Urban Stormwater Systems in Failure

using infrastructure asset management as a path to flood resilience

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IAM - MN

Outline

Asset Management Topic	Edina Water Resources Example
What is infrastructure asset management?	My asset management journey
Failure modes, systems engineering	Climate change, water resources management, a system in failure
Service level setting	Flood risk reduction task force
Risk management	Flood risk reduction strategy ~~and surface water plan major amendment~~
Life cycle service delivery	~~Flood infrastructure project &~~ Utility management lessons learned

topic and example reference guide

- Concept example (just Ross diagramming ideas)
- Graph or analysis (I signed this or presented publicly)
- Resource (someone else's professional work)
- Link in presentation download

What is infrastructure asset management?

- ISO 55001 (International Organization for Standardization)
- Asset management is “the coordinated activity of an organization to realize value from assets.”
- An asset is an “item, thing, or entity that has potential or actual value to an organization.”
- The institute of asset management, theiam.org, Asset management – an anatomy (2015 v3)
- The 10 Steps to Asset Management, Water Research Foundation SIMPLE

SIMPLE
Sustainable Infrastructure Management Program Learning Environment

What is infrastructure asset management?

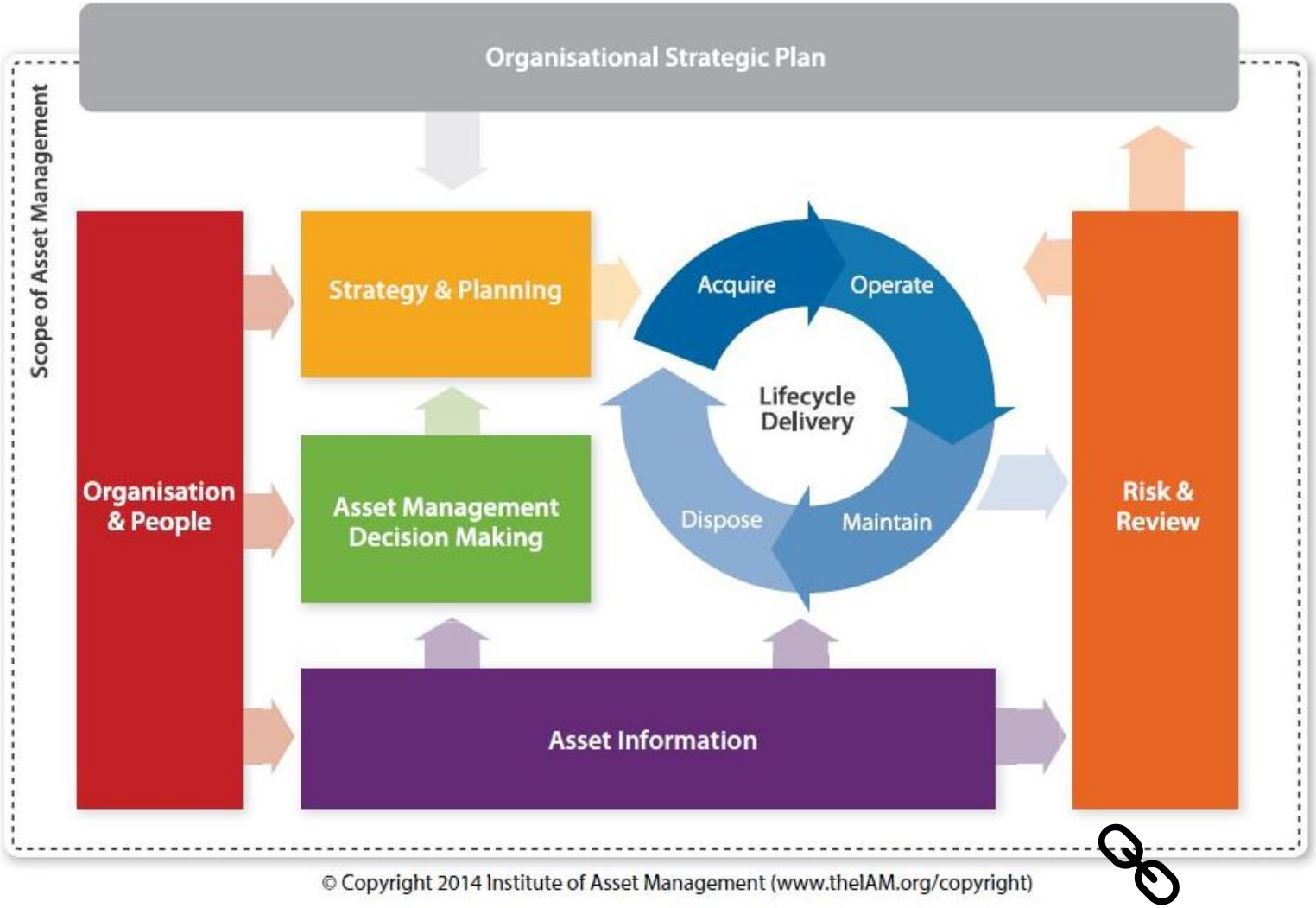
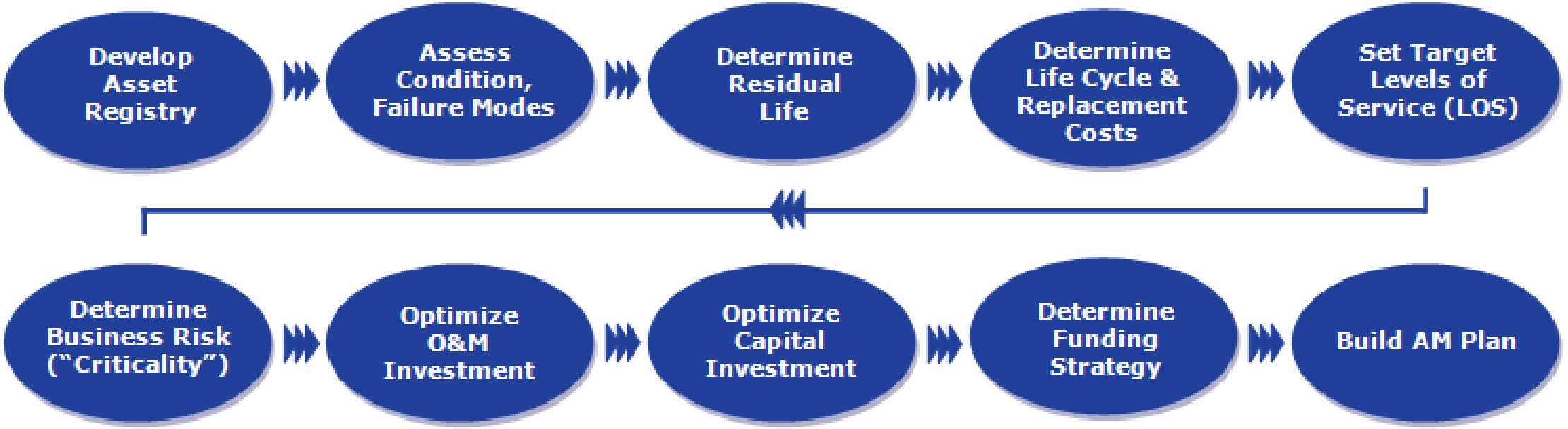


