Balancing Competing Priorities in an Urban Creek Restoration

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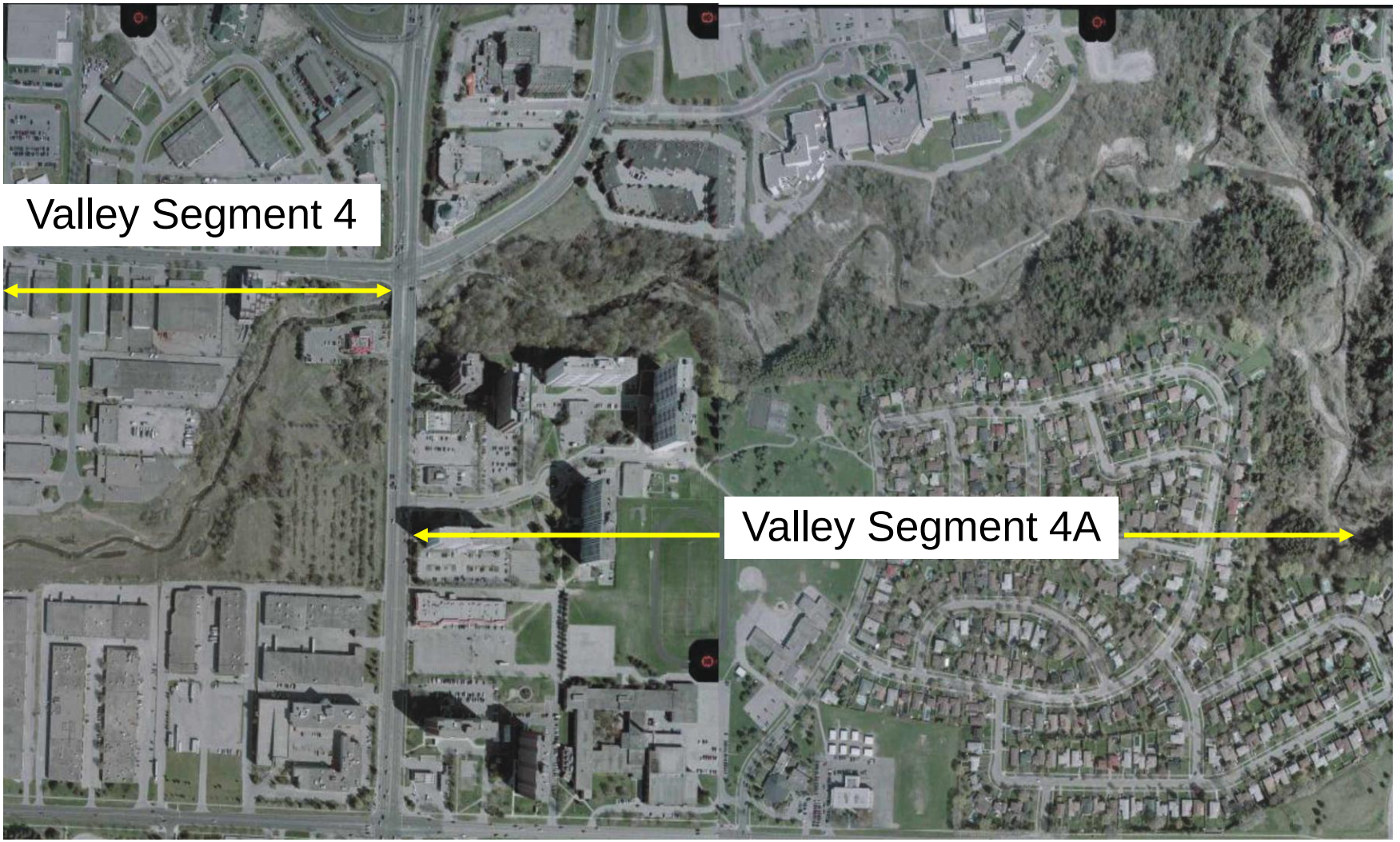
Introduction and Context

