An Introduction to Strategically Planning and Assessing Stormwater Programs

CASQA Webinar
June 22, 2015

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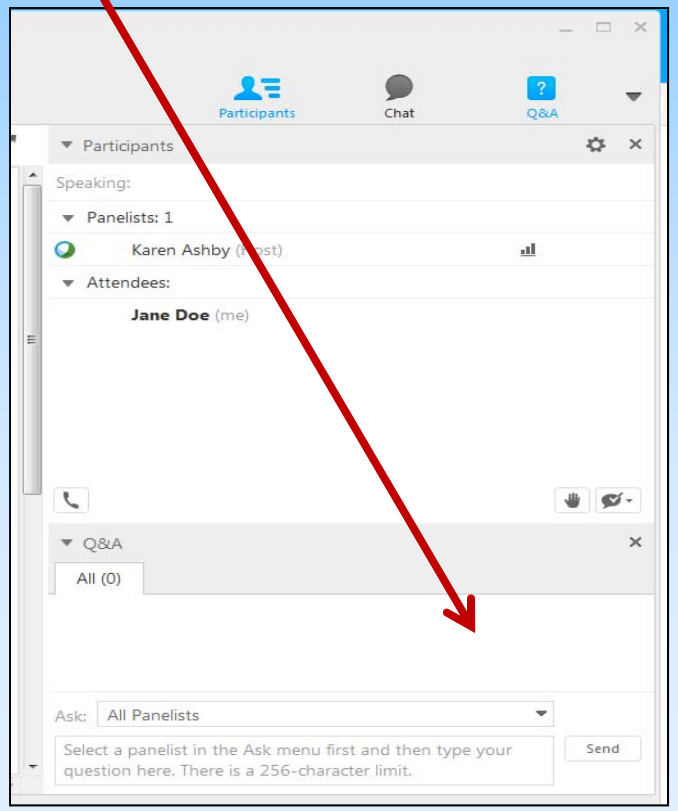
Instructions for Today

- Participants will be muted
- Asking questions – send via chat

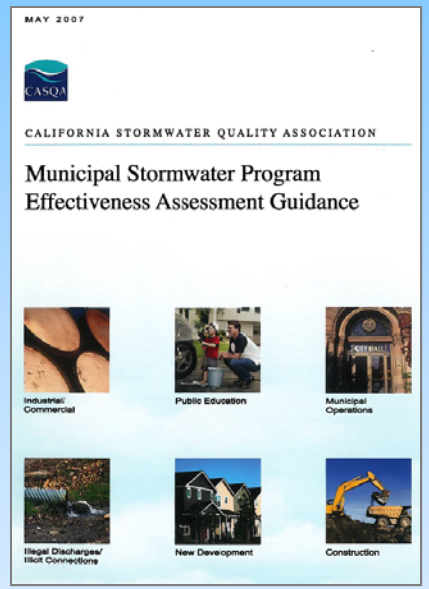


Topics

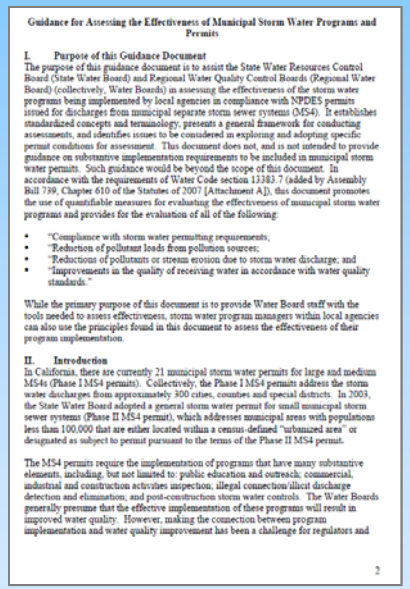
- Background
- Key Concepts
- Introduction to Outcome Types
- Introduction to Strategic Planning for Stormwater Programs
- Case Studies

Background

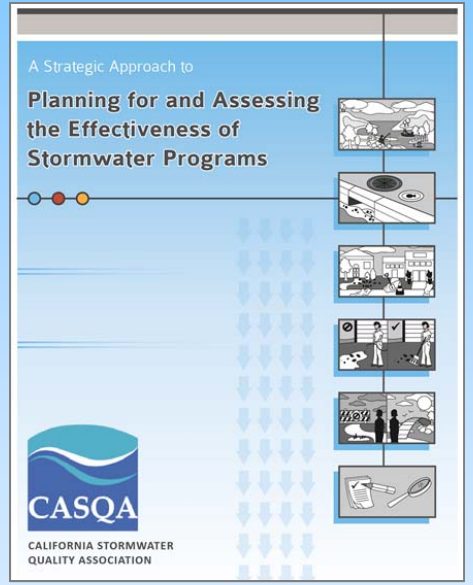
A Brief History of Recent Effectiveness Assessment Work



CASQA (2007)



SWRCB (2011)



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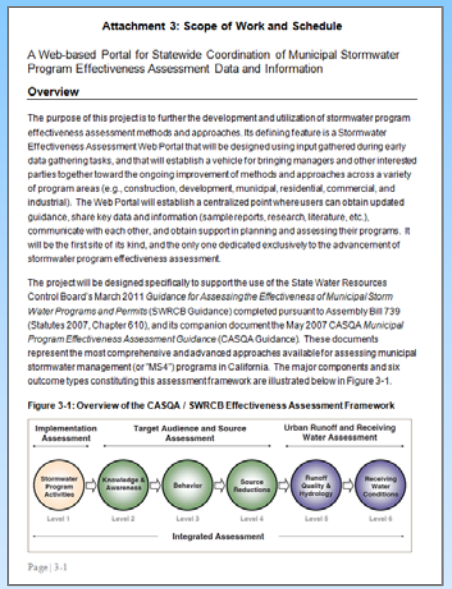
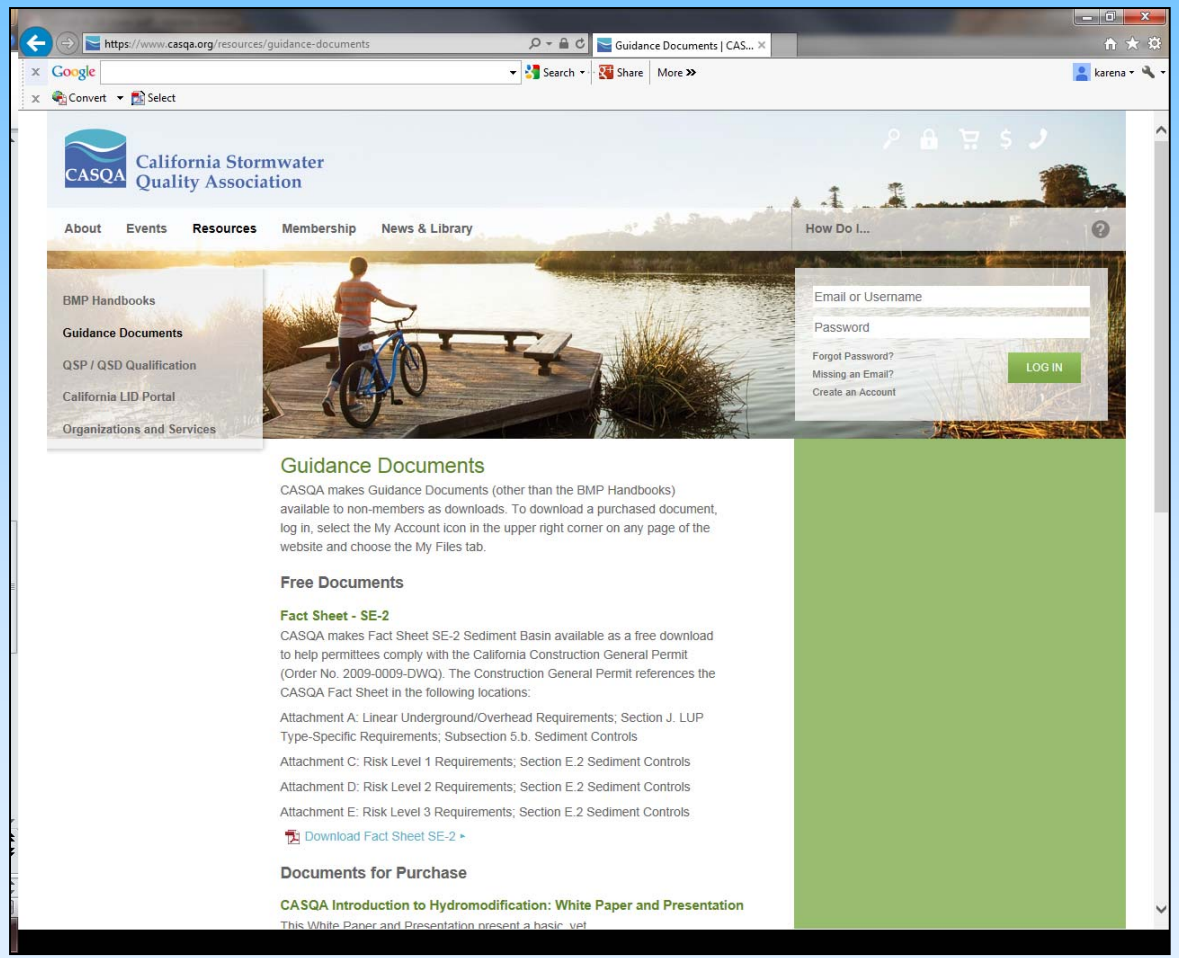


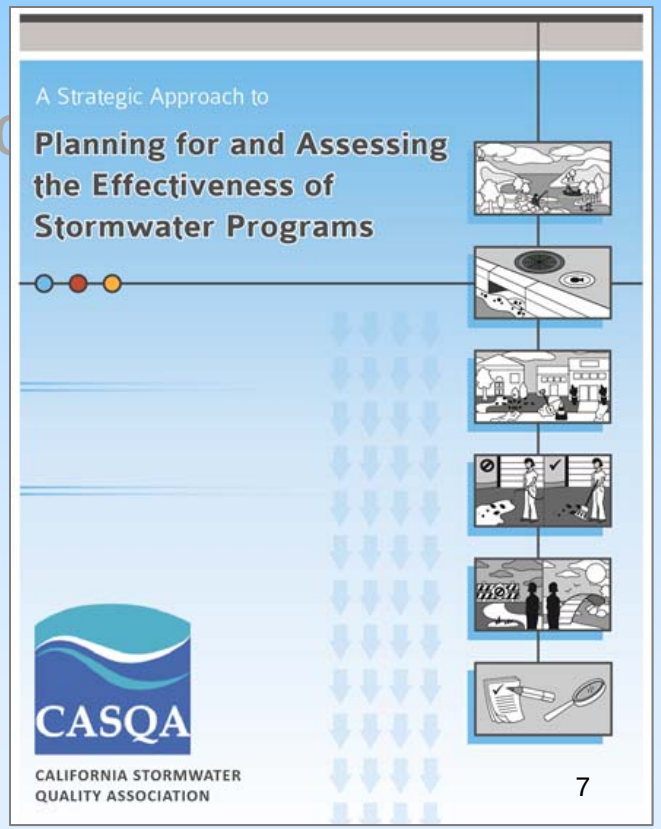
Prop 84 Grant (2012-15)

https://www.casqa.org/effectiveness_assessment



Proposition 84 – Web Portal Project

- Task 3 - CASQA Guidance Manual Update
- Task 4 - Assessment of Existing Practices and User Needs
- Task 5 - Education and Outreac
- Task 6 - Project Evaluation



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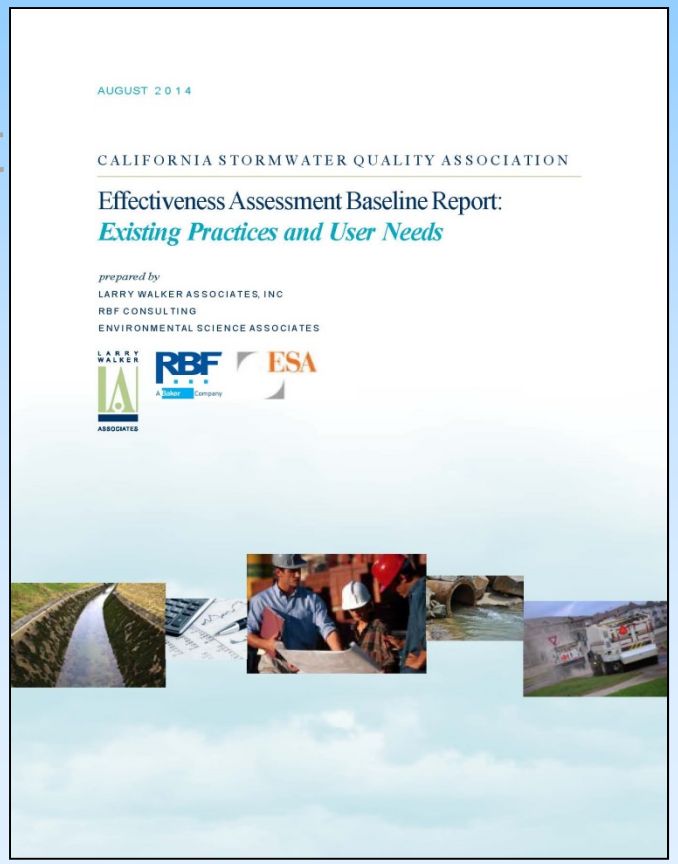

Proposition 84 – Web Portal Project

- Task 3 - CASQA Guidance Manual Update
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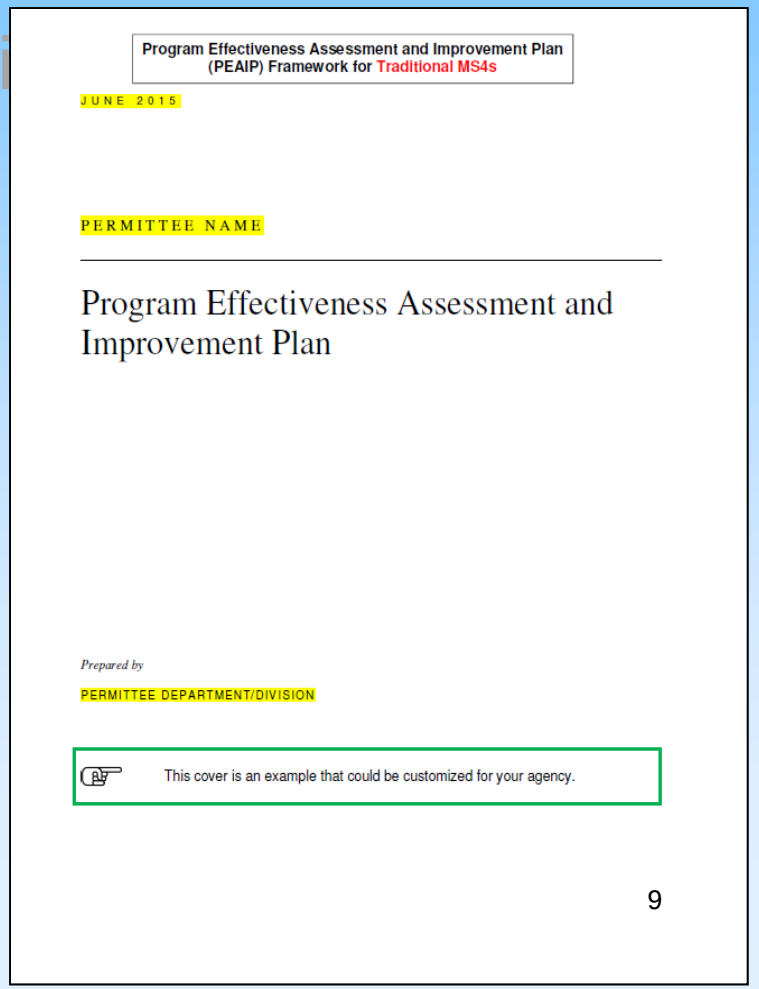
- Task 6 - Project Evaluation



Program Effectiveness Assessment and Improvement Plan (PEAIP) Framework for Traditional MS4s

JUNE 2015

PERMITTEE NAME

Program Effectiveness Assessment and Improvement Plan

Prepared by

PERMITTEE DEPARTMENT/DIVISION

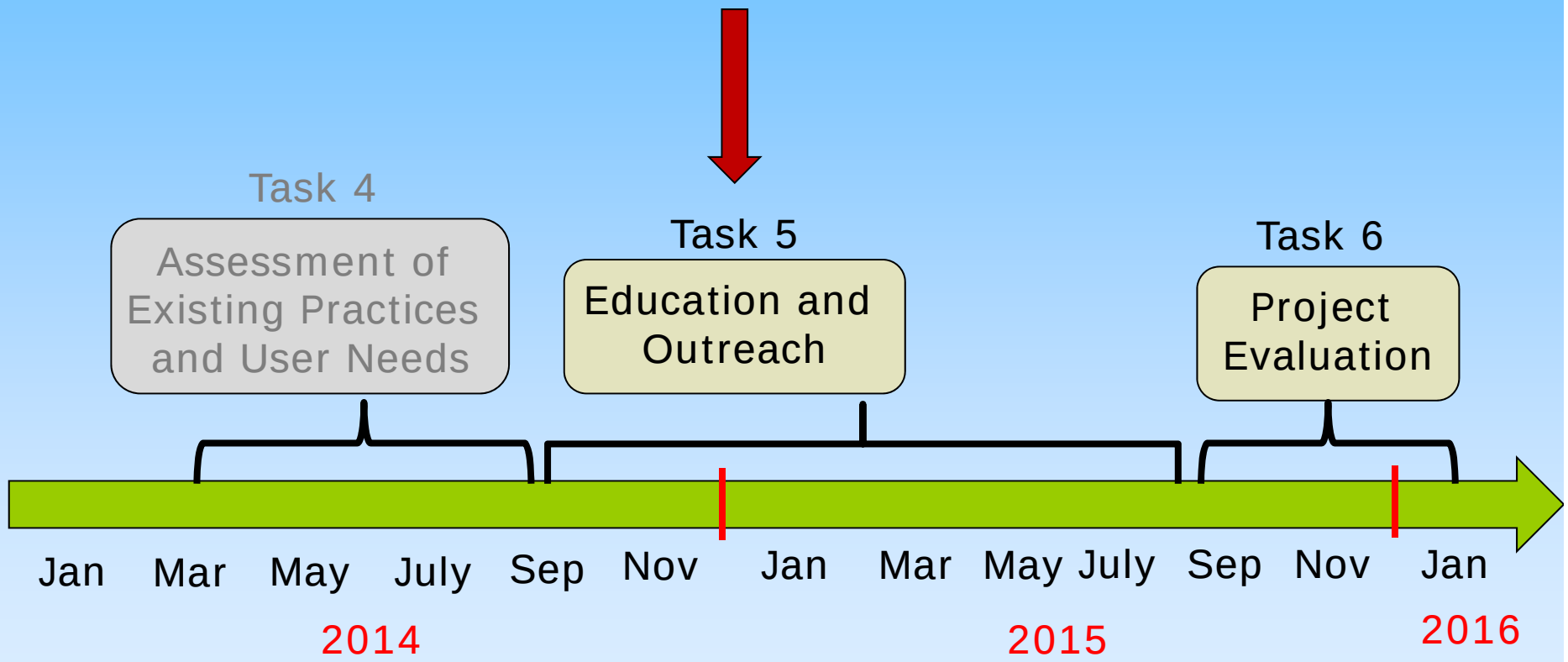
This cover is an example that could be customized for your agency.

9

Proposition 84 – Web Portal Project

- Task 3 - CASQA Guidance Manual Update
- Task 4 - Assessment of Existing Practices and User Needs
- Task 5 - Education and Outreach
- Task 6 - Project Evaluation

Next Steps


Task 4
Assessment of Existing Practices and User Needs
Task 5
Education and Outreach
Task 6
Project Evaluation
Jan
Mar
May
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2014
2015
2016

Questions?

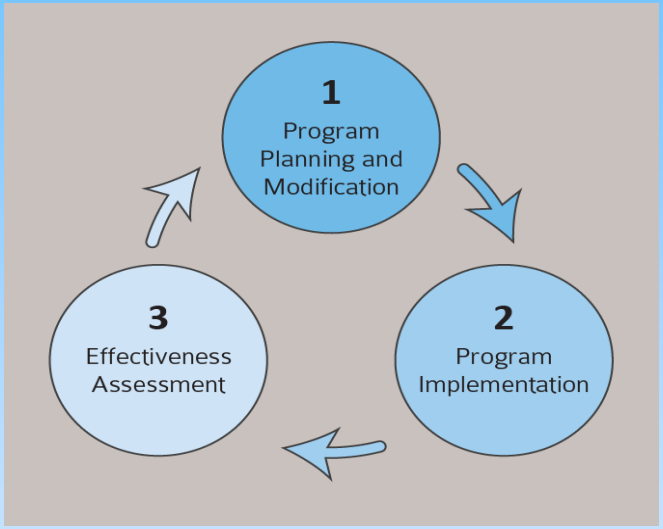
Key Concepts

Effectiveness assessment consists of the methods and activities that managers use to evaluate how well their programs are working and to identify modifications necessary to improve results.

A Strategic Approach to Planning and Assessing Municipal Stormwater Management Programs

Table of Contents

The Relationship of Planning and Assessment

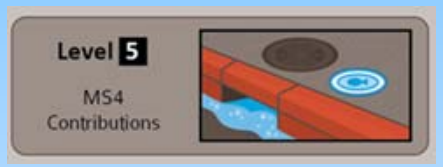


- Planning provides a road map for assessment
- Assessing “after-the-fact” limits managers’ ability to evaluate
- Assessment measures and methods should be identified during planning
- Programs that “plan to assess” increase measurability and effectiveness

Outcomes are measurable endpoints associated with programs, people, and physical systems.

