

# A Fractal Approach to Evaluating Infrastructure Projects

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# Outline

- Sustainability
  - Definition and History
  - The Journey of Sustainable business
- Sustainable project overview
- Fractal approach
- Sample project
- Questions

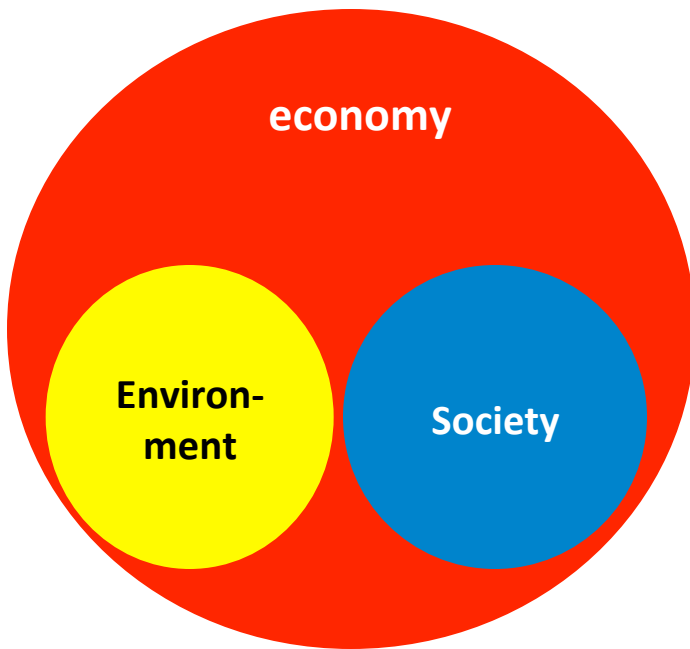
# Sustainability

- Sustainable development is-  
*“development that meets the **needs of the present without compromising the ability of future generations** to meet their own needs.”*