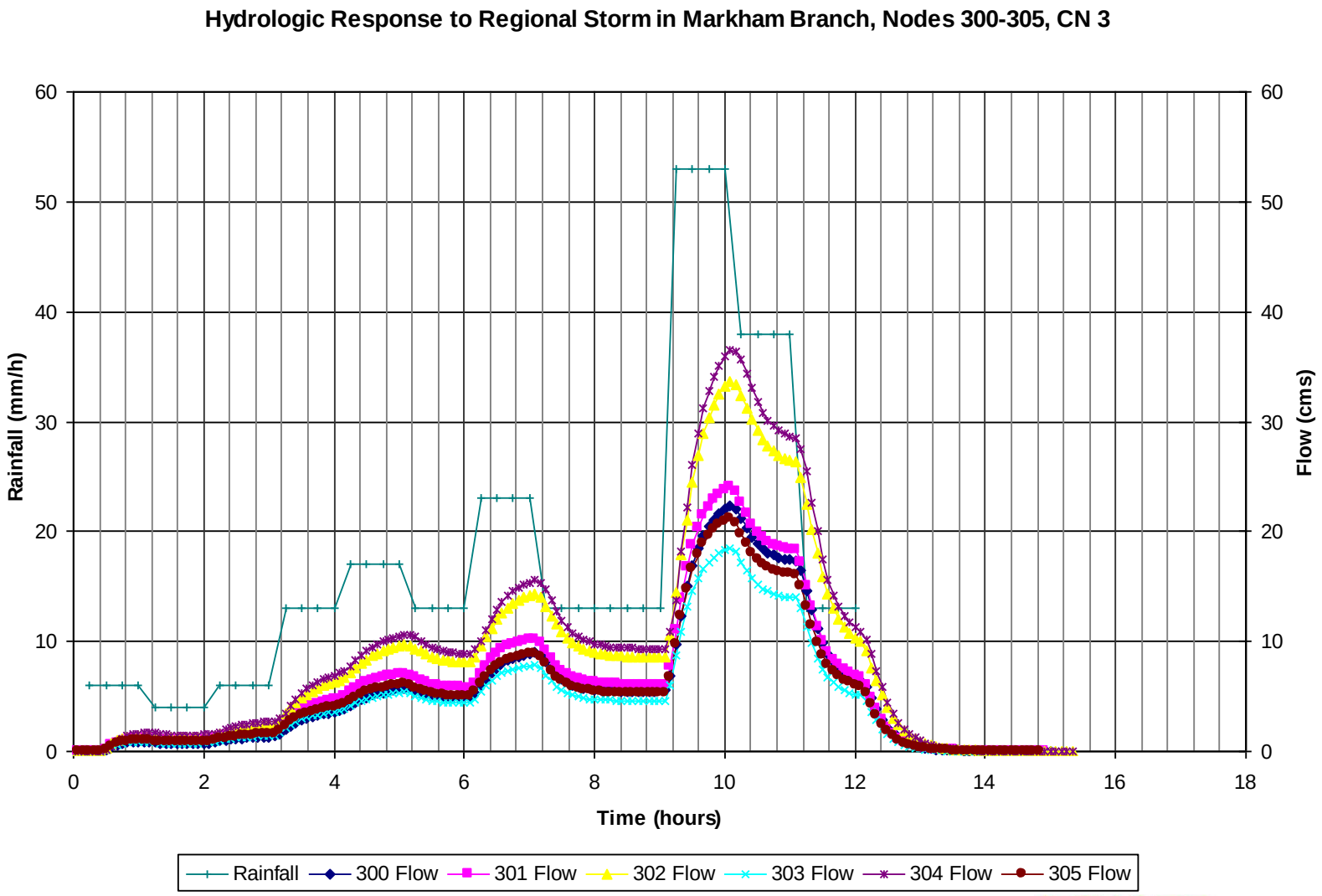
Location

Lake Ontario

Channel and Valley



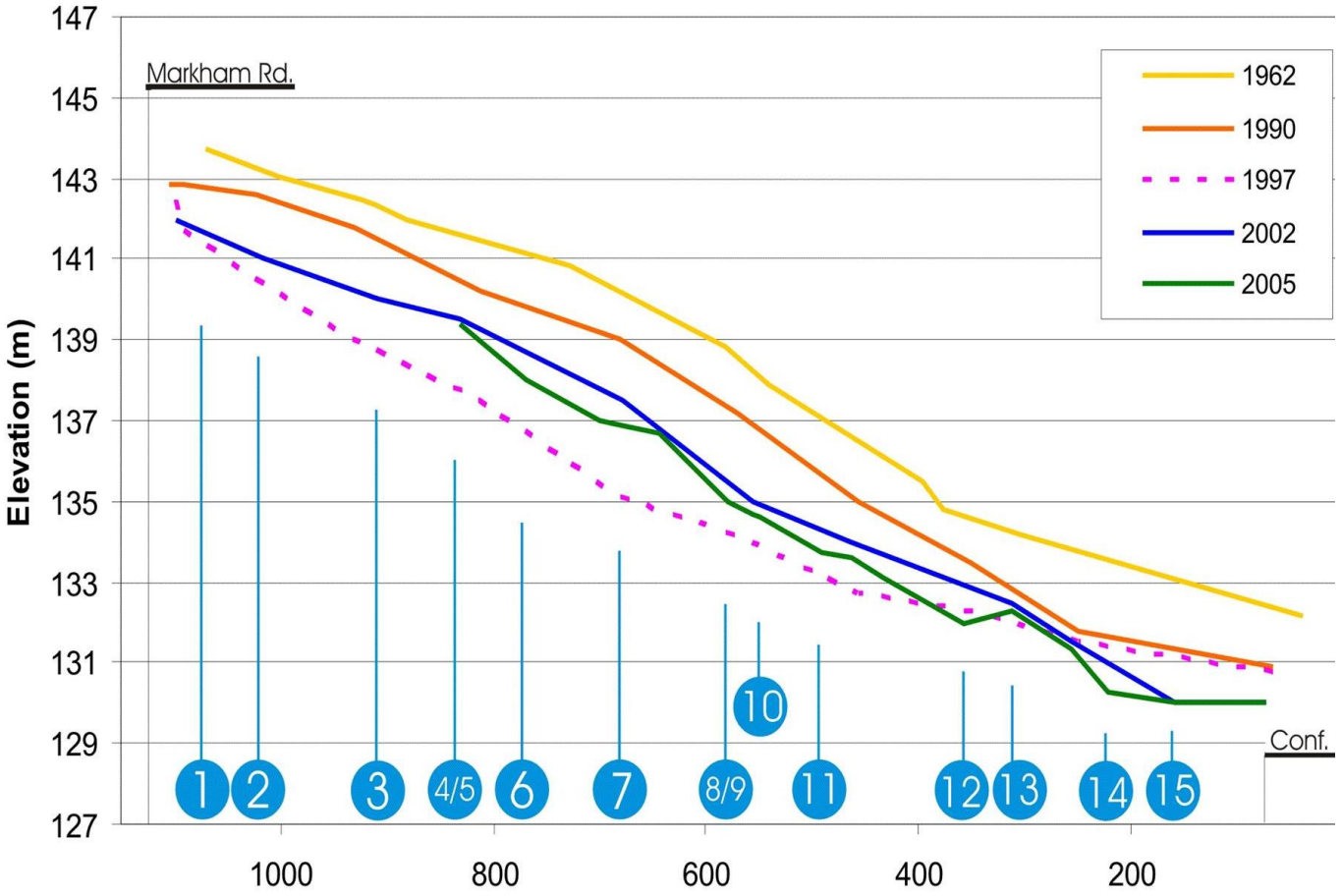
The Problem: Hydrologic Response



The Result: Channel Degradation

Down-cut average of 3m (10 feet) since 1962

Rate of incision has drastically increased



Channel Condition

Repaired in 1980,entire systems have failed,

Some repairs are being done as ‘emergency work’

Primary Stakeholders and Motivation,

Design Obstacles

Factors against success

- Watershed shape (wide, high flow volume per unit of channel)
- Urban setting (75% impervious, one of the most urbanized watersheds in the Toronto area)
- Location on the watershed profile, (near the downstream end, erosional zone, steep inclination of channel bed)
- Significant infrastructure (provides working constraints – 4 exposed sanitary sewer crossings – 5 emerging)
- Highly incised valley setting (minimal floodplain access)