Physical Systems

Receiving Water Conditions

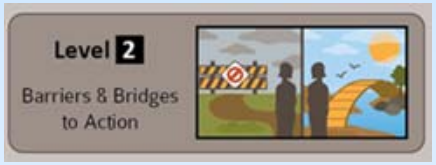


MS4 Conditions

Source Contributions

People

Target Audience Actions

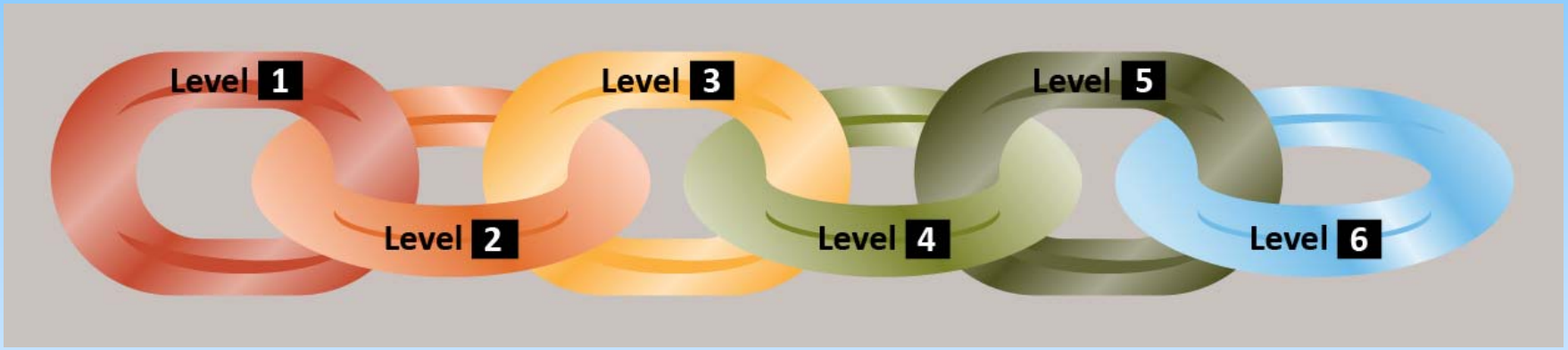


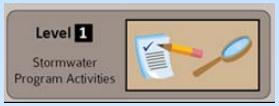
Barriers & Bridges to Action

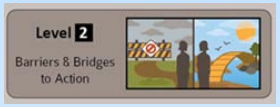
Programs

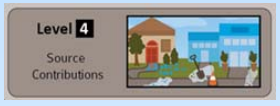
Stormwater Program Activities

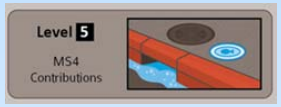
Outcomes are Interrelated



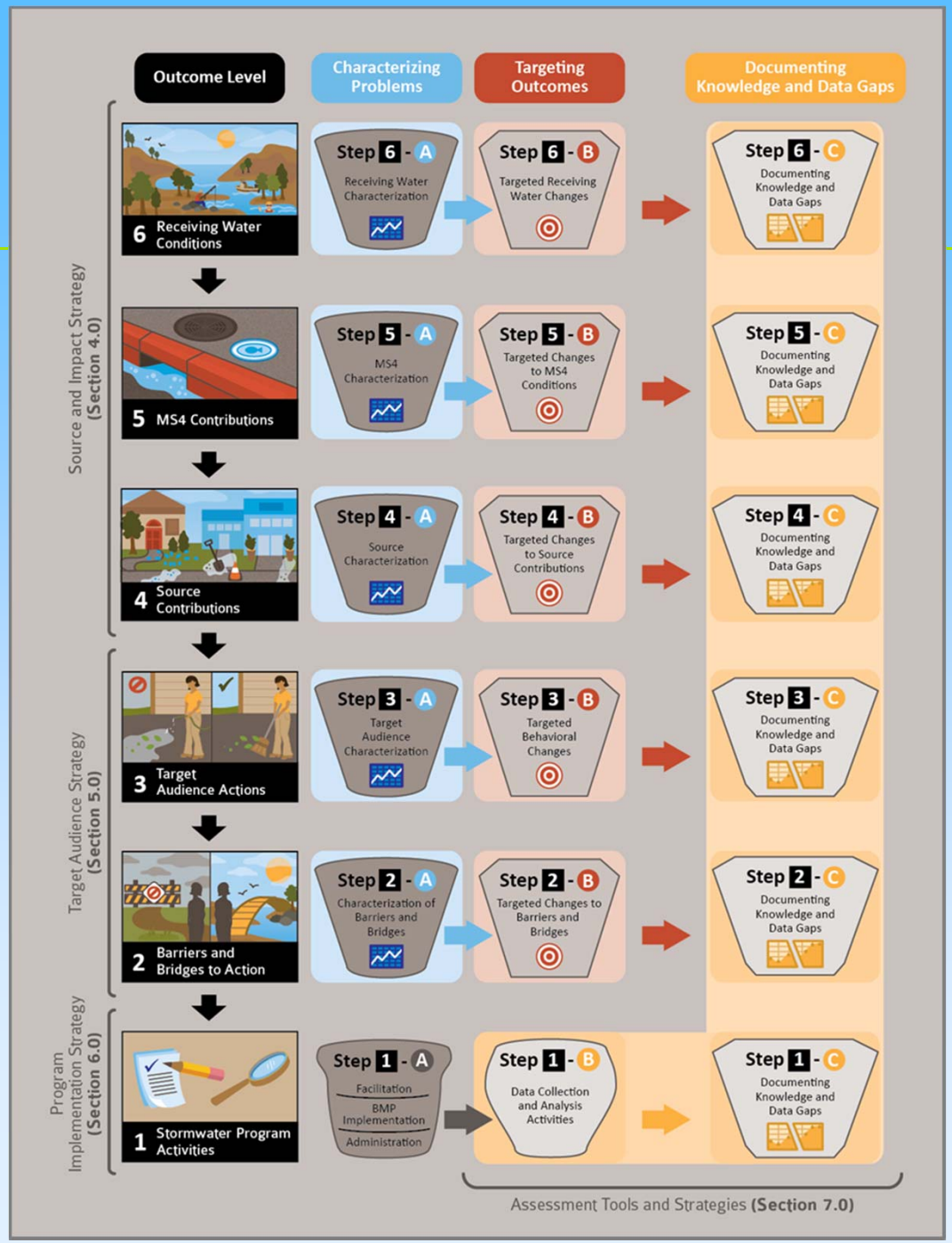








Core Steps in a Structured Planning Process


Outcome Level
Characterizing Problems
Targeting Outcomes
Documenting Knowledge and Data Gaps
Source and Impact Strategy (Section 4.0)
Target Audience Strategy (Section 5.0)
Program Implementation Strategy (Section 6.0)
6 Receiving Water Conditions
Step 6 - A Receiving Water Characterization
Step 6 - B Targeted Receiving Water Changes
Step 6 - C Documenting Knowledge and Data Gaps
5 MS4 Contributions
Step 5 - A MS4 Characterization
Step 5 - B Targeted Changes to MS4 Conditions
Step 5 - C Documenting Knowledge and Data Gaps
4 Source Contributions
Step 4 - A Source Characterization
Step 4 - B Targeted Changes to Source Contributions
Step 4 - C Documenting Knowledge and Data Gaps
3 Target Audience Actions
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Step 3 - B Targeted Behavioral Changes
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Step 2 - A Characterization of Barriers and Bridges
Step 2 - B Targeted Changes to Barriers and Bridges
Step 2 - C Documenting Knowledge and Data Gaps
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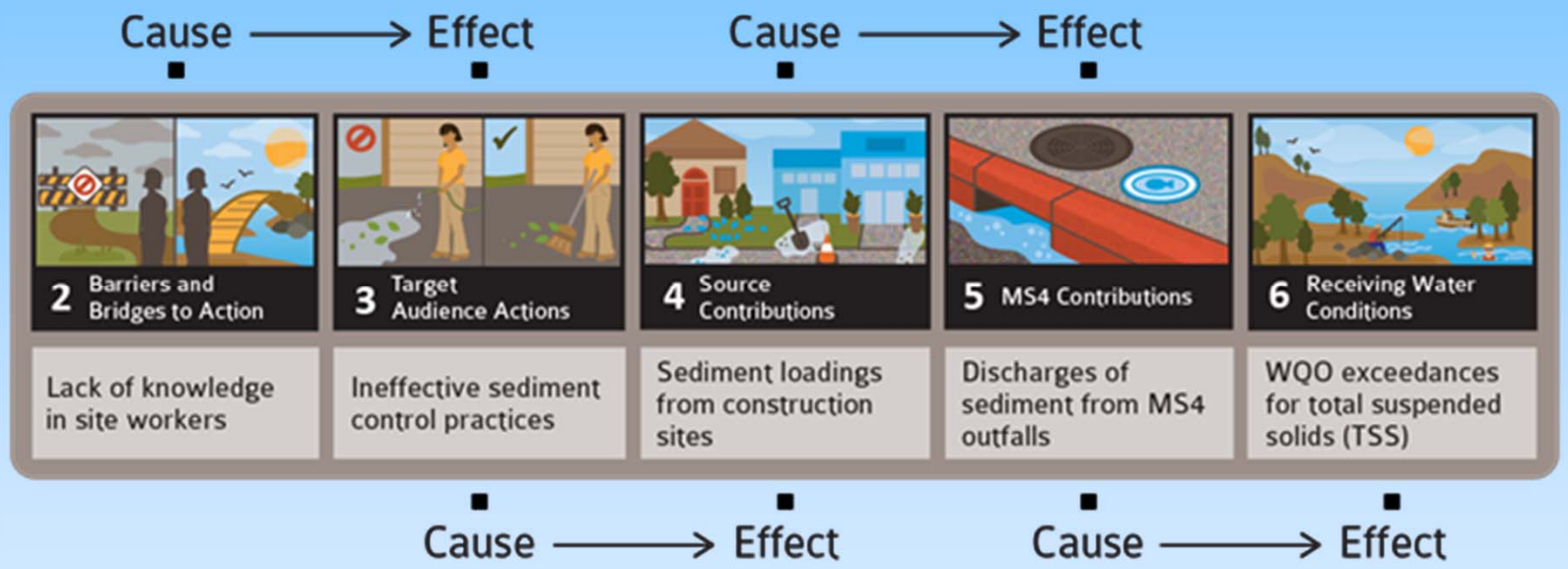
Step 1 - A Facilitation BMP Implementation Administration
Step 1 - B Data Collection and Analysis Activities
Step 1 - C Documenting Knowledge and Data Gaps
Assessment Tools and Strategies (Section 7.0)

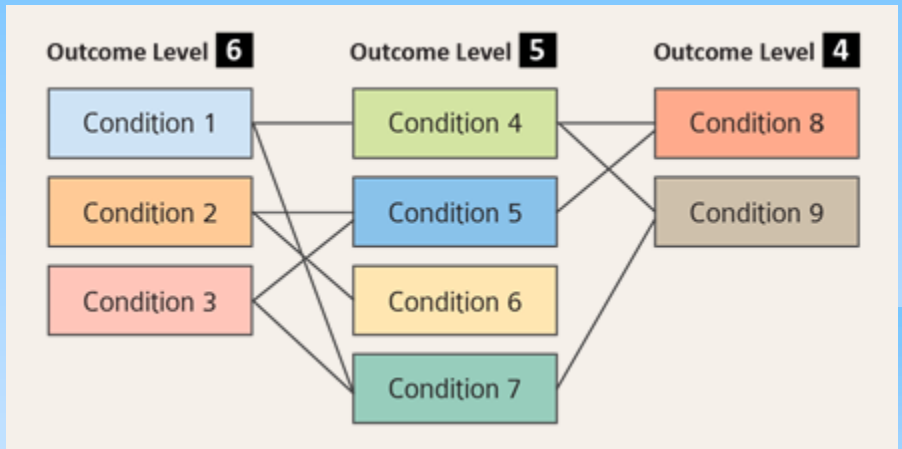
Key Concept 2

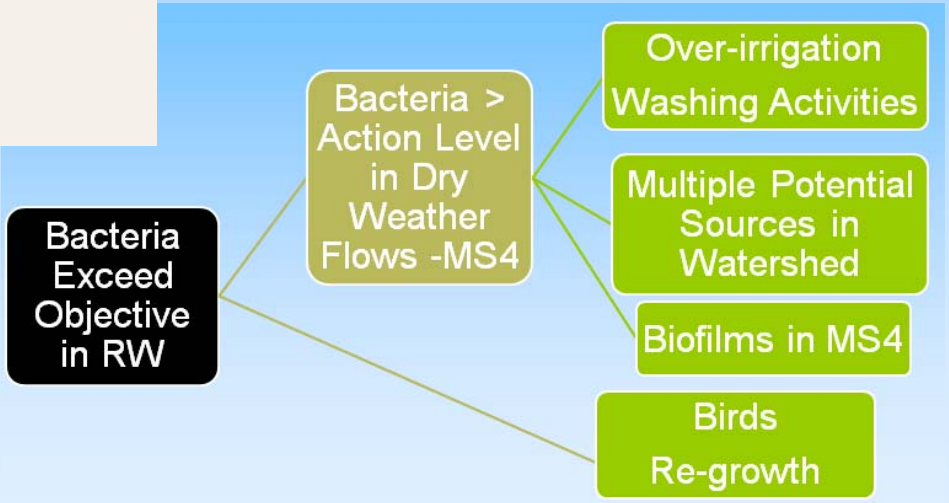
Problem conditions are "causally" linked



Key Concept 3

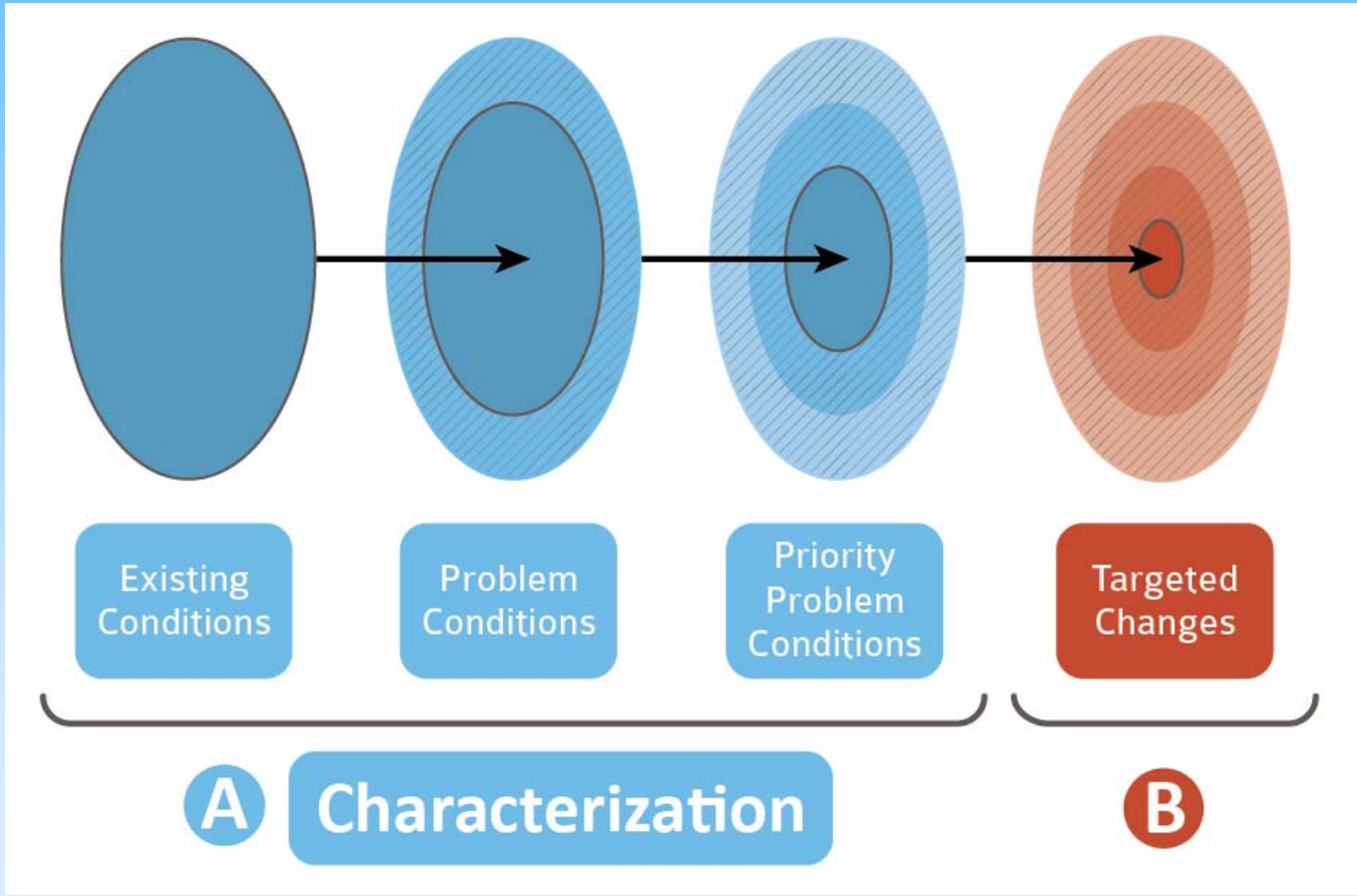
Relationships between conditions resemble webs more than chains





Key Concept 1

Prioritization is Essential to Strategic Planning



Key Concept 4

Linkages and Relationships exist in different stages of certainty

Problem 1	Hypothesis -- Co-occurrence -- Correlation -- Causation	Problem 2
"cause"	➔ Increasing strength of relationship ➔	"effect"

Questions?

Introduction to Outcome Types

Three Planning and Assessment Elements

First Element

Sources and Impacts

(Section 4.0)

Second Element

Target Audiences

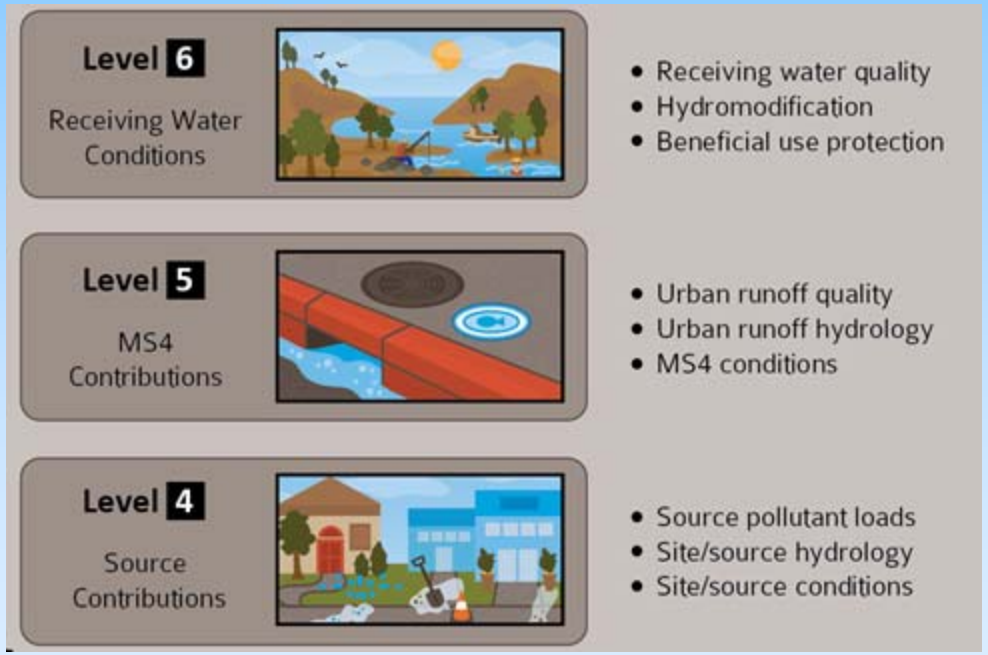
(Section 5.0)

Third Element

Stormwater Programs

(Section 6.0)

First Element
Source & Impact Strategies



Level 6 Outcomes

Table 4.2: General Types and Examples of Receiving Water Conditions

Type of Condition	Examples
Chemical Conditions	
Constituents in flows (wet, dry, and ambient)	• Chemical constituent concentrations or loads (metals, pesticides, nutrients, etc.)
Constituents in sediments	• Metals, pesticides, nutrients, etc.
Toxicological Conditions (aquatic and sediment; acute and chronic)	
Toxicity from chemical constituents	• Metals, pesticides, nutrients, etc.
Toxicity from other stressors	• Temperature, turbidity, etc.
Biological Conditions	
Pathogens and indicators	• Bacterial indictors in wet and dry weather flows • Pathogens (bacteria,. viruses, protozoa, etc.) in wet and dry weather flows
Habitat and communities	• Macro-invertebrate community integrity • Biodiversity • Algal abundance and diversity • Habitat integrity (wetlands, riparian cover, etc.)
Physical Conditions	
Physical condition of channels and banks	• Geomorphic conditions • Erosion and sedimentation • Hydromodification • Extent and amount of trash
Flow conditions within channels	• Presence or absence of flow or ponded water • Volume, velocities, and durations of flows
Other	• pH, temperature, conductivity, dissolved oxygen, turbidity

Table 4.3: SWRCB Beneficial Use Designations

Municipal and Domestic Supply (MUN) Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Agricultural Supply (AGR) Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

Industrial Process Supply (PROC) Uses of water for industrial activities that depend primarily on water quality.

Industrial Service Supply (IND) Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

Ground Water Recharge (GWR) Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Freshwater Replenishment (FRSH) Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).

Navigation (NAV) Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Hydropower Generation (POW) Uses of water for hydropower generation.

Water Contact Recreation (REC-1) Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not

Cold Freshwater Habitat (COLD) Uses of water that support c water ecosystems including, but not limited to, preservation enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

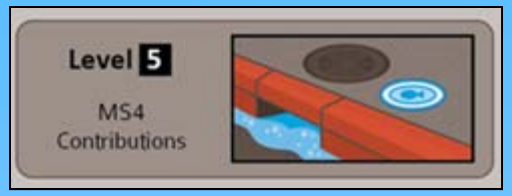
Inland Saline Water Habitat (SAL) Uses of water that support saline water ecosystems including, but not limited to, preserv or enhancement of aquatic saline habitats, vegetation, fish, o wildlife, including invertebrates.

Estuarine Habitat (EST) Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Wetland Habitat (WET) Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, wildlife, and other unique wetland functions which enhance v quality, such as providing flood and erosion control, stream b stabilization, and filtration and purification of naturally occurr contaminants.

Marine Habitat (MAR) Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish shellfish, or wildlife (e.g., marine mammals, shorebirds).

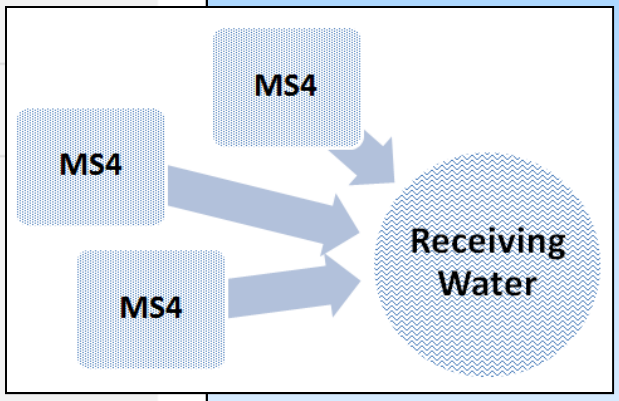
Wildlife Habitat (WILD) Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildl water and food sources



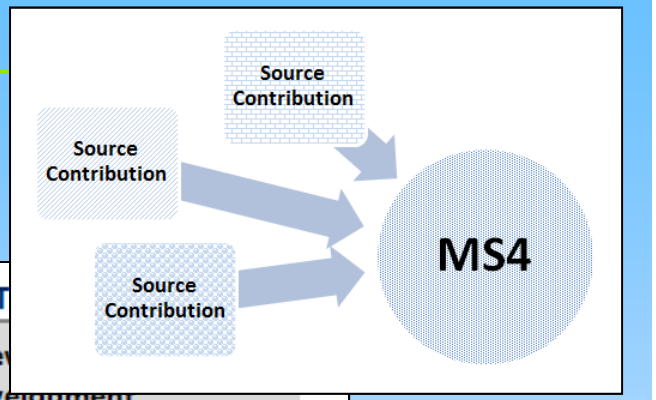
Level 5 Outcomes

Table 4.10: General Types and Examples of MS4 Conditions

Type of Condition	Examples
Chemical Conditions	
Constituents in flows (wet, dry, and ambient)	• Chemical constituent concentrations or loads (metals, pesticides, nutrients, etc.)
Biological Conditions	
Pathogens and indicators	• Bacterial indictors in wet and dry weather flows • Pathogens (bacteria, viruses, protozoa, etc.) in wet and dry weather flows
Toxicological Conditions	
Toxicity of discharges from MS4 outfalls	• Metals, pesticides, nutrients, etc.
Physical Conditions	
Physical condition of MS4 facilities (channels, streets, roads, inlets, outlets, etc.)	• Geomorphic conditions • Erosion and sedimentation • Structural integrity • Extent and amount of trash
Flow conditions within the MS4 and from outfalls	• Presence or absence, volume, velocities, and durations of flows
Other	• pH, temperature, conductivity, dissolved oxygen, turbidity



Level 4 Outcomes



General Source Categories

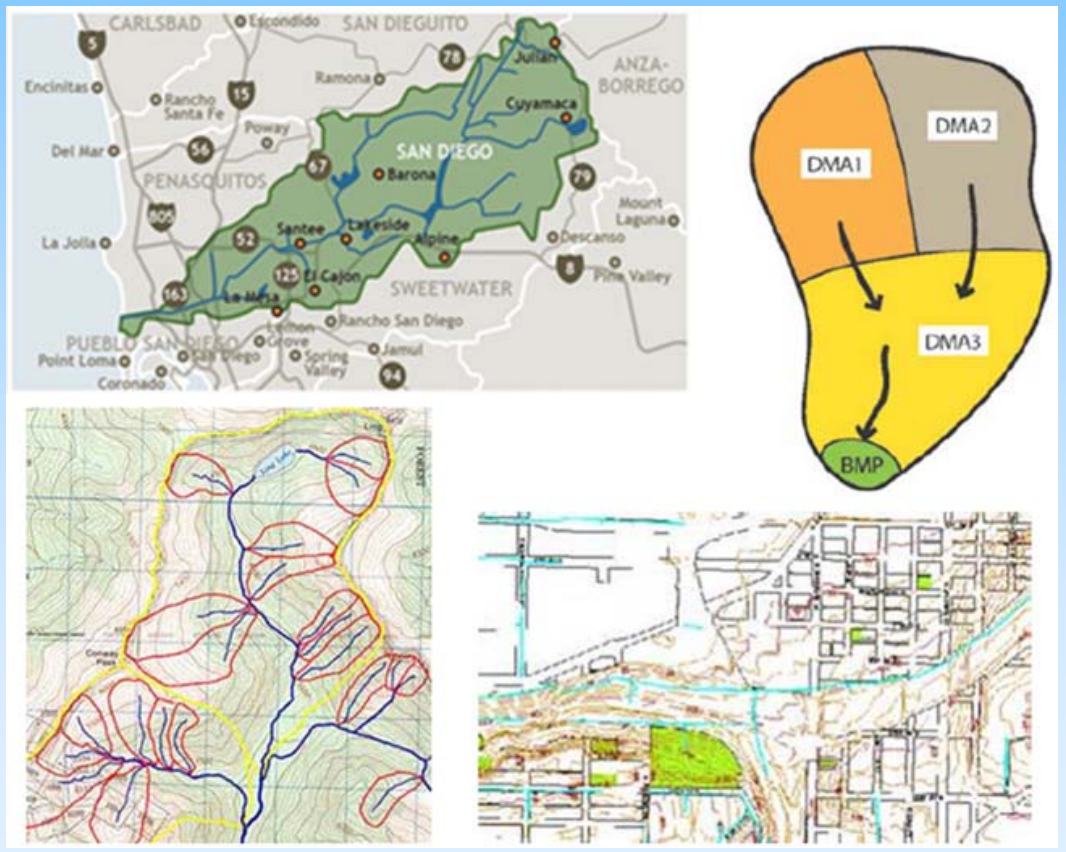
Table 4.14: Major Source Categories and Examples of Specific Source T

Existing Development			New Redevelopment	
Municipal Sources	**Residential Sources**	**Industrial/ Commercial Sources**	**Construction Sources**	**Development & Redevelopment Sources**
• Solid waste facilities • Wastewater operations • Streets and roads • MS4s • Parks • Office buildings	• Single family housing • Multiple family housing • Apartments • Mobile homes • Rural residential areas • Inner city neighborhoods	• Restaurants • Automotive maintenance • Nurseries • Horse stables • Mobile operations (landscaping, pool care, pest control, etc.)	• Commercial and industrial development • Single family homes • Major subdivisions • Capital improvement projects • Redevelopment sites	• Commercial and industrial development • Single family homes • Major subdivisions • Capital improvement projects • Redevelopment sites

Types of Source Contributions

Type of Contribution	Examples
Materials and Wastes	
	• Fertilizers • Yard waste • Paint • Automotive fluids (motor oil, brake fluid, etc.) • Trash and debris
Pollutants	
Chemical Constituents	• Metals (e.g., Cd, Cu, Cr, Pb, Ni, Ag, Zn) • Pesticides (e.g., organophosphates, pyrethroids) • Nutrients (e.g., nitrates, phosphates)
Biological Constituents	• Bacterial indictors (total and fecal coliform, enterococcus, etc.) • Pathogens (bacteria, viruses, protozoa, etc.)
Physical Constituents	• Sediment • Floatables • Temperature
Flows	• Stormwater flows (volume, velocities, and durations) • Non-stormwater flows (presence or absence, volume, velocities, and durations)

Drainage Areas



Drainage Area Attributes

Land Area Characteristics

- ☑ Geographic boundaries
- ☑ Land uses (residential, industrial, transportation, etc.)
- ☑ Zoning classifications (residential, commercial, mixed use, etc.)

