the spreadsheets. The key for this color coding scheme can be found at the to
the key can be seen below:



GENERAL USER INPUTS

						Key
1	Project Name		Test 10			= User Input*
	Current Year		2013			= Calculation Cell
	Location	State	MA			= Results
		County*	Suffolk			
		City/Town*	Boston			

*County and City/Town lists are conditional on the State chosen.

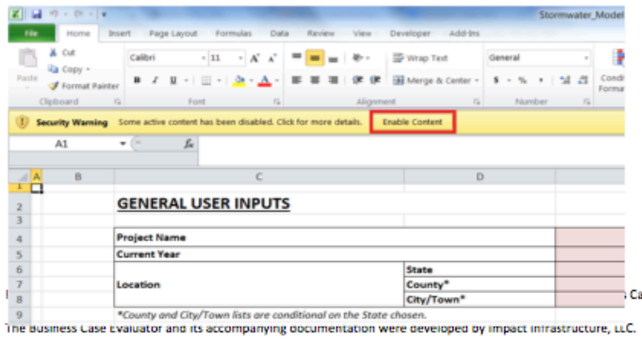
		Low Value	Expected Value	High Value	Distribution Type	Related Envision™ Credit (if applicable) - Possible Link, Probable Link
2	Are there currently any direct revenues generated from the reference case?		No			
	If Yes, what are the current annual revenues?				Normal, 95% CI	
3	Will the potential project require a different number of full time equivalent (FTE) employees than the reference case?		Yes			QL1.2, QL1.3,
	If yes, what is the current number of FTE employees	8	12	16	Normal, 95% CI	QL1.2, QL1.3,

Key	
	= User Input*
	= Calculation Cell
	= Results

A cell is an input that can be modified by the user. In the results pages, important results are shaded in yellow, while calcula
that should be manipulated in any way by the user should be the cells shaded in red, unless otherwise specified.

Opening the Document

When first opening the document, it is important that editing and content are both enabled. This can be completed by selecting the "Enable Editing
buttons are usually embedded in a yellow band near the top of the window, or they may popup in dialogue boxes that require your permission. An
screenshot below:



Case Evaluator User Manual (found

The Business Case Evaluator and its accompanying documentation were developed by Impact Infrastructure, LLC.

RESULTS - RISK ADJUSTED METRICS

Show All Background Worksheets | Hide All Background Calculations Worksheets

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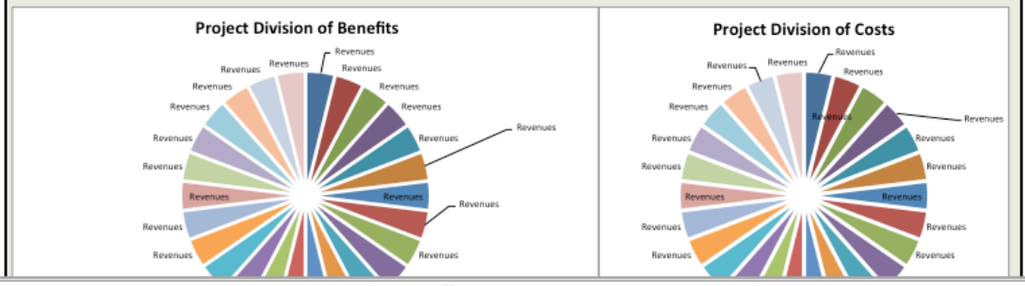
GRAPHICAL REPRESENTATION OF ATTRIBUTION OF BENEFITS