Balancing Priorities

Engineering
Erosion Control

- Harden Bed
- Harden Banks
- Enlarge channel section
- Reduce flood risk

Ecology
Valley System

- Manage valley connectivity
- Increase forest cover
- Protect valley slopes

Geomorphology
Dynamic Stability

- Manage sediment
- Reduce flow velocity
- Allow fish passage

Adaptive Management Approach

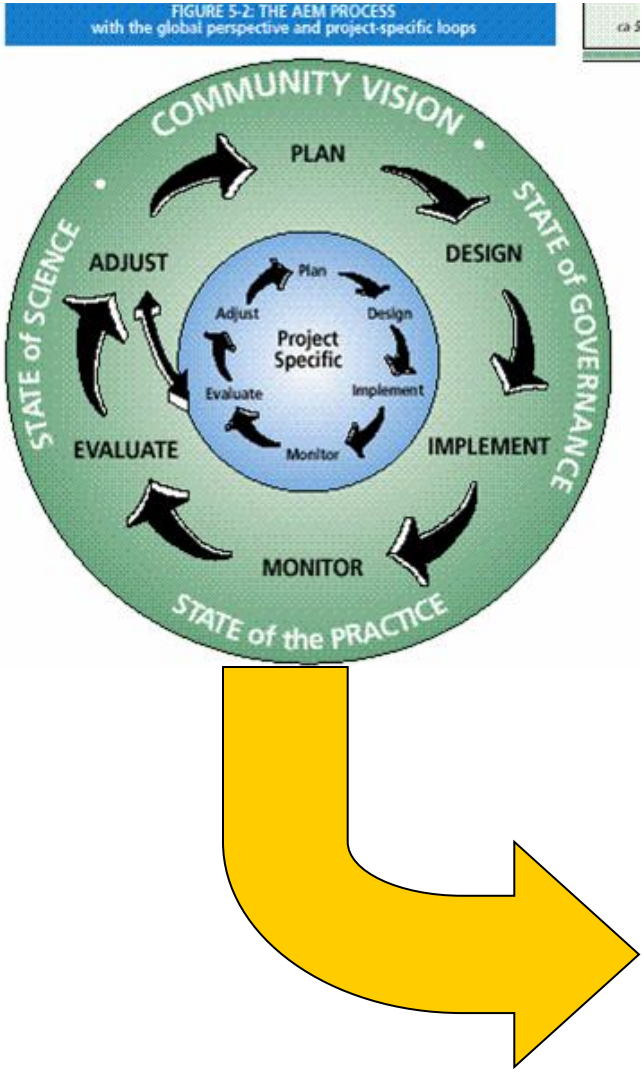
What is Adaptive Management?

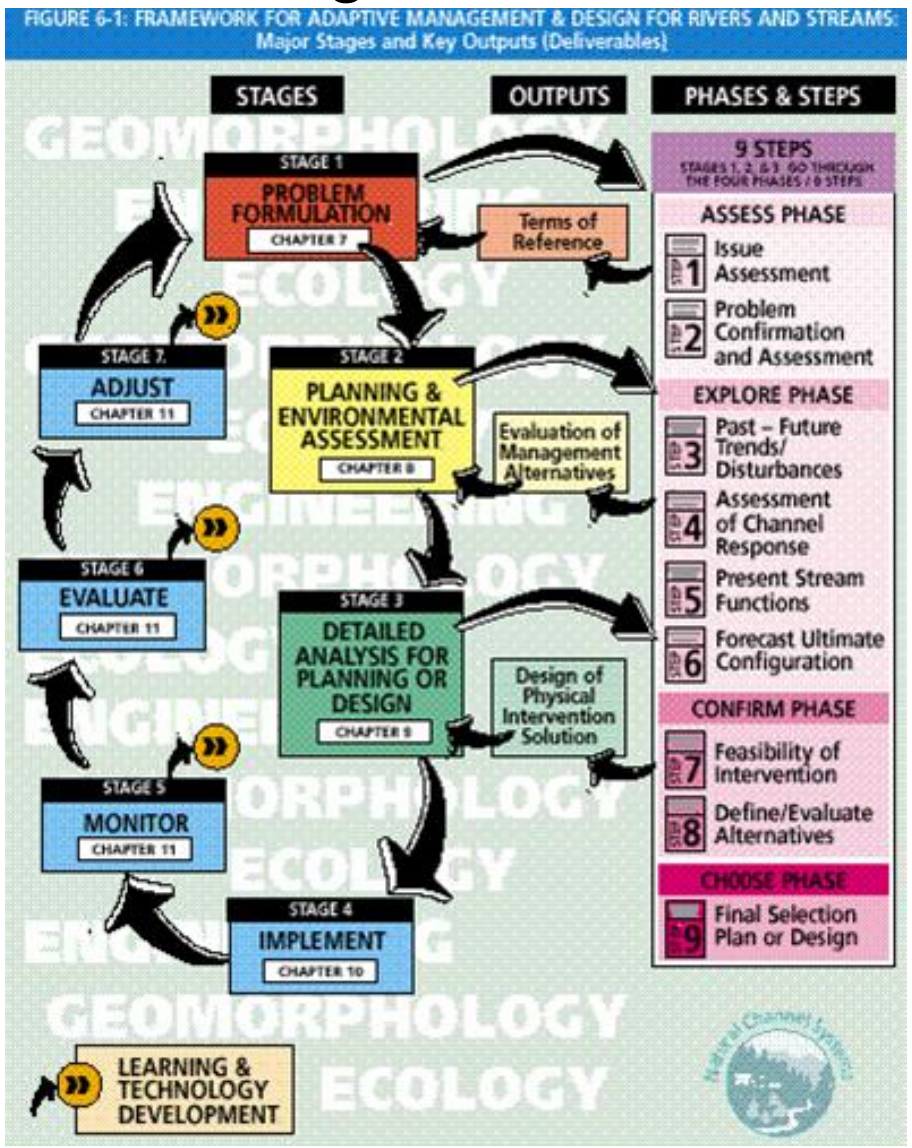
- Many interpretations
- Understand mechanism of success and failure, assess associated risk, make decisions on future maintenance anticipated intervention, apply appropriate action – based on prediction and monitoring – attach redundancies on the anticipation of failure