Sources of Pollutants and Flow

- ☑ Areas of pollutant and flow generation (area-wide, land use-specific, etc.)
- ☑ Source locations (industrial areas, facility locations, etc.)

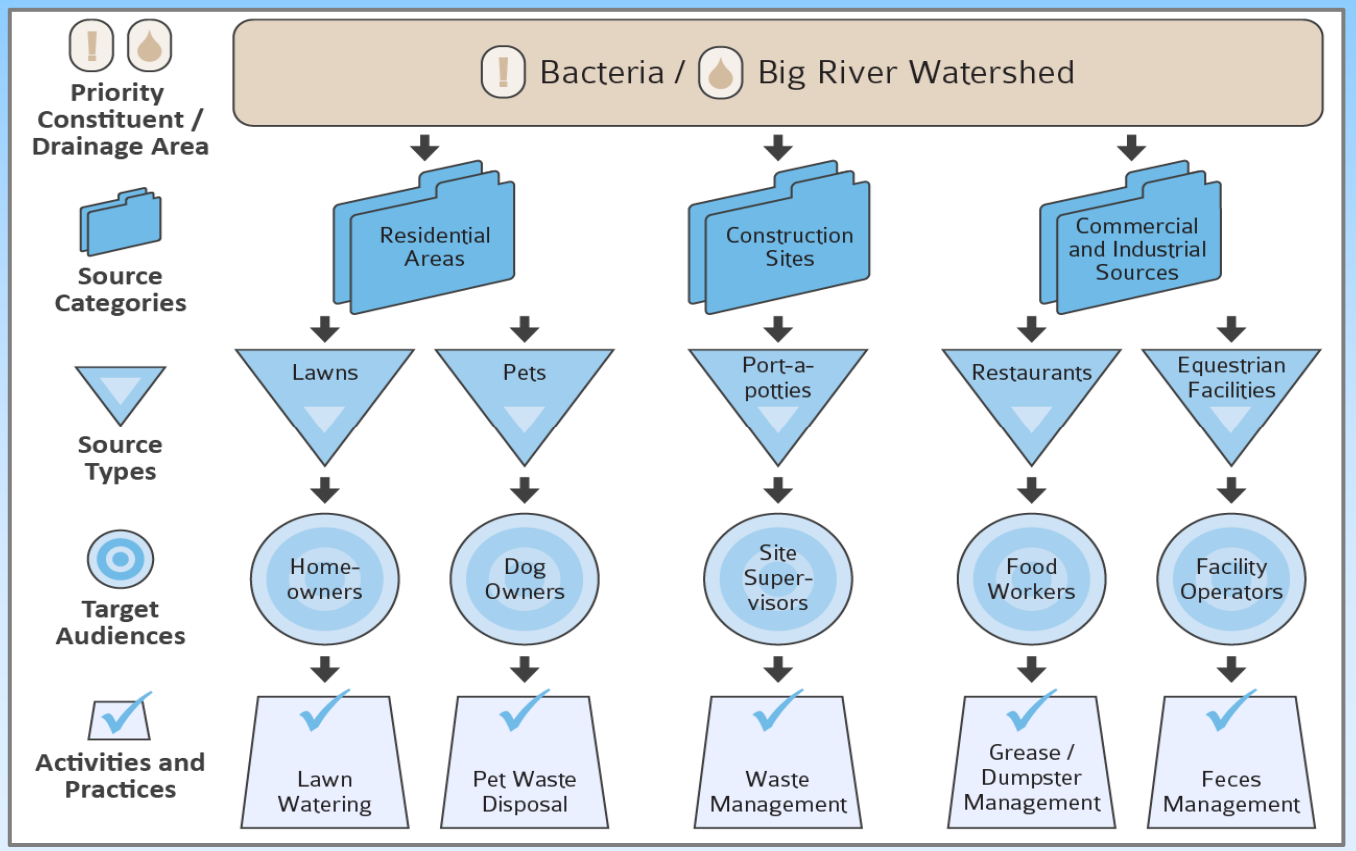
Population Characteristics

- ☑ Demographics (ethnicity, gender, age, etc.)
- ☑ Population distribution (density, communities, etc.)

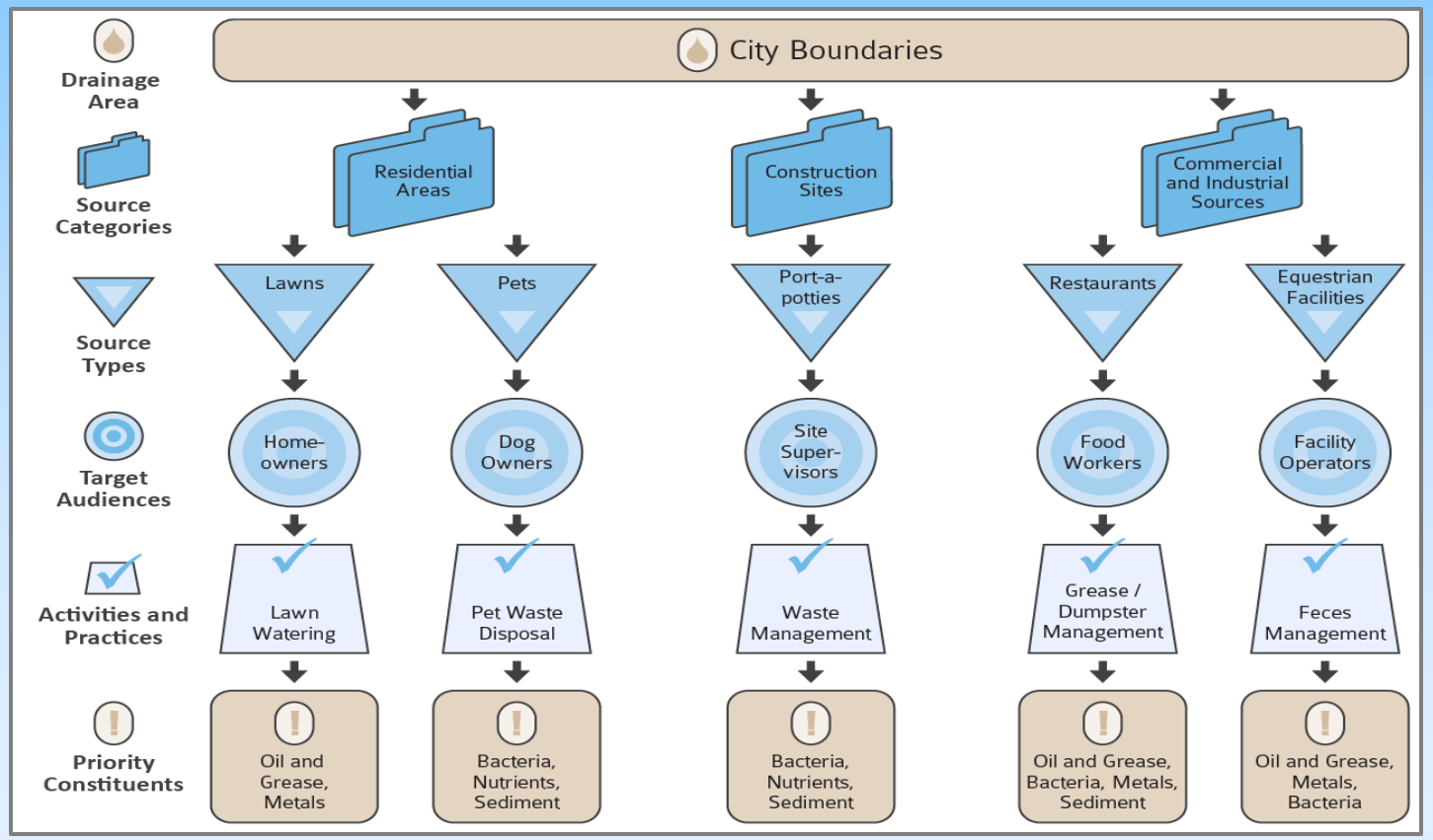
Physical Characteristics

- ☑ Locations of receiving waters and MS4s
- ☑ Patterns of precipitation and runoff
- ☑ Topography, soil types, and vegetation
- ☑ Areas of imperviousness, open space, or infiltration

Constituent-based organizational approaches (start at Levels 5 and 6)

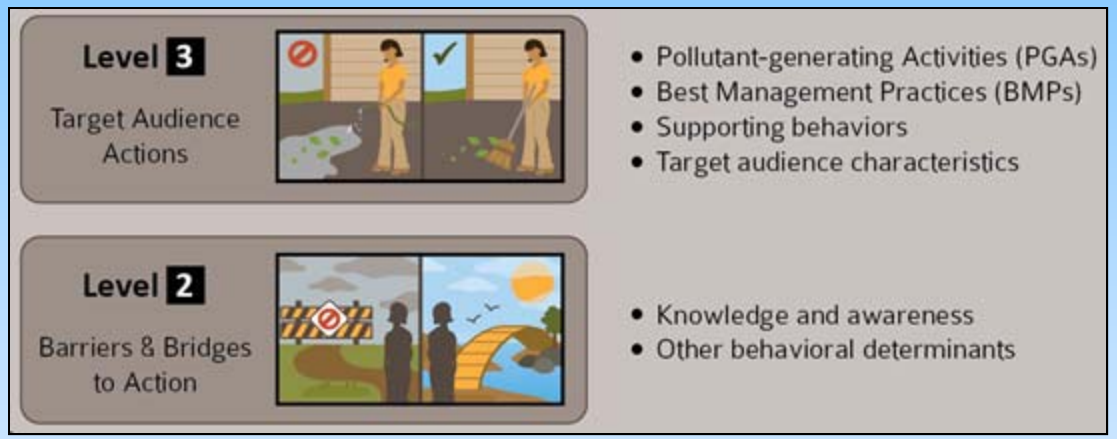


Source-based organizational approaches (start at Level 4)



Questions?

Second Element
Target Audience Strategies



Level 3 Outcomes

Potential Target Audiences by Source Category

Residential Sources	
Do-it-yourselfers (e.g., gardening and yard care; home improvement; power washing; vehicle washing, maintenance, and repair)	Pet owners
	Livestock owners
	Smokers
	Recreational water users (swimmers, surfers, etc.)
Service providers (commercial operations corresponding to same activities as above)	Schoolchildren
	Hotline callers
Municipal Sources	
Garbage collectors	Waste water collection and water distribution maintenance staff
Street maintenance staff	Animal control staff
Park and grounds maintenance staff	Law enforcement staff
Building maintenance staff	Flood control or reclamation district maintenance staff
Grading plan or permit reviewers	Hazardous materials inspectors
Grading or construction inspectors	
Industrial and commercial business inspectors	
Industrial and Commercial Sources	
Owners	Mobile operators
Managers and supervisors	Contractors (landscaping, parking lot sweeping, etc.)
Employees (skilled workers and laborers)	Industry associations
	Employee unions
Construction Sources	
Owners	Contractors (plumbing, etc.)
Developers	Skilled workers
Planning groups	Laborers
New Development and Redevelopment Sources	
Engineers and architects	Developers
Landscape architects	Housing authorities
Urban planners	Flood control or reclamation district planners
Engineers	

General Types of Target Audience Actions

Pollutant-generating activities (PGAs) are behaviors that contribute pollutants or increase flows to runoff. In this illustration, a woman is using a hose to clean up an outdoor area. If other precautions are not taken to prevent flows and pollutants from leaving the site, this action is likely to be a PGA.

Best management practices (BMPs) are practices designed to prevent, reduce, or eliminate discharges of pollutants and flow. Here the woman has instead chosen to use a broom for cleaning up. Dry sweeping methods are an excellent example of choosing a BMP over a PGA.

Supporting behaviors are actions that encourage or facilitate BMP implementation. Supporting behaviors can be initiated by virtually anyone; in some cases, by dischargers (facility self-inspections, staff training, etc.) and in others by interested parties (pollution reporting, joining an environmental advocacy group, etc.).

Level 3 Outcomes

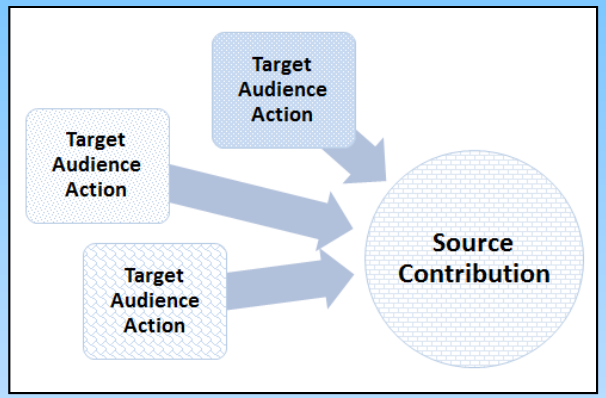
PGA-BMP Packages

PGA
Application of insecticides for ant control

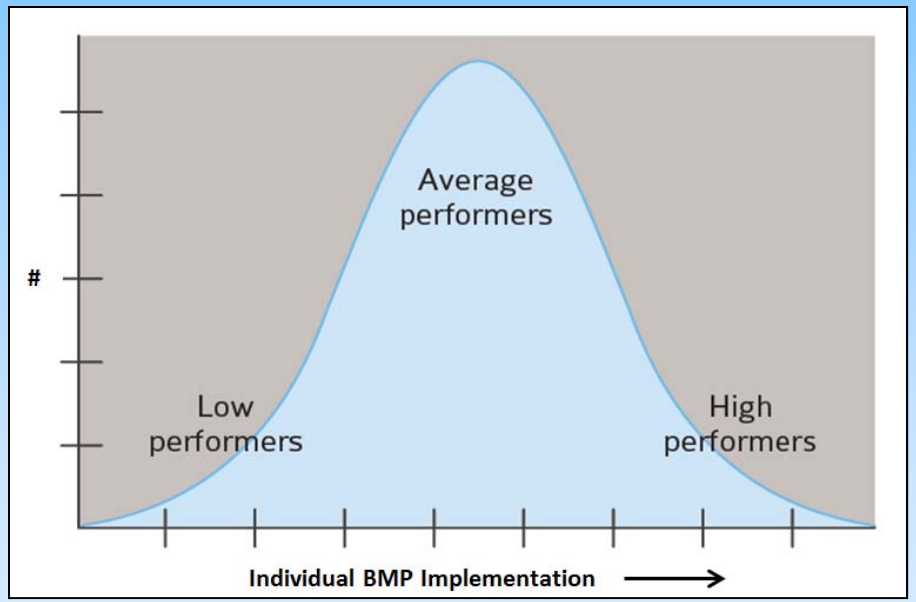
BMP Option 1	BMP Option 2	BMP Option 3
Use less toxic products	Change timing of application	State and federal source control regulation

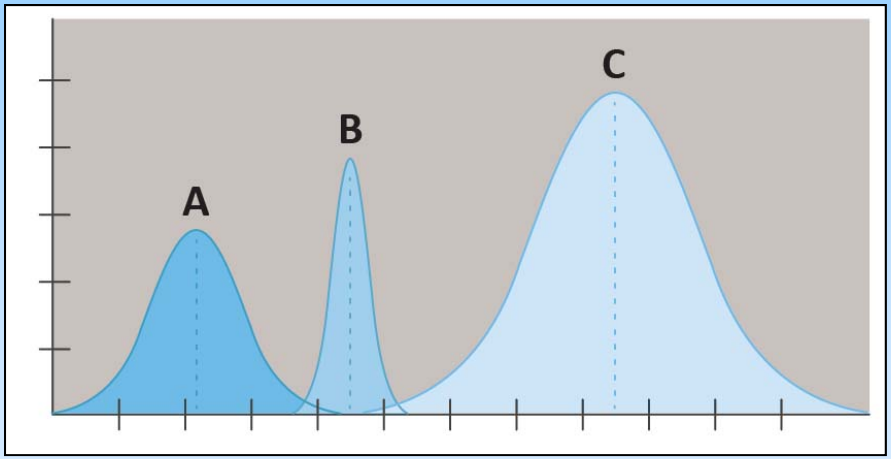
PGA
Runoff from vehicle washing

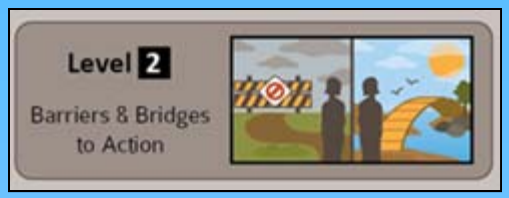
BMP Option 1	BMP Option 2	BMP Option 3
Use controllable spray nozzles	Wash over a permeable surface	Use "dry washing" techniques



Behaviors are Distributed within Target Audience Populations

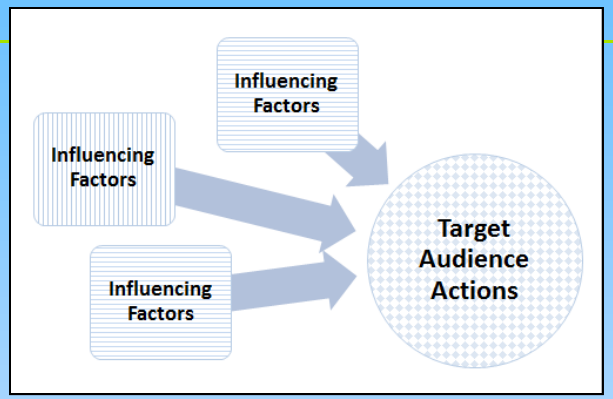


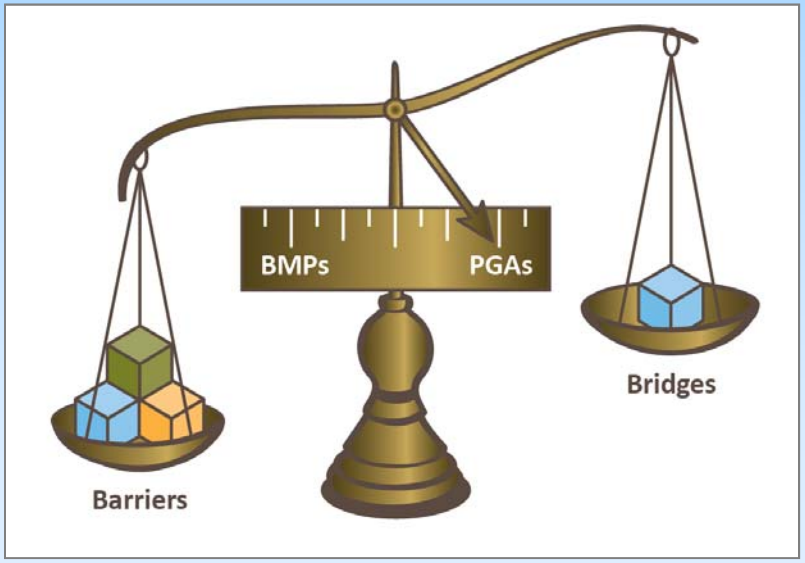


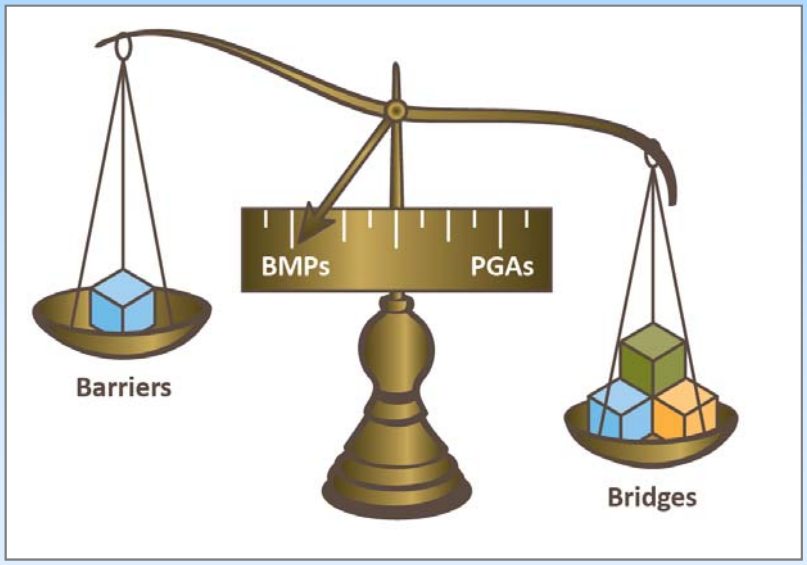


Level 2 Outcomes

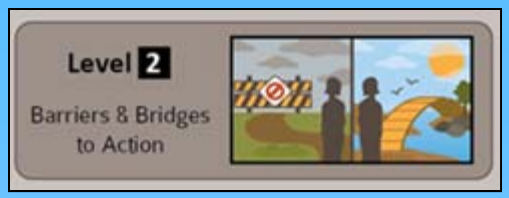
Barriers + Bridges = Influencing Factors







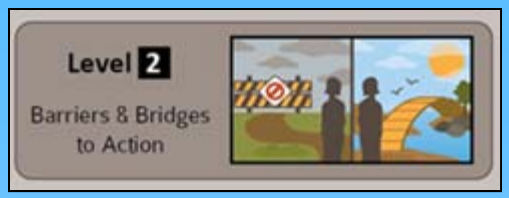

Barriers List
Barrier 1 Barrier 5
Barrier 2 Barrier 6
Barrier 3 Barrier 7
Barrier 4
PGAs
Barrier 1
Barrier 2
Barrier 3
Barrier 5
BMPs
Barrier 4
Barrier 6
Barrier 7



Personal Factors

Table 5.11: Examples of Personal Factors that Can Affect Behaviors

	Pesticide Use	Vehicle Washing	Disposal of Reusables	Sediment Discharge
Knowledge	Pesticides should be applied according to label instructions	Controllable spray nozzles can significantly reduce runoff	Compost piles should be turned at least weekly	Silt fences should not be used at the base of a slope
Awareness	My pesticides can harm aquatic life	Commercial car washes minimize runoff	Training on composting is locally available	Discharges can be reported to a local hotline
Attitudes	Healthy plants are more important than environmental protection	People have a right to wash their cars on the street	Composting is too messy to bother with	Construction will be completed long before anyone notices our runoff