**Sustainable Development = Sustainable = Sustainability**

# The Definition of Sustainability

*Industrial-age view of sustainability*



*“The business of business is business”*

Milton Friedman

*“The economy, stupid”*

James Carville

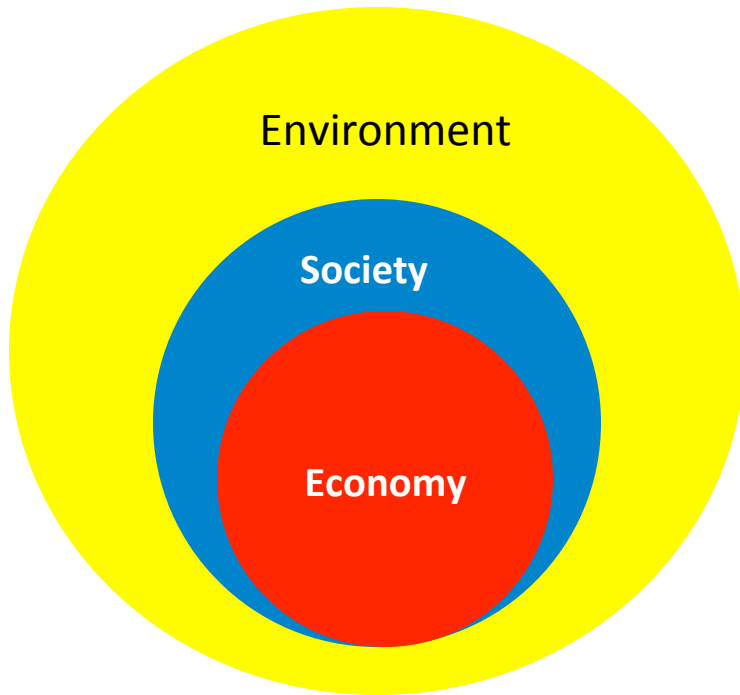
# The Definition of Sustainability

*Industrial-age view of sustainability*

*“What is the business case for your sustainability program?”*

# The Definition of Sustainability

*Holistic view of sustainability*



*“In nature nothing exists alone.”*

--Rachel Carson, *Silent Spring*

# The Definition of Sustainability

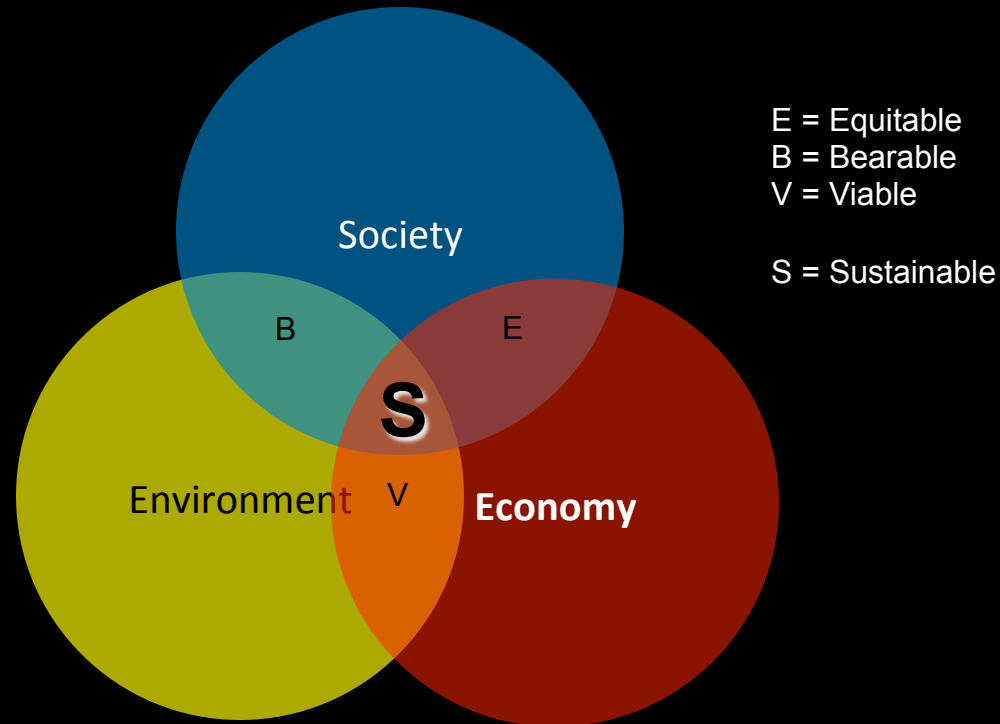
*Holistic view of sustainability*

*Another way to put this is;*

*“What is the sustainability case for your business?”*

# The Definition of Sustainability

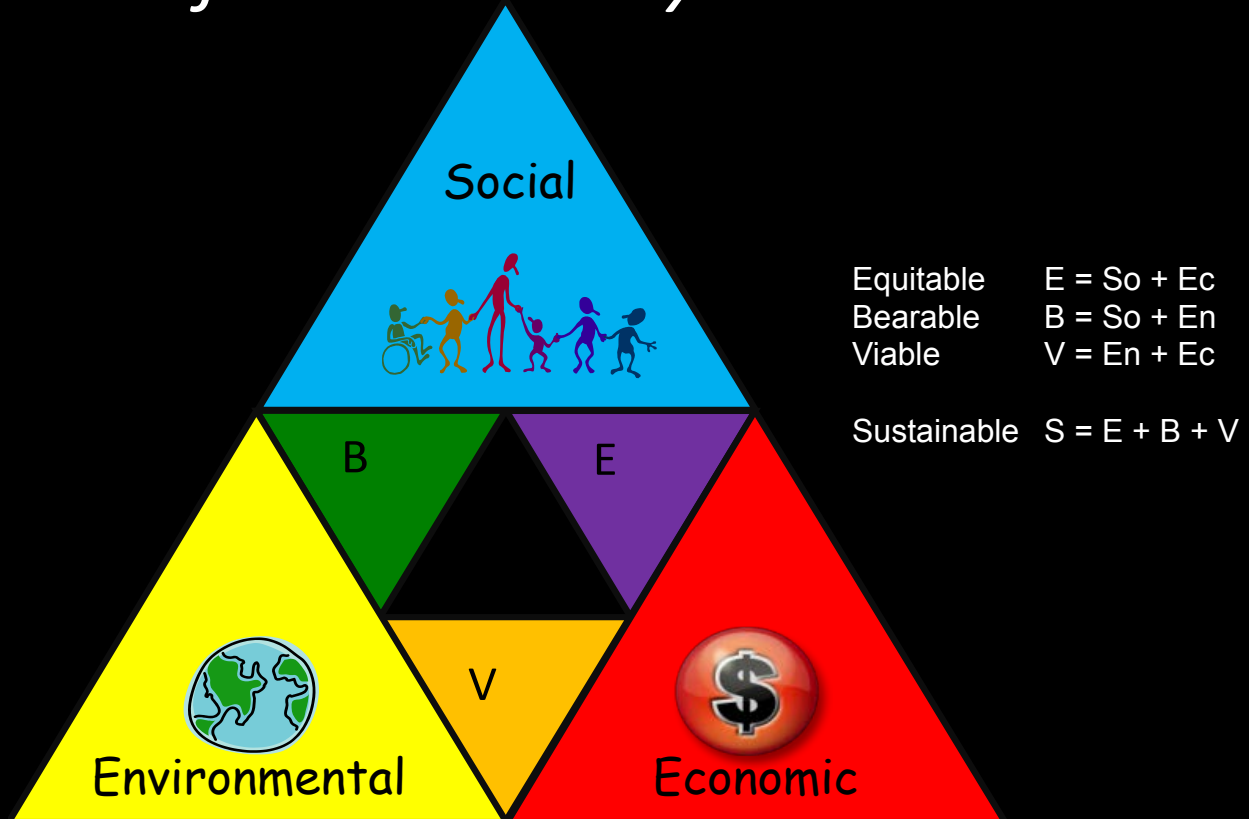
*A familiar view of sustainability.....*



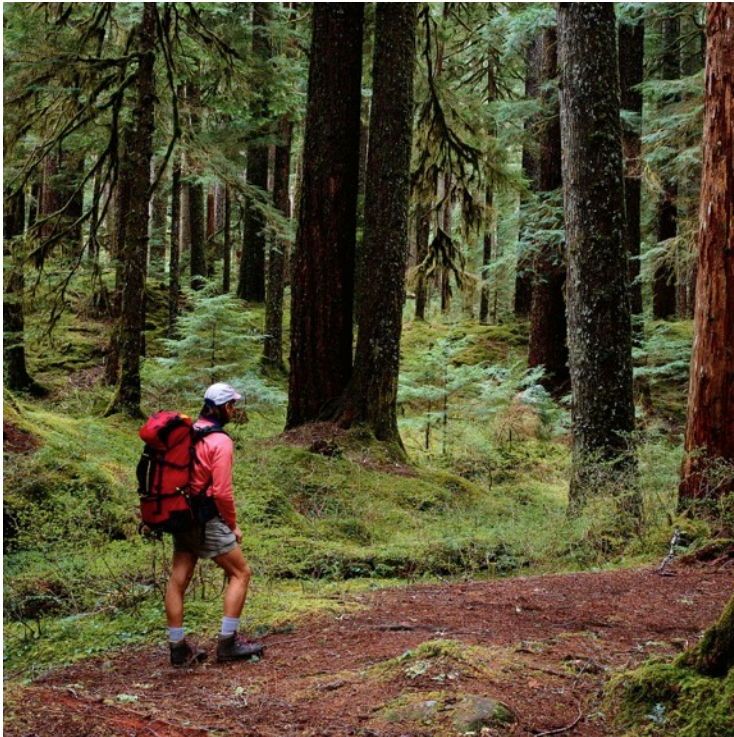


# The Definition of Sustainability

- *A fractal view of sustainability....*



# The Journey



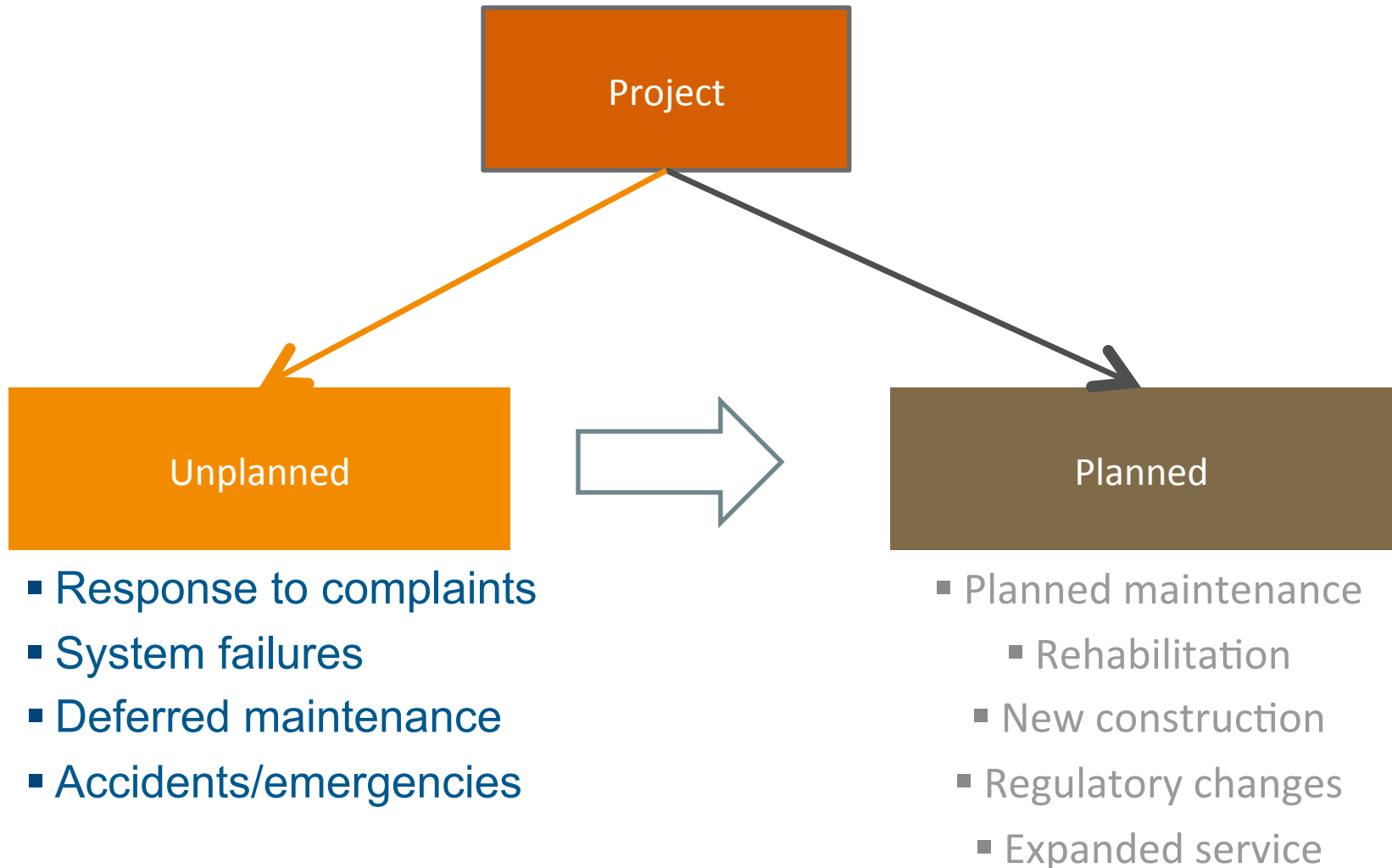
*“In every walk with  
nature one receives far  
more than he seeks”*