Figure 3: The IAM's Conceptual Asset Management model

- A framework to get the parts and people working together to achieve business objectives and deliver value to the customer

What is infrastructure asset management?



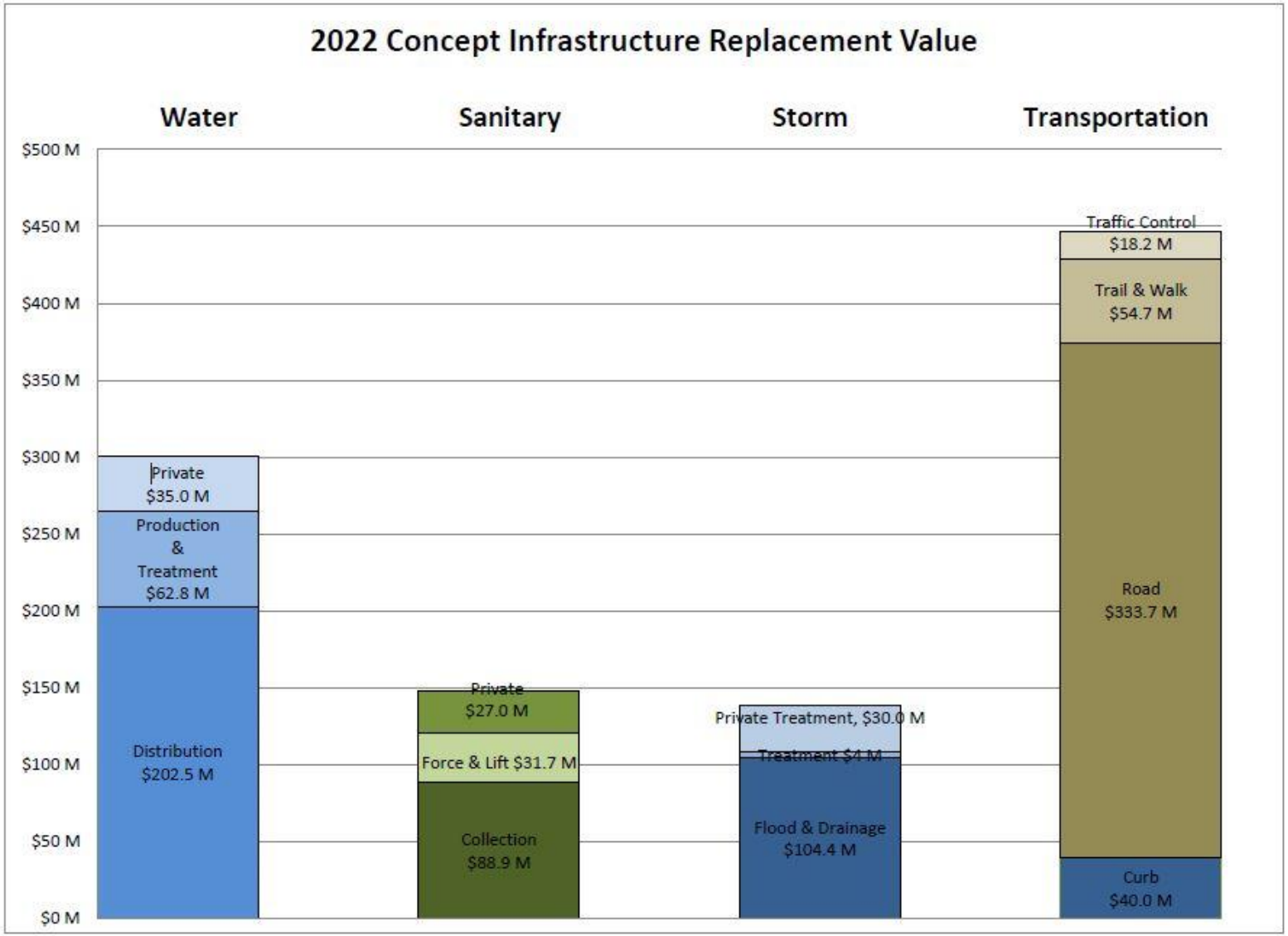
- Asset management can help utilities make sound planning decisions, meet customer and regulatory expectations, and manage capital intensive inventory.