Look at creeks as an asset, not a liability

- What can the creeks do for the community/water quality/flood protection (creeks as stormwater management) fix a creek, fix an ecosystem – geomorphic systems

AEM - Adaptive Environmental Management





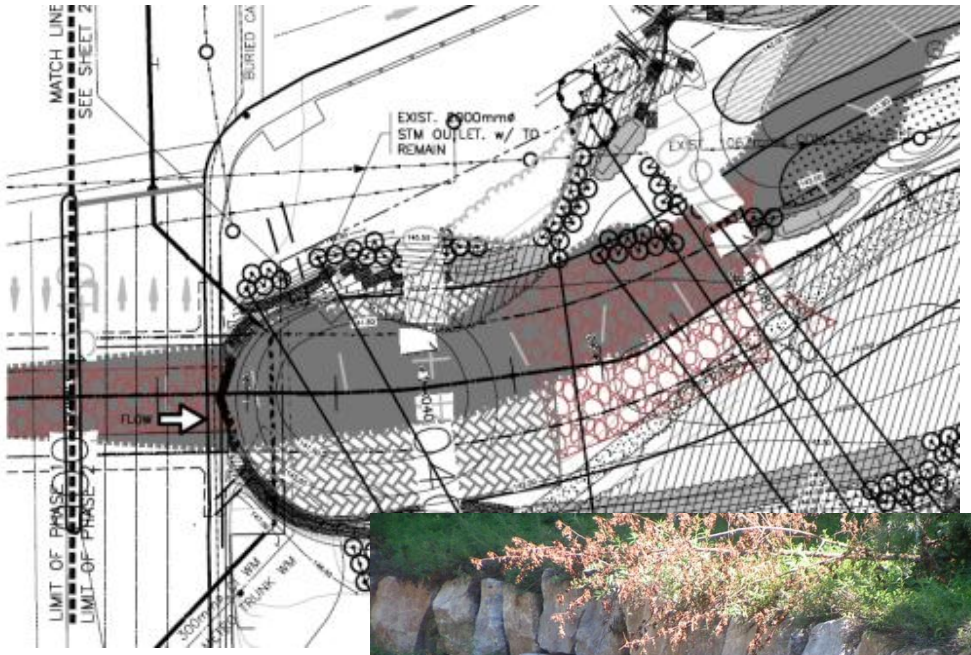
Infrastructure Protection

There is a need to repair, protect and enhance the installed systems

Stabilize valley slopes to retain building foundations and roadway platforms

Desire to reduce the frequency of enacting repairs on an ‘emergency basis’