--John Muir

# Sustainable Project Overview

- Outline....

# Infrastructure Project Planning



# Defining Projects

*Nobody plans to fail,  
but many of us often  
fail to plan.*



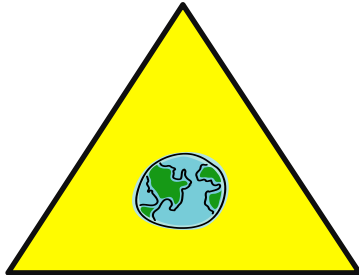
# Impact of Unplanned Projects

- Distraction from routine activities
- More expensive to execute
- Increases worker and public exposure
- Reduces quality of work
- Often results in patch work of repairs
- Difficult to plan future repairs
- Increases cost
- Compliance issues

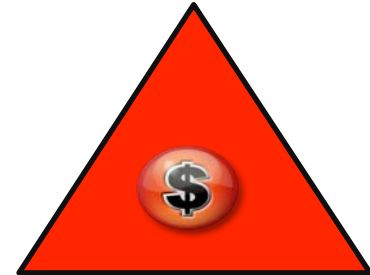
# Unplanned Projects NOT Sustainable



**Social**



**Environment**



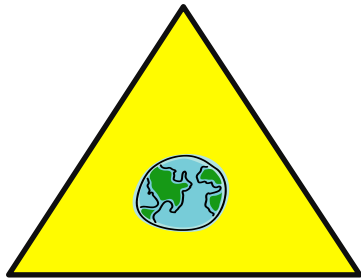
**Economic**

# Unplanned Projects are NOT typically Sustainable



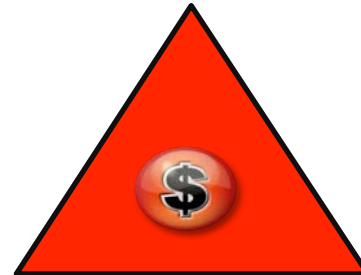
## Social

- Worker exposure
- Public inconvenience
- Public exposure
- Lower quality of work



## Environment

- Less time to minimize impact
- May not be able to choose best components/materials
- Releases to environment (sewage)
- Loss of resources (water)



## Economic

- Typically costs more
- Likely has short life
- Needs more freq repairs
- Pay premium for labor



# How can we plan successful projects?

- Understand

Eng 101


- Project requirements and objectives
- Existing systems and equipment
- Design limitations
- Stakeholder interests

- Execute

Project Execution

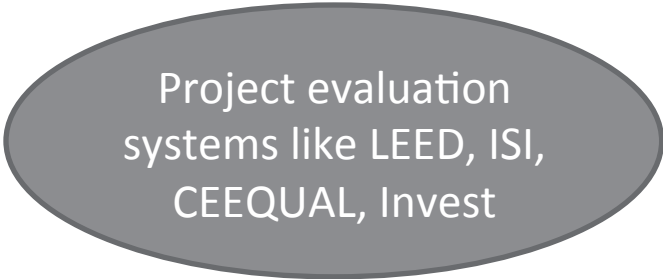
- Ask “is this the right project?”
- Ask “how do we do the project right?”

