OUTCOME-BASED MANAGEMENT FOR SUSTAINABILITY

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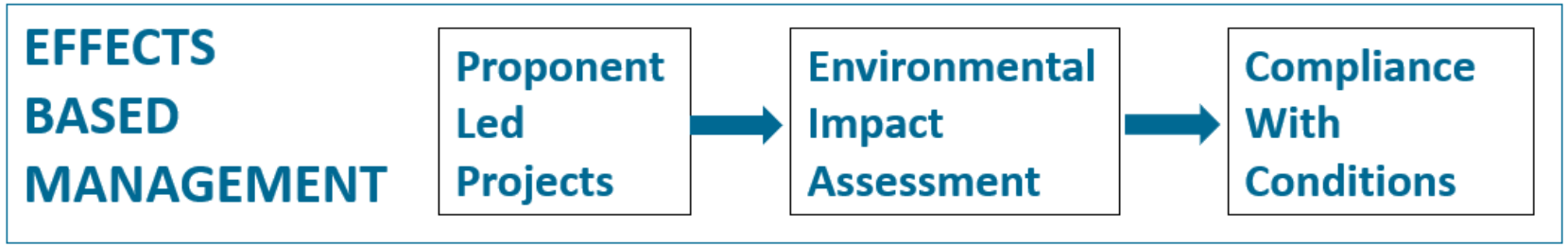
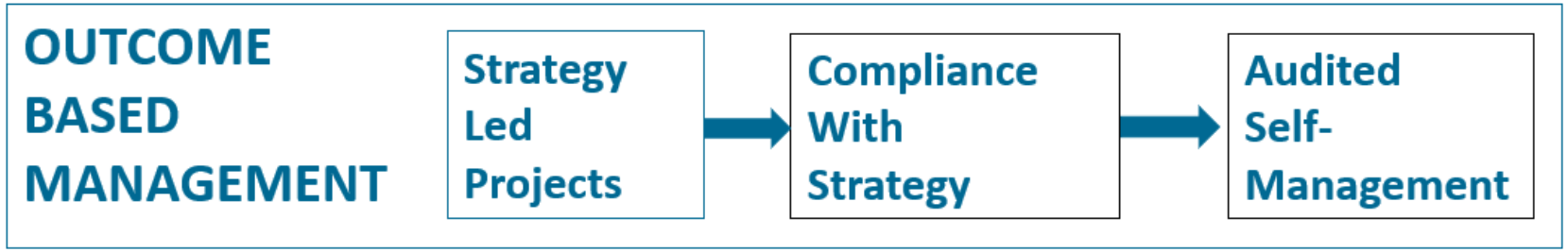
PROBLEM: Effects-based management is not delivering environmental outcomes