Account Name	Description	Total NPV of Project per Account
Societal or Full Value	*Full societal valuation incorporates all of the market value (cash value) and the benefits and costs that are not reflected in the market values where willingness to pay exceeds what is actually paid or required compensation differs from the expenditures actually incurred.*	*$0.00*
Direct Financial Value	*Incremental revenues generated by project. What is paid to acquire what is provided less incremental expenditures that are incurred to supply it.*	*#DIV/0!*
Government or Taxpayer	*Incremental tax and other revenues that government realizes less any incremental expenditures that government incurs. When government is project proponent could be merged with financial or market account.*	*#DIV/0!*
User / Target-Beneficiary or Customer Service	*Net benefit or consumer surplus - the maximum willingness to pay in excess of what the actually pay.*	*#DIV/0!*
Economic or Business Activity	*Net benefits or producer surplus or economic rents that business and workers derive from incremental economic activity from project – the amount the actually receive in excess of minimum they would have to receive to willingly provide goods and services. e.g. the increase in pre-tax income accruing to persons who would otherwise be unemployed or underemployed. It also measures net costs where amounts received are less than minimum compensation required for supply with no net loss.*	*#DIV/0!*
Environmental	*Nature extent and significance of biophysical and natural resource impacts not captured in other accounts – positive or negative externalities from project.*	*#DIV/0!*
Community or Other	*Nature extent and significance of social and community impacts not captured in other accounts – positive or negative externalities from project. e.g. community population stability, services and quality of life. It could also include income distributional or equity considerations. It should not, however, include impacts already documented under the other accounts (e.g. local government financial effects).*	*#DIV/0!*

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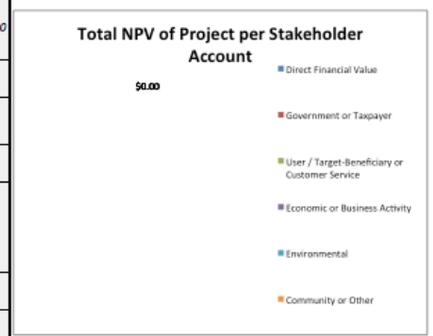

	Account 1	Account 2	Account 3	Total NPV	NPV of Benefits per Account: Societal or Full Value	Direct Financial Value	Government or Taxpayer	User / Target-Beneficiary or Customer Service	Economic or Business Activity	Environmental	Community or Other
Revenues	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Capital Expenditures	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
O&M Costs	Government or Taxpayer			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Employee Costs	Government or Taxpayer			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Electricity Costs	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Natural Gas Costs	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Propane Costs	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Diesel Costs	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Other Energy Costs	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Change in Waste Costs	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Change in Water Costs	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Change in Materials Costs	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Change in Other Costs (Present Value)	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
One Time Subsidies/Grants	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Recurring Subsidies/Grants	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Shadow Wage Benefit	Economic or Business Activity	Government or Taxpayer		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Recreational Use Value	Community or Other			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Change in Property Values - Resident Port	User / Target-Beneficiary or Customer Service			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Change in Property Values - Gov's Portion	Government or Taxpayer			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Heat Stress Mortality	Community or Other	Government or Taxpayer		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Water Quality and Habitat Enhancement	Environmental	Government or Taxpayer		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Wetland Enhancement	Environmental	Government or Taxpayer		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CO2 Emissions	Environmental	Government or Taxpayer		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Air Pollution	Environmental	Government or Taxpayer		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Residual Value of Assets	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Decomissioning Costs	Direct Financial Value			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Total Value					*0.00*	*#DIV/0!*	*#DIV/0!*	*#DIV/0!*	*#DIV/0!*	*#DIV/0!*	*#DIV/0!*

	Total NPV
Only Direct Costs/Benefits to Primary Party/Stakeholder	#DIV/0!
Including Benefits to Government	#DIV/0!
Including Benefits to Residents/Society/Environment	0.00

Return on Investment Calculations	
Duration of Project	14
Final Inflation Adjustment Factor	1.512589725
Primary Party/Stakeholder	#DIV/0!
Including Government	#DIV/0!
Including Society/Residents	#DIV/0!

Business Case Evaluator

Business Case Evaluator

A Value and Risk Based Enhancement to Envision™

User & Documentation Manual

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Acknowledgements

Preface

The authors are grateful to the members of the ISI Economics Committee who have directed, reviewed, and suggested changes to the model structure and documentation. The ISI Economics Committee took up the challenge laid before it with enthusiasm and gusto. It was a pleasure to follow their vision and course corrections to reach this exciting first step. As a volunteer organization we have been impressed by the dedication and commitment of the members to support the industry and to donate their time to the benefit of the ISI community – a wonderful example of a positive externality.