# Project Execution



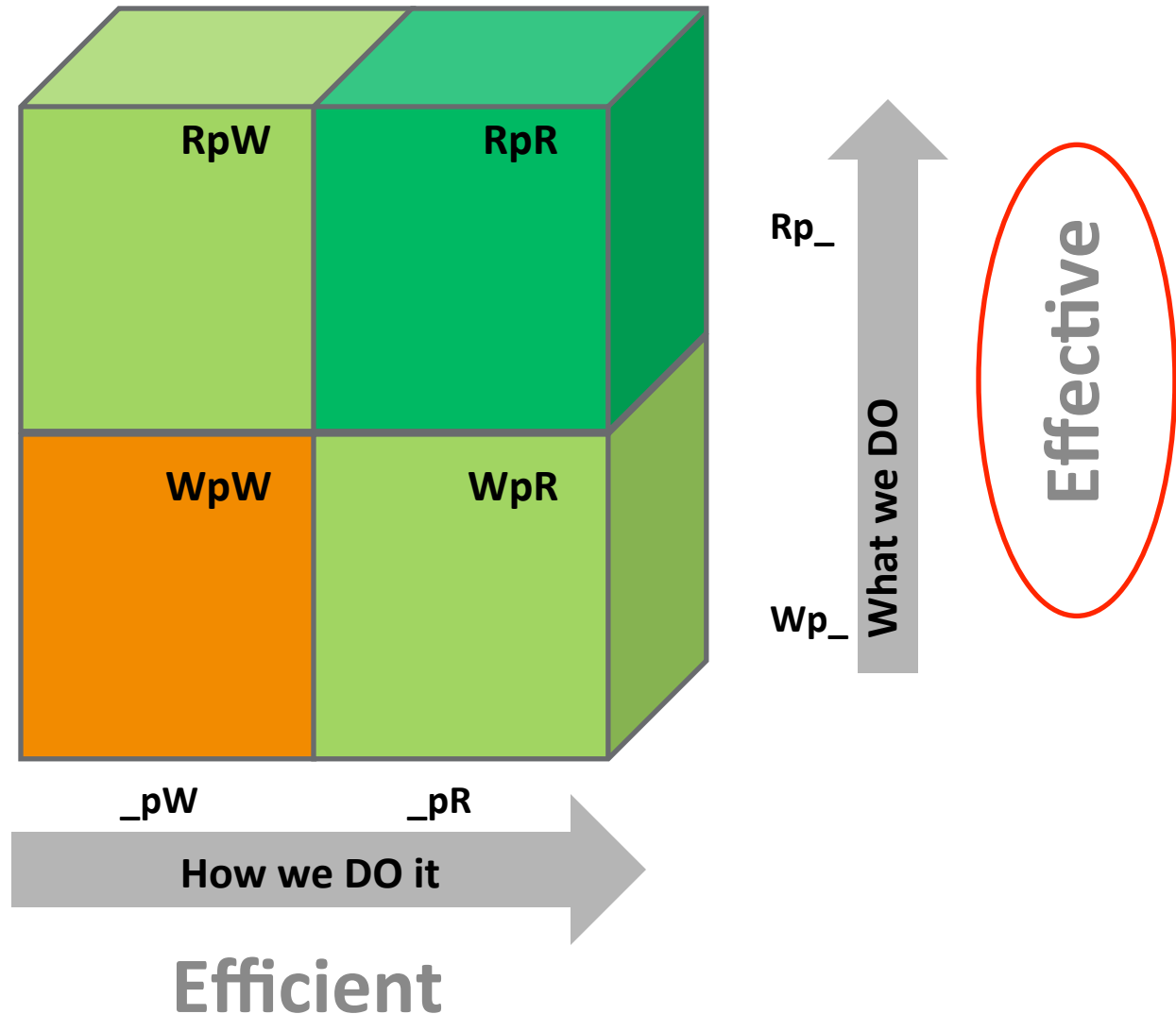
The focus of this presentation

- Effective projects
  - The type of project we select
  - WHAT we do (i.e., Doing the RIGHT project)
- Efficient projects
  - The way we execute a project
  - HOW we do it (i.e., Doing the project RIGHT)



Project evaluation systems like LEED, ISI, CEEQUAL, Invest

# Project Execution



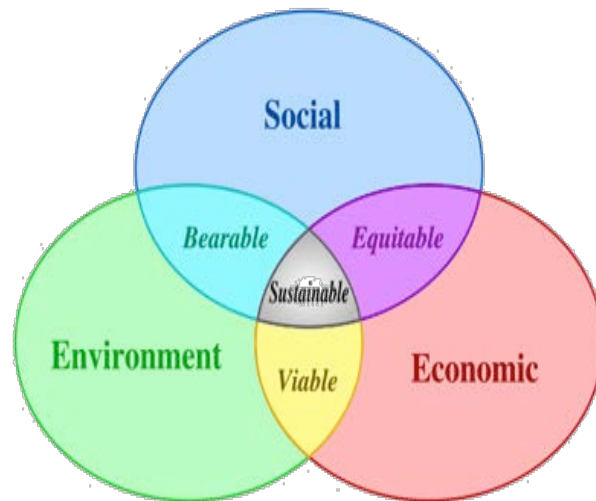
# Sustainable Projects

- Want to make sure it is the RIGHT project
- How?
- Who will be the judge?
- What will matter?
- What will matter most?
- How will we measure and compare?

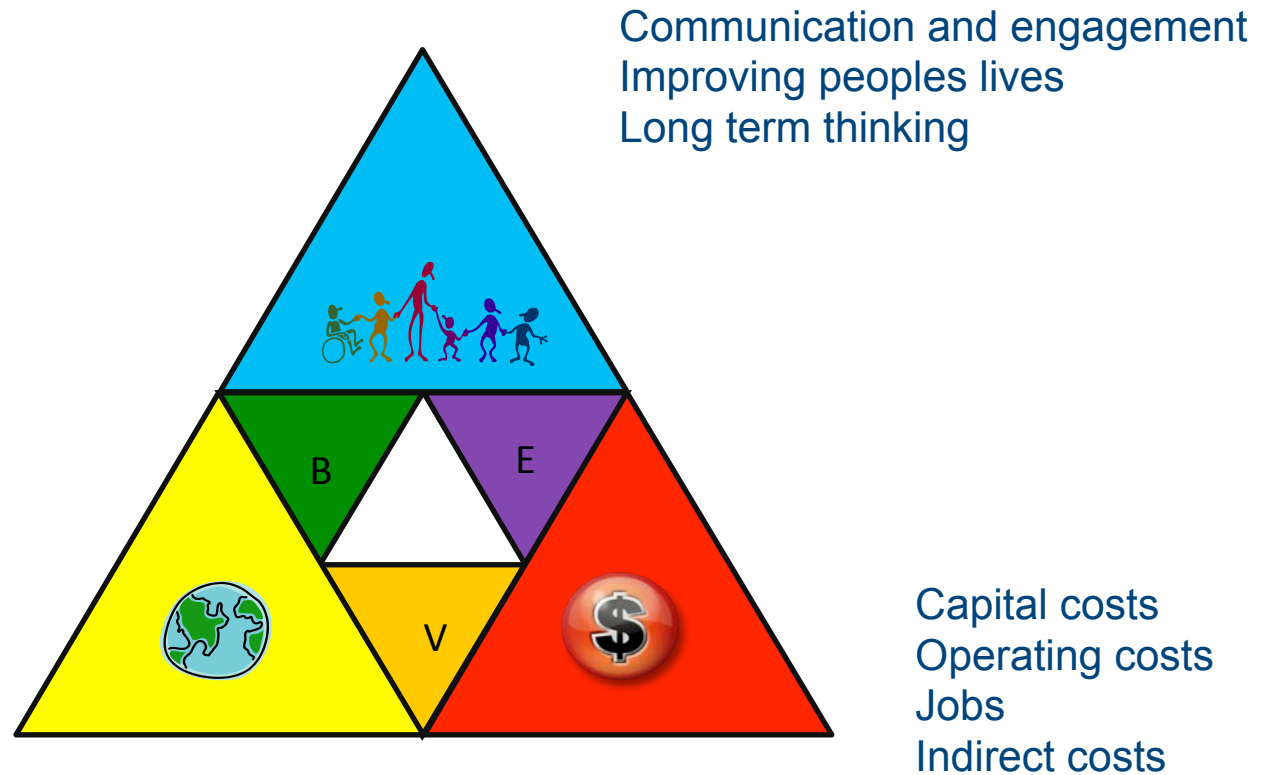


# Sustainable Projects

- Starts with understanding the
  - Project Purpose and
  - 3 responsibilities of sustainability

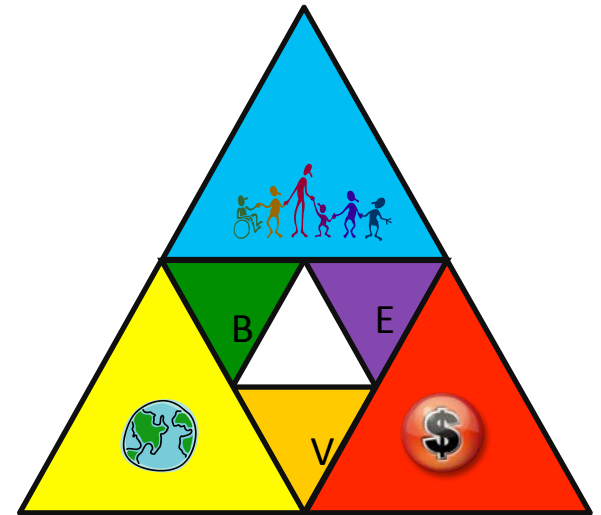


# Understanding the Responsibilities



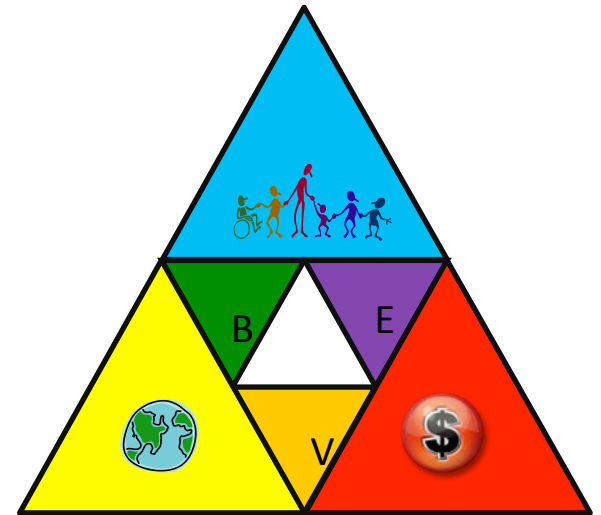
# Evaluating Sustainable Projects

1. Purpose of the project
2. ID aspects and impacts
3. Identify the options
4. Develop criteria
5. Rate and compare options



# Purpose, Aspects and Impacts

- Why is projected needed?
  - Pump station
  - Force main
  - I/I
- What aspects?
- Potential impacts?



