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What critical steps need to occur and pivotal links need to be established (such as relationships between municipalities and communities) for the successful adoption and implementation of GI practices and approaches within urban communities?

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Steps

- Municipality
  - understand the stormwater issue
  - understand the content and ramifications of the MS4
  - know what they are doing now
  - develop a simple plan of action
  - to take ownership
  - willing and able to adapt
  - lead
- Technical assistance must foster co-production of solutions by the municipality
- Community must understand and be involved

Links

- Successful programs have all community members or their representatives involved in the process
- Municipal agencies are all on the same page and reading from the same script
- Multi-community links (peer pressure, kicking the tires)
- The key decision maker possesses respect and confidence from supervisors and dedication of staff. This person dictates the progress and implementation of GI (challenge is in finding this person in each community)

Not Champions, Rather Leaders who make the decisions

- Philly flower boxes
- Dover catch basin systems

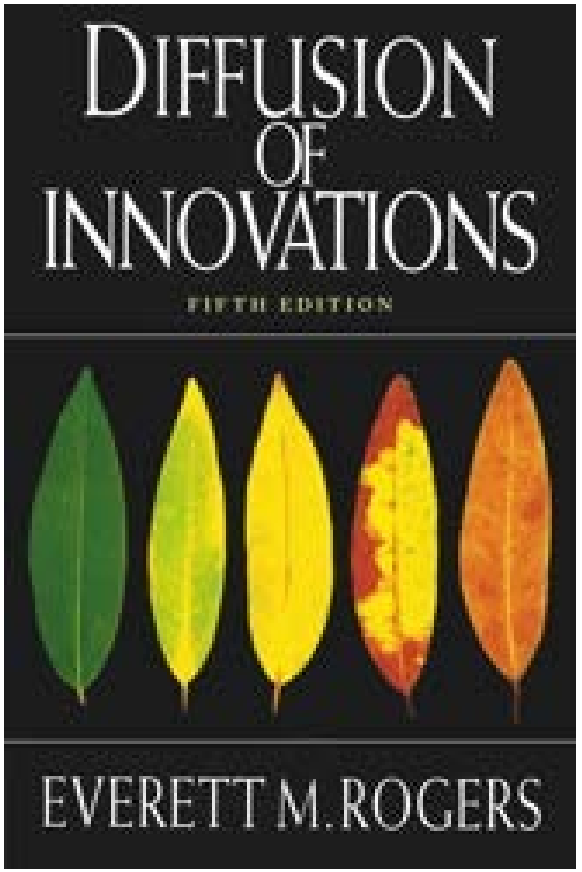
If we know what the problem is…
…and science informs potential…
…Then how are we doing on implementation?

In many cases implementation competence lags behind technical competence

How do innovations spread through populations?