Ronald Coase, Nobel prize winning economist, died on September 2nd 2013, aged 102, just as we were finishing this work. His Coase Theorem dealt with market "externalities": economic choices that impose social costs or benefits on others. His work on property rights and externalities is the basis for our view that Risk Analysis and Multi-Account Benefit Cost Analysis is useful. He said:

"A scholar must be content with the knowledge that what is false in
he can count on ultimately seeing it accepted, if only he lives long e

As we submit this documentation for peer review, we hope that the IS
Impact Infrastructure looks forward to working with the Committee o
the scope to help ISI members with the challenges of developing susta

John F. Williams II
Chairman & CEO, Impact In
Chairman, ISI Economics Co

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with respect to the accuracy or completeness of the contents of this book and associat
or fitness for a particular purpose.
For more information contact: Info@ImpactInfrastructureLLC.com
Co-Created By: Impact Infrastructure, LLC and The ISI Economics Committee

Conventions & Navigation

Spreadsheet Conventions and Navigation

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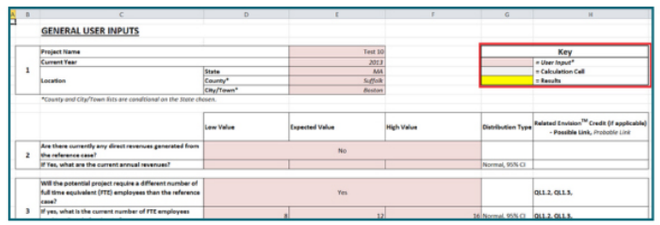
Baseline Information



A closer look at the key can be seen below:

Key	
	*= User Input**
	= Calculation Cell
	= Results

Any cell that is shaded in red is an input that can be modified by the user. In the results pages, important results are shaded in yellow, while calculations cells are shaded in grey. The only cells in the model that should be manipulated in any way by the user should be the cells shaded in red, unless otherwise specified.

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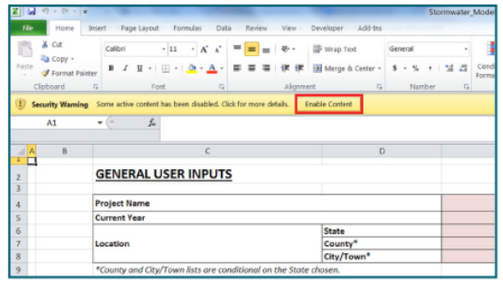
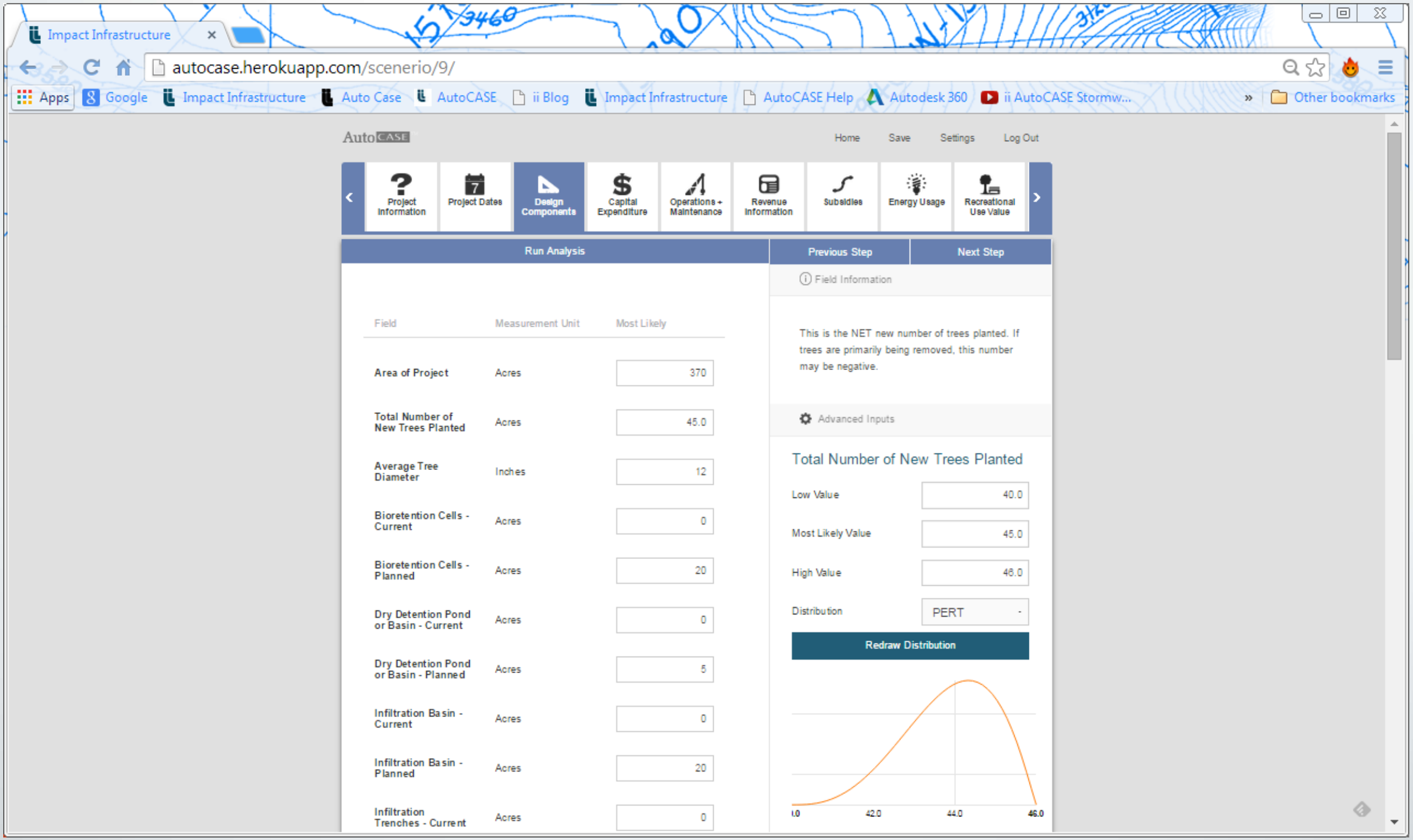