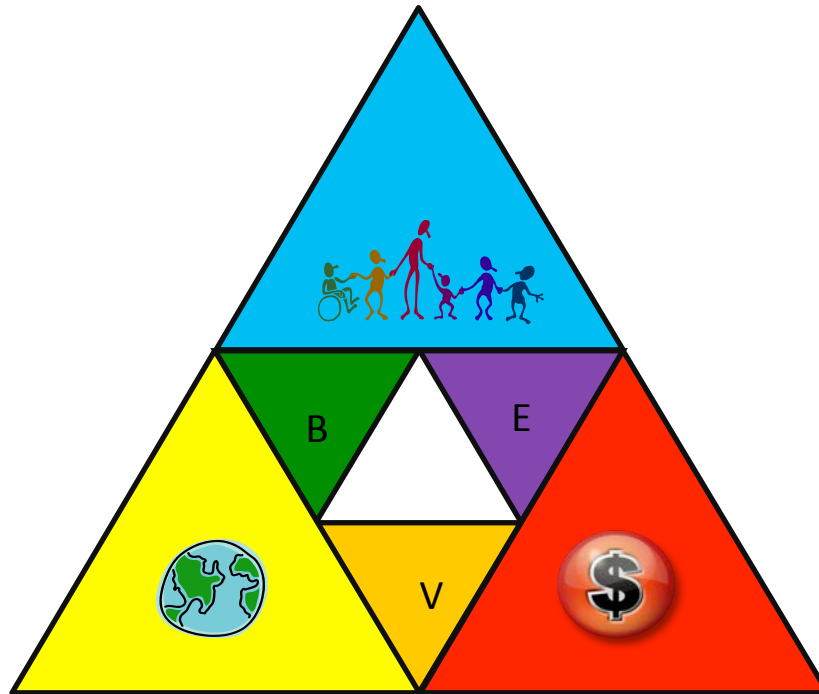


# Developing the Criteria

So1 = community support

So2 = social benefit

So3 = permanence



En1 = regulatory

En2 = resources

En3 = permanence

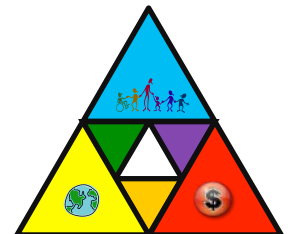
Ec1 = capital

Ec2 = operating cost

Ec3 = indirect costs

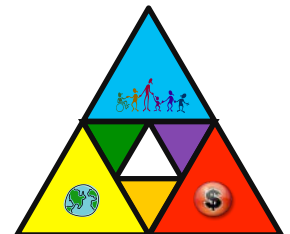
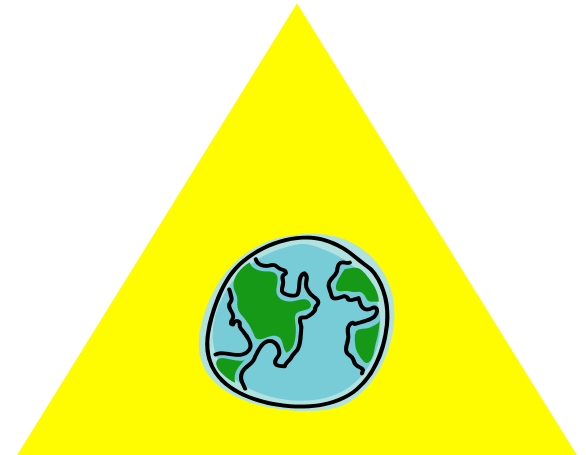
# Social Well-Being Criteria

Social		
code	Title	Description
So1	Community Support	To what extent will the community support this project?
So2	Community Benefit	To what extent will the community benefit from this project?
So3	Permanence of Social Benefit	How long will the community realize the social benefits of this project?



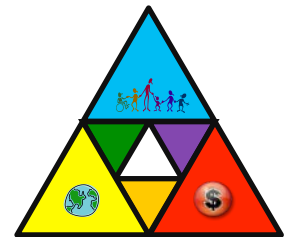
# Environmental Criteria

Environmental		
<i>code</i>	<i>Title</i>	<i>Description</i>
En1	Regulatory Aspects	What are the regulatory impacts of this option?
En2	Resource Impact	How will this project impact natural resources?
En3	Permanence	How long will the environmental benefits of this project be realized?



# Economic Criteria

Economic		
<i>code</i>	<i>Title</i>	<i>Description</i>
<b>Ec1</b>	Capital Costs	To what extent will this project impact Capital costs vs the minimum required option?
<b>Ec2</b>	Operating Costs	To what extent will this project impact Operating Costs vs the minimum required option?
<b>Ec3</b>	Indirect costs	How significant might the indirect savings be if this project is executed





**Built to Last**  
How Practical Sustainability  
Concepts Influenced the  
Design, Construction, and Operation of a  
Large Scale Wastewater Pumping Station

Presented by: Jim Barsanti  
Assistant Director of Water and Wastewater - Engineering  
Framingham Department of  
Public Works