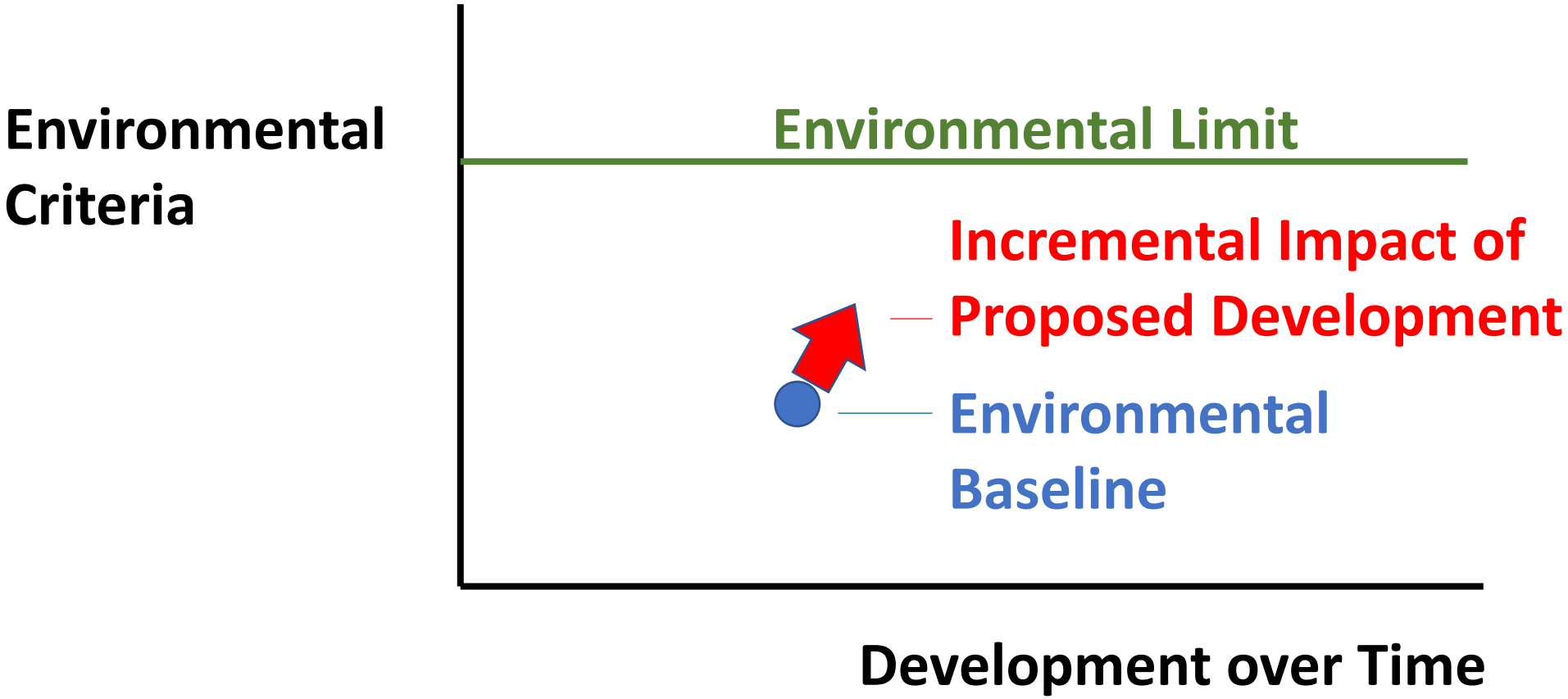




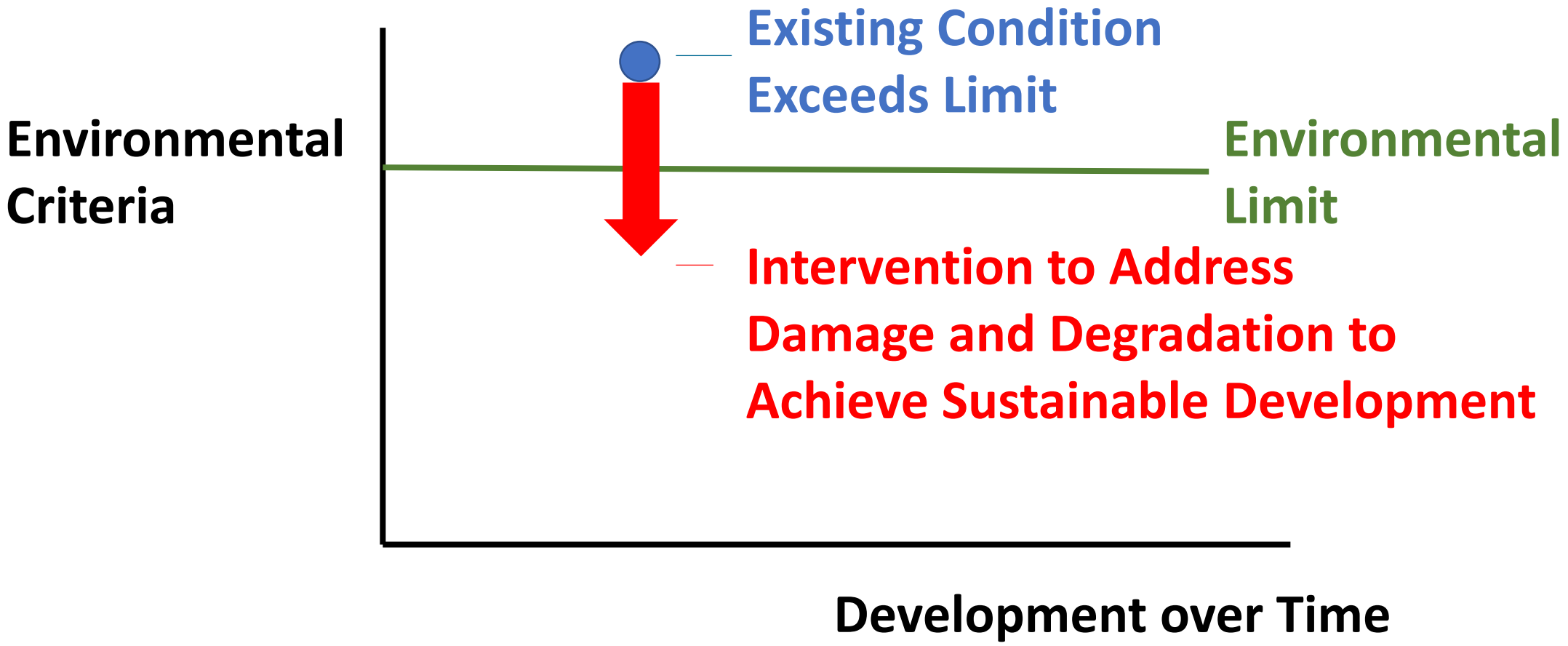
SOLUTION: Outcome-based management which needs a different approach