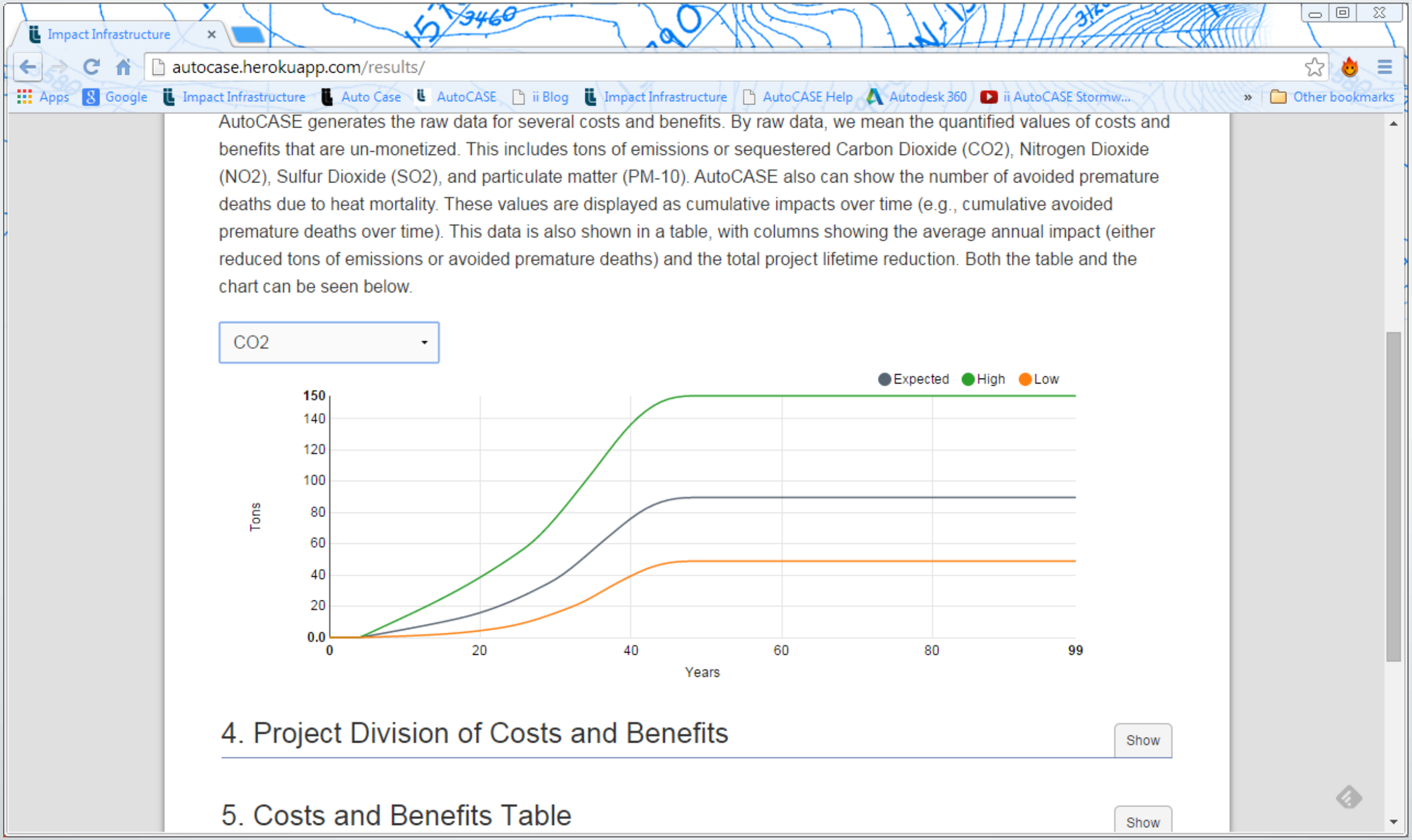
Compare Design Alternatives

Tune Designs to Optimize Outcomes