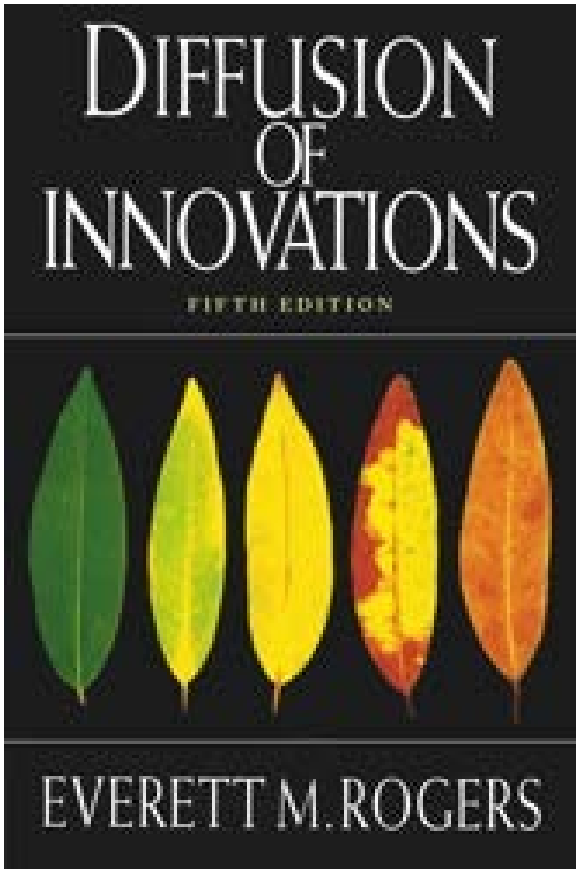
Diffusion of Innovation

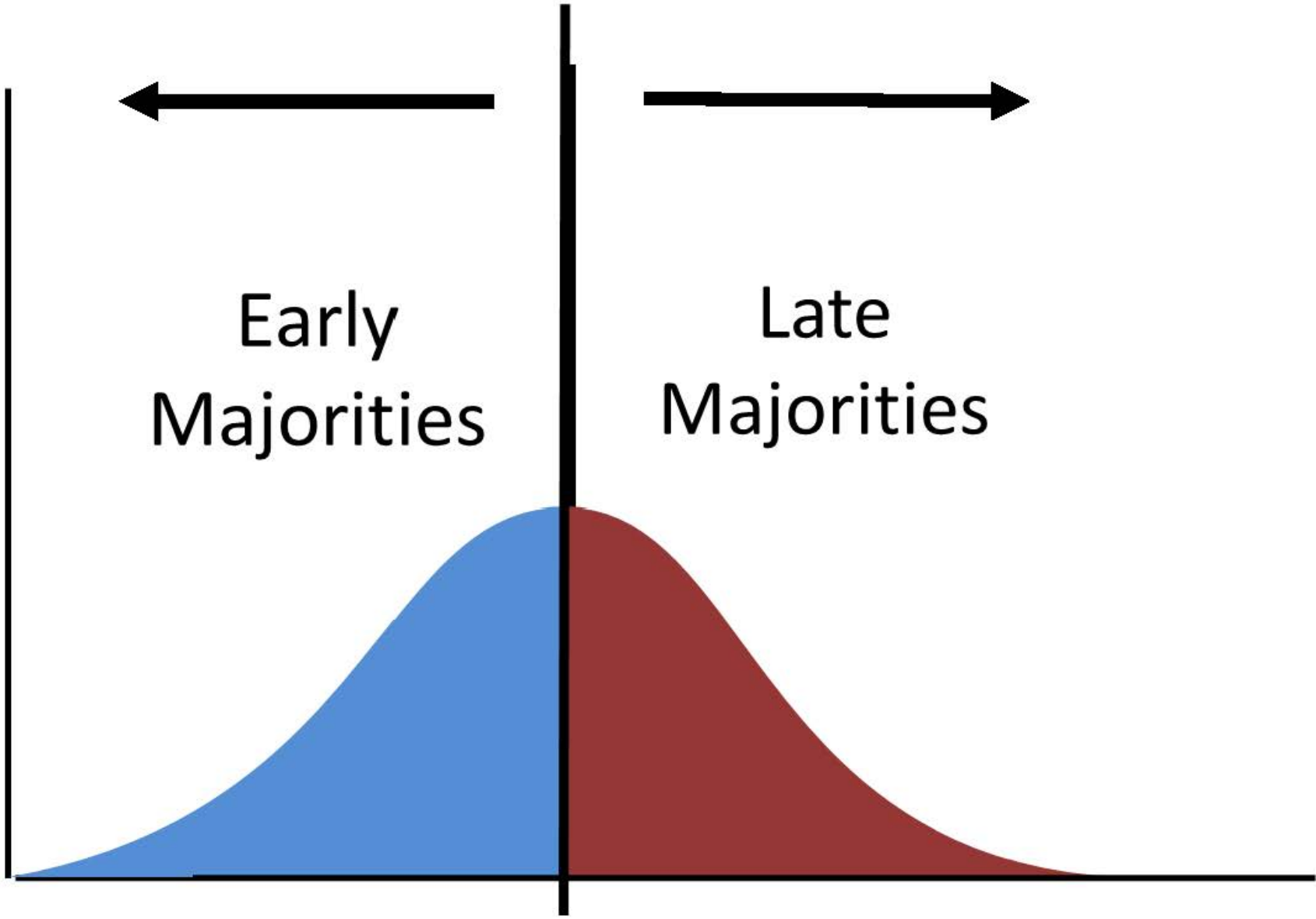
- Diffusion of innovation is the process by which an **innovation** is communicated through certain channels over time among the members of a social system (Rogers, 2003)