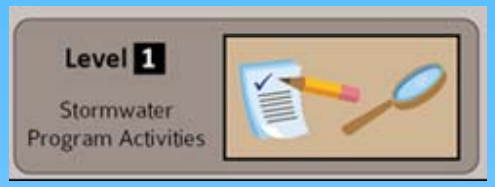
External Factors

Table 5.12: Examples of How External Factors Can Influence Behavior

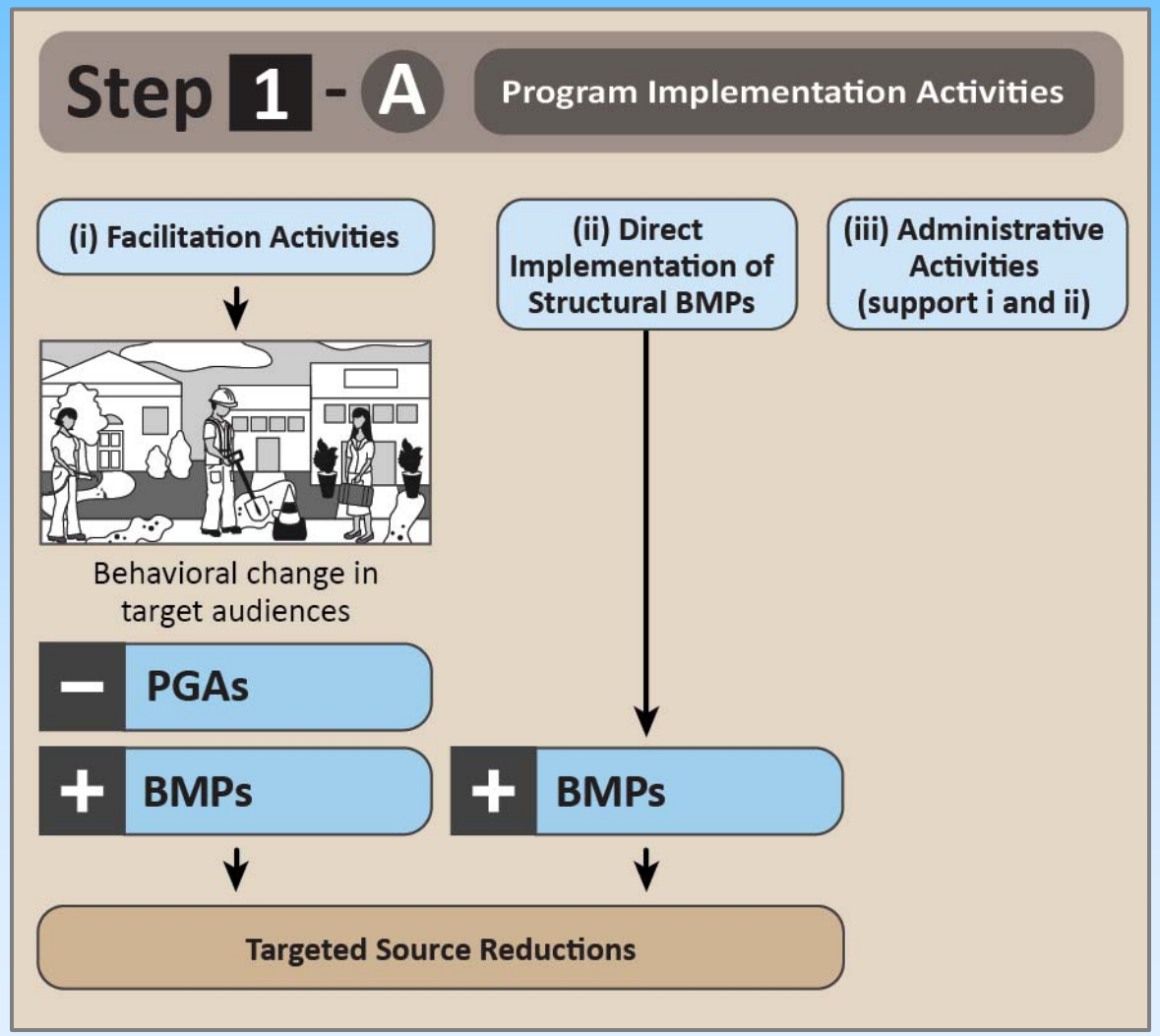
	Pesticide Use	Vehicle Washing	Disposal of Reusables	Sediment Discharges
Regulatory factors	Some pesticides can be applied only by licensed pest control applicators; others are freely available	A program prohibits discharges from businesses, but not at residences	Re-use of materials is encouraged rather than legally required	Ordinances prohibit discharges, but do not require prevention through erosion control practices
Economic factors	Many pesticides are inexpensive or cheaper in large quantities	Washing in a driveway is cheaper than using a car wash	Changes in practices may require upfront investments (e.g., composting bins)	Materials needed for stabilization projects can be expensive
Technological factors	Effective alternatives do not exist for a particular use (e.g., ant control)	Controllable spray nozzles are widely available	Technologies are not widely available for recycling of "higher numbered" materials	A variety of products are available for effectively managing discharges
Structural factors	Site safety issues limit the use of pesticide alternatives	A nearby parking lot with a pervious surface could facilitate environmentally friendly car washing	A community garden provides residents access to composting bins	Site topography or space limitations inhibit the use of sediment control practices
Organizational factors	A business lacks a policy or procedures on pesticide use	A company has an offsite vehicle washing policy	Employees are actively encouraged to recycle and reuse	Site maintenance is not an organizational priority
Societal factors	Green lawns are valued as part of a community's identity	Washing soapy water onto streets is considered "low class"	Composting is valued by the community	Sediment discharges onto public streets are considered unsightly
Communication factors	Residents lack information on pesticide alternatives	Information on "dry washing" techniques is widely available	Recycling and reuse policy is not communicated to employees	Information on effective erosion control practices is not widely available

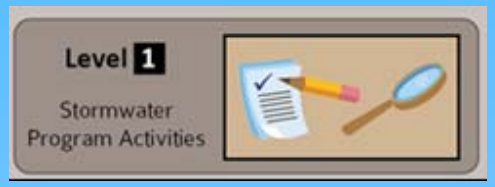
Questions?

Third Element
Target Audience Strategies

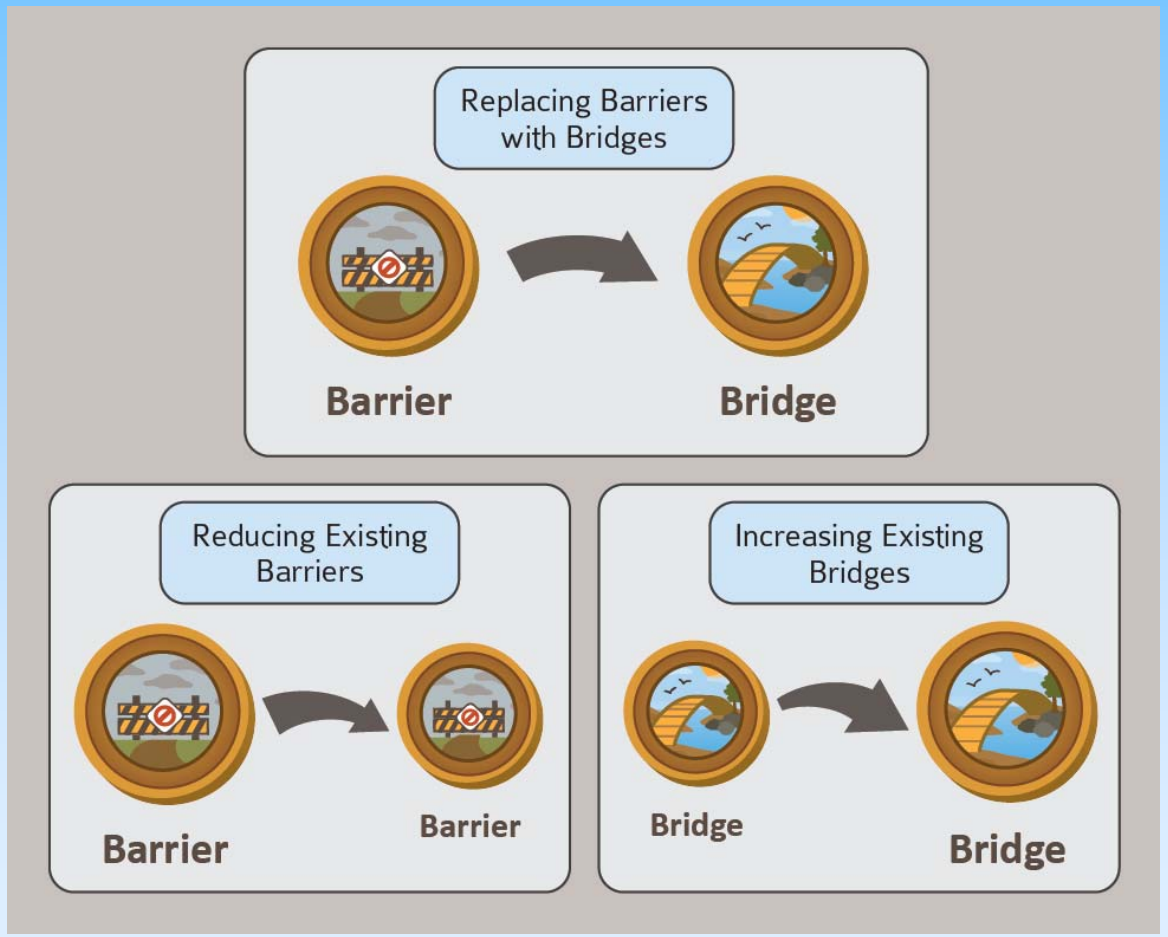


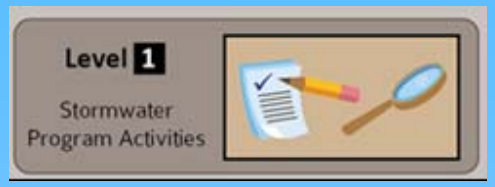
Level 1 Outcomes



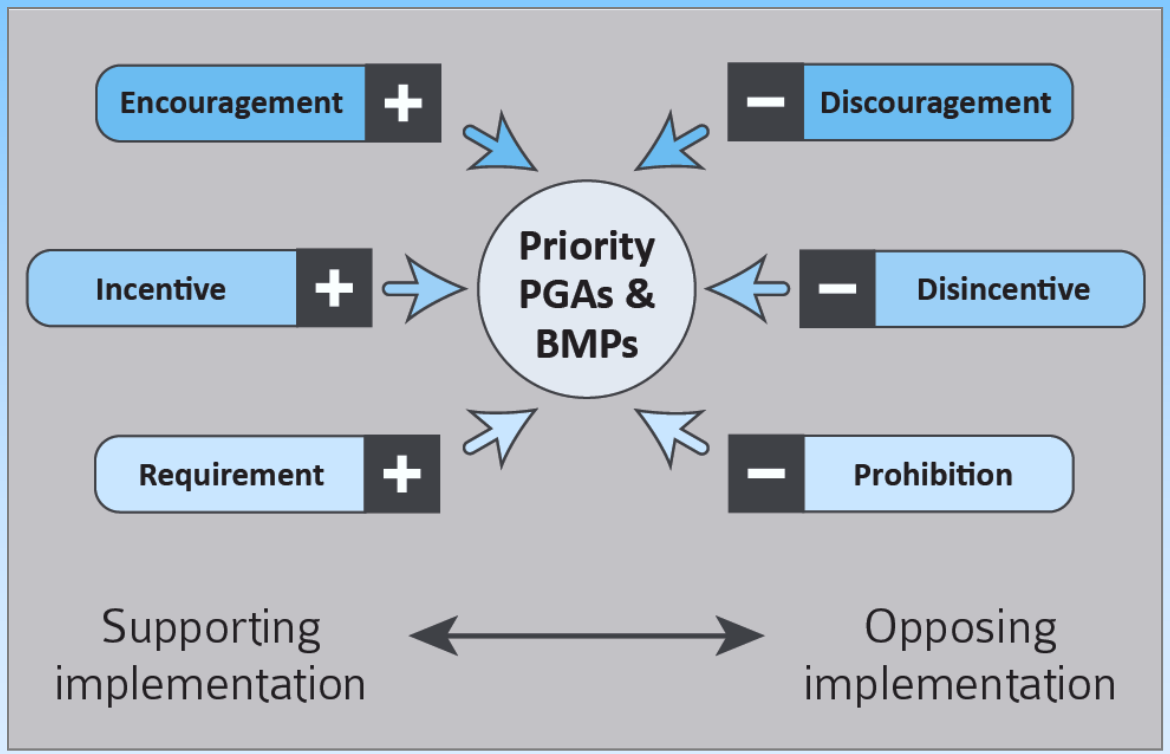


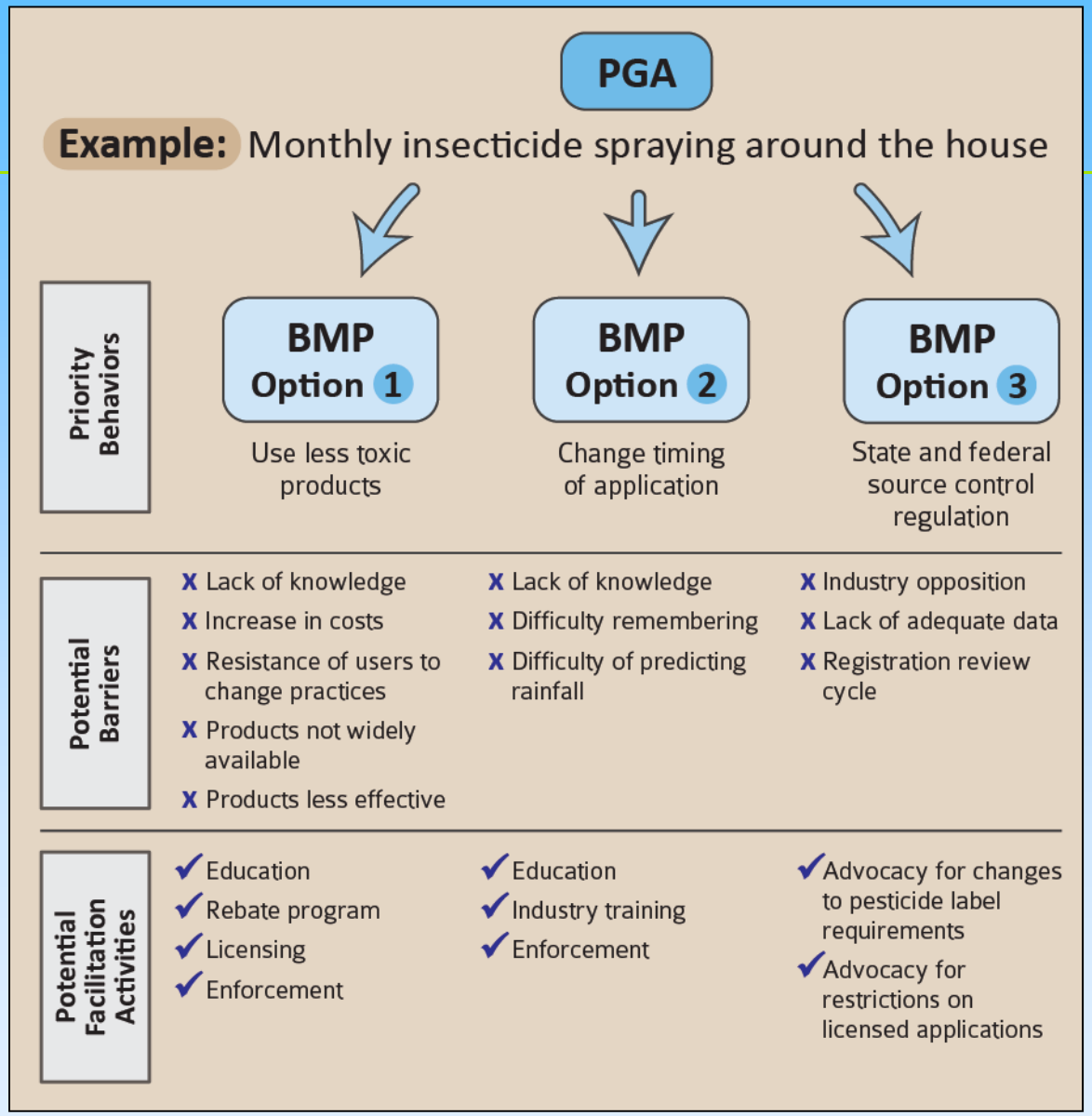
Facilitation Activities





Facilitation Activities

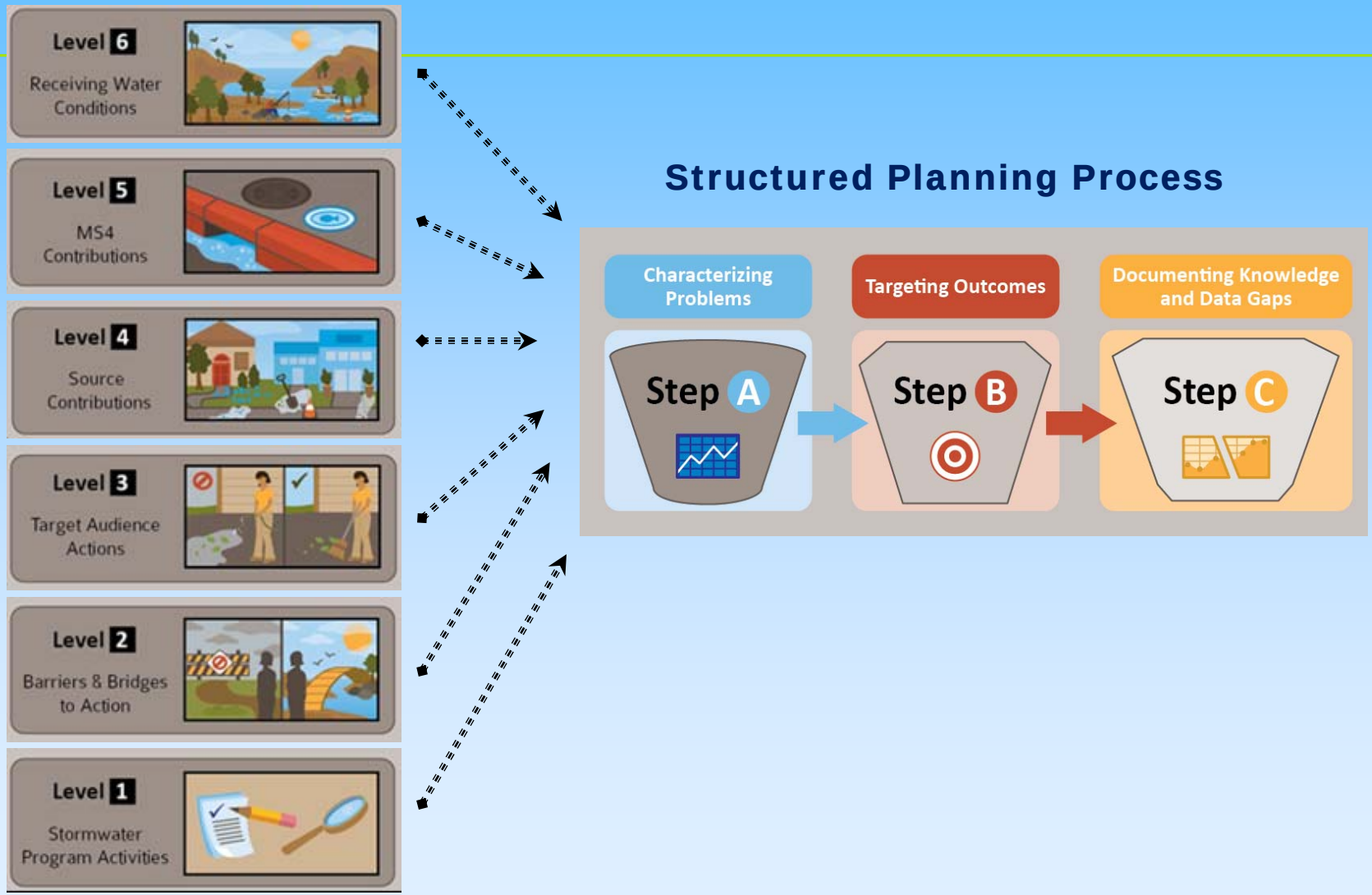


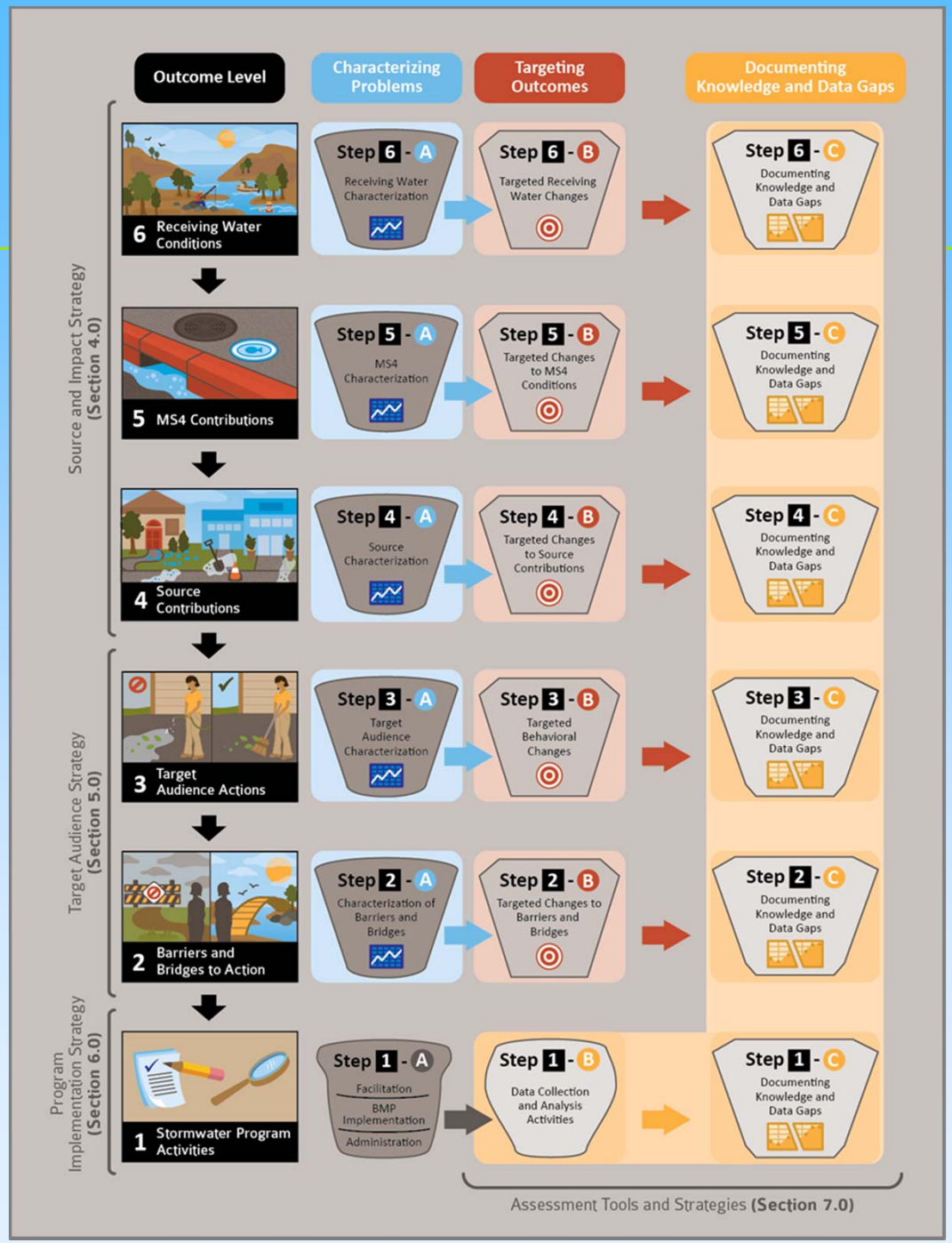

PGA
Example: Monthly insecticide spraying around the house
Priority Behaviors
BMP Option 1
Use less toxic products
BMP Option 2
Change timing of application
BMP Option 3
State and federal source control regulation
Potential Barriers
X Lack of knowledge
X Increase in costs
X Resistance of users to change practices
X Products not widely available
X Products less effective
X Lack of knowledge
X Difficulty remembering
X Difficulty of predicting rainfall
X Industry opposition
X Lack of adequate data
X Registration review cycle
Potential Facilitation Activities
✓ Education
✓ Rebate program
✓ Licensing
✓ Enforcement
✓ Education
✓ Industry training
✓ Enforcement
✓ Advocacy for changes to pesticide label requirements
✓ Advocacy for restrictions on licensed applications

Questions?