IAIA 2019 Conference, Brisbane, 29 April – 2 May 2019

IMPACT MANAGEMENT:
INCREMENTAL IMPACTS WITHIN ENVIRONMENTAL LIMITS



SUSTAINABILITY STRATEGY:
INTERVENTIONS WHEN ENVIRONMENTAL LIMITS EXCEEDED



SUSTAINABILITY STRATEGIES

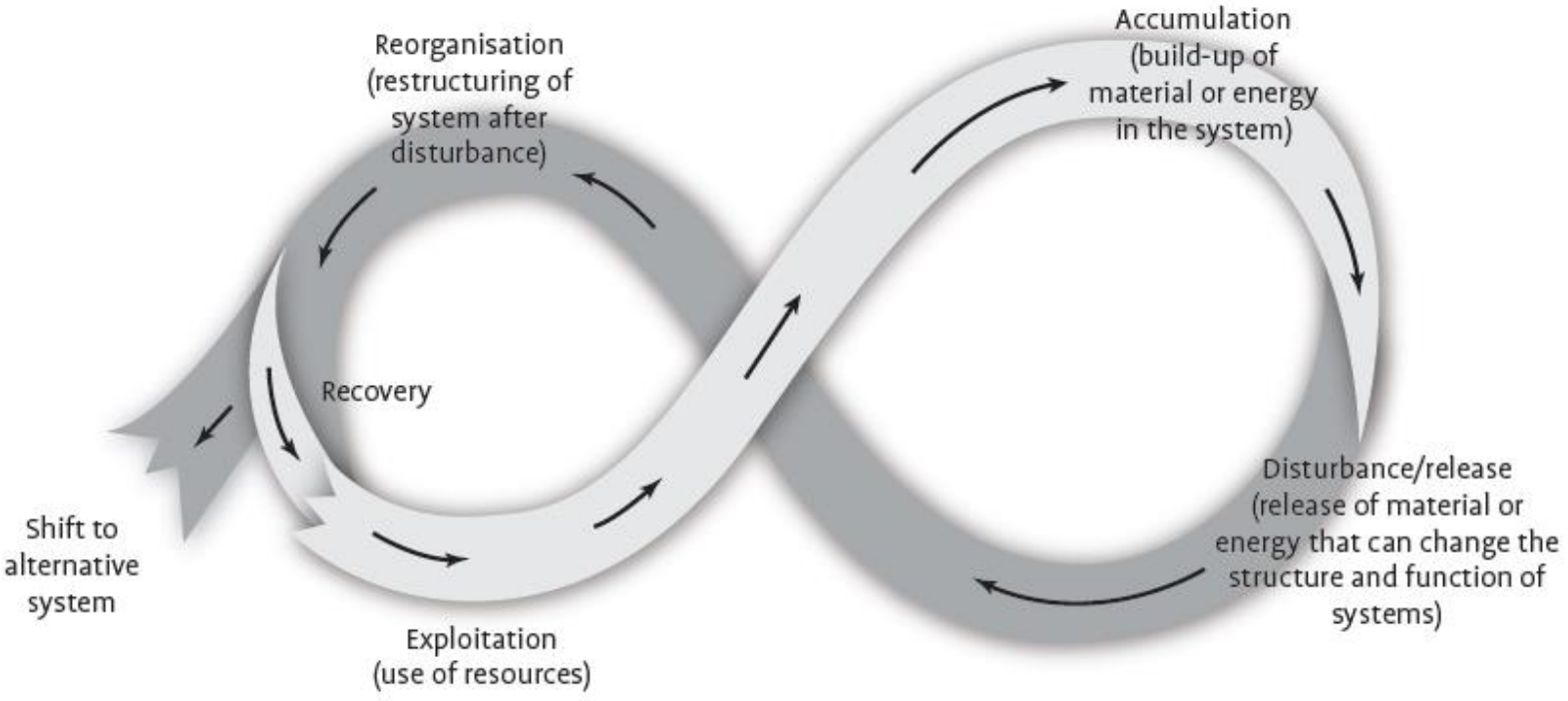
- Sustainability strategies need to address cumulative impacts of multiple users
- Complex systems analysis at bioregional scale in advance of further development
- Existing users are likely to have current environmental approvals
- Needs management of socio-economic system as well as biophysical system
- Needs willingness of existing users to change
- Needs a financial mechanism to implement
- Emphasis on incentives rather than regulation
- Allocation of allowable impact contributions to meet cumulative limits has equity considerations
- Nested system of monitoring and management of aggregate and individual impacts
- Existing and future development needs to be compatible with strategy

SYSTEMS APPROACH FOR SUSTAINABLE OUTCOMES

1. ***Adaptive Cycle***: system response to disturbance
2. ***Linked Biophysical and Socio-economic systems***
3. ***Nested Adaptive Systems***: different spatial and time scales with linkages
4. ***Failure Pathways***: processes that can lead to system collapse
5. ***Critical Variables*** on failure pathways and thresholds leading to collapse
6. ***Management Interventions*** to address failure pathways
7. ***Sustainability Strategy***: combination of interventions to achieve sustainable outcomes

ADAPTIVE CYCLE AND FAILURE PATHWAY ANALYSIS

- Interpret issues as adaptive cycles
- Identify critical variables for potential failure pathways and resilience thresholds