Innovation

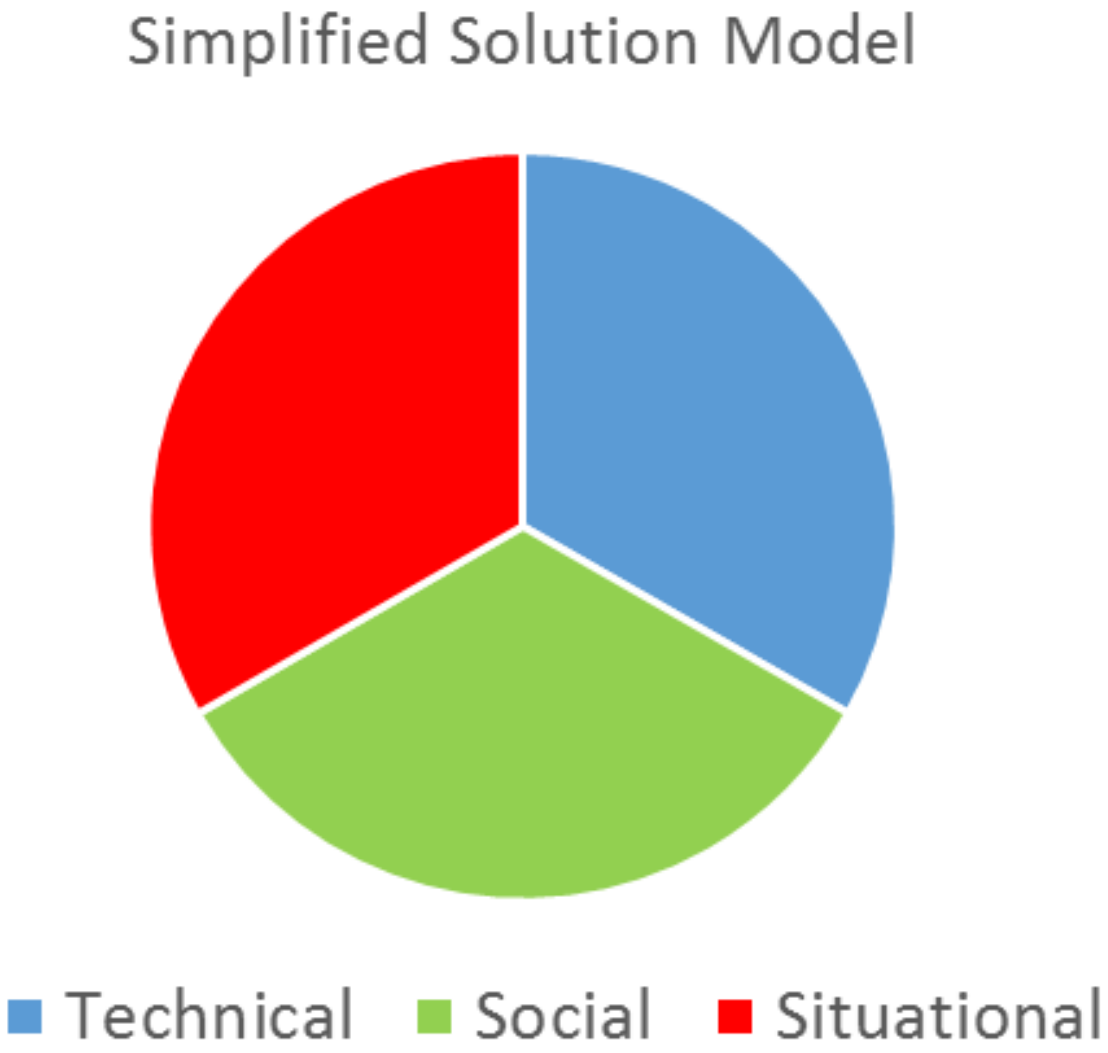
- An idea, practice, or object that is perceived as **new** by an individual or other unit of adoption (Rogers, 2003).





Adapted from Rogers, 2003

Breaking Adoption into Components



Factors that Influence Adoption of Innovation

Technical: Elements pertaining to efforts that require technical expertise and understanding