Introduction to Strategic Planning for Stormwater Programs

Overview of Structured Planning Process


Level 6
Receiving Water Conditions
Level 5
MS4 Contributions
Level 4
Source Contributions
Level 3
Target Audience Actions
Level 2
Barriers & Bridges to Action
Level 1
Stormwater Program Activities
Structured Planning Process
Characterizing Problems
Targeting Outcomes
Documenting Knowledge and Data Gaps
Step A
Step B
Step C


Outcome Level
Characterizing Problems
Targeting Outcomes
Documenting Knowledge and Data Gaps
Source and Impact Strategy (Section 4.0)
Target Audience Strategy (Section 5.0)
Program Implementation Strategy (Section 6.0)
6 Receiving Water Conditions
Step 6 - A Receiving Water Characterization
Step 6 - B Targeted Receiving Water Changes
Step 6 - C Documenting Knowledge and Data Gaps
5 MS4 Contributions
Step 5 - A MS4 Characterization
Step 5 - B Targeted Changes to MS4 Conditions
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Step 4 - A Source Characterization
Step 4 - B Targeted Changes to Source Contributions
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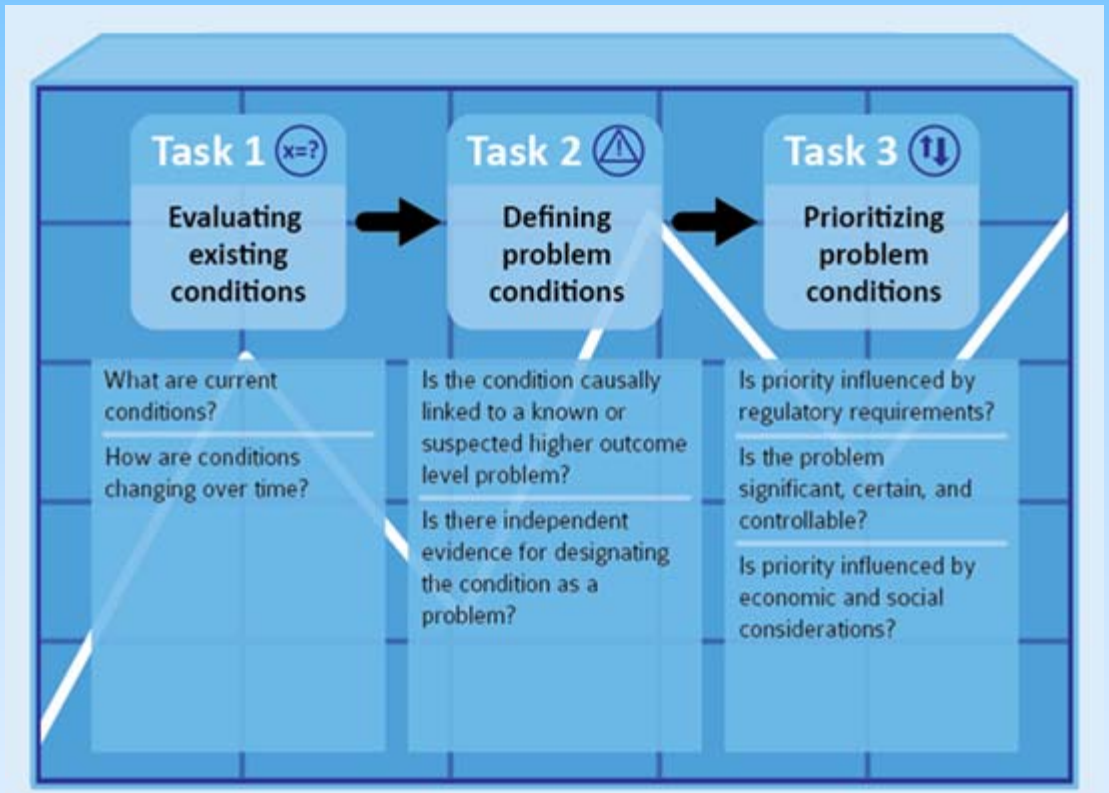
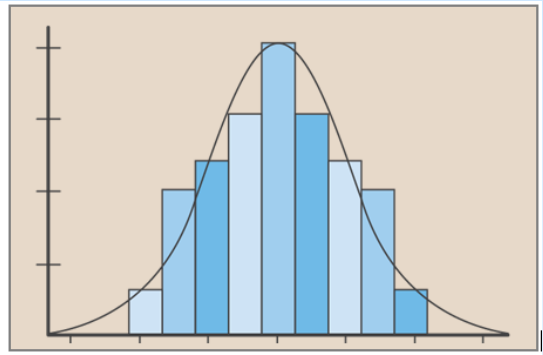
Step 1 - B Data Collection and Analysis Activities
Step 1 - C Documenting Knowledge and Data Gaps
Assessment Tools and Strategies (Section 7.0)

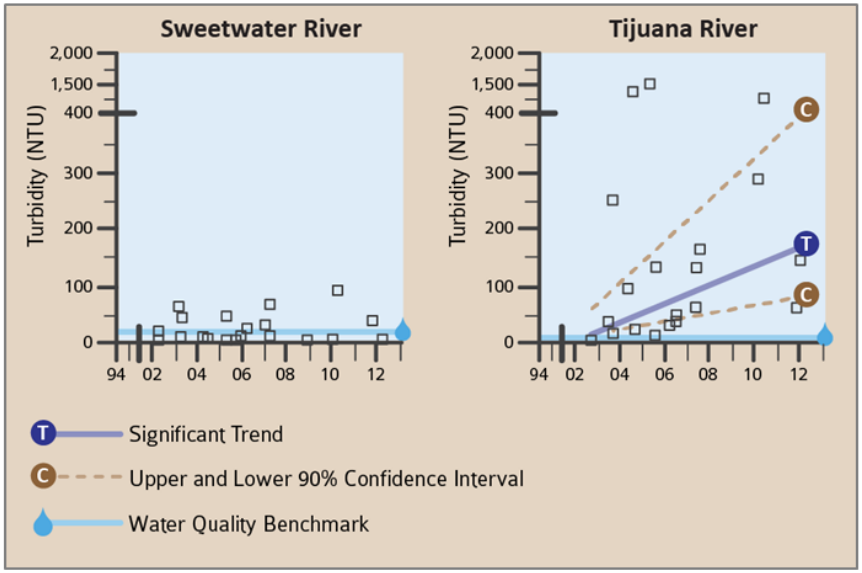
Step A Characterizing Problems



Step A Task 1 Key Questions
Evaluating Existing Conditions

Inputs	Key Questions	Outputs
Available Data, Information, and Results	**Question 1:** What are current conditions? **Question 2:** How are conditions changing over time?	**Existing Conditions** X=?

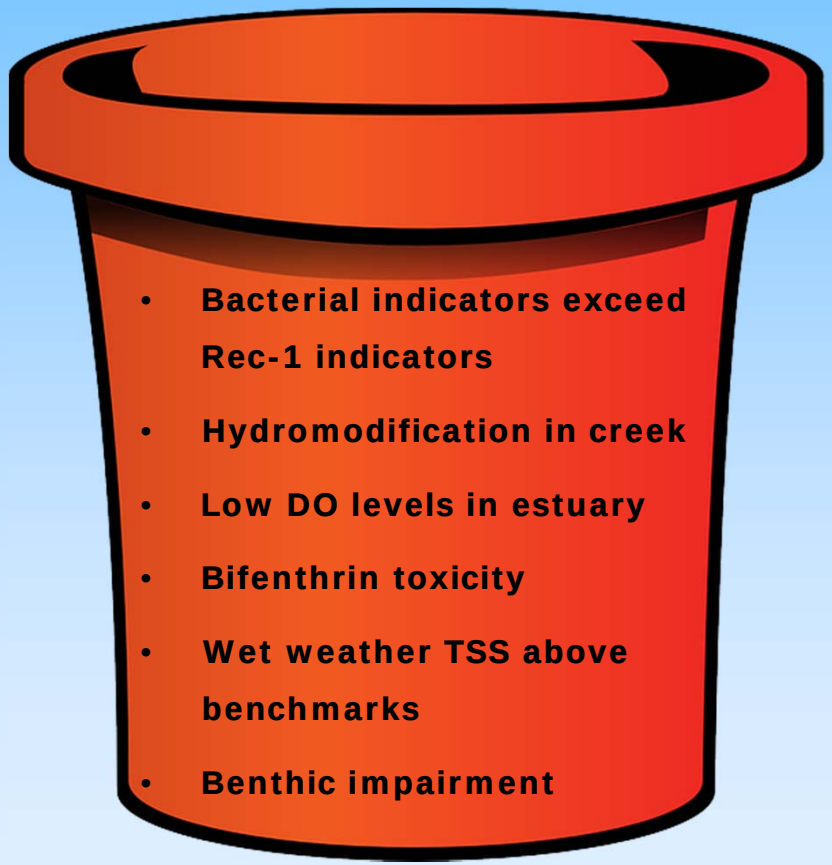




Step A Task 2 Key Questions
Defining Problem Conditions

Inputs	Key Questions	Outputs
Existing Conditions	**Question 1:** Is the condition causally linked to a known or suspected higher outcome level problem? **Question 2:** Is there independent evidence for designating the condition as a problem?	**Problem Conditions**

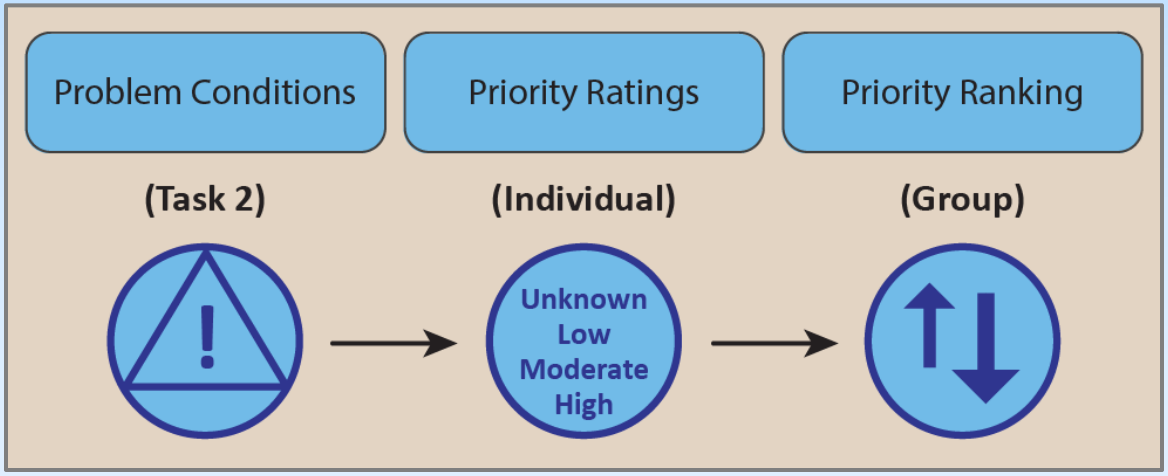
Multiple Problem Conditions Require Prioritization



Task 3 Prioritizing Problem Conditions

Step A Task 3 Key Questions
Prioritizing Problem Conditions

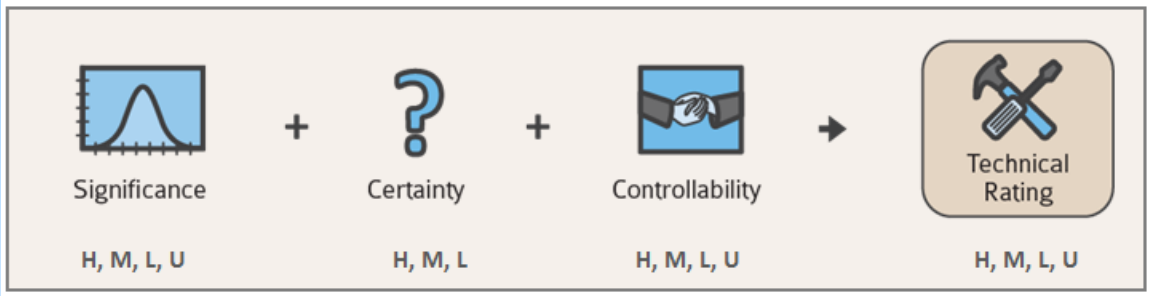
Inputs	Key Questions	Outputs
Problem Conditions	**Question 1:** What is the priority rating of each problem condition?	**Priority Problem Conditions**
	Question 2: What is the relative importance of each problem condition?	



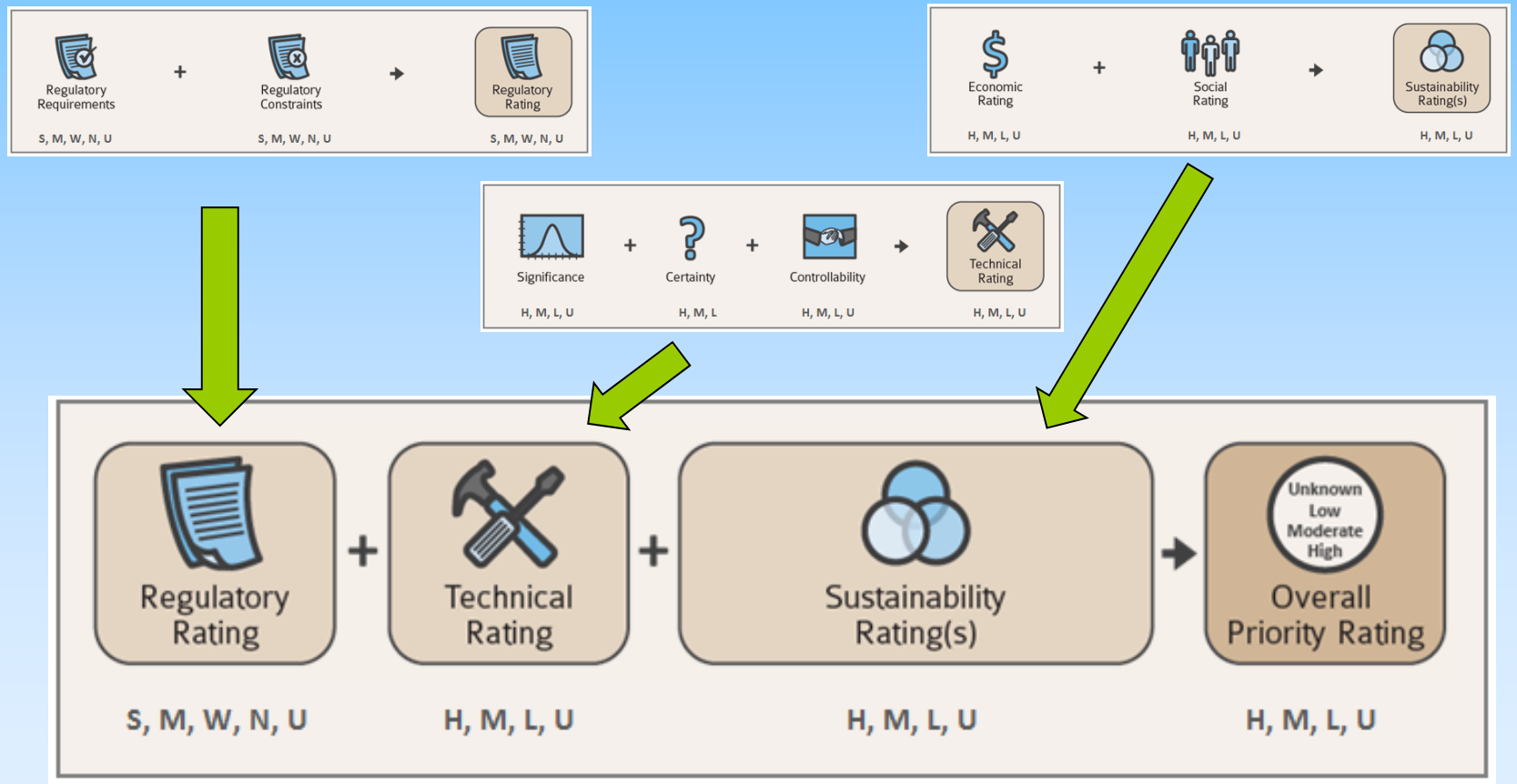
First Prioritization Step
Rating Problem Conditions

Tier 1

Tier 2



Tier 3


Regulatory Requirements
S, M, W, N, U
Regulatory Constraints
S, M, W, N, U
Regulatory Rating
S, M, W, N, U
Economic Rating
H, M, L, U
Social Rating
H, M, L, U
Sustainability Rating(s)
H, M, L, U
Significance
H, M, L, U
Certainty
H, M, L
Controllability
H, M, L, U
Technical Rating
H, M, L, U
Regulatory Rating
S, M, W, N, U
Technical Rating
H, M, L, U
Sustainability Rating(s)
H, M, L, U
Unknown
Low
Moderate
High
Overall Priority Rating
H, M, L, U

Second Prioritization Step
Ranking Problem Conditions

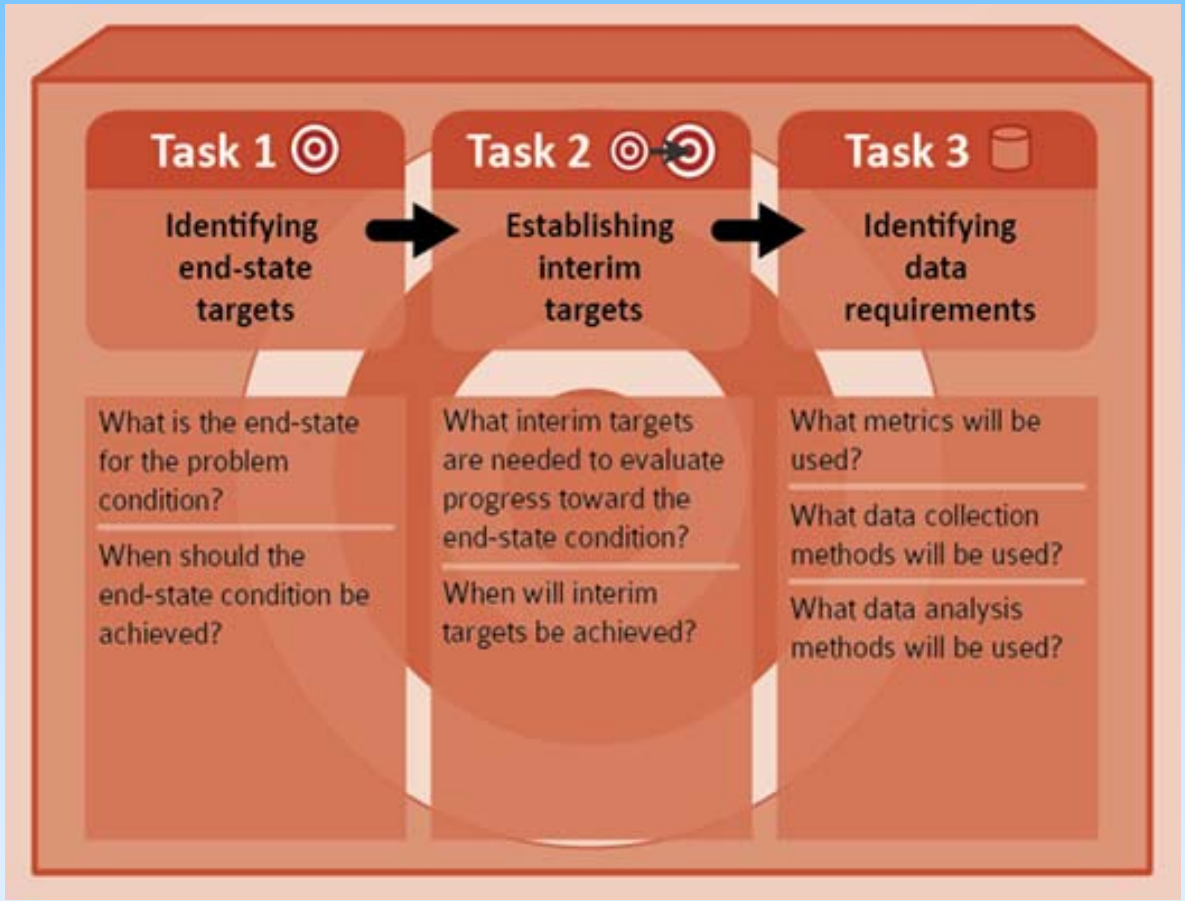
Increasing Priority ↑

RANKED ORDER EXAMPLE	GROUPED RANKING EXAMPLE
1. Bacterial indicators exceed REC-1 standards 2. Low DO levels in estuary 3. Wet weather TSS above benchmarks 4. Hydromodification in creek 5. Benthic impairment 6. Bifenthrin toxicity	**GROUP A (Moderate)** • Bacterial indicators exceed REC-1 standards • Low DO levels in estuary • Wet weather TSS above benchmarks • Hydromodification in creek **GROUP B (Low)** • Benthic impairment • Bifenthrin toxicity

Prioritized Problem Conditions Can Be Targeted for Change

↑ Increasing Priority ↑	RANKED ORDER EXAMPLE	GROUPED RANKING EXAMPLE
	1. Bacterial indicators exceed REC-1 standards 2. Low DO levels in estuary 3. Wet weather TSS above benchmarks 4. Hydromodification in creek 5. Benthic impairment 6. Bifenthrin toxicity	**GROUP A (Moderate)** • Bacterial indicators exceed REC-1 standards • Low DO levels in estuary • Wet weather TSS above benchmarks • Hydromodification in creek **GROUP B (Low)** • Benthic impairment • Bifenthrin toxicity

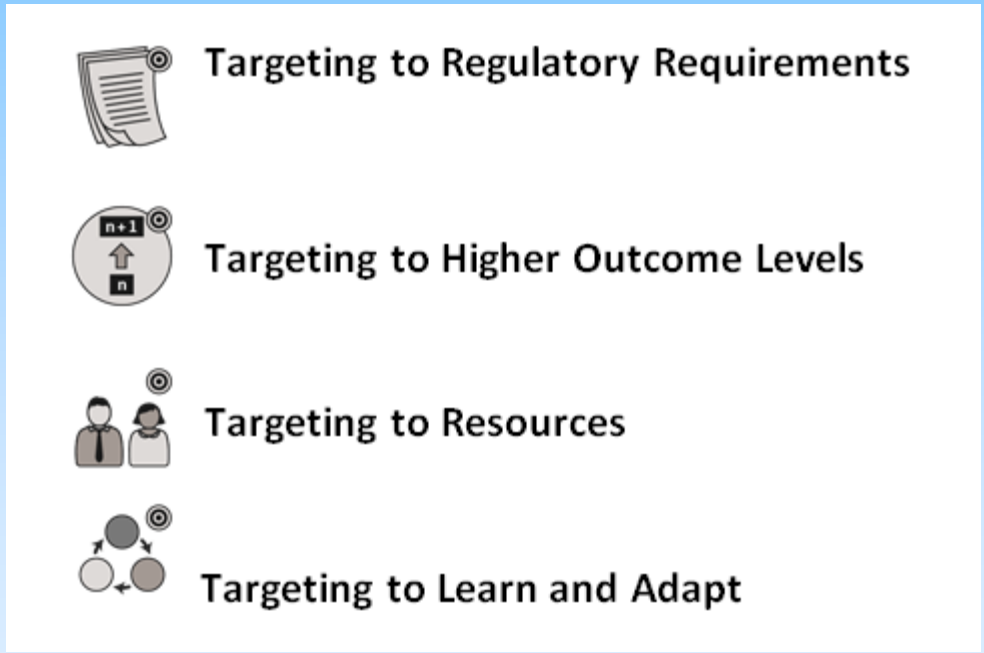
Step B Targeting Outcomes



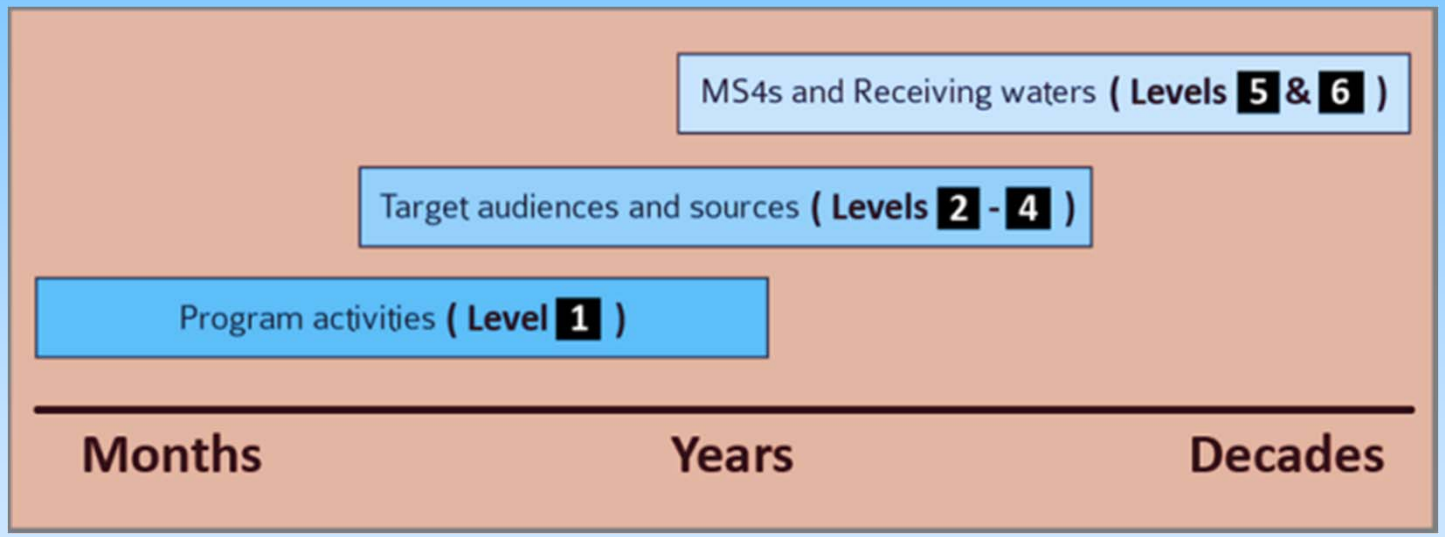
Step B Task 1 Key Questions
Identifying End-state Targets