https://simple.waterrf.org/Books/Contents/The-10-Steps-to-Asset-Management

My asset management journey

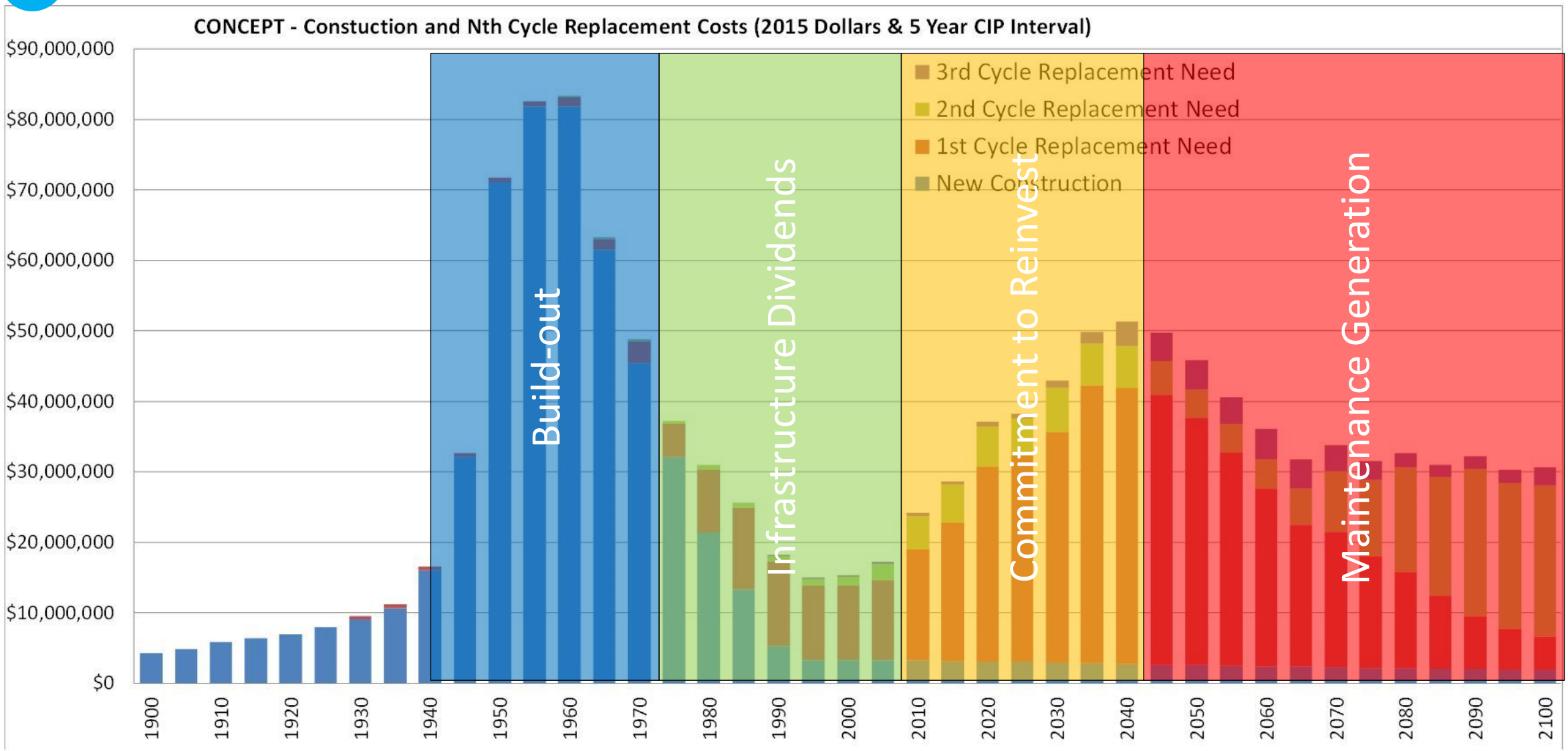
- 2014-2017 “state of the infrastructure” presentations and structural funding gap analysis, capital improvement plan recommendations.
- 2017 kickoff of theIAM local chapter, MN ASSET MANAGEMENT IAM The Institute of Asset Management
- 2017 Asset management planning certificate from Institute of Public Works Engineering Australasia (IPWEA).
- 2018 Surface water plan, and comprehensive plan water resources chapter
- A thing with value, venn diagram of infrastructure vs. natural resources services in water resources management

System Replacement Value – Edina 2022



- If we had to replace the entire system today, what would it cost?
- Each year we replace a percentage of the system, are we investing enough?
- What percentage of the system do we replace each year at current level of funding?

2014-17 State of the utilities presentations



Failure modes and systems engineering

- Failure modes (Water research foundation simple.waterrf.org/)
  - Capacity
  - Service level
  - Mortality
  - Efficiency
- Systems Engineering (theIAM – An Anatomy 2015)
  - An interdisciplinary, collaborative approach to derive, evolve and verify a life cycle balanced system solution that satisfies customer expectations and meets public acceptability. (3.1.3, #13)
  - Systems engineering… …considers interface between new assets and the existing assets or systems. (6.3.3)

Failure Mode	Definition	Tactical Aspects	Management Strategy
Capacity	Volume of demand exceeds design capacity	Growth, system expansion	(Re)Design
Level of service	Functional requirements exceed design capacity	Codes & permits: NPDES, CSOs, life safety, etc.	(Re)Design
Mortality	Consumption of asset reduces performance below acceptable level	Physical deterioration due to age, usage, acts of nature	O & M, optimization, renewal
Efficiency	Operation costs exceed that of feasible alternatives	Pay-back period	Replace

https://simple.waterrf.org Figure 3 Failure Modes:

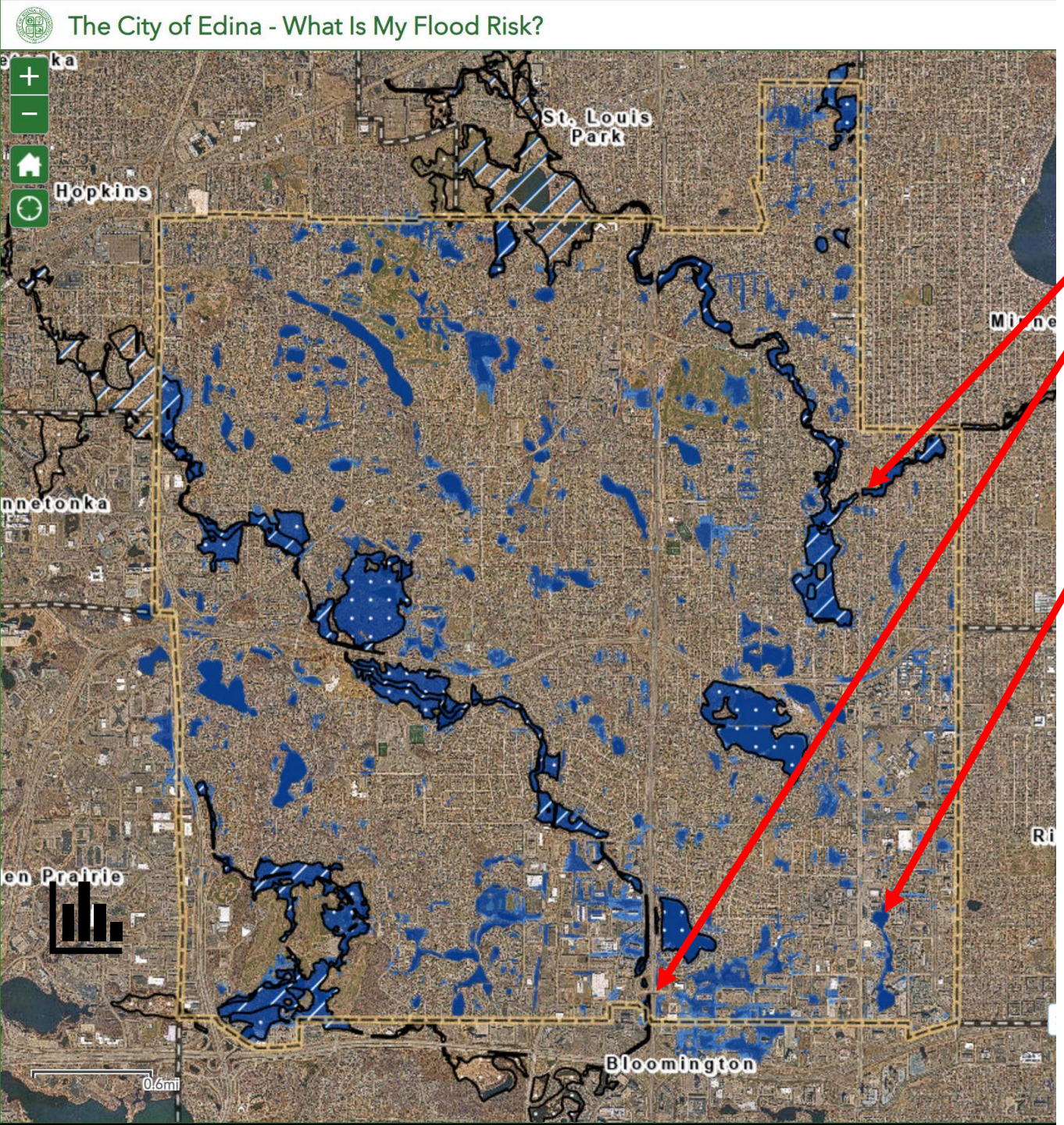
A water resource system in failure

How urban stormwater systems are failing

- Capacity
- Service level
- Mortality
- Efficiency

System Level > ~~Subwatershed Level~~ > Catchment Level > ~~Resident Level~~

City of Edina “What is my flood risk” public facing interactive map.