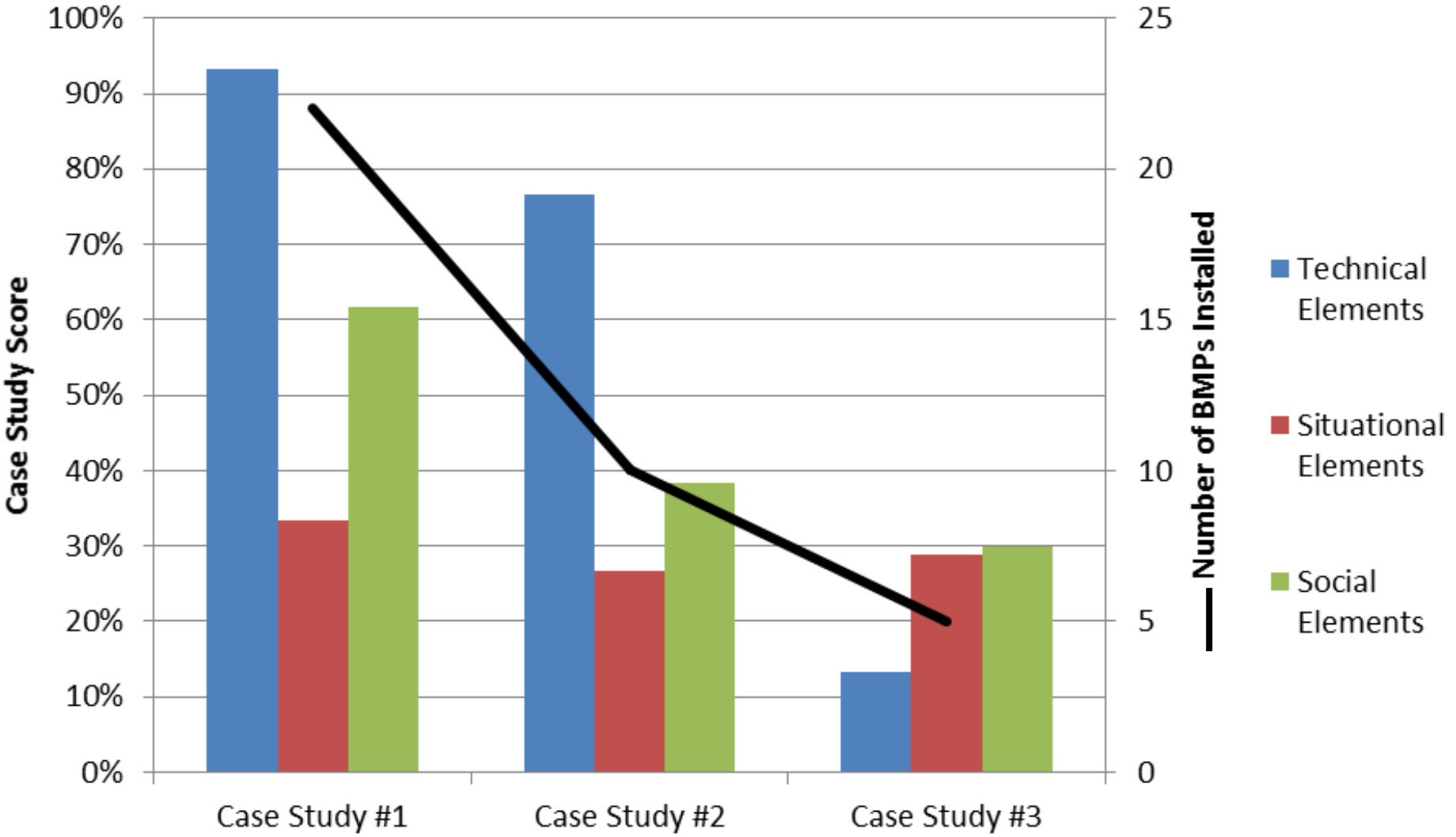
Social: Elements pertaining to efforts that relate to public involvement and civic support for a cultural approach or common social responsibility.