Protect, or reduce the risk to damage downstream of site



Terrestrial Linkages

Forest cover in urban areas is at a premium

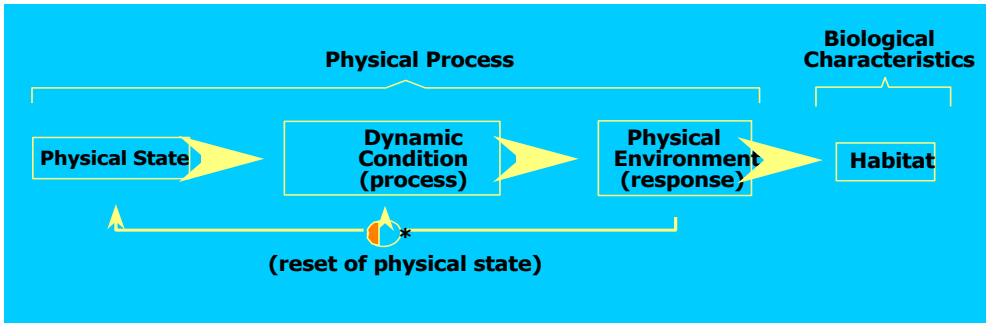
Loss of forest means loss of terrestrial linkages

Desire to reduce tree loss and connectivity platform

Concern over reduction in area in favour of creek habitat

Fisheries Resources – Fish Habitat

- Specifically watershed based climate change study completed suggests low peak storm events increasing in frequency (6mm to 10mm events)
- Fish inventories suggest fish are present, but monitoring shows spawning habitat is short lived
- Solution requires flow velocities to be halved (4.0m/s to 2.0 m/s max habitat threshold)
- Design channel cross section to convey large flow events, but maintain low flow channel
- Offset riffle crests to create local backwater

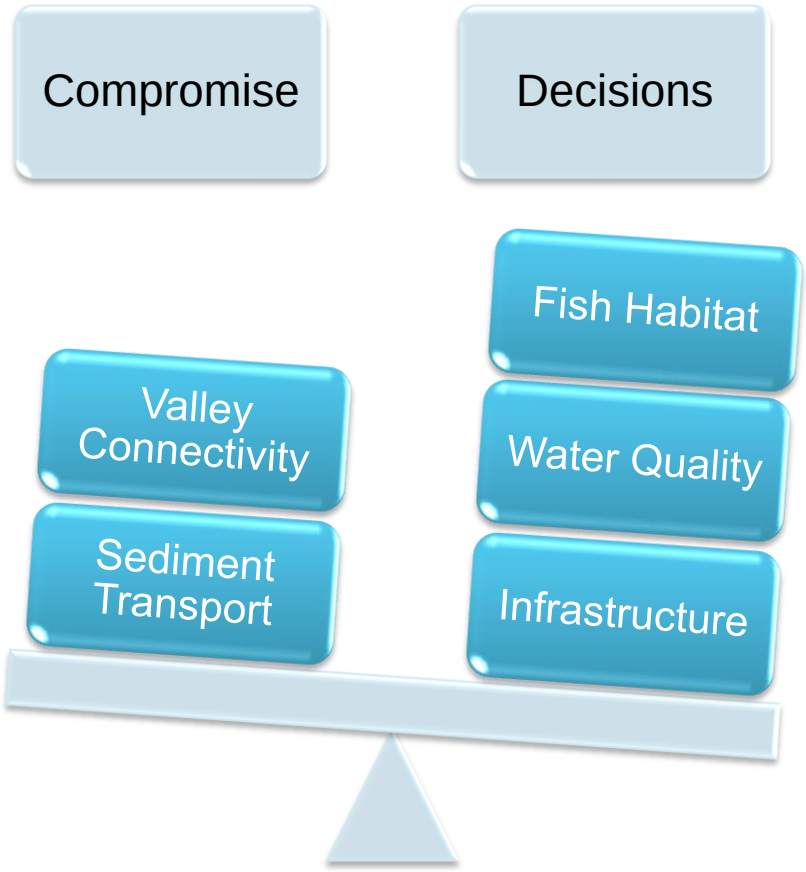


How to Converge (habitat needs, erosion, valley health)

- Spawning for species need froude of 1.0
- Reduction in velocity is necessary to provide the parameter for low peak events (shows in hydraulic model)
- Harden channel to protect infrastructure, but create enough backwater to allow passage and energy reduction – achieve sub-critical flow condition
- Create valley retaining structures to reduce forest loss in conjunction with channel section enlargement
- Create in-stream training structures to direct flow in new plan form
- Sediment regime difficult to replicate in hardened conditions, create off line pools to provide habitat diversity
- Ensure channel stability is achieved without reliance on sediment source

Philosophy – (intangible)