Inputs	Key Questions	Outputs
Priority Problem Conditions 	**Question 1:** What is the end-state for the problem condition? **Question 2:** When should the end-state condition be achieved?	**End-state Targets** 

Establishing End-state Targets

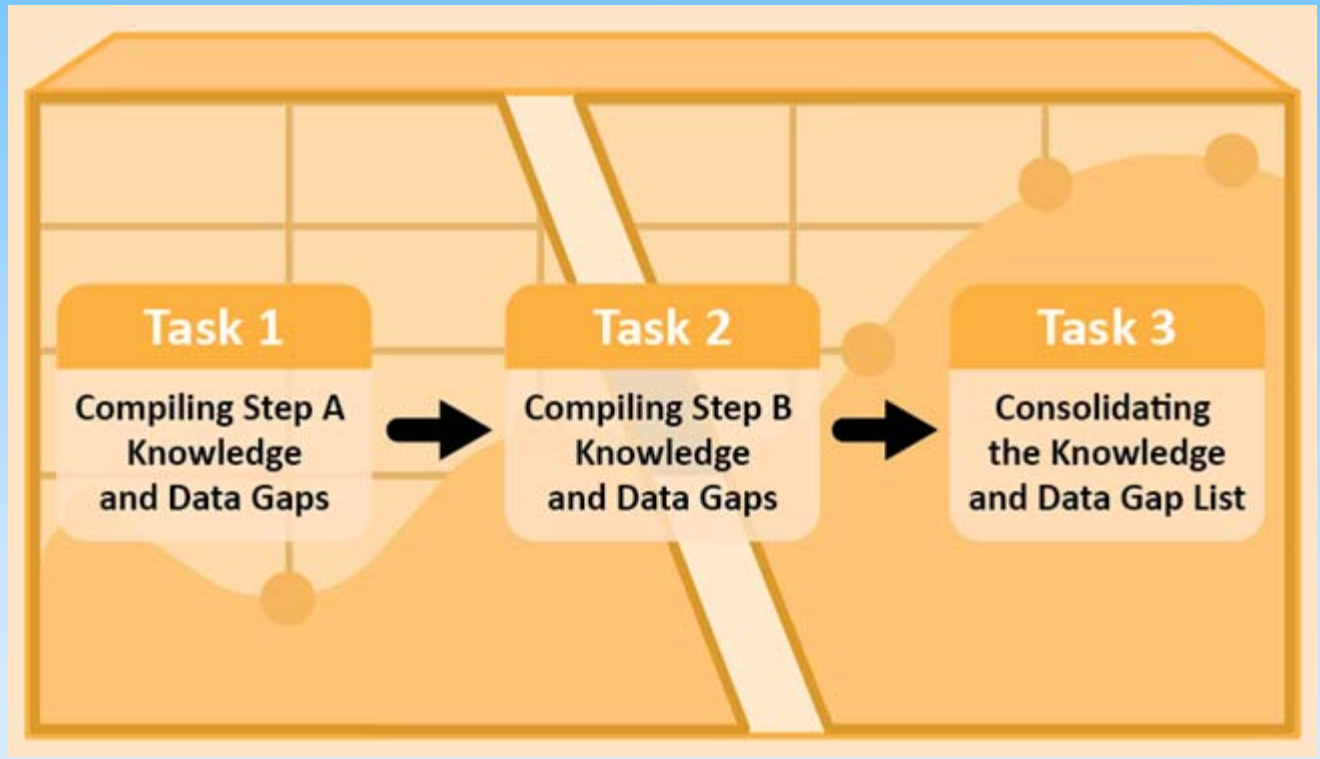


Timelines for Achieving Targeted Outcomes



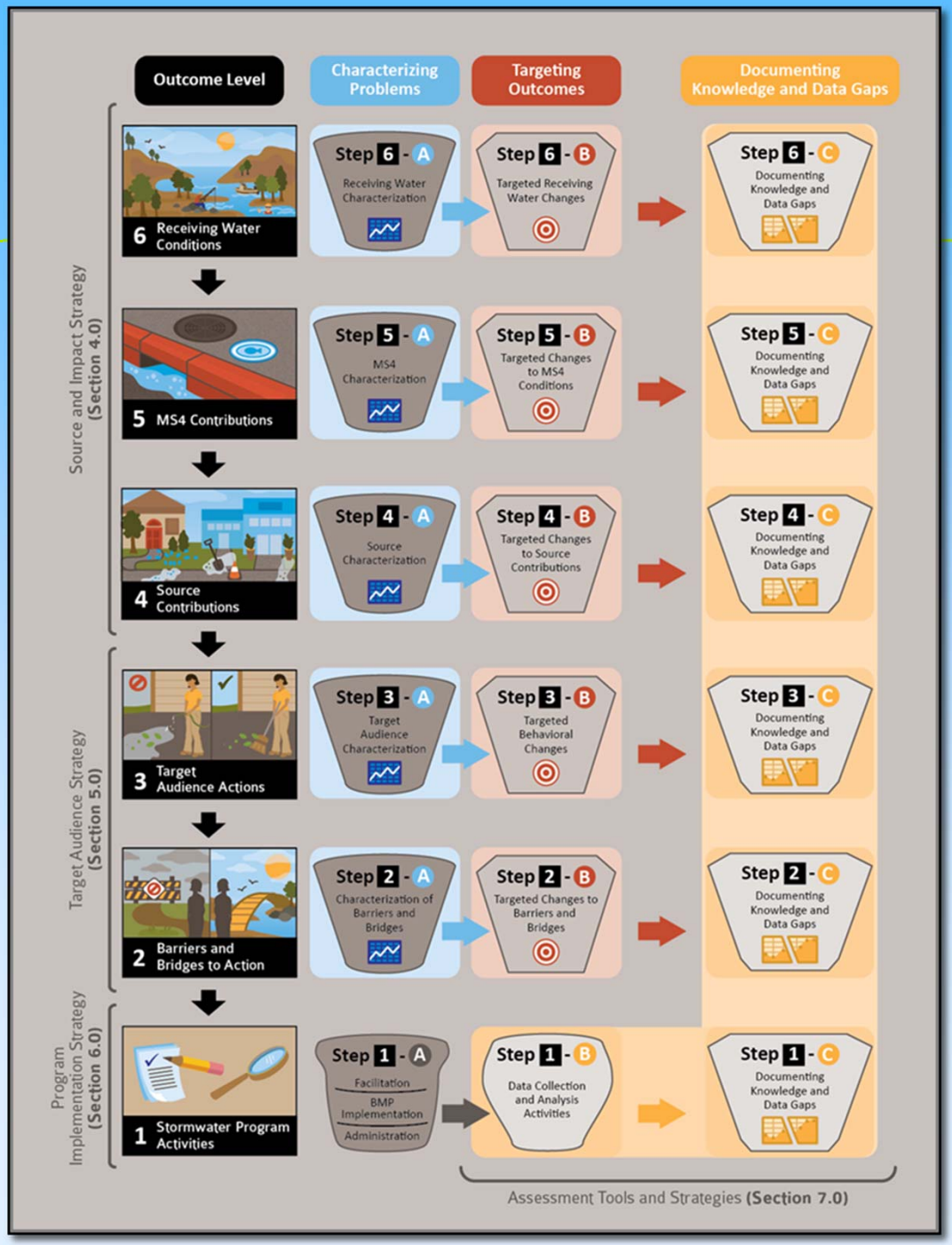
- Complexity
- Cost
- Scale
- Metrics and methods of measurement
- Variability

Step C Documenting Knowledge and Data Gaps



Examples of Potential Knowledge and Data Gaps (Level 4)

- ✓ Understanding of drainage area contributions (EMCs, monitoring data, methodologies, etc.)
- ✓ Understanding of drainage area attributes (land uses, areas of pollutant and flow generation, population distribution, etc.; see also **Table 4.14**)
- ✓ Understanding of source contributions (potential or actual wet and dry weather discharges of pollutants or flows)
- ✓ Understanding of source attributes (number, size and types of sites or facilities; activities and practices; operations conducted; materials and wastes; see also **Table 4.15**)
- ✓ Adequacy of facility or other monitoring data (sample size, representative sampling, etc.)
- ✓ Knowledge of target audience attributes
- ✓ Knowledge of economic and social factors affecting drainage areas and sources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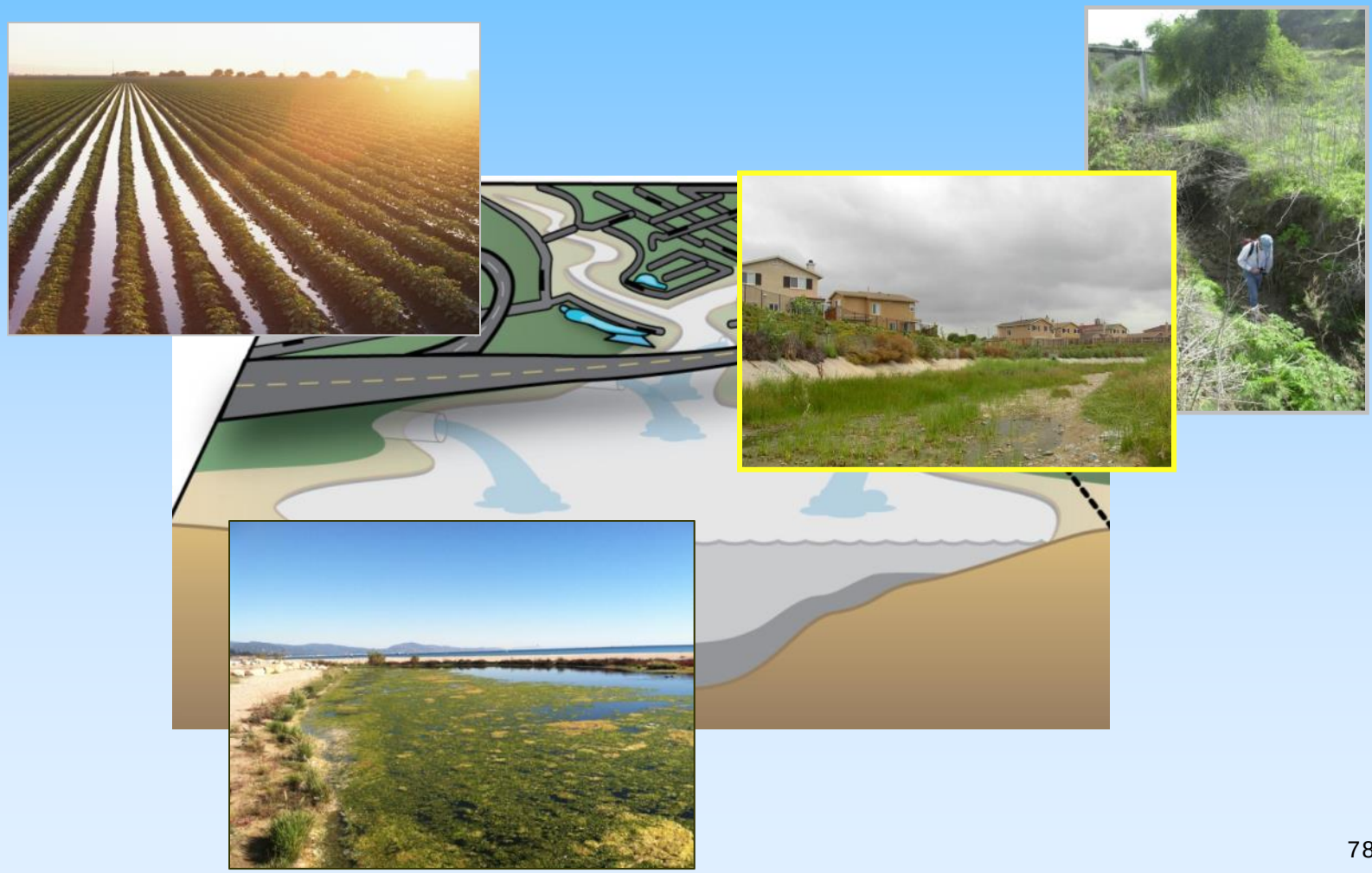
Questions?

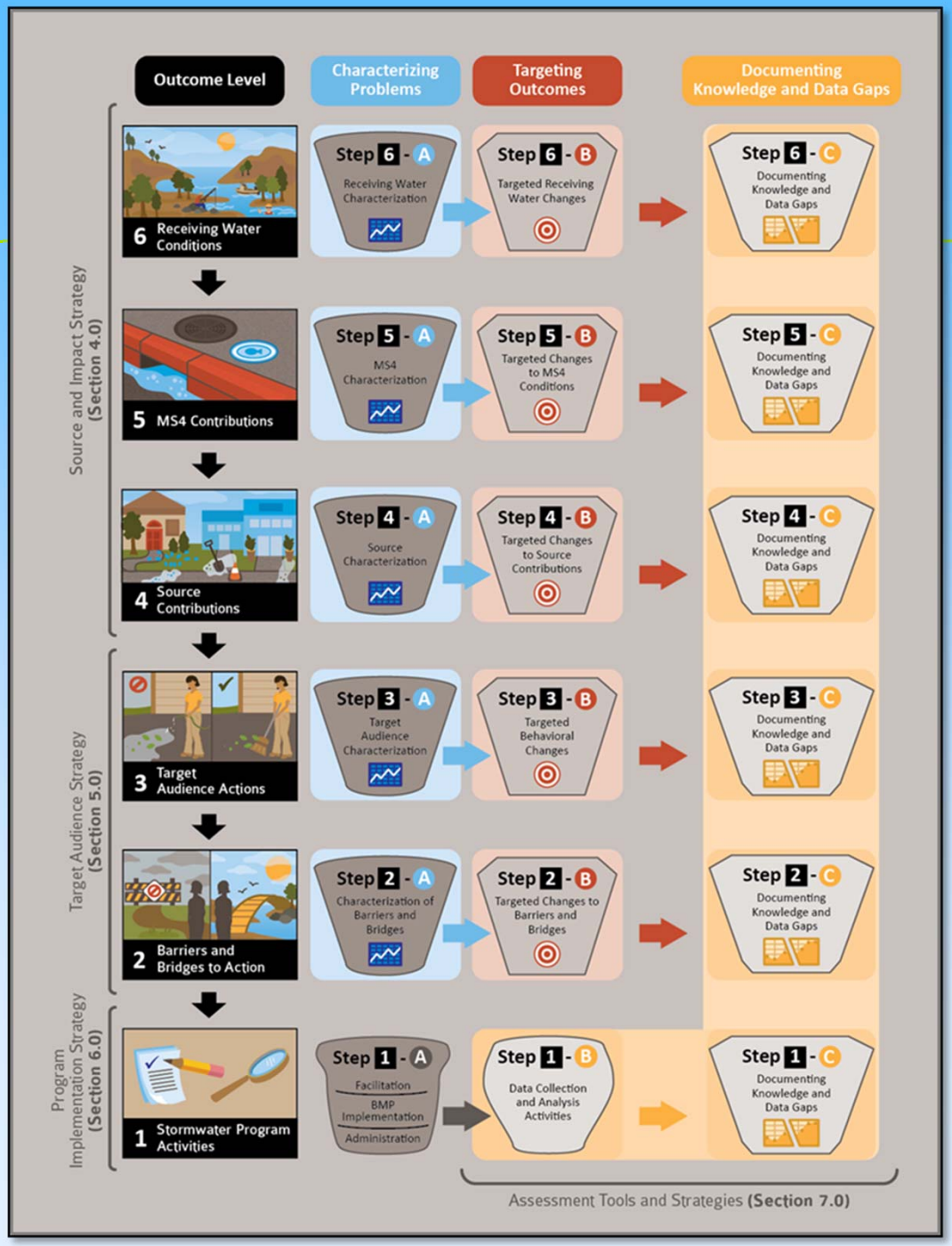
Case Studies

Case Studies

- Case 1- Outcome Levels 6 through 1
  - Receiving water and MS4 water quality data available
  - Constituent based approach
  - Potential sources have been identified
- Case 2- Begins at Level 4
  - Source based approached
  - Limited water quality data

Case Study 1: Assessment of Levels 6 through 1

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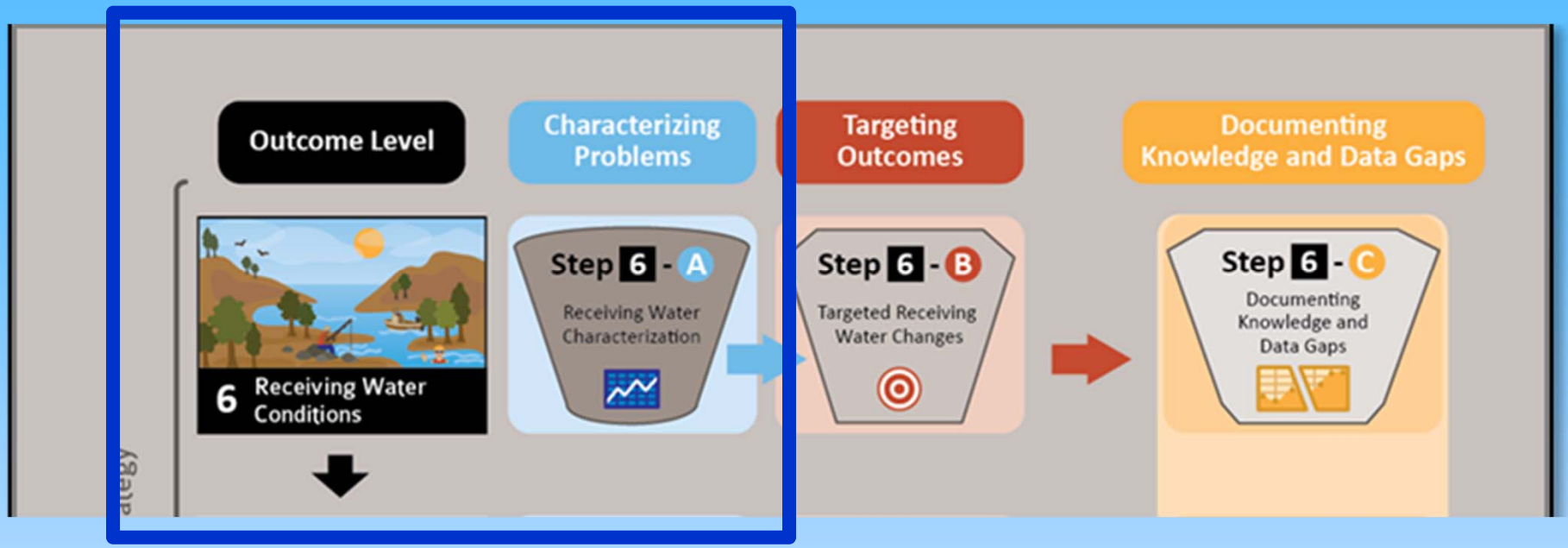
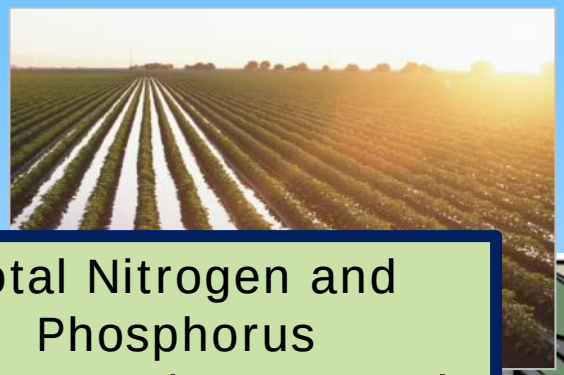


- What are the priority receiving waters?
  - Estuary, listed segments of creek upstream of estuary
- What are priority problems for each priority receiving water?