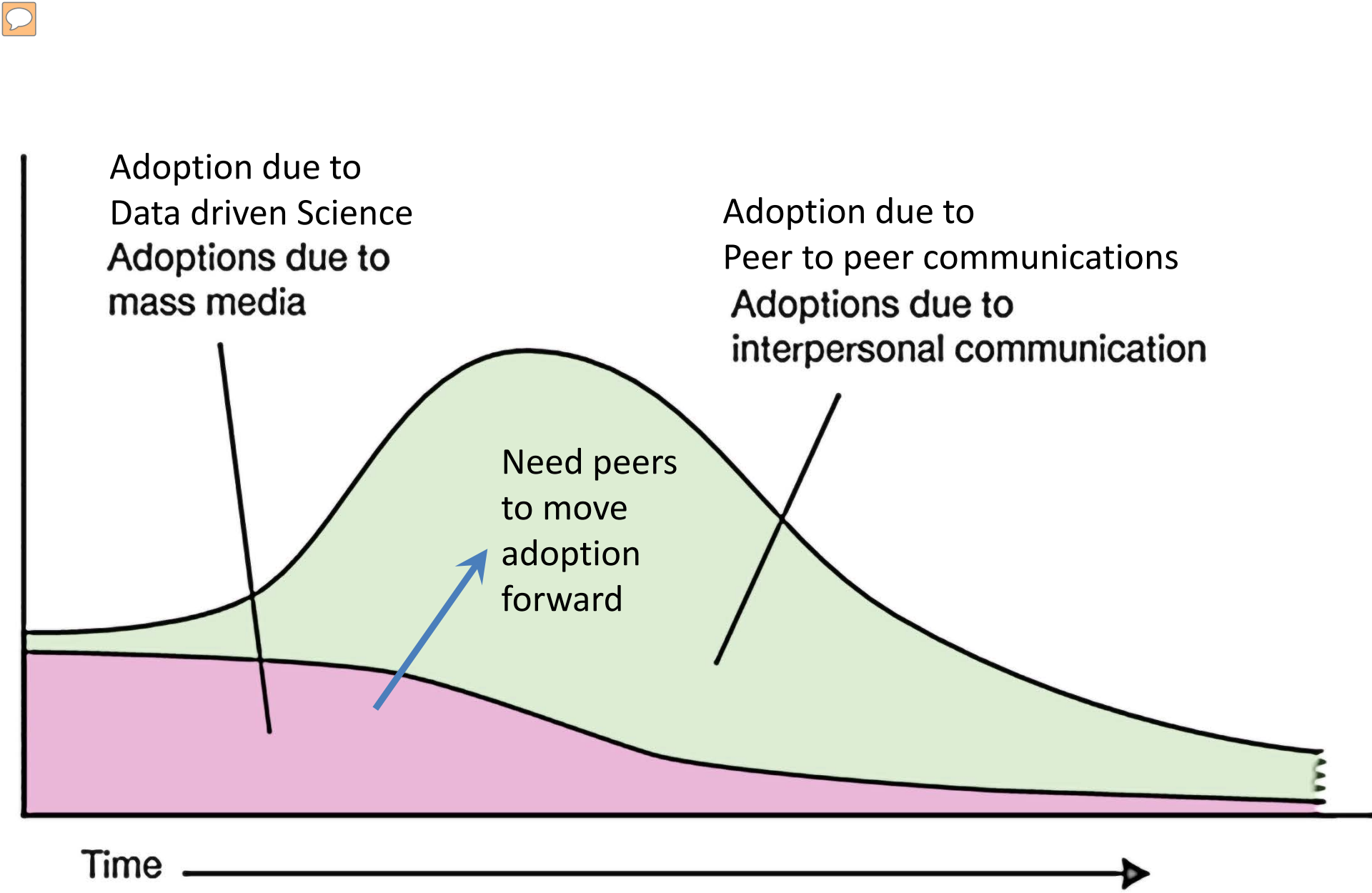
Situational: Elements that are largely out of the control of any municipality or occur according to an external probability, such as an event or regulation.