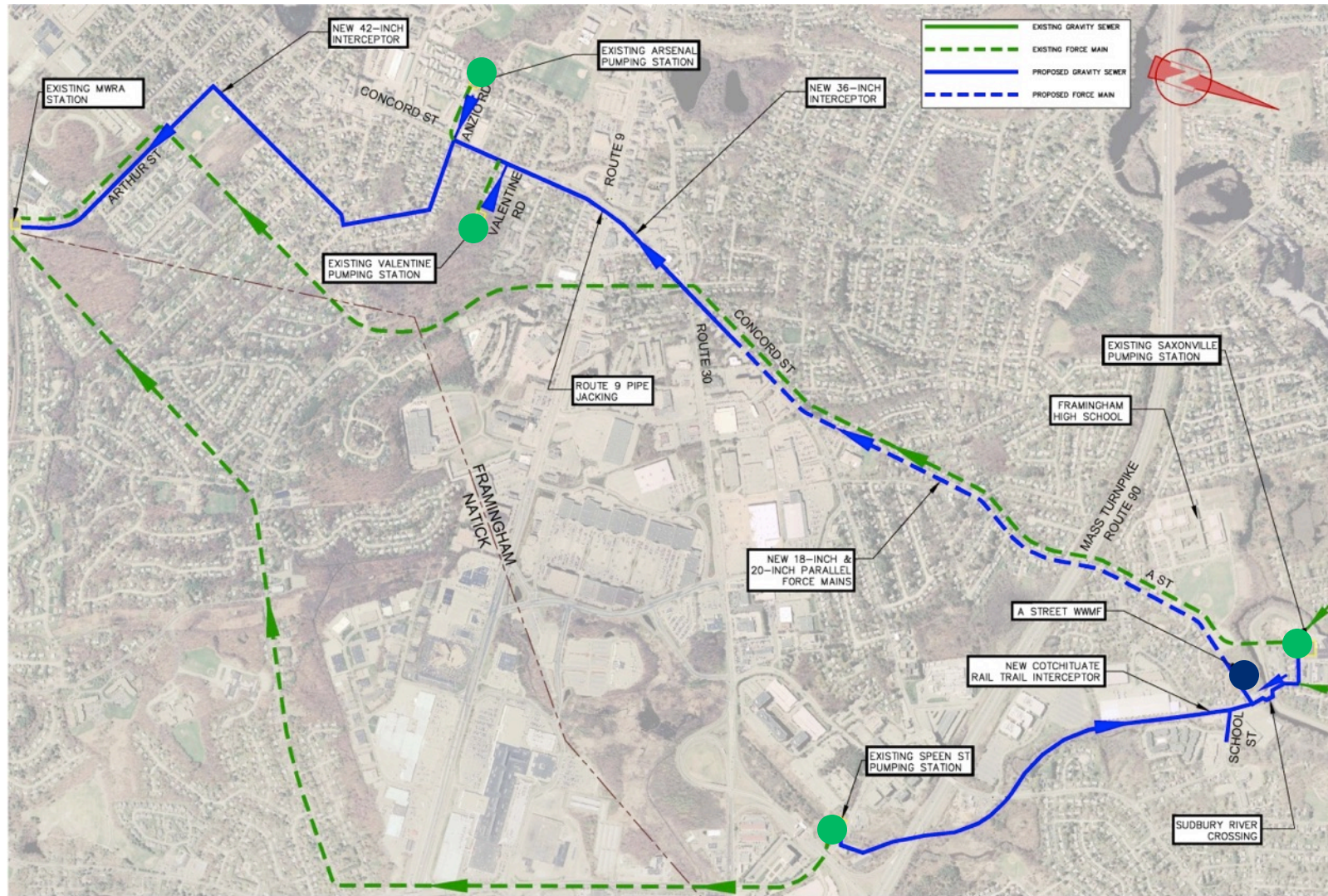
# Town of Framingham

## Capital Improvement Program - Background

- MADEP Consent Agreement & MWRA Settlement Agreement
  - Reduce SSOs – Undersized sewers, hydraulic restrictions
  - Reduce H<sub>2</sub>S loadings – Odor issues, corrosion, breaks
- Historically Poor Master Planning - Address piece-meal development of system
- East Framingham Sewer Improvements Project: Reconfigure collection system
  - Net reduction in number of pump stations
  - Net reduction in length of force main
  - New deep gravity interceptor system
  - Upgrades of water, stormwater, communications, gas utilities



# East Framingham Sewer Improvements Project - Reconfiguring the System



# Identify the Aspects and Impacts

1. Numerous pump stations
2. Impact on public during construction
3. Proximity to High School
4. Antiquated piping
5. Odor issues from existing system
6. History of neighborhood
7. Need to involve public and get approvals



# Preconstruction Issues Require Sustainable Solutions!

- Multiple Meetings with Town Boards and Committees
- Educating the Public – Use and Operation
- Resident Concerns – Noise, Odor, Activity
- School Department Concerns – Proximity to High School
- Aesthetics – Architecture and Buffers
- Permitting – Conservation, DEP and FEMA



# Saxonville Village Architecture



# Existing Watson Place Pump Station 1960s Vintage Construction



# Identify the Options

Option No	Option Name	Description	Advantages	Challenges
1	Do Nothing	Use existing PS and deal with regulatory issues, neighbor complaints, and potential law suits	no capital investment, no planning required	reactive maintenance, potential for significant legal expenses, likely resulting in OT, and deferred maintenance
2	Upgrade Existing Pump Stations	Upgrade the existing PS to modernize pumps, controls, and equipment	doesn't require major capital investment, allows town to meet minimum regulatory requirements	difficult to execute upgrades while keeping the PS running
3	Build New PS	Build a new PS (similar to old one) on nearby lot, but keep it to the minimum features and eliminate other PS	Eliminates a pump station, results in significant reliable upgrade	Requires deep cuts, and the construction of a wet well, architecture does not fit the surroundings, likely to get complaints
4	Build New PS with community meeting room	same as 3	same as 3, provides storage for DPW vehicles for winter events, provides meeting place, matches the local architecture	same construction challenges as Option 3, may come with a higher capital cost

Note: Author's interpretation of potential options prior to project selection. These options do not represent opinions expressed or presente by the Town of Framingham.



# Build a New PS using old plans?



# Community Minded Architecture

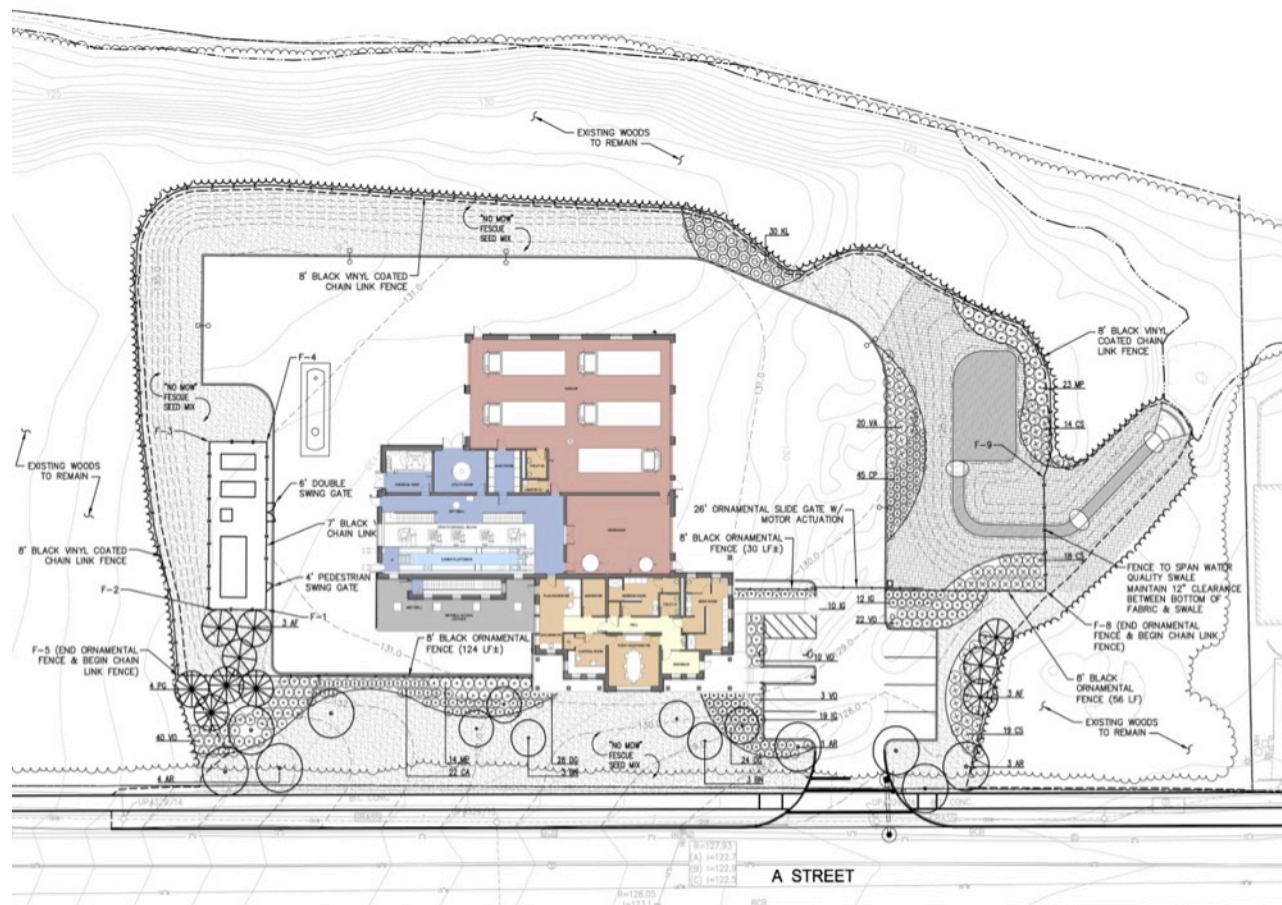
- Natural, durable, long-life, maintenance-free building materials
- Regional building materials (Slate from Vermont, brick from Maine)
- Management of glare and natural light through roof canopies and overhangs
- High ceilings and windows to increase natural light
- Light colored membrane roof with high solar reflectance to reduce the 'heat island effect'
- Pull-through garage bays allow for natural ventilation