Case Study 1: Assessment of Levels 6 – Receiving Water

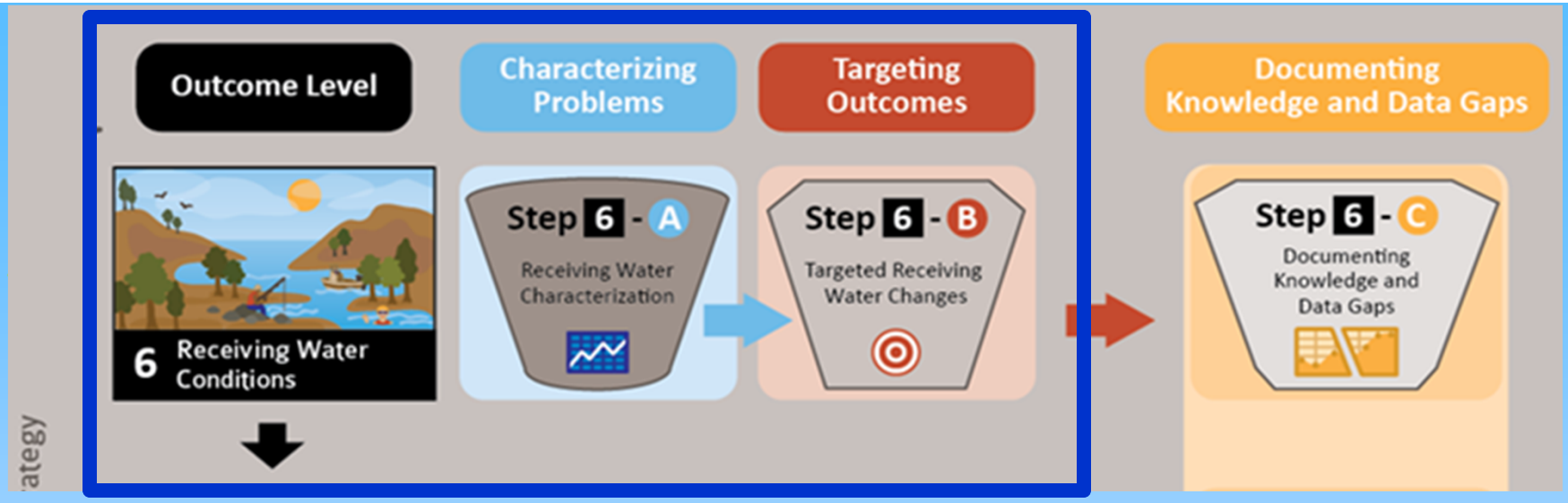


Total Nitrogen and Phosphorus Concentrations exceed water quality objectives in **Creek** dry weather flows

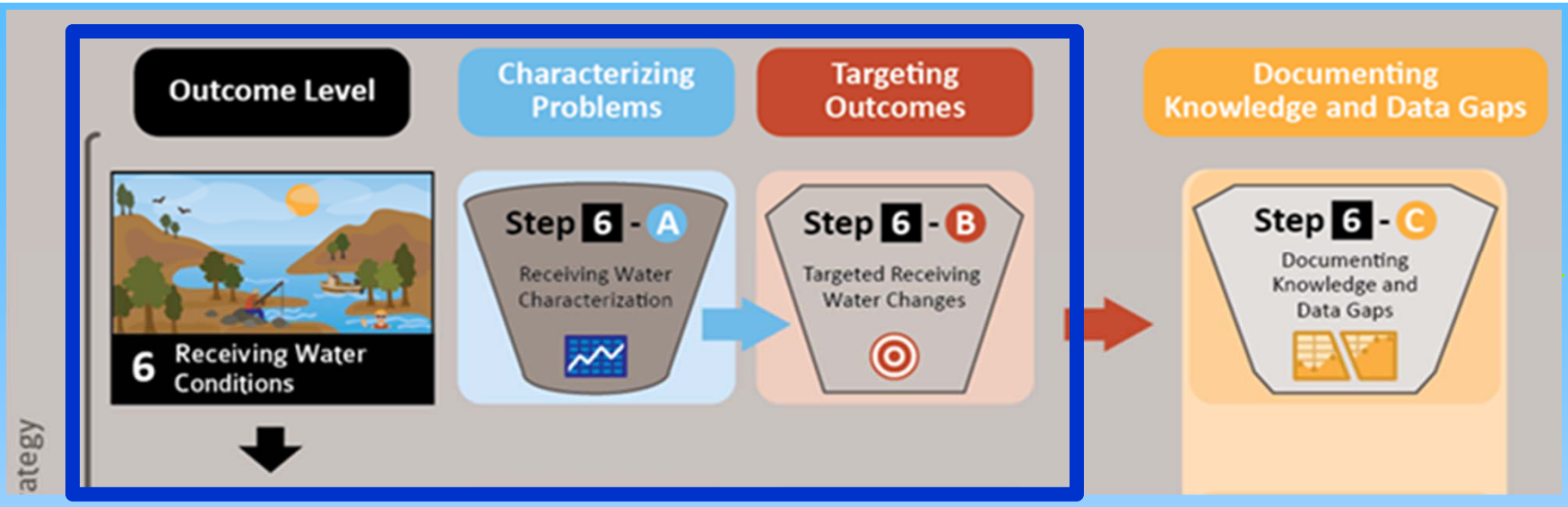
Evidence of Hydromodifcation in Local **Streams**

Biological Impairment in **Creek** based on Bioassessment Data

Algae Blooms, Low DO and Sediment Deposition in **Estuary**



- What Changes will be targeted for the receiving water?
  - Improvement in Water Quality– Reduce nutrient load from dry weather watershed flows
  - Changes in Physical Characteristics – Reduce peak volume storm flows resulting in hydromodification in creek

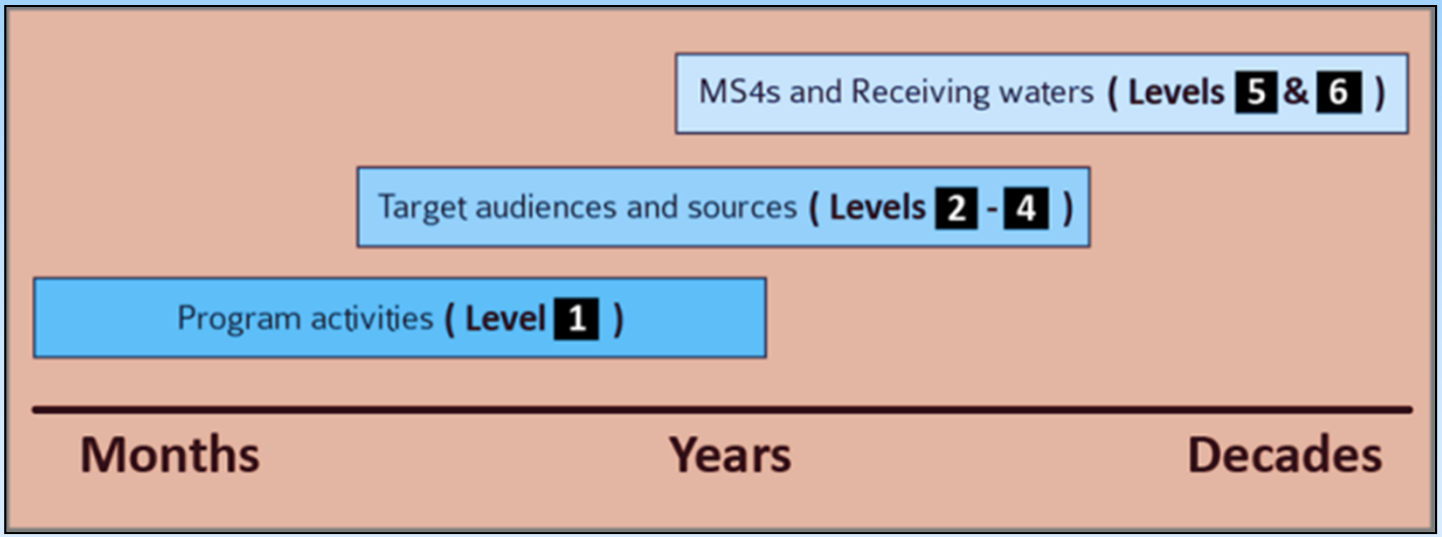


When and how will targeted changes be measured?

- Long-term Trend (5-10 years) measurements of:
  - Improvement in Water Quality –nutrient concentration and flows (load) from dry weather watershed flows
  - Reduction of peak storm flow volume

Step B Targeting Outcomes

General Timelines Needed for Achieving Targeted Outcomes



Targeting Change - Spatial

Level/Spatial Area	Site	Drainage Area	Hydrologic Unit	Watershed
Level 6 – Receiving Water	% Reduction in Nutrient Load			
Level 5 – Urban Runoff/MS 4	% Reduction in Nutrient Load			
Level 4 - Sources	% Conversion of High Fertilizer Use Landscaping			

Complexity (depends) and Cost to Measure Targeted Change

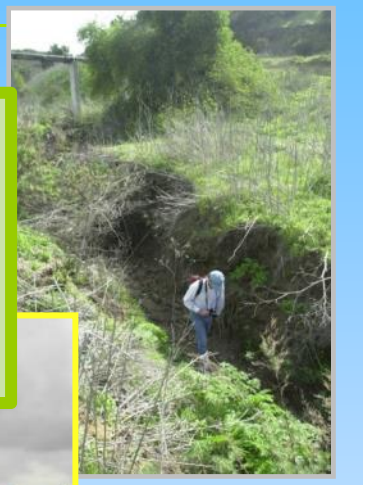
- What data is still needed for characterization and targeting outcomes?
  - Adequacy and quality of the water quality data?
  - How are nutrient concentrations impacting biological resources of creek and estuary?
  - What are priority drainage areas that contribute to creek erosion due to hydromod?

Questions?

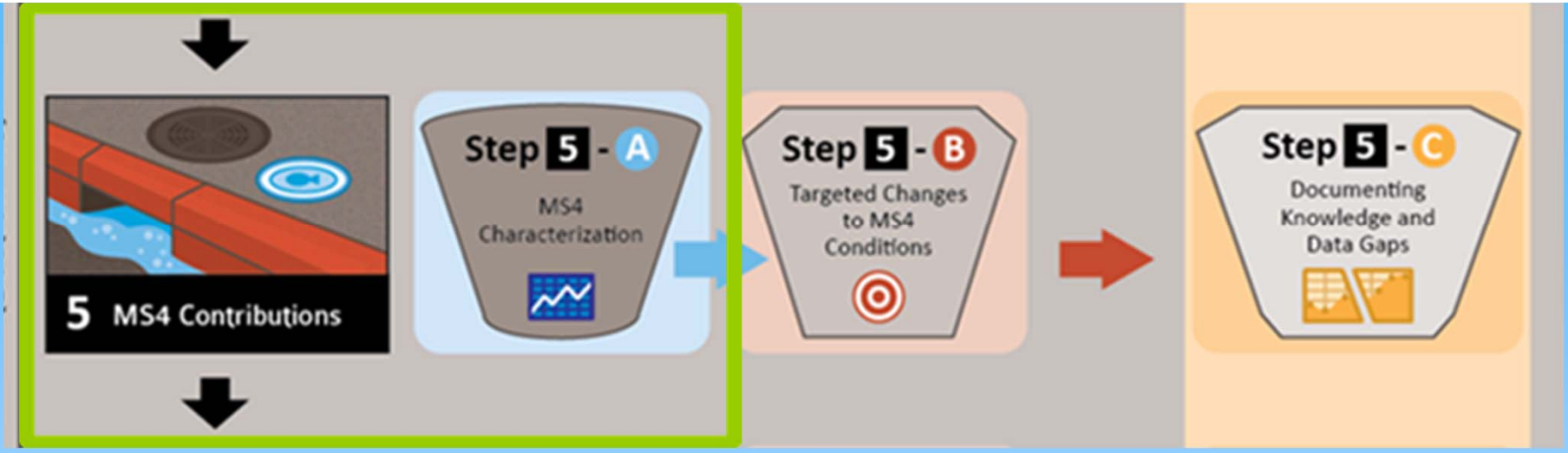
Case Study 1: Assessment of Level 5- MS4 Contributions

Nutrient Concentrations highest in runoff from Upstream Agricultural Land Use

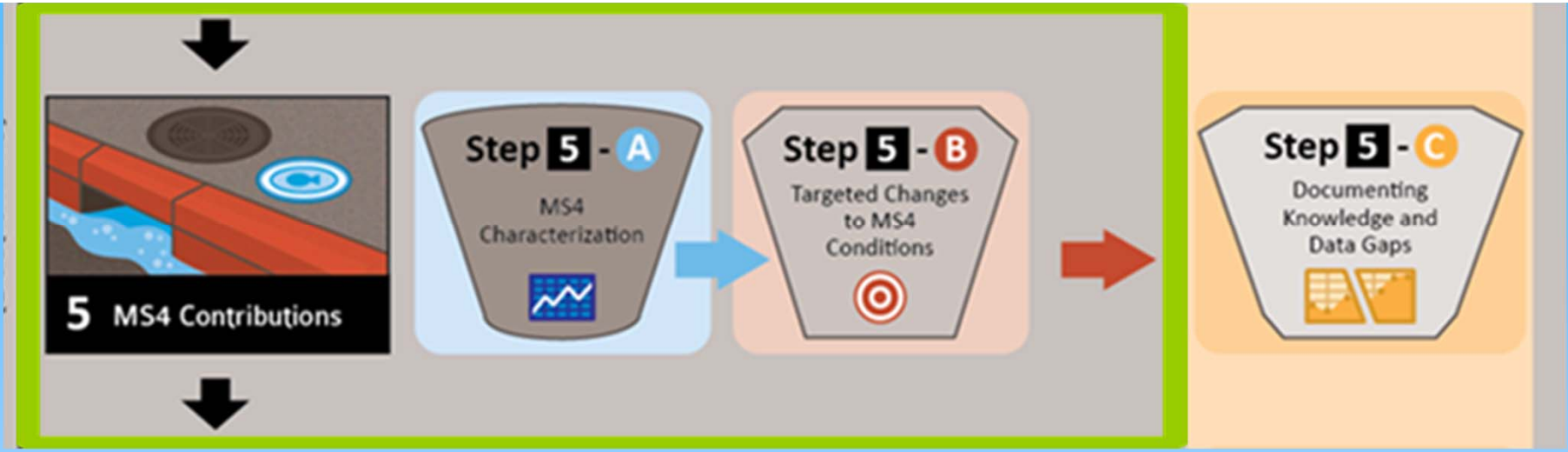
Peak Flows from MS4 Outfalls linked to downstream evidence of extensive erosion of Local Streams



MS4 Outfalls with highest dry weather flows also contribute largest Nutrient loads

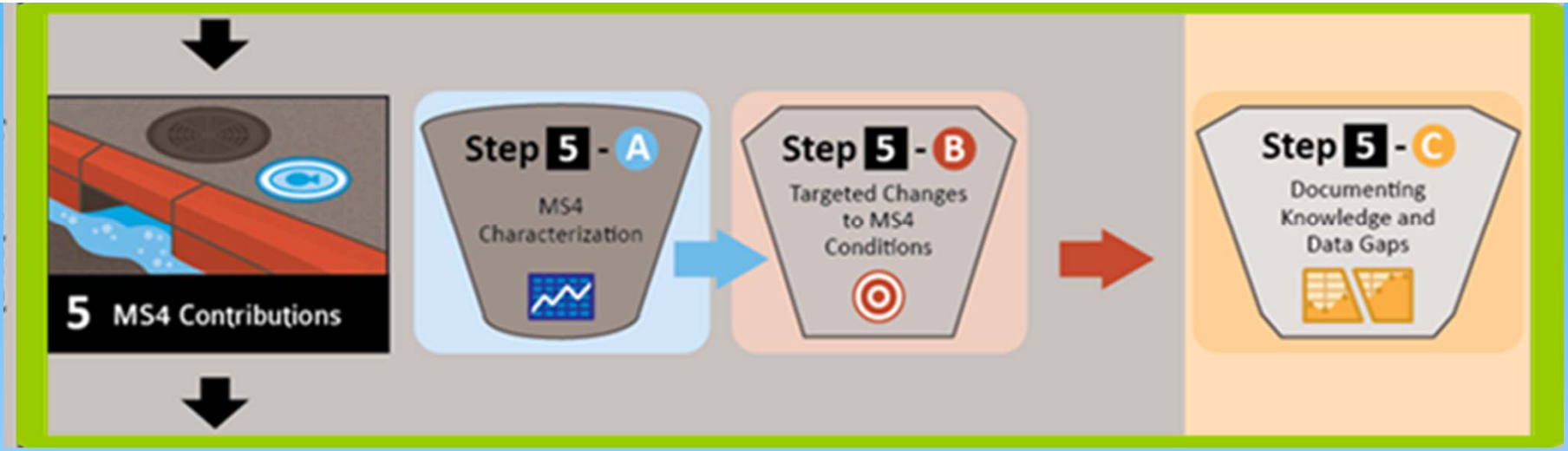


- Which MS4 facilities convey flows to priority receiving waters?
- Which facilities or portions of the MS4 are the highest priorities?
  - MS4s discharging to listed segment of creek that have highest dry weather flows and/or nutrient concentrations
  - MS4s discharging to segment of creek with greatest erosion and increase in peak flow



- What Changes in MS4 conditions will be targeted and how will they be measured?
  - Reductions in priority MS4s dry weather flows and/or nutrient concentrations
    - Annual flow monitoring and 2-5 yr. random sampling
  - Reductions in priority MS4s storm flow volumes
    - Storm event flow monitoring

Step B Targeting Outcomes

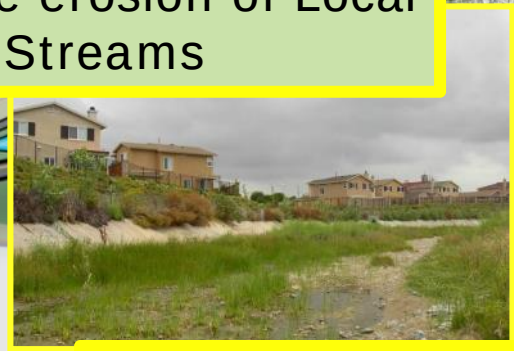


- What data is still needed for characterization and targeting outcomes?
  - Have baseline flows been measured in priority MS4 outfalls to assess change (adequacy)?
  - What contribution does groundwater have in nutrient loading to receiving water compared to MS4?
  - What contribution does runoff from agricultural areas compared to MS4 outfalls?

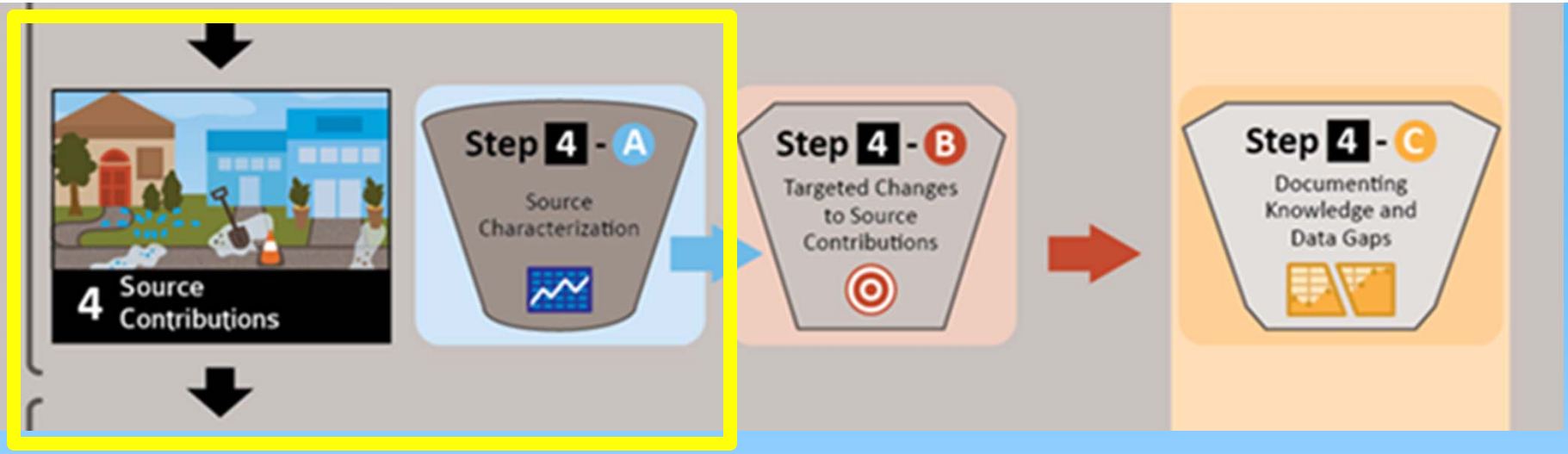
Case Study 1: Assessment of Level 4- Sources

Upstream Agricultural Land Use has measured higher Nutrient Concentrations in runoff

Priority Drainage Areas that contain older development linked to downstream evidence of extensive erosion of Local Streams



Residential and Commercial Landscaped areas in Priority Drainage Area with highest dry weather flows contribute largest Nutrient loads



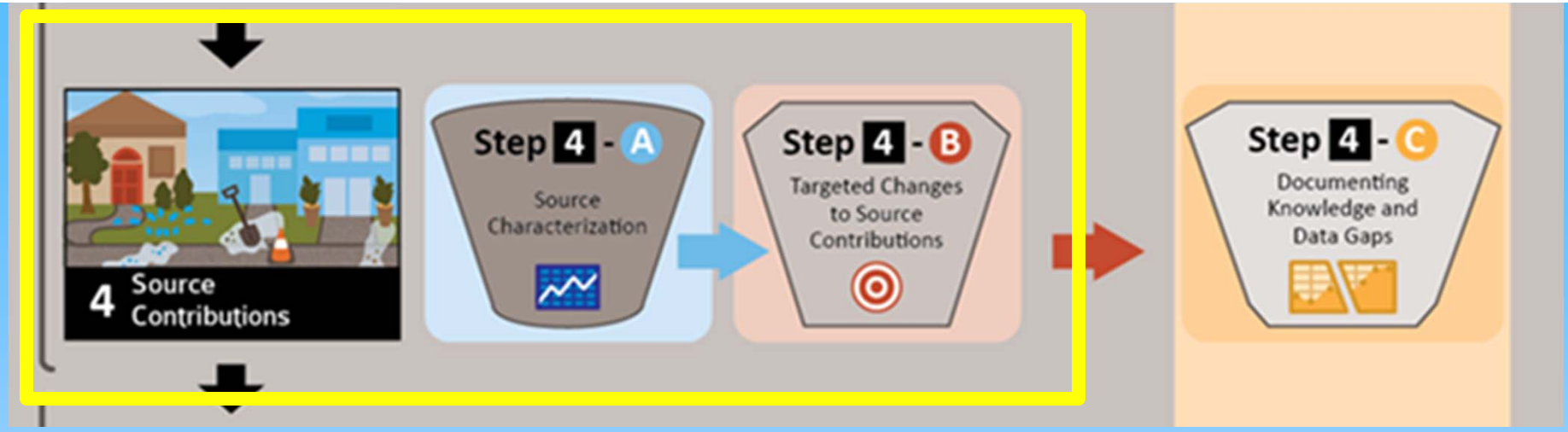
Apply to Single or Set of Priority MS4 Outfalls

- Which drainage areas contribute priority flows or pollutants to the receiving water?
- Which portions of identified drainage areas are the highest priority?
- What are priority sources of pollutants or flow within drainage area?

Case 1: Source and Impacts – Step A Characterizing Problems

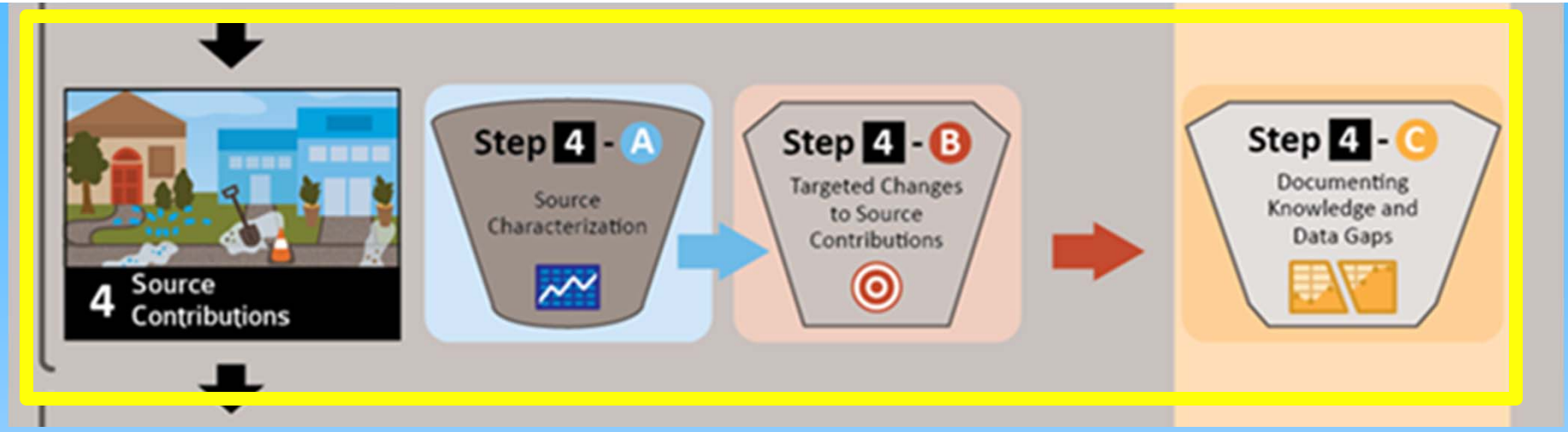
Level 6 – Receiving Water	**•Water Quality - Eutrophication of Estuary - Excess Algae and Low DO in Summer •Bio-indicators – Benthic impairment in creek •Physical Evidence of Hydromod. in creek**
Level 5 – Urban Runoff	**•Water Quality -Nutrient Loading from MS4 •Physical Evidence of Erosion at and downstream of outfalls**
Level 4 - Sources	**Likely Water Quality Sources: •Upstream Agricultural Runoff •Fertilized Landscape in Residential Comm. •Landscape and Organic Debris in MS4 •Groundwater •Air Deposition •Natural Sources of Nutrients •Physical - Concentrated Higher Peak Flows from Urbanized Areas**

Step A Characterizing Problems



What changes will be targeted for each priority source and how will it be measured?

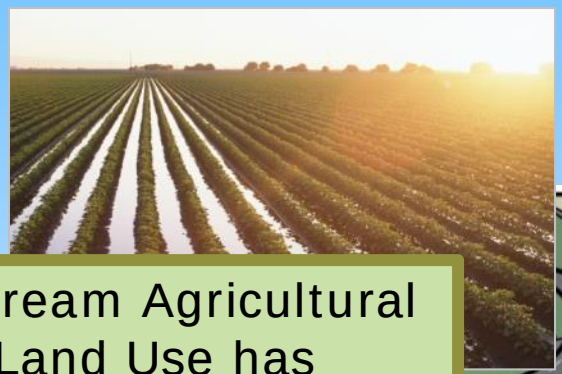
- Reductions in nutrient loading in priority areas.
  - Reduce yard waste in MS4
  - Conversion to zero or minimal fertilized landscapes
  - Measured reductions of dry weather flows
- Reduction in peak storm flows from priority drainage areas from older developed areas



- What data is still needed for characterization and targeting outcomes?
  - Is there baseline data on nutrient contributions from residential and commercial landscaped areas and yard waste in MS4? (complex)
  - What baseline data is available on dry weather flows from targeted land uses?
  - What are contributions from other potential sources and how do they compare to targeted sources?