Adopting a GI for Stormwater Management

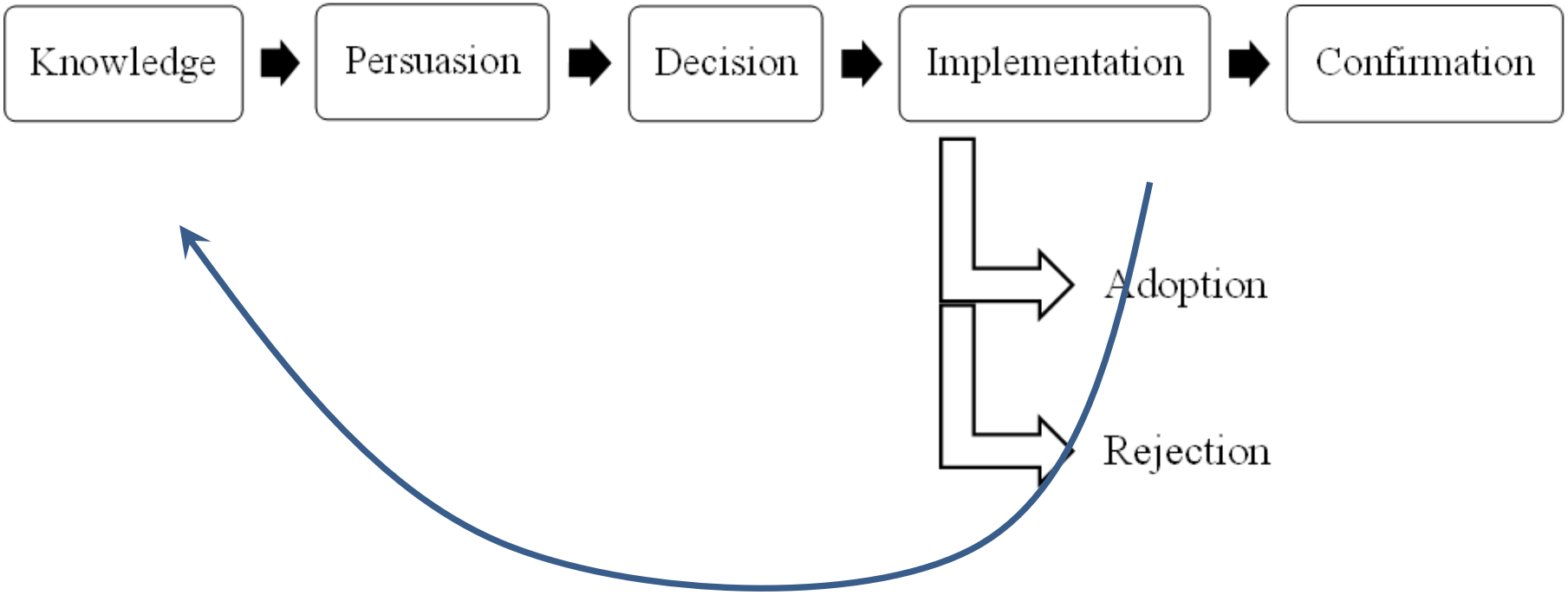
- If we develop measures to quantify these three elements for any community and then compare one community to another as to their implementation of GI (i.e. BMPs in the ground, updated stormwater regulations passed, innovative stormwater controls required)…

Case Study Score vs # BMPs




Adoption due to
Data driven Science
Adoptions due to
mass media
Adoption due to
Peer to peer communications
Adoptions due to
interpersonal communication
Need peers
to move
adoption
forward
Time

Innovation Decision Process



Ability to reinvent to reflect local needs and foster ownership

How Innovations Spread

- Determine the audiences that are most ready and receptive to the innovation
- Work with early majorities where possible
- Maximize the implementation of all elements of the conceptual model
- Recruit early majority representatives to carry the message forward
- Facilitate and foster the reinvention process

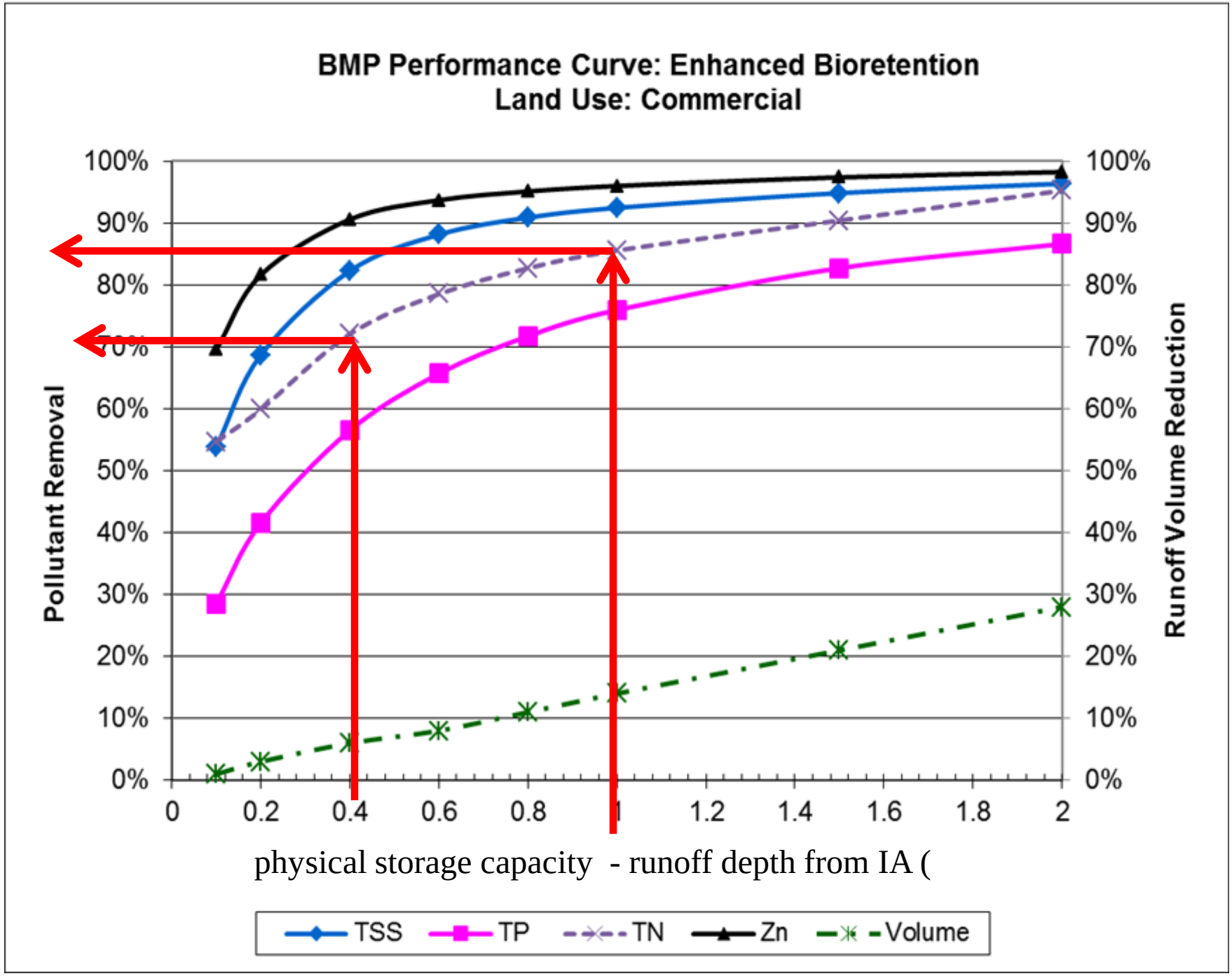
Rigid Constructs Inhibits Adoption and Innovation