## Site Planning is Critical!

- Minimize disturbance/ maintain wooded buffers
- Optimize vehicle turning movements to limit pavement area
- Reuse of Site Containing Contaminated Soils
- Stormwater System consisting of subsurface infiltration system for roof runoff
- Low maintenance, water efficient plantings
- Optimize placement and circuitry of LED exterior lights
- Dual-generators to allow ramp-up based on actual demand

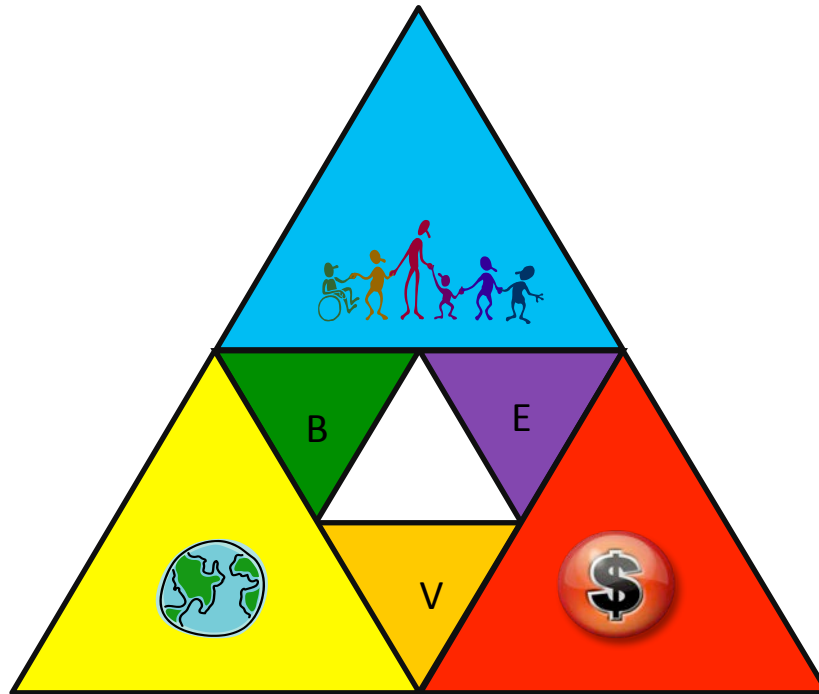


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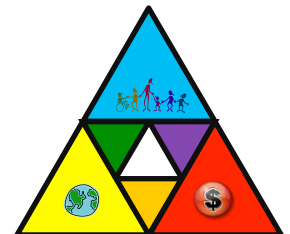
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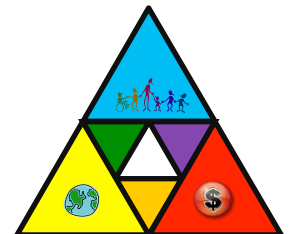
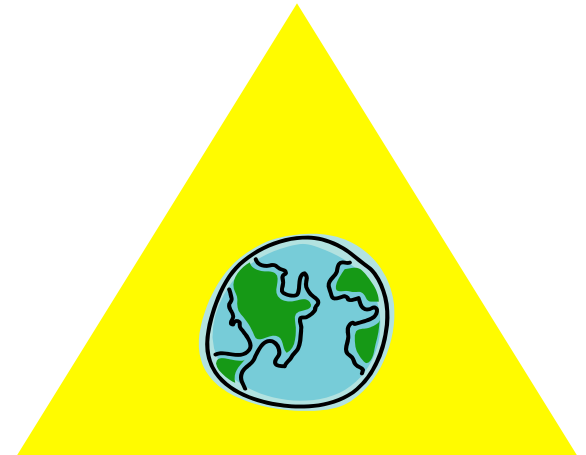
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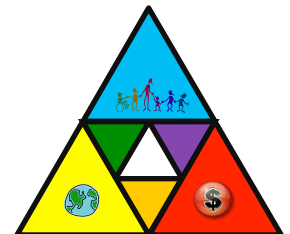
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# Rate Options

[illegible]

# Simple Comparison of Options

		Environmental	Social	Economic	Raw Sustainability Score
Option No	Option Name	Sum En	Sum So	Sum Ec	
min	Minimum Score	3.0	3.0	3.0	9.0
1	Do Nothing	5.0	4.0	7.0	16.0
2	Upgrade Existing Pump Stations	8.0	9.0	9.0	26.0
3	Build New PS	12.0	11.0	11.0	34.0
4	Build New PS with community meeting room	12.0	14.0	11.0	37.0
Max	Maximum Score	15.0	15.0	15.0	45.0

$$\text{S-Score} = \text{sum}(\text{Ave En} + \text{Ave So} + \text{Ave Ec}) \times \text{Ave OP} \times \text{Ave Fe}$$