- Decisions, Politics and Compromise
- Weight of Fish Habitat vs. Terrestrial Habitat
- Infrastructure protection vs. sediment regime



Implementation and Monitoring

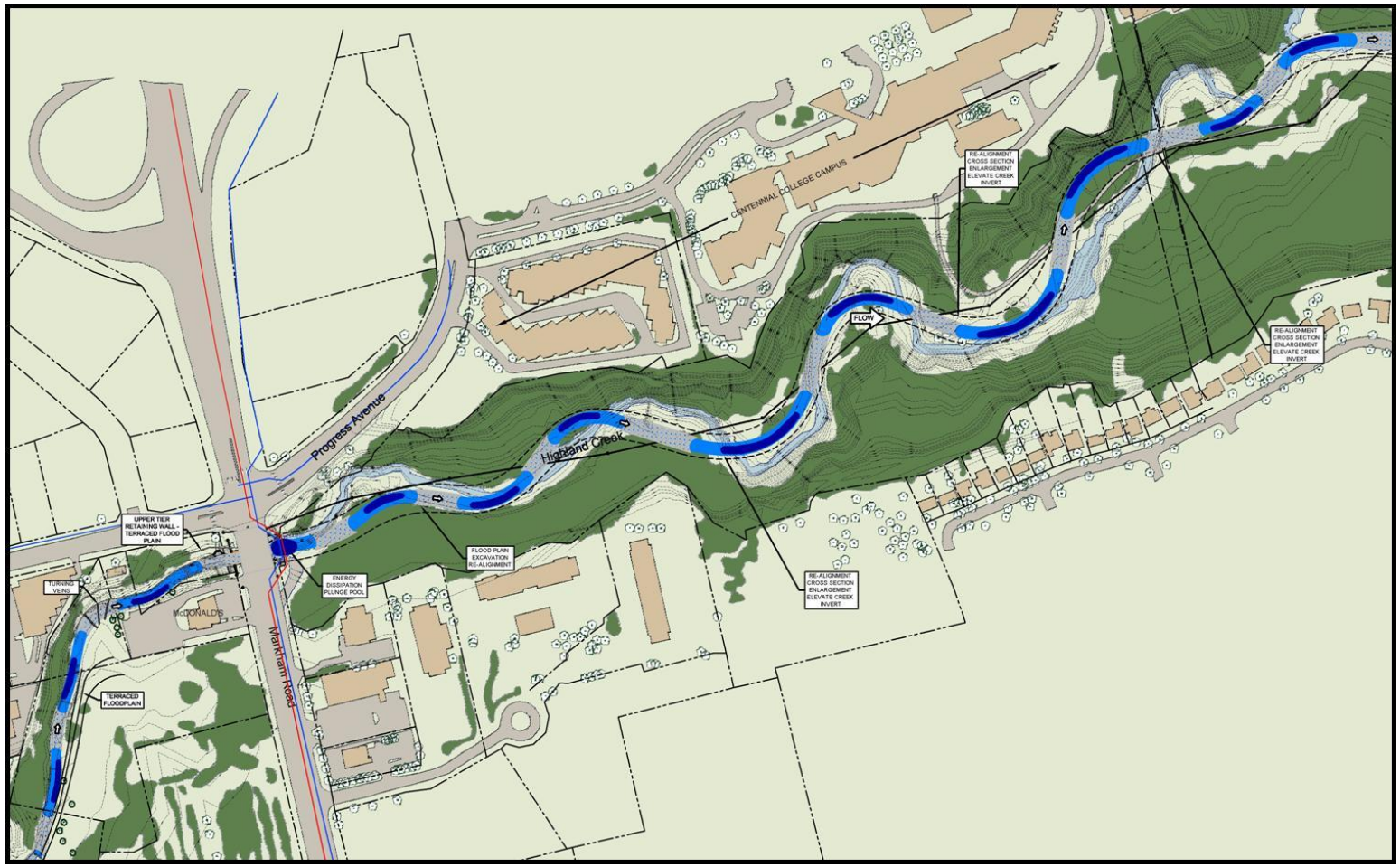
600m of rock weirs and vanes U/S,

1400m of riffles and pools D/S,

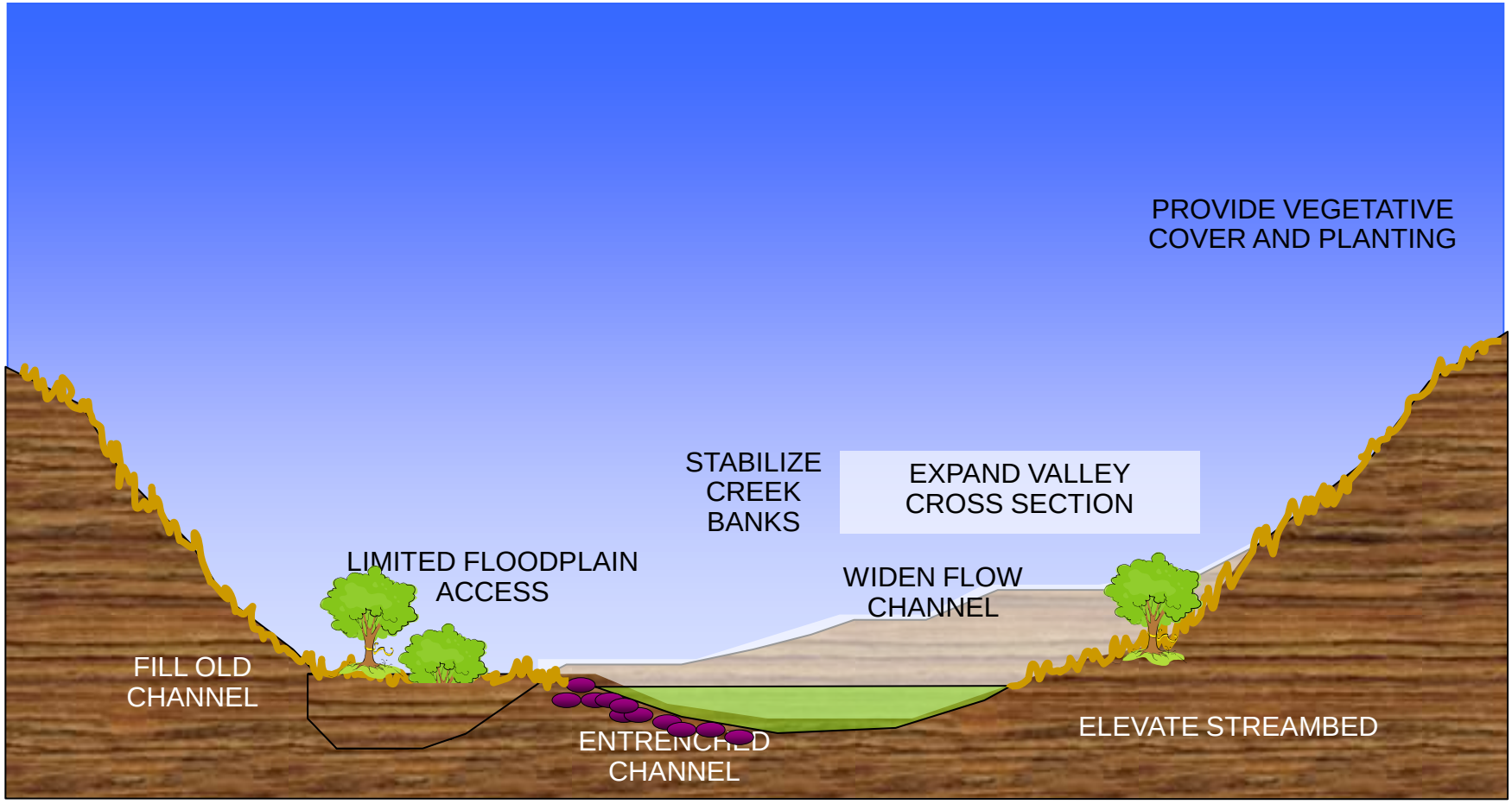
Reduced meander amplitude,

Widened channel section

Landscape Restoration



Reconstruction Concept



RE-ALIGNMENT CROSS SECTION

What did we learn

- That low peak events in an urban system can have dramatic impacts on habitat viability
- That flow velocities need to be reduced to sustain long term fishery resources
- That design redundancy can provide risk reduction, but at a high cost
- That decisions cannot be based on science alone
- That providing a Natural Channel in an urban setting is near impossible in the strict sense of the term, but providing one with ‘Natural Channel Design Principles’ is, and it can be made to co-exist with urban constraints.

Thank You