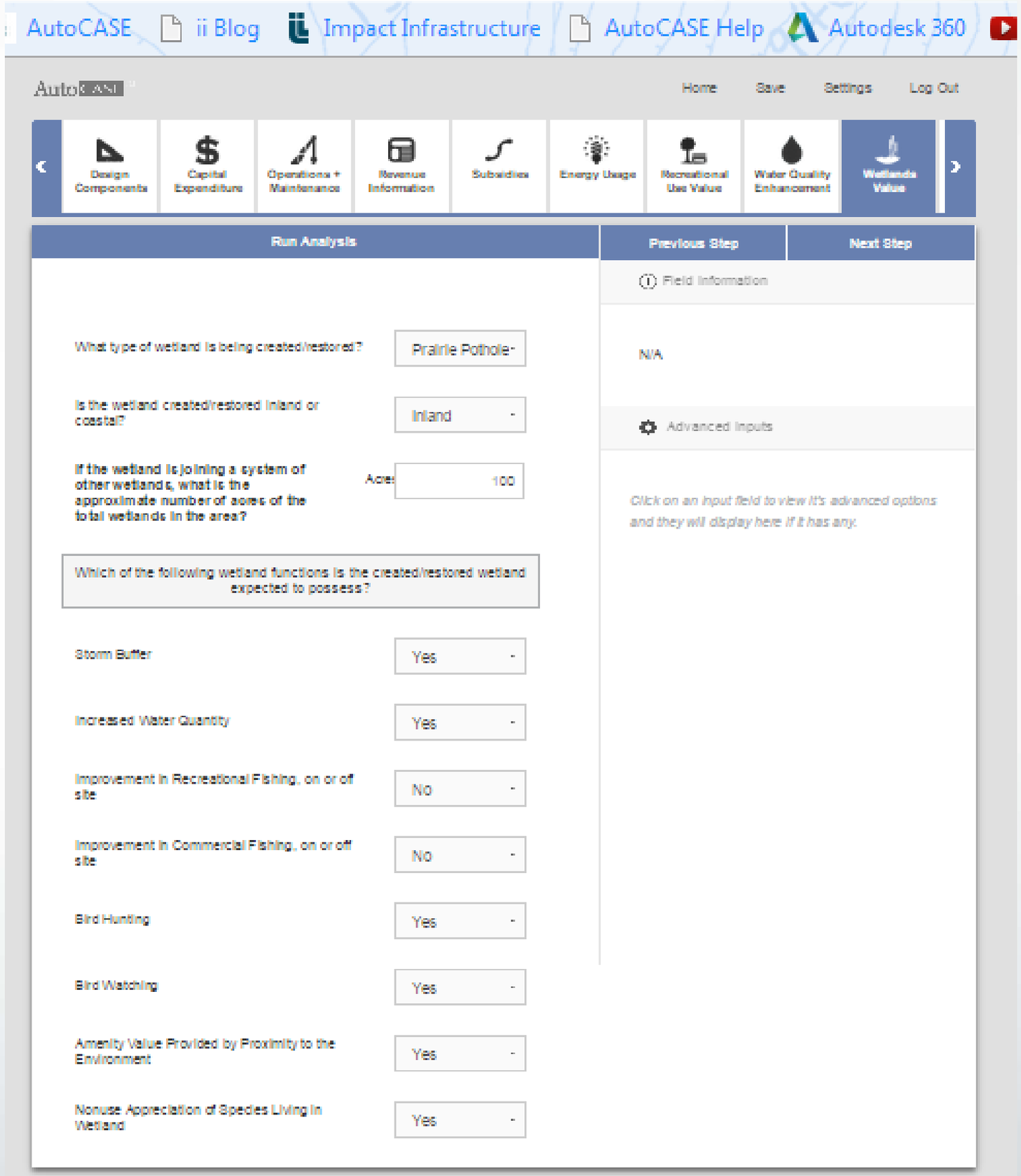


Review and Compare Results

Dynamic Modeling



Uses Meta-Analysis for Environmental Benefits