There is no right size, but it is wrong to do nothing
OR
The WQV Fixation

- Significant benefits to even small GI systems
- UNHSC research…no loss in treatment performance for storms up to the WQV except SGW
- Design for the WQV fine for new development, For redevelopment/retrofits, anything is better than nothing from a water quality perspective

The Big Picture

- WQV design is a great concept
- For retrofits, cannot always fully size to the WQV
- Undersized system performance is still remarkable
- Adding in dynamic sizing means that we could be saving 30% to 60% of the cost estimates floating around to meet TMDL targets….literally billions of dollars can be saved…or for the same money, we could be managing more stormwater if we dynamically size and/or size towards a design goal


BMP Performance Curve: Enhanced Bioretention
Land Use: Commercial
Pollutant Removal
Runoff Volume Reduction
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
physical storage capacity - runoff depth from IA (
TSS
TP
TN
Zn
Volume

Entities and Relationships

- Structured agency
- Inter-agency
- Private sector
- Community
- Inter-community
- Professional sector

Rigid and Static, Regulatory or Legal Frameworks are not Capable of Long Term Success

- Models and conditions are dynamic and not static
- Watersheds are dynamic and not static
- Land use is dynamic and not static
- Implementation is dynamic and not static

Why then should a 20 or 25 year plan have static constraints on performance, solutions, and options?

The Key to Successful Implementation

Heavy handed regulations or one-sided directives do not often result in adoption of new practices. The keys to successful implementation are:

- Build Trust
- Build Relationships
- Create a Process

Trust

- Assured reliance on the character, ability, strength, or truth of someone or something (Merriam-Webster). …complex mix of personality, culture, and experience (Hurley, 2006)
- Trust underpins the success of organizations and initiatives. Organizations, businesses, and relationships built on trust outcompete others (Harvard Business Review, 2006).