Systems Level

- Capacity – climate change is driving regional system level failure.
- Service level - Past system designs were smaller, assumed free outfall and no tailwater, conditions that no longer exist
- Mortality – systems are 50-70 years old
- Efficiency – deferred maintenance burden, replacement more effective than maintenance in some cases

Catchment Level

- Capacity – new surface bypass, overflows, or backflows emerge in failure conditions
- Service level – Extent of flooding and low floors and low openings of lowest homes limits achievement of infrastructure-based exposure reduction strategy
- Mortality – system components decay at varying rates. (Ex. RCP vs. CMP)
- Efficiency – designs for inlet capacity and debris management are outdated, P2 and debris management activities benefits overlap

A water resource system in failure

- Surface water systems engineered for flood protection?
  - A verified, life cycle balanced system solution? Satisfied customer expectations? Publicly acceptable? No, No and No.
- The needed but daunting challenge of systems engineering
  - Permit by permit vs. systems engineering
  - Risk communication, service communication
  - Model boundary assumptions at scale
  - Multi-mandate and tradeoffs of flood, clean water, drainage
- Business requirements are based on customer value, and should relate to system level performance
  - More on this topic coming up!

Famous Quotes (from Edina engineering and others)

“Ross, you used the **F**-word again”

-Chad Millner

But Chad, “**F**ailure is the default condition of our aging infrastructure”

-Ross Bintner

“Nature understands no jesting; she is always true, always serious, always severe; she is always right, and the errors and faults are always those of man.”

-Johann Wolfgang von Goethe

Service level setting

Service level: Parameters, or combination of parameters, which reflect social, political, environmental and economic outcomes that the organization delivers.

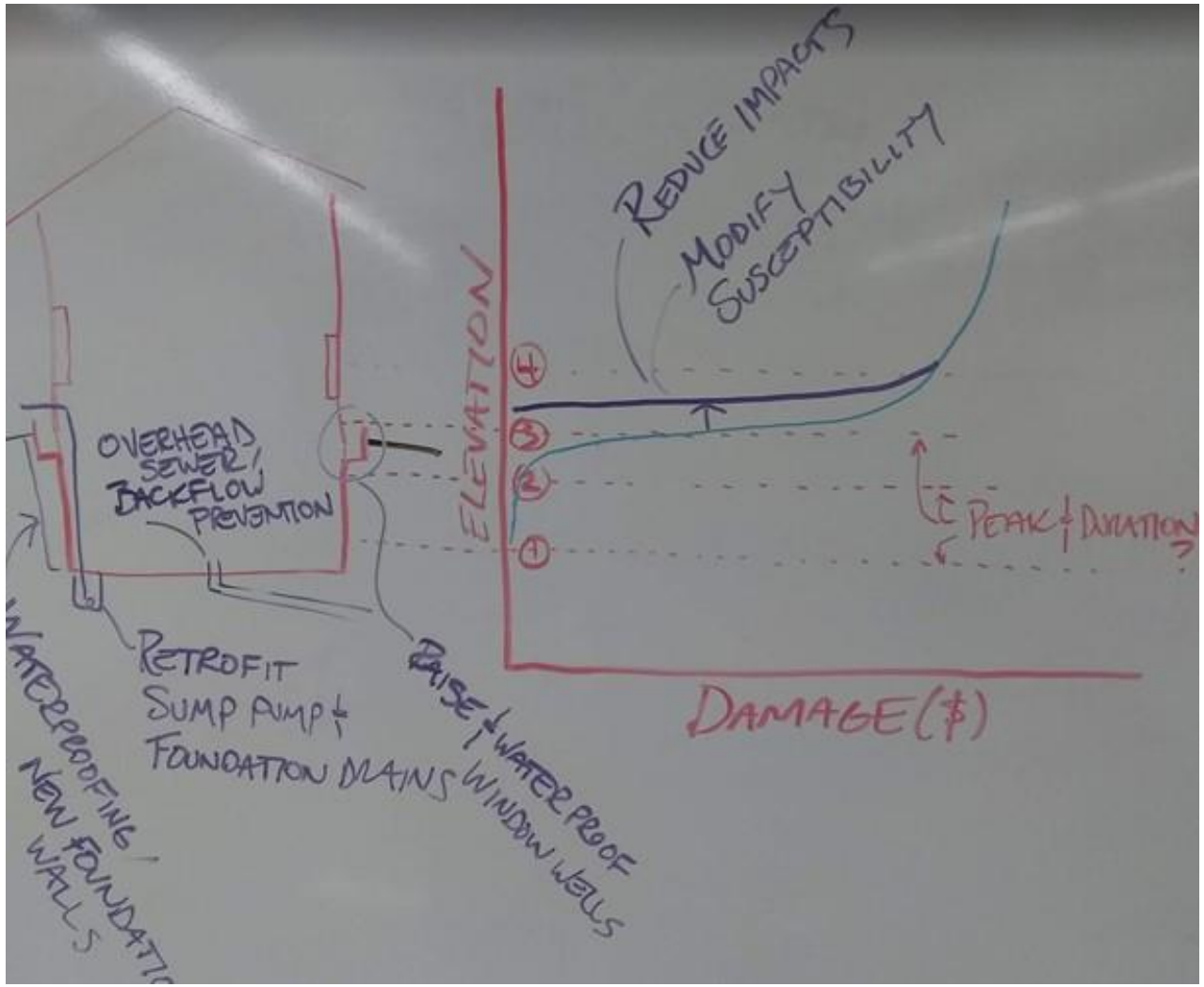
The parameters can include safety, customer satisfaction, quality, quantity, capacity, reliability, responsiveness, environmental acceptability, cost and availability.