Adapted from Gunderson and Holling 2002

PHASES OF ADAPTIVE CYCLE

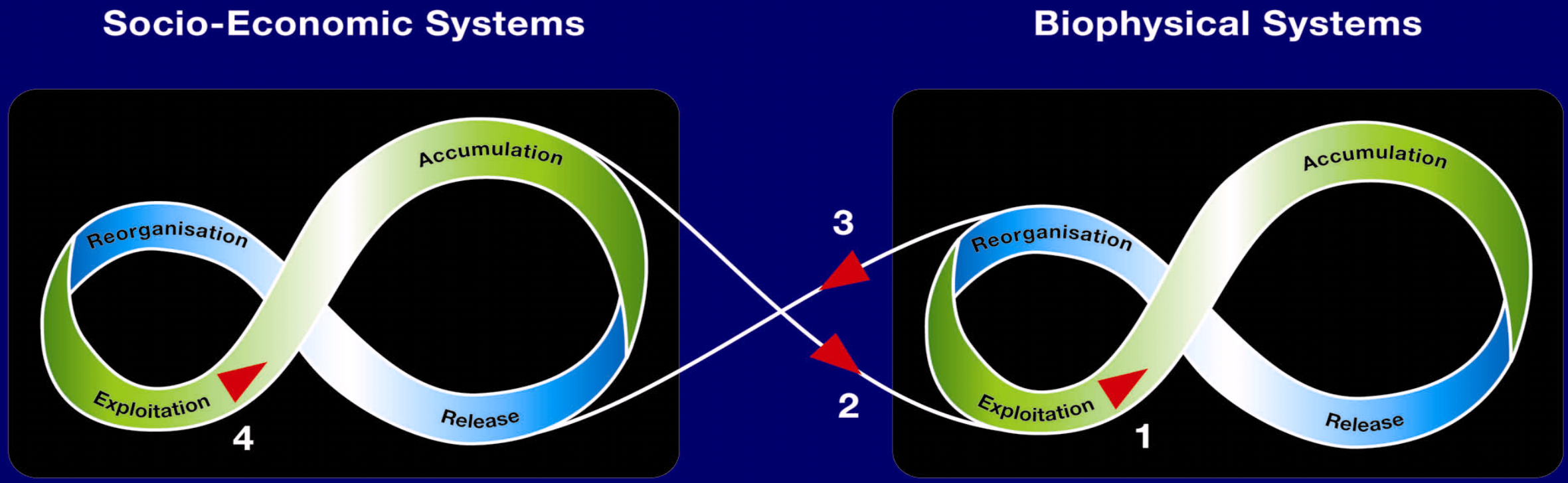
Exploitation
- Use of resources

Accumulation
- Build-up of material or energy

Disturbance
- Release that can change system

Reorganisation
- Recovery, or
- Shift to alternative system

TYPES OF SUSTAINABILITY ISSUES



1. Capacity of the Biophysical System to be maintained
2. Capacity of the linkages of the Socio-Economic System to the Biophysical System
3. Capacity of the linkages of the Biophysical System to the Socio-Economic System
4. Capacity of the Socio-Economic System to be maintained

NESTED SYSTEMS: ALGAL BLOOMS IN RIVERS

1 Catchment Exploitation
Nutrient intensive farming

2 Catchment Accumulation
Cumulative load of nutrient sources

3 Catchment Disturbance
Contamination of runoff and groundwater

4 Catchment Reorganisation
Nutrient attenuation

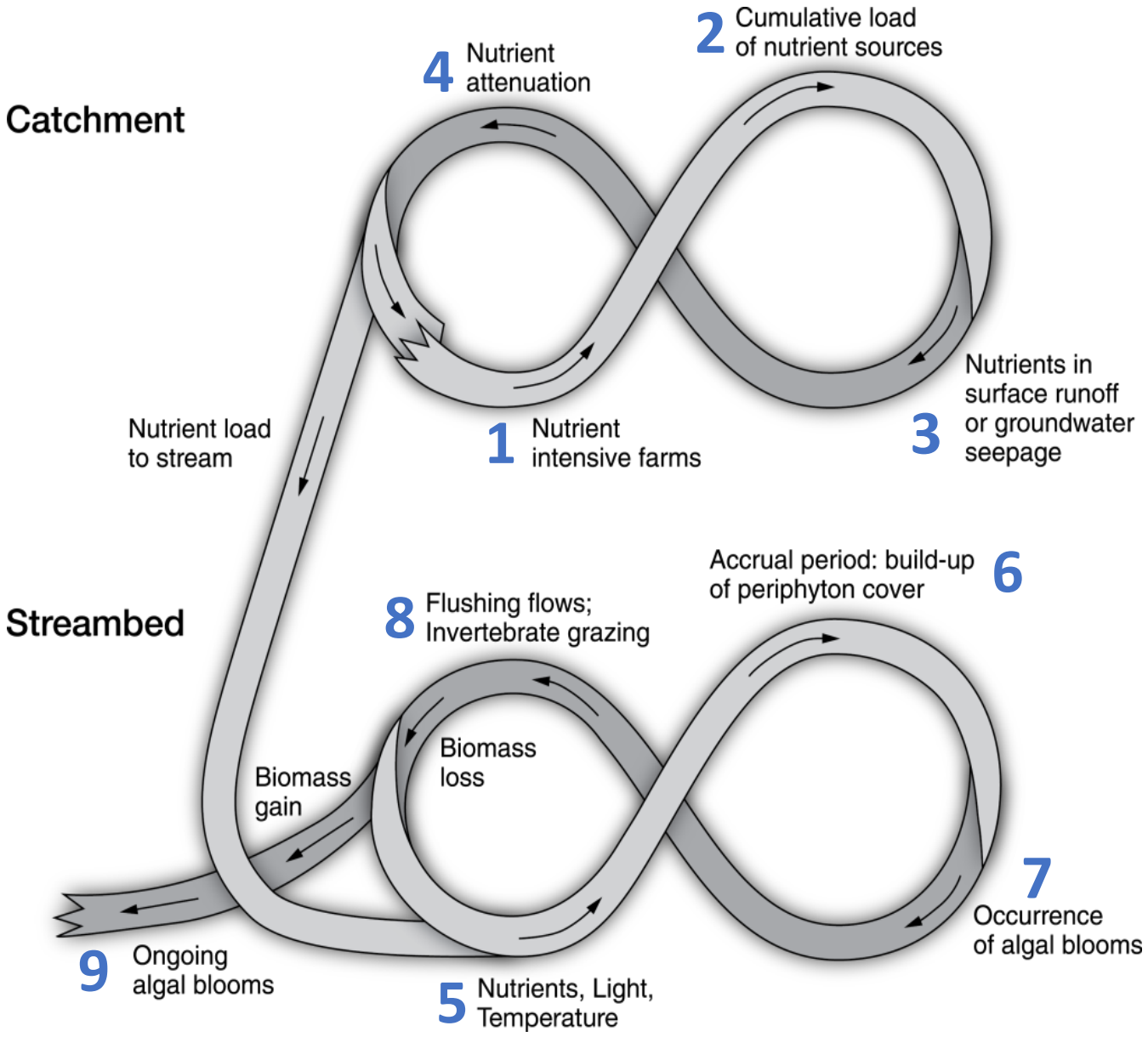
5 Streambed Exploitation
Nutrient contamination of river