# Fractal Comparison of Options

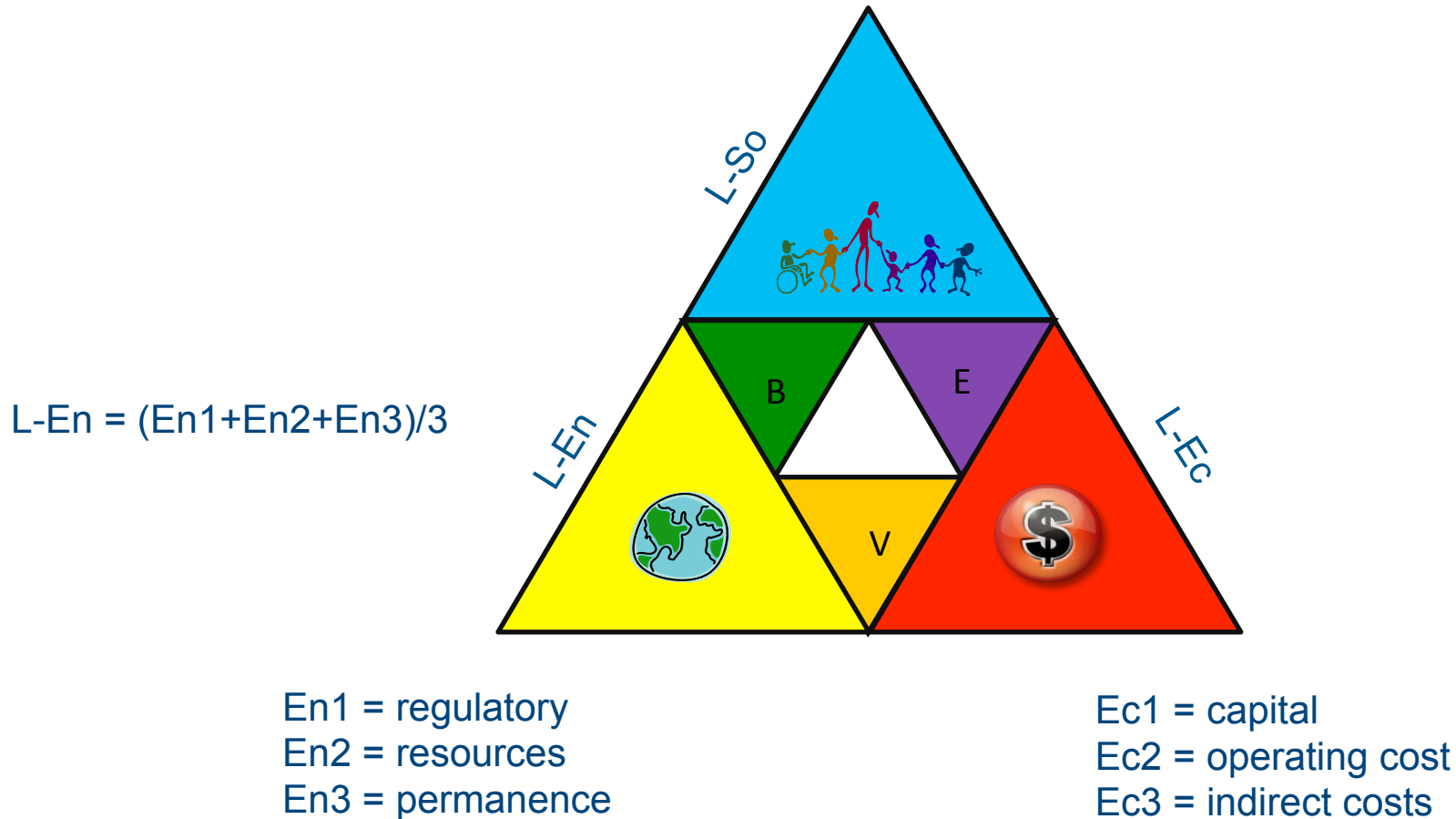
Option No	Option Name	Environmental		Social		Economic	
		Sum En	Ave En	Sum So	Ave So	Sum Ec	Ave Ec
min	Minimum Score	3.0	1.0	3.0	1.0	3.0	1.0
1	Do Nothing	5.0	1.7	4.0	1.3	7.0	2.3
2	Upgrade Existing Pump Stations	8.0	2.7	9.0	3.0	9.0	3.0
3	Build New PS	12.0	4.0	11.0	3.7	11.0	3.7
4	Build New PS with community meeting room	12.0	4.0	14.0	4.7	11.0	3.7
Max	Maximum Score	15.0	5.0	15.0	5.0	15.0	5.0

# Fractal Comparison

So1 = community support

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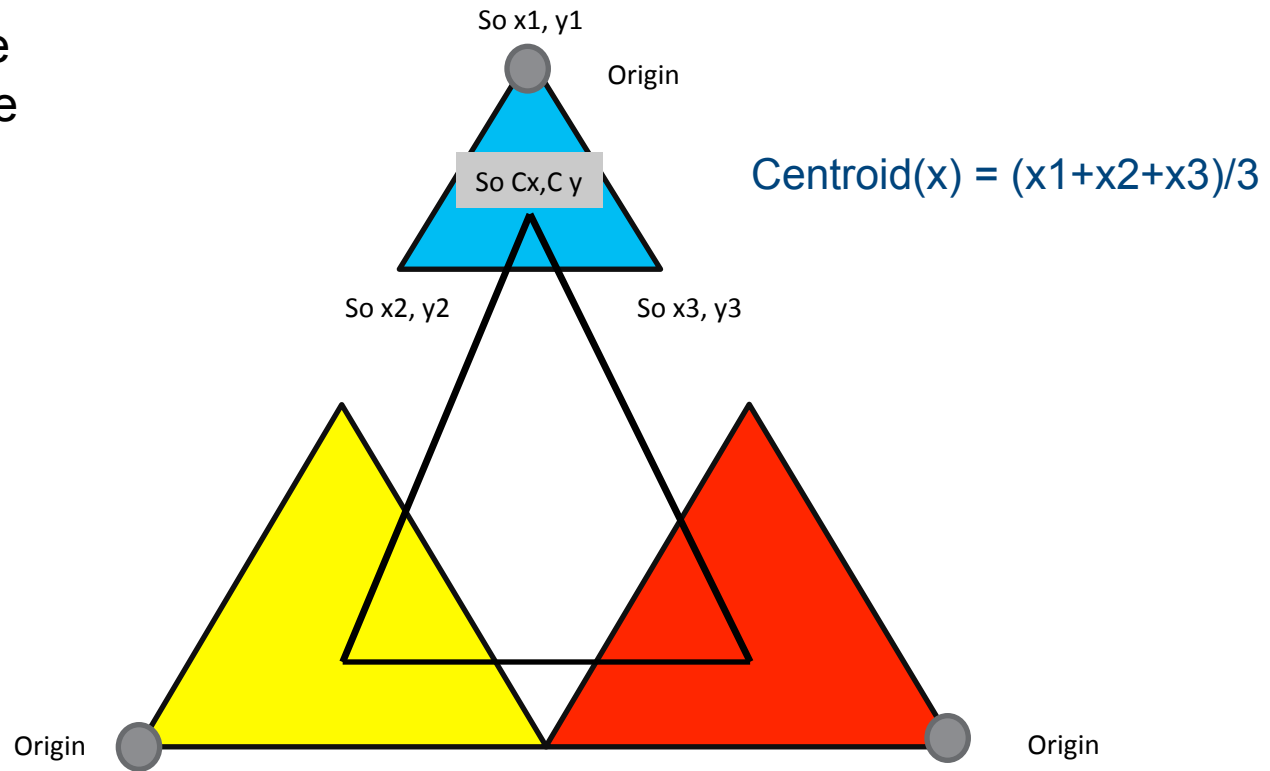


# Fractal Comparison

As the responsibility decreases,  
the centroid stretches out the

Lines for

- Bearable
- Equitable
- Viable





# Summary

- Important to understand 3 responsibilities
- Develop simple criteria that fit your aspects and impacts
- Spend time vetting the criteria prior to evaluation
- Qualitative evaluations of subjective material are never perfect!

**QUESTIONS?**

# Contact Information

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