- Customer Expectation example
  - Safe and reliable drinking water
- Technical Requirements example
  - EPA Maximum Contaminant Level (MCLs)

Flood risk reduction task force

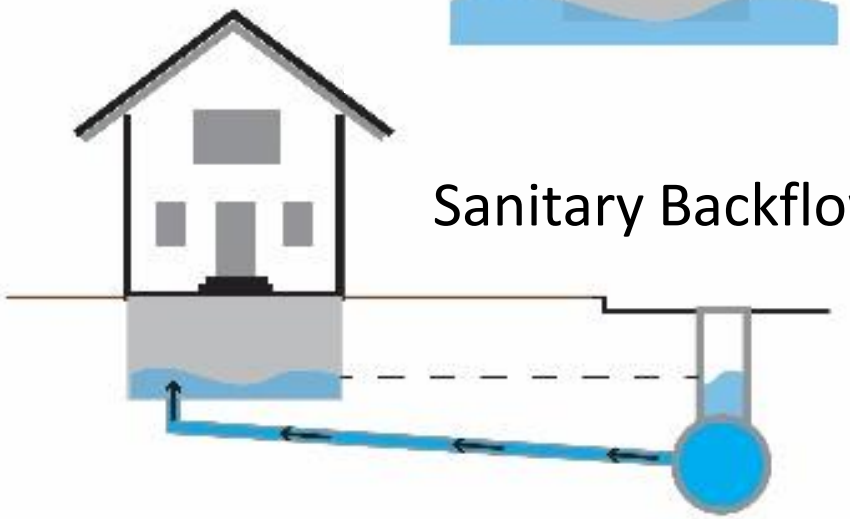
- 8 Members from around the community, half in areas with homes with predicted flood exposure
- Customer Expectation
  - My home should not take on water in a flood
- Mind the Gap

Flood risk reduction task force



Surface Water

Ground Water



Sanitary Backflow

Risk management

- Ensure that your organization acknowledges, understands and manages risk effectively. You choose to tolerate every risk you don’t manage.
- Risk is defined in ISO55001 and ISO 31000:2009 as the ‘effect of uncertainty on objectives’ where an ‘effect’ is a deviation from the expected.
- Risk management creates and protects value.
- Tolerate, Transfer, Treat, Terminate (4Ts of risk management)
- IPWEA Abridged Process

Flood risk reduction strategy

Strategy development

- How we understand risk
- Climate adaptation and resilience inspiration
- How much does impervious matter
- How much does private storage matter
- Areas of work
- Strategy