6 Streambed Accumulation
Build-up of periphyton

7 Streambed Disturbance
Occurrence of algal blooms

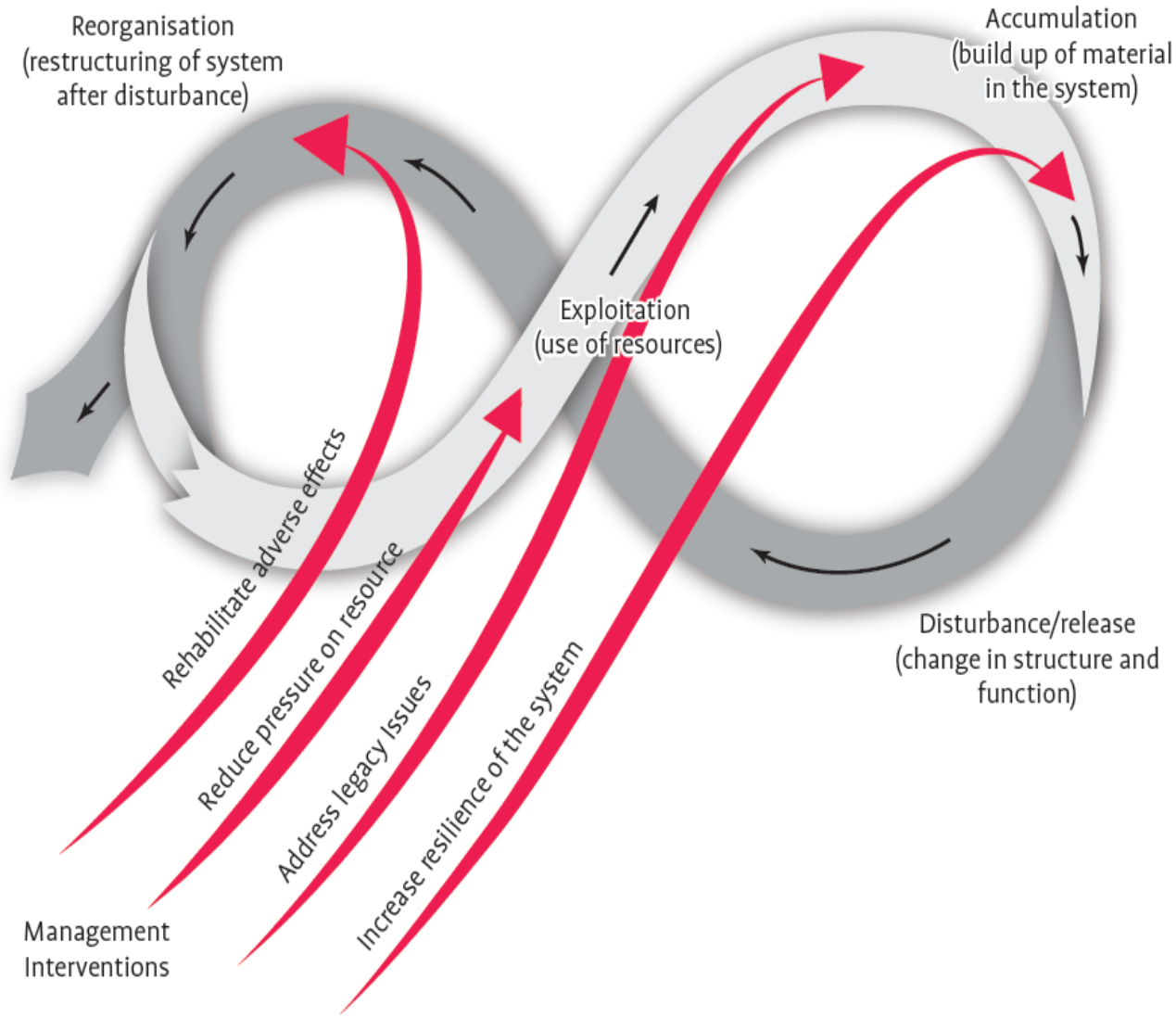
8 Streambed Reorganisation
Flushing flows; Invertebrate grazing