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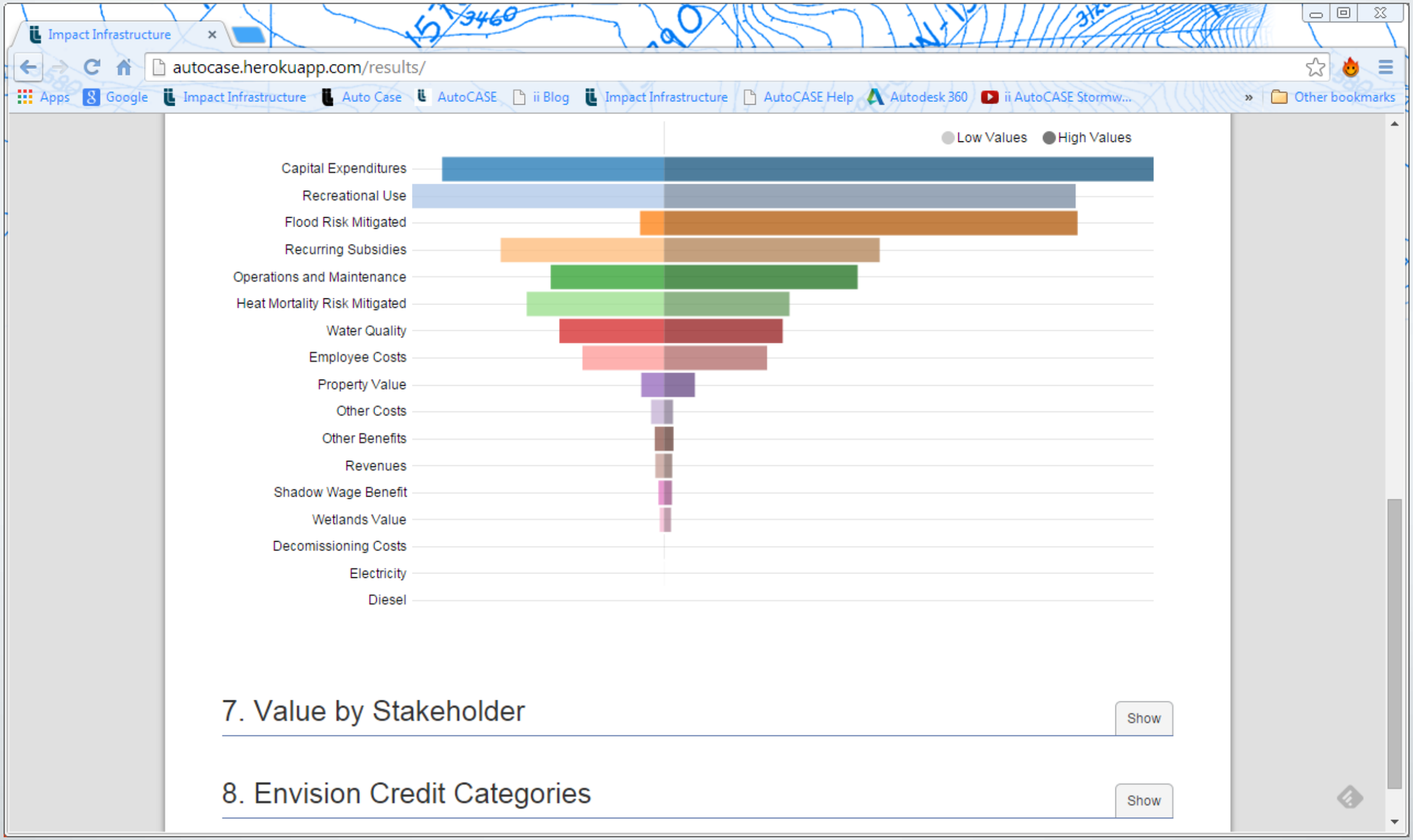
CAD Data Refines Calculations