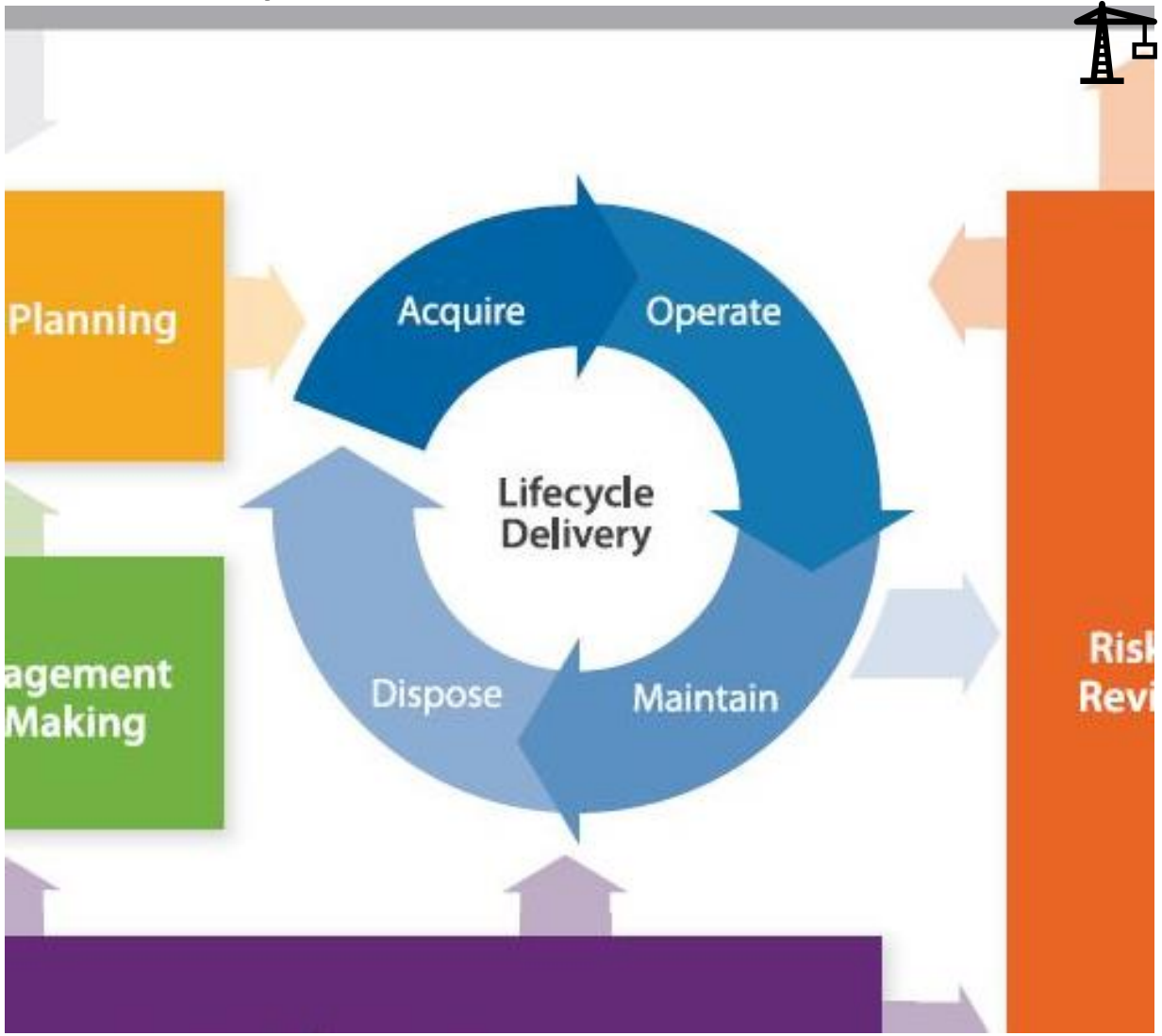
FLOOD RISK FACTORS

DRIVERS OF INCREASING FLOOD RISK

Lifecycle service delivery

Value is realized at the system and portfolio levels.

Most effort is spent at acquisition phase, but value comes from the long O&M phase



Surface water and utility management

Work to make MFIP perform at systems and portfolio level

- Good neighbor and public participation approach
- Downstream flood risk reduction
- Downstream water quality benefit
- Model boundary assumptions and groundwater, systems level value

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Contact and Q&A

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