9 Shift to Alternative System
Ongoing algal blooms



MANAGEMENT INTERVENTIONS TO ADDRESS FAILURE PATHWAYS

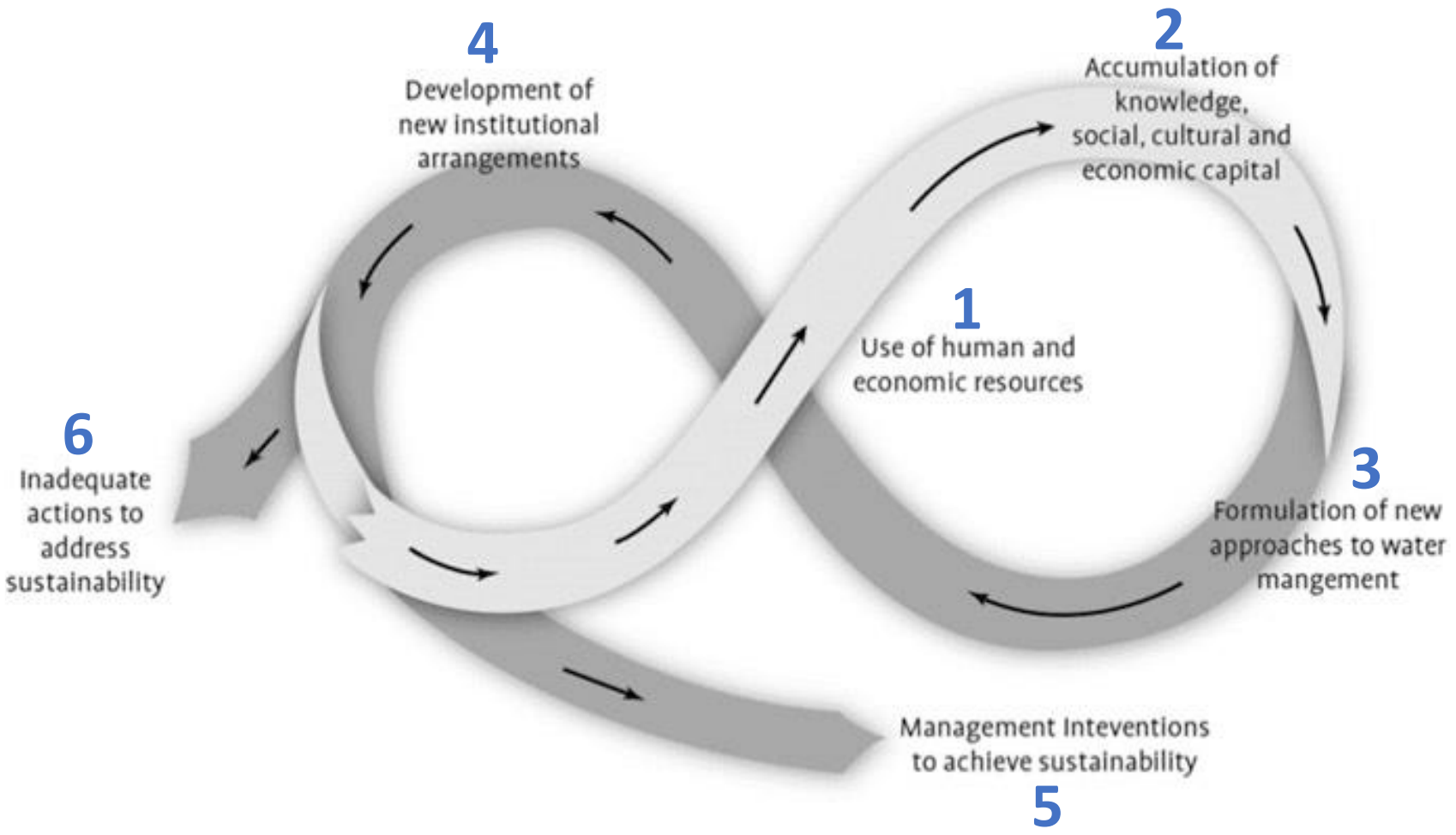
- Reduce pressure on resource
- Address legacy issues
- Increase resilience of the system
- Rehabilitate adverse effects



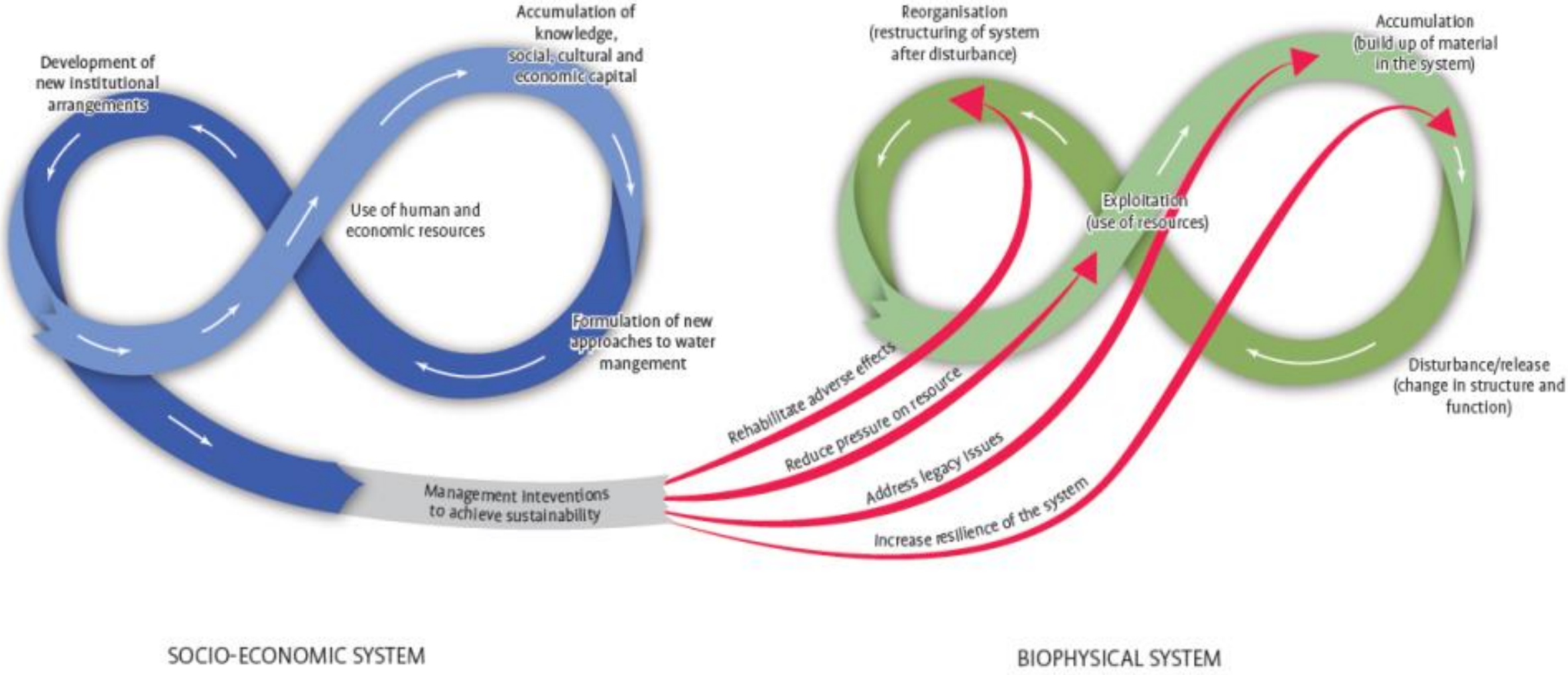
ADAPTIVE CYCLE PHASES	CRITICAL VARIABLES	MANAGEMENT INTERVENTIONS
Catchment Exploitation **Nutrient intensive farming**	**Nutrient loss rates**	**Improved farm management practices to reduce loss rates**
Catchment Accumulation **Cumulative load of nutrient sources**	**Catchment contaminant load**	**Catchment limit on contaminant load**
Catchment Disturbance **Contamination of runoff and groundwater**	**Nutrient concentration in surface runoff and groundwater seepage**	**Riparian planting** **Woodchip bioreactors**
Catchment Reorganisation **Nutrient attenuation**	**Nutrient attenuation factors**	**Constructed wetlands**
Streambed Exploitation **Nutrient contamination of river**	**Nutrient concentrations, temperature, light**	**Concentration limits for nutrients** **Shading of streambed**
Streambed Accumulation **Build-up of periphyton**	**Accrual period between flushing flows**	**Maintenance of freshes in environmental flow requirements**
Streambed Disturbance **Potential for algal blooms**	**Periphyton cover** **Chlorophyll a level**	**Public health warnings**
Streambed Reorganisation **Recovery from algal blooms**	**Flushing flows** **Invertebrate grazing**	**Sediment removal to increase invertebrate habitat**