Simulates Outcomes



Monte Carlo Simulations

Risk Adjusted Business Cases

Impact Infrastructure

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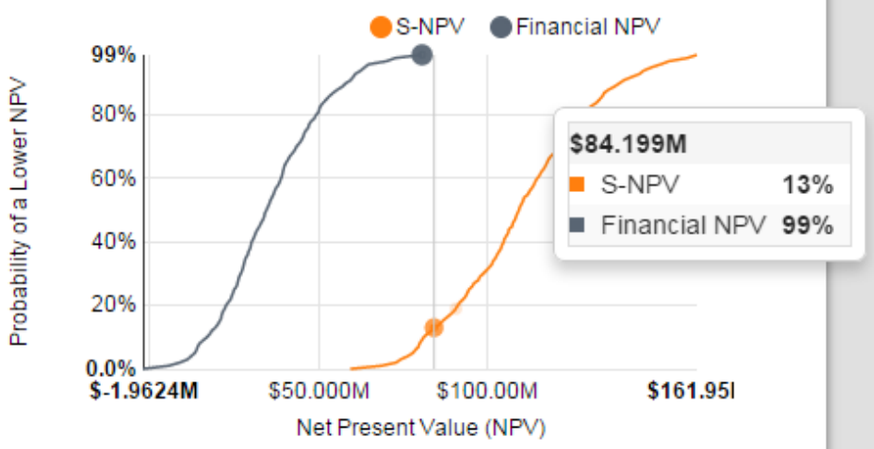
Raw Inputs | Executive Summary | Project Summary | Detailed Results

This project has a positive Sustainable Net Present Value, or S-NPV, of **$110,185,832**. This means that after accounting for the time value of money, the project has a positive overall value to society. As with all financial projections, the value should be thought of as probabilities of outcomes rather than definitive project value. To help with this, AutoCASE provides a probability distribution showing potential project value. A chart showing this value can be seen the right:

The chart shows two curves; the red curve is the Direct Financial NPV, while the green curve is the Sustainable NPV. The Direct Financial NPV only includes costs and benefits that involve real transfers of dollars. Examples include Capital Expenditures, Operations and Maintenance costs, Employee costs, Revenues generated, etc. The Sustainable NPV then includes all the costs and benefits to society and the environment. Examples include Reductions in Heat Mortality, Flood Risk Mitigation, Property Value Uplift, etc.



As can be seen in the above chart, there is a 95% probability that the Direct Financial NPV will be greater than **$68,673,850**, its expected value is approximately **$46,158,579**, and it is unlikely (less than 5%) to exceed **$32,815,760**. In comparison, the S-NPV is **greater than** the Direct Financial NPV; the S-NPV has a 95% probability of being greater than **$139,658,791**, its expected value is approximately **$135,777,622**, and it is unlikely (less than 5%) to exceed **$134,252,451**.