Building Relationships

- Trust
- Mutual respect
- Communication
- Ability to see from other points of view
- Willing to compromise, and understanding that compromise moves us forward
- Being positive is a great catalyst
- Know who is, and should be, involved (stakeholders)
- Simple handholding/leading from behind

Create the Process to take that Trust and the Relationships to Act on GI

- Strategies for funding
- Codes and regulations
- Standards of practice
- Expectations
- Review
- Adaptive

Have the House in Order

- Stormwater Regulations
- Stormwater codes
- Design review
- Construction and installation oversight
- Operation and maintenance contigencies
- Process to periodically revise and update

Implementation is Hindered by Barriers: Real or Perceived

Barriers to Implementation: Perceptions

- Too expensive
- Unfamiliarity
- Prone to Failure
- More big government
- GI does not work (no value)
- Excessive maintenance requirements
- Lack of objective consideration
- Barrier to progress
- Not required in local codes/policy
- Lack of clear permit review procedures

Barriers to GI Implementation

- Cold Climate Performance suspicions
- Long-term-clogging and durability concerns
- Water quality performance ignorance
- Construction Challenges
- Modern design specs
- Staging Issues: logistics and placement
- Designer unfamiliarity
- The impossible challenge
- Maintenance Misperceptions
- Maintenance practices
- Cleaning frequency
- Snow and ice treatments
- Costs
- Ease of permitting traditional technologies
- Patchwork development
- Misinformation and folklore
- The local expert, isn't

Long Term Clogging and Durability Concerns

- Systems require periodic, planned maintenance
- System performance fairly consistent
- Systems perform well throughout the year

  – Often this issue is not even raised for conventional technology

Construction

- Simple excavation
- Straightforward paving
- Common materials
- Conventional plumbing

Designer unfamiliarity

- GI designs are relatively new, the profession is slow to change
- Vast majority of practicing designers have not been trained on GI design

Many State Stormwater Manuals Contain Erroneous Design Information

- Based on logic, but never tested
- Examples
  - geofabrics
  - depth to frost
  - depth to groundwater
  - infiltration needs of native soils

Retrofit Strategies

- GI often considered impractical, too expensive, unnecessary
- A “do nothing” option will always cost less that requiring GI

Parking Lot Retrofit

Street Retrofit

Street Retrofit

Long Term Implementation Success

- Requires GI to be successfully in the long term
- Long term means
  - Operation
  - Inspection
  - Maintenance

Maintenance

- Maintenance Misperceptions
- Maintenance practices
- Cleaning frequency
- Snow and ice treatments

Maintenance

- GI fails due to lack of maintenance
- “See, it does not work!” is a serious barrier to implementation

ANALOGIES

- Buy new fire truck, do not maintain, cannot make fire call, “see, firefighting does not work”
- Buy a snow plow, do not maintain…

Maintenance Must be Included in the Design Process

- Not by the designers, but by the people who are expected to do it and pay for it

Maintenance Misperceptions

- Conventional systems may be rarely maintained
- LID systems are presented as being maintenance nightmares….based on what evidence or data?
- LID maintenance is portrayed as being foreign and out of the grasp of local utilities or homeowner associations

If the System Removes Sediment, Maintenance is Necessary

- Infilled ponds
- Infilled swales
- Infilled catch basins
- Clogged gutters

The Impossible Challenges

- Scenarios posed selectively to GI

  Contaminants and infiltration

  Freezing and infiltration

  Maintenance

Hidden/Unconsidered Costs

- Water quality degradation
- Lost recreational values
- Watershed impairments (death by 1,000 cuts)
- Property values
- Uncontrolled contaminants (temperature, energy)
- Sustainability (water supply, low flow)

The Costs of Water Quality Impairments

- When pricing the inability to meet water quality standards, costs to bring stormwater runoff up to standards far exceed the construction and maintenance costs (Khan, 2006)
- LID water quality performance greatly exceeds that of conventional technology

Ease of permitting traditional technologies

- Designers understand the process with conventional technologies
- Reviewers know what to look for in conventional technologies
- Regulators are more likely to approve systems they understand and that were designed by local standards

Acceptance

- Regulators (local boards through permit agencies) are reluctant to accept technologies with which they are unfamiliar.

Designer Unfamiliarity

- Conventional methods have been used for decades
- Conventional methods are often still allowable
- Urban GI often must meet more constraints
- Contractor capacity ,may be limited

The Human Dimension

- Many of the barriers reflect human perceptions, values, etc.: the human dimension

- The human dimension is a holistic view of how humans function in a system. These systems include environment, culture, community, politics and society, among others.

Human dimension

- GI Adoption and Implementation takes a Village
- Most GI barriers are human-based
- Designer training still in need

Carrot or Stick Approach?

- Penalties for non-GI
  - Fee schedule
  - Tax rate
  - Utility rate
- Reward for GI
  - Tax break
  - Utility break

Each has ramifications on project success

Successful Change

- Inclusion
- Introduction
- Feedback
- Targeted implementation
- Funding

End

Yes, climate change gives us pause to think, but IC is the 800-pound gorilla