INSTITUTIONAL ARRANGEMENTS FOR MANAGEMENT INTERVENTIONS

SOCIO-ECONOMIC PHASES
1 *Exploitation* **Use of human and economic resources**
2 *Accumulation* **Build -up of knowledge, social, cultural and economic capital**
3 *Disturbance* **Formulation of new approaches**
4 *Reorganisation* **Development of new institutional arrangements**
5 *Sustainability transformation* **Management interventions to achieve sustainability**
6 *Sustainability failure* **Inadequate actions to address sustainability**



FRAMEWORK FOR DEVELOPING SUSTAINABILITY STRATEGIES



STRATEGY FOR PAHAU CATCHMENT

Hurunui Catchment Analysis

- Pahau tributary greatest nutrient contributor

Outcome Sought

- Reduction in nutrient load

Actions

- Stock access control and land use improvements by farmers
- Riparian planting by river reach groups
- Irrigation management by irrigation company

Regional Council Actions

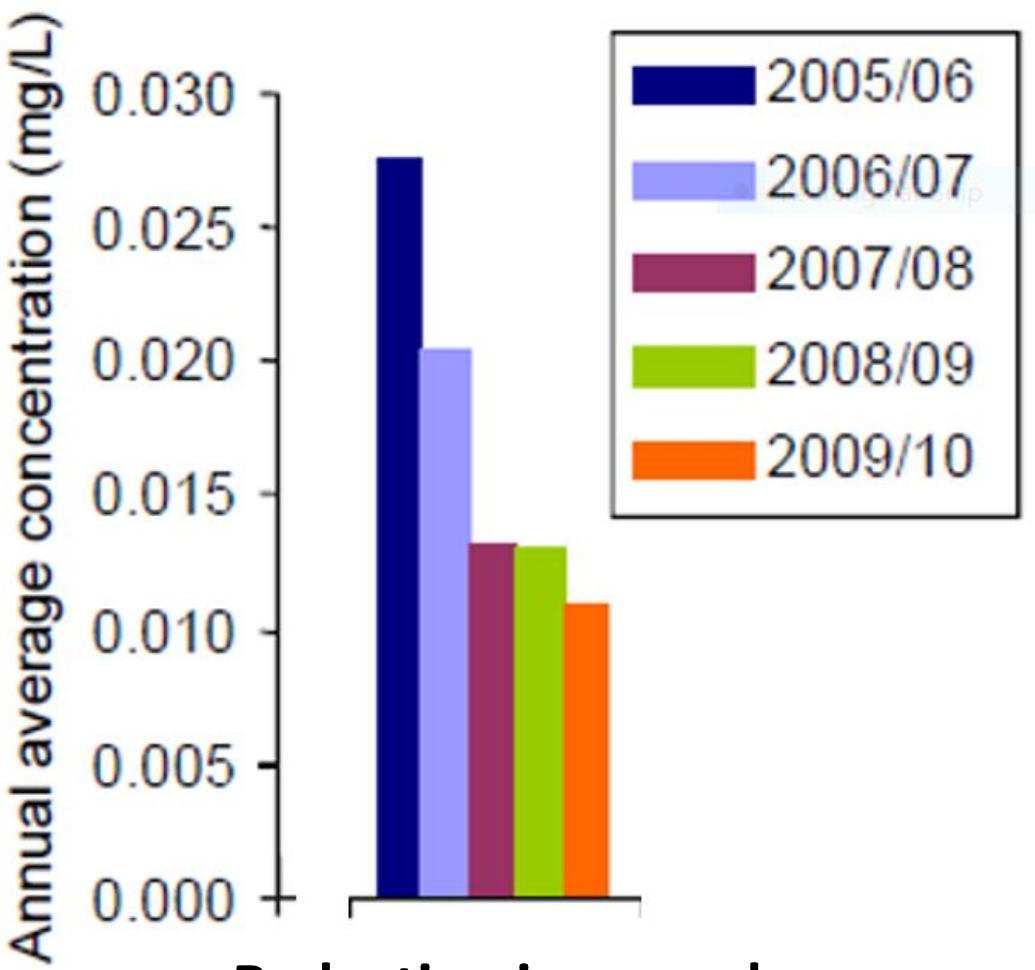
- Facilitation and extension advice
- Water quality monitoring

Institutional Arrangements

- Community/government partnership

Financing

- Voluntary actions by farmers



Reduction in annual average phosphorus concentration in the Pahau River

STRATEGY FOR CHRISTCHURCH AIRSHED

Christchurch Airshed Analysis

- Particulates from wood-burners 90% of peak concentrations during inversions

Outcome Sought

- Particulates meet Air Quality Standard

Actions

- Replace wood-burners with heat pumps

Regional Council Actions

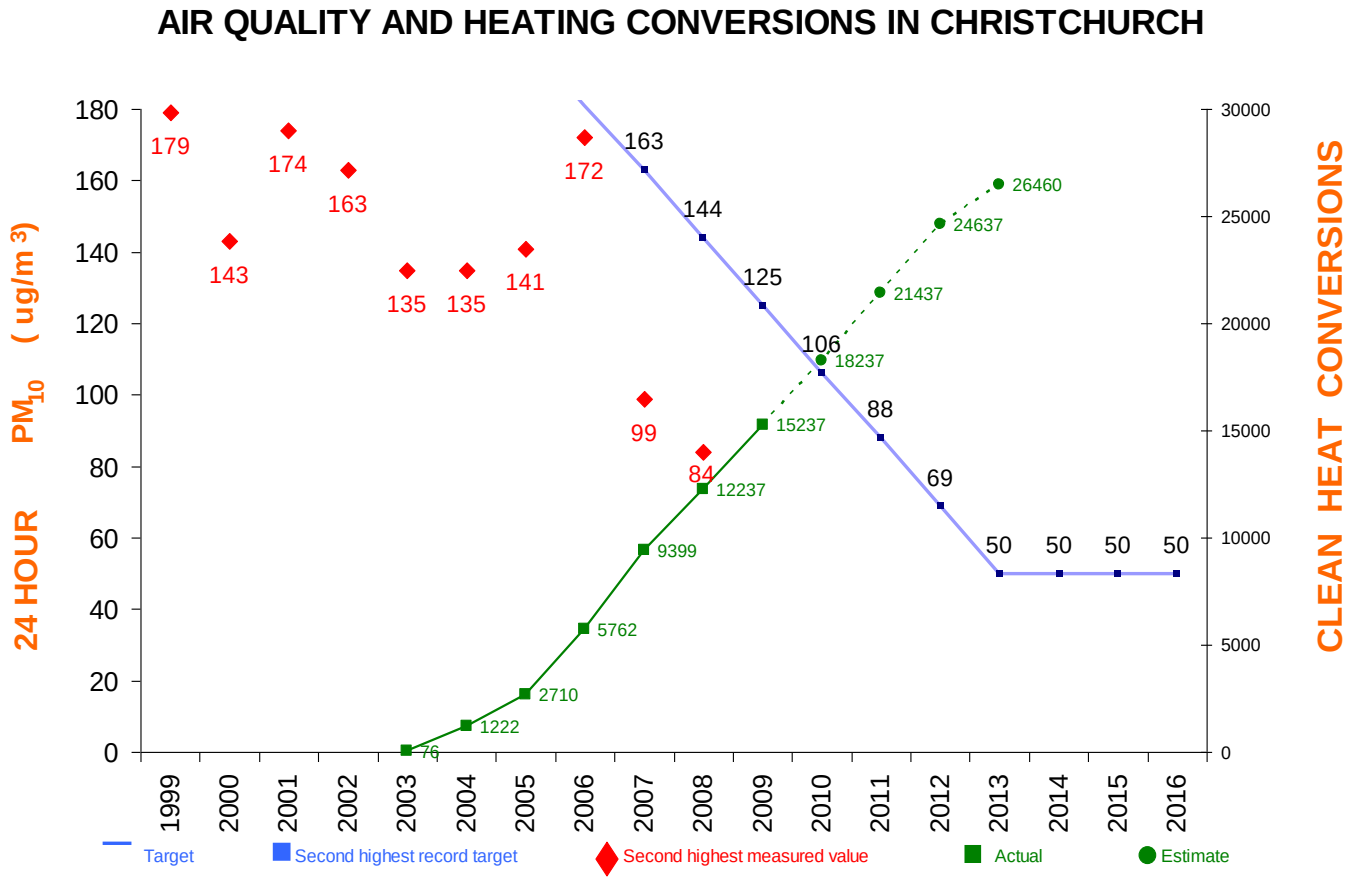
- Subsidy for heat pump installation
- Regulation for wood-burners
- Project management service

Institutional Arrangements

- "Clean Heat" group of inspectors and project managers

Funding Mechanism

- Beneficiary contribution by targeted rate



REVOLUTION NOT EVOLUTION

Outcome Based Management	Effects Based management
Sustainability Strategies based on Nested Adaptive Systems	Projects and Programs with Impact Assessment
Strategy-led Development	Proponent-led Development
Systems Analysis of Failure Pathways and Management Interventions	Impact Analysis of Effects of Actions
Focus on Outcomes	Focus on Effects
Consideration of All Users	Focus on New Actions
Focus on Incentives	Focus on Regulation
Monitoring and Management of Aggregate and Individual Outcomes	Compliance with Conditions of Approval
Redesign Institutional Arrangements	Reliance on Existing Institutional Arrangements
Need Financial Mechanism for Implementation	Proponent Bears Cost of Implementation