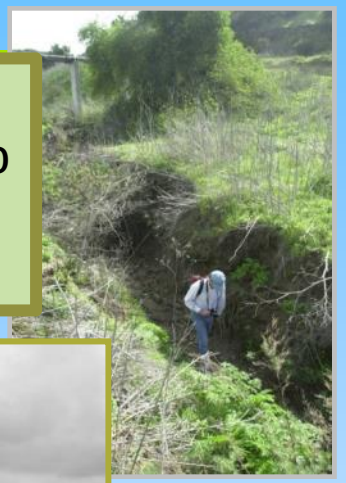
Questions?

Case Study 1: Assessment of Level 3- Target Audience Actions

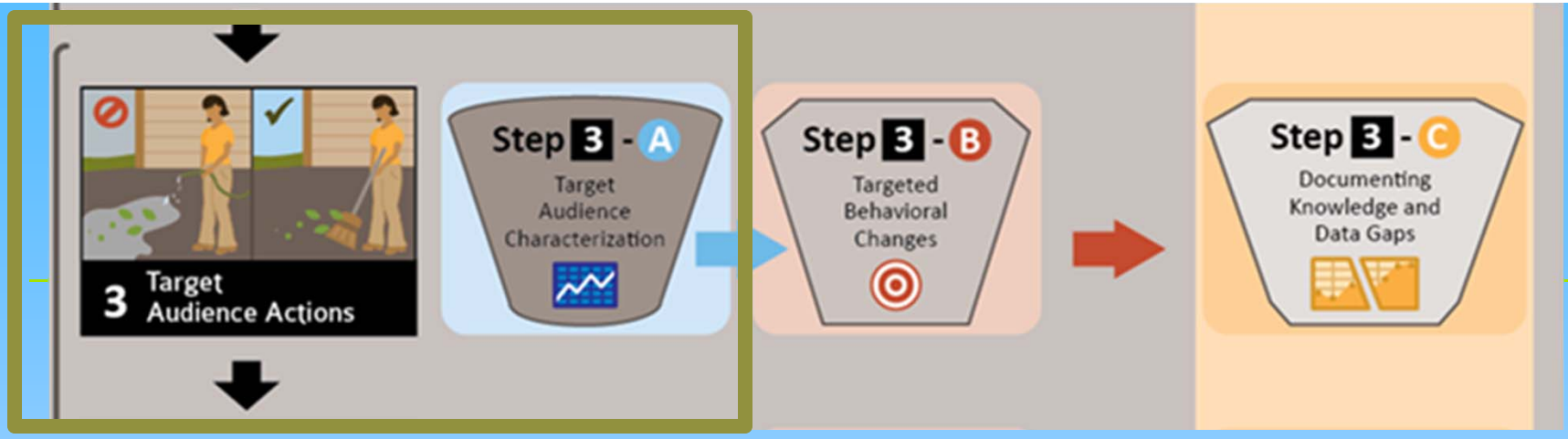


Upstream Agricultural Land Use has measured higher Nutrient Concentrations in runoff

Older development owners and HOAs with no stormwater retention on-site



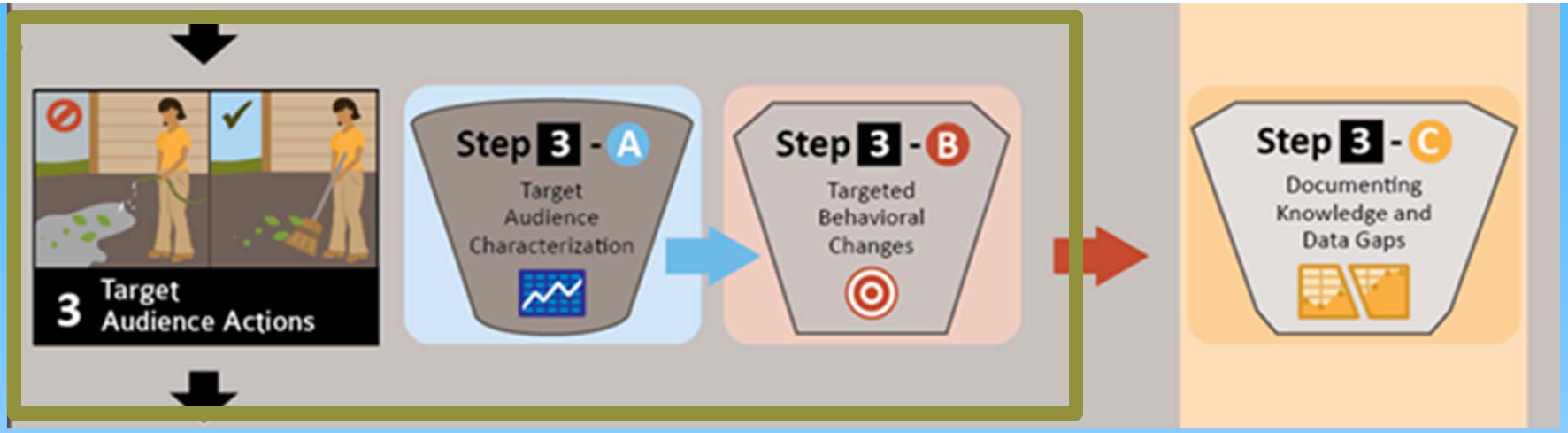
Residential and Commercial Owners with Landscaped Areas in Priority Drainage Areas and Landscape Contractors – over-use of fertilizer, over-irrigation and poor management of yard waste



Who are the target audience responsible for each source contribution?

What specific behaviors are contributing to priority source contribution?

- Commercial/Residential Property owners –High fertilizer use and over-irrigation in landscaped areas
- Landscape Contractors – Overuse of fertilizer, poor maintenance of irrigation systems and improper disposal of yard waste



- What behavioral changes will be targeted to reduce or eliminate priority source contributions?
  - Decrease in pollutant generating activities – over-use of fertilizer, over-irrigation and improper disposal of yard waste
  - Implementation of BMP – *non-structural* – change over-use of fertilizer and disposal practices of yard waste by residential and landscape contractors – *structural* –turf replacement

Step B Targeting Outcomes

Case 1: Targeted Change –Metrics

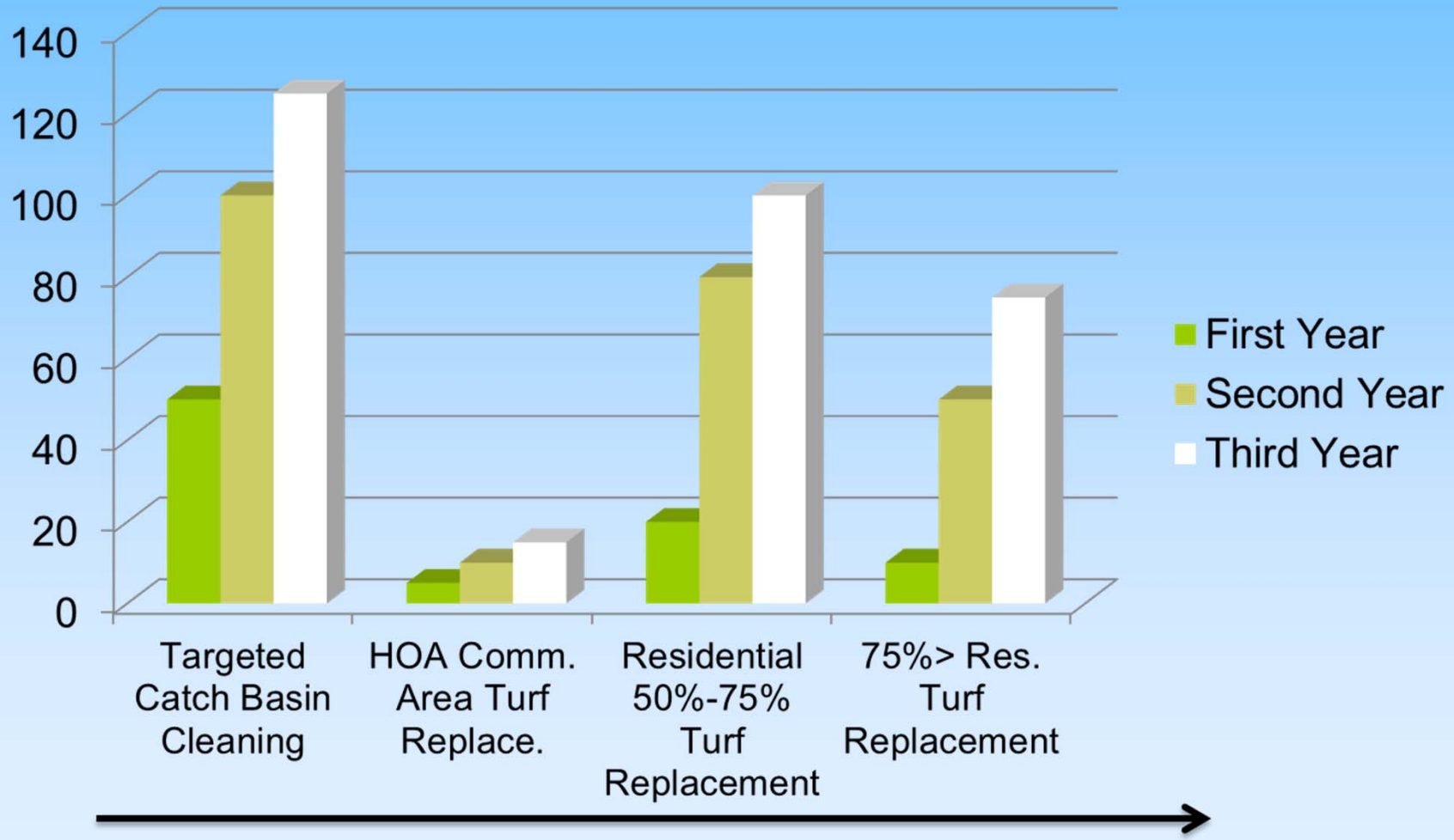
Level	Interim Targeted Change	5 Year Timeline- Measurement of Targeted Change
6 – Rec. Water	• Decreasing trend in • nutrient concen.	• Monitor Nutrients, DO & Algae – 1X/5 years
5 – Urban Runoff	• % Reduction of Nutrient Load	• Conduct Random Sampling of MS4 outfalls – 2-5 year intervals • Annual Flow measurements
4 – Sources	• Achieve % increase in converted lawns • Reductions at priority sites	• Count % of residences & commercial sites converted to lower fertilizer use landscape • Conduct Runoff Monitoring of Selected Sites- converted landscapes
3- Target Audience	• **Reduce % occurrence of high fertilizer use and improper disposal of yard waste**	• **Count % occurrence of activities by target audience with higher nutrient loading potential - compare with baseline year**

Level 3 Outcomes

Potential Target Audiences by Source Category

Residential Sources	
Do-it-yourselfers (e.g., gardening and yard care; home improvement; power washing; vehicle washing, maintenance, and repair)	Pet owners
	Livestock owners
	Smokers
	Recreational water users (swimmers, surfers, etc.)
Service providers (commercial operations corresponding to same activities as above)	Schoolchildren
	Hotline callers
Municipal Sources	
Garbage collectors	Waste water collection and water distribution maintenance staff
Street maintenance staff	
Park and grounds maintenance staff	Animal control staff
Building maintenance staff	Law enforcement staff
Grading plan or permit reviewers	Flood control or reclamation district maintenance staff
Grading or construction inspectors	
Industrial and commercial business inspectors	Hazardous materials inspectors
Industrial and Commercial Sources	
Owners	Mobile operators
Managers and supervisors	Contractors (landscaping, parking lot sweeping, etc.)
Employees (skilled workers and laborers)	
	Industry associations
	Employee unions
Construction Sources	
Owners	Contractors (plumbing, etc.)
Developers	Skilled workers
Planning groups	Laborers
New Development and Redevelopment Sources	
Engineers and architects	Developers
Landscape architects	Housing authorities
Urban planners	Flood control or reclamation district planners
Engineers	

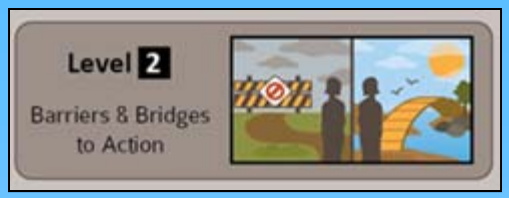
Tools to Measure Targeted Change – Targeted Sources & PGAs – Shorter Timeline



Questions?

Apply to each priority behavior

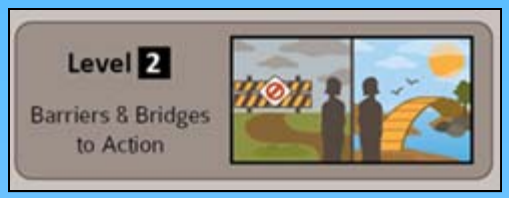
- Who are the factors that favor the implementation of pollutant generating activities (PGA)?
- Which of these barriers is contributing to priority PGA's?



Personal Factors

Table 5.11: Examples of Personal Factors that Can Affect Behaviors

	Pesticide Use	Vehicle Washing	Disposal of Reusables	Sediment Discharge
Knowledge	Pesticides should be applied according to label instructions	Controllable spray nozzles can significantly reduce runoff	Compost piles should be turned at least weekly	Silt fences should not be used at the base of a slope
Awareness	My pesticides can harm aquatic life	Commercial car washes minimize runoff	Training on composting is locally available	Discharges can be reported to a local hotline
Attitudes	Healthy plants are more important than environmental protection	People have a right to wash their cars on the street	Composting is too messy to bother with	Construction will be completed long before anyone notices our runoff



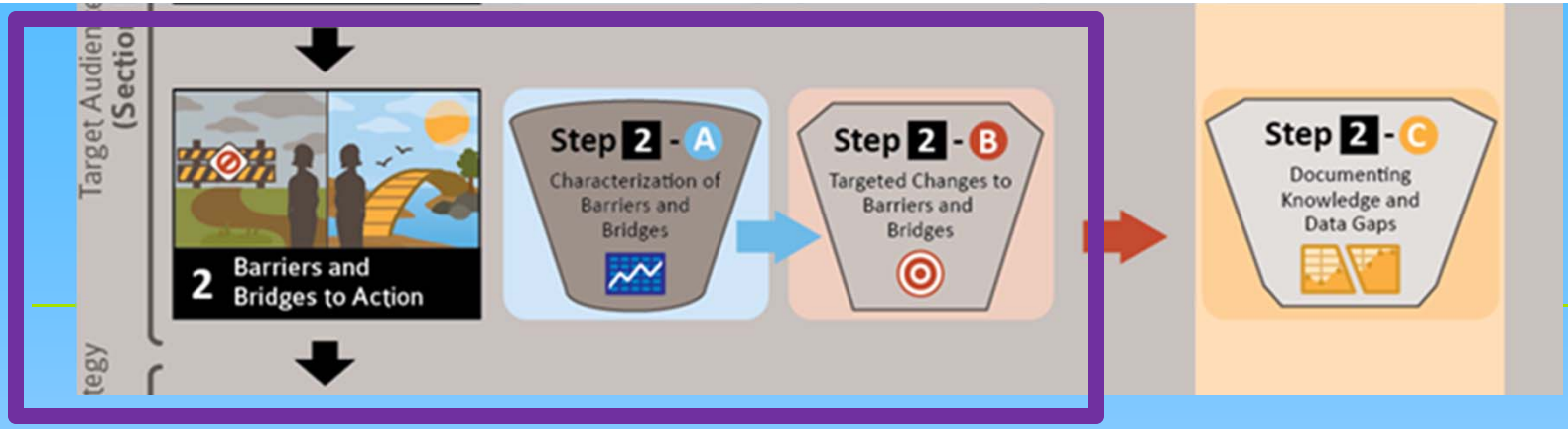
External Factors

Table 5.12: Examples of How External Factors Can Influence Behavior

	Pesticide Use	Vehicle Washing	Disposal of Reusables	Sediment Discharges
Regulatory factors	Some pesticides can be applied only by licensed pest control applicators; others are freely available	A program prohibits discharges from businesses, but not at residences	Re-use of materials is encouraged rather than legally required	Ordinances prohibit discharges, but do not require prevention through erosion control practices
Economic factors	Many pesticides are inexpensive or cheaper in large quantities	Washing in a driveway is cheaper than using a car wash	Changes in practices may require upfront investments (e.g., composting bins)	Materials needed for stabilization projects can be expensive
Technological factors	Effective alternatives do not exist for a particular use (e.g., ant control)	Controllable spray nozzles are widely available	Technologies are not widely available for recycling of "higher numbered" materials	A variety of products are available for effectively managing discharges
Structural factors	Site safety issues limit the use of pesticide alternatives	A nearby parking lot with a pervious surface could facilitate environmentally friendly car washing	A community garden provides residents access to composting bins	Site topography or space limitations inhibit the use of sediment control practices
Organizational factors	A business lacks a policy or procedures on pesticide use	A company has an offsite vehicle washing policy	Employees are actively encouraged to recycle and reuse	Site maintenance is not an organizational priority
Societal factors	Green lawns are valued as part of a community's identity	Washing soapy water onto streets is considered "low class"	Composting is valued by the community	Sediment discharges onto public streets are considered unsightly
Communication factors	Residents lack information on pesticide alternatives	Information on "dry washing" techniques is widely available	Recycling and reuse policy is not communicated to employees	Information on effective erosion control practices is not widely available

Case 1: Target Audiences/ Barriers and Bridges

Level 4 – Sources	•Upstream Agricultural Runoff •Fertilized Landscape in Residential Comm. •Landscape and Organic Debris in MS4
Level 3 – Target Audiences	•Agricultural Community •Residences •Landscapers •Landscape Contractors •Municipal O&M - Street/Catchment •Over-irrigation
Level 2 - Barriers & Bridges	**Personal Factors (awareness, knowledge, attitudes)** • **Lack of knowledge of over-use of fertilizer link to WQ** • **Indifference to changing fertilization use or irrigation practices** **External Factors (regulatory, financial, social)** • **Agricultural community –under waiver**



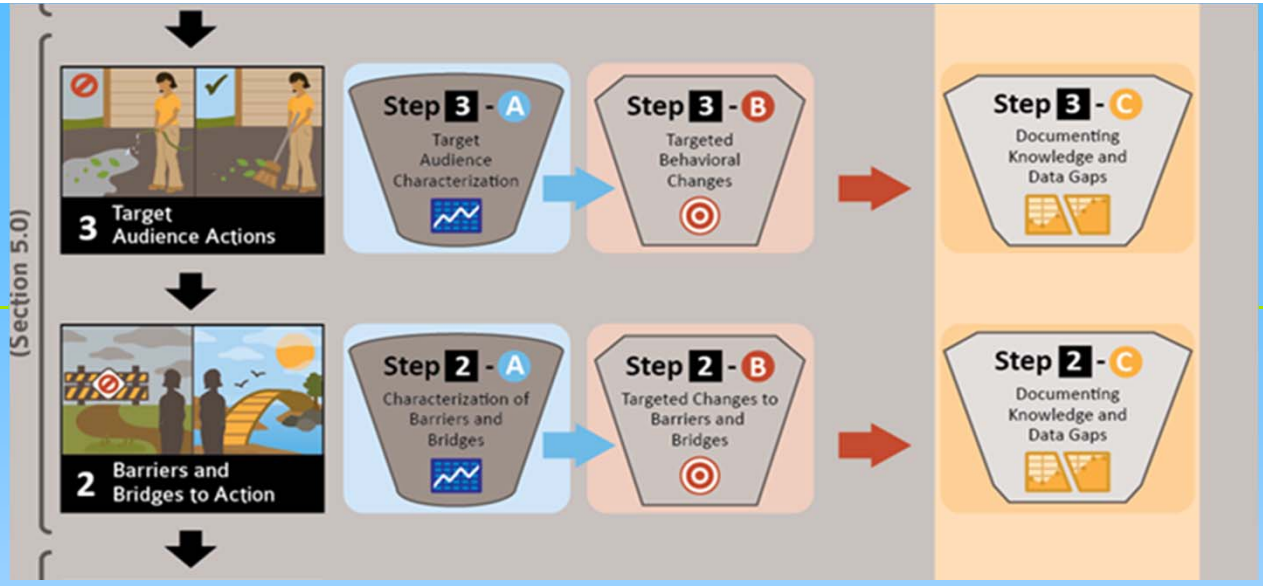
Apply to each priority behavior

- What bridges are necessary to address priority source contributions?
  - Change in regulatory regime to address agricultural waiver; training to increase knowledge of workers; training and education to change awareness and incentives to change old practices.
  - What are the metrics to measure success?

Step B Targeting Outcomes

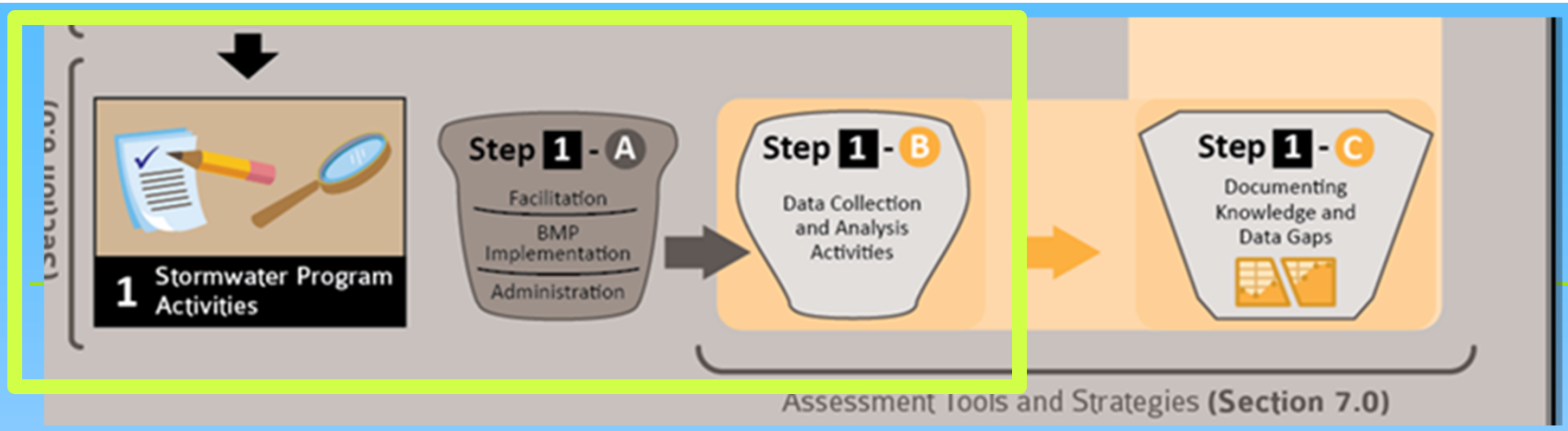
Case 1: Step B Targeting Outcomes

Level	Interim Targeted Change	5 Year Timeline- Measurement of Targeted Change
3 – Target Audience	• % of highest priority agricultural properties implement BMPs • % of Residences for target are that use trained landscapers • Number of residences that use more efficient irrigation system	• Survey highest priority sites for pollutant generating activities (PGA) modified per nutrient reduction plan • Based on survey of residences within target area that have changed to trained landscaper • Based on applications for rebates for smart irrigation systems, turf replacement, drip irrigation upgrades
2 – Bridges & Barriers	• Change awareness and knowledge of residences & landscape contractors, on PGAs and the BMPs to reduce over-use of fertilizer, over-irrigation & yard waste disposal.	• Surveys and interviews with residences and landscape contractors in target areas



- What data is still needed for characterization and targeting outcomes?
  - Is the targeted audience that is surveyed for change in awareness and knowledge consistent or is there high turn-over reducing effectiveness?
  - Are there other behaviors and barriers that contribute to greater source contributions that have not been identified, prioritized and targeted?

Step 1 - C Documenting Knowledge and Data Gaps



- What facilitation activities will be targeted to reduce or eliminate priority PGAs in target audience?
  - Cooperation Agreement with Agricultural Community
  - Development of Nutrient Reduction Plans – BMPs
  - Training Programs for Ag. Workers and Landscapers
  - Establishment of Rebate System to incentivize residents to convert landscaping & irrigation system
- What program data collection, management and reporting is needed?

Case 1: Step B Targeting Outcomes

Level	Interim Targeted Change	5 Year Timeline- Measurement of Targeted Change
1 – Stormwater Program Activities	• Obtain cooperation agreements with % of priority agricultural sources • Institute training for agricultural workers, & landscape contractors on BMPs • Establish rebate program	• Number of agricultural properties that sign up for cooperation agreement on nutrient reduction plan • Record number of agricultural workers trained and use BMPs • Number of rebates given for irrigation BMPs and number installed

Questions?

Case Study 2: Levels 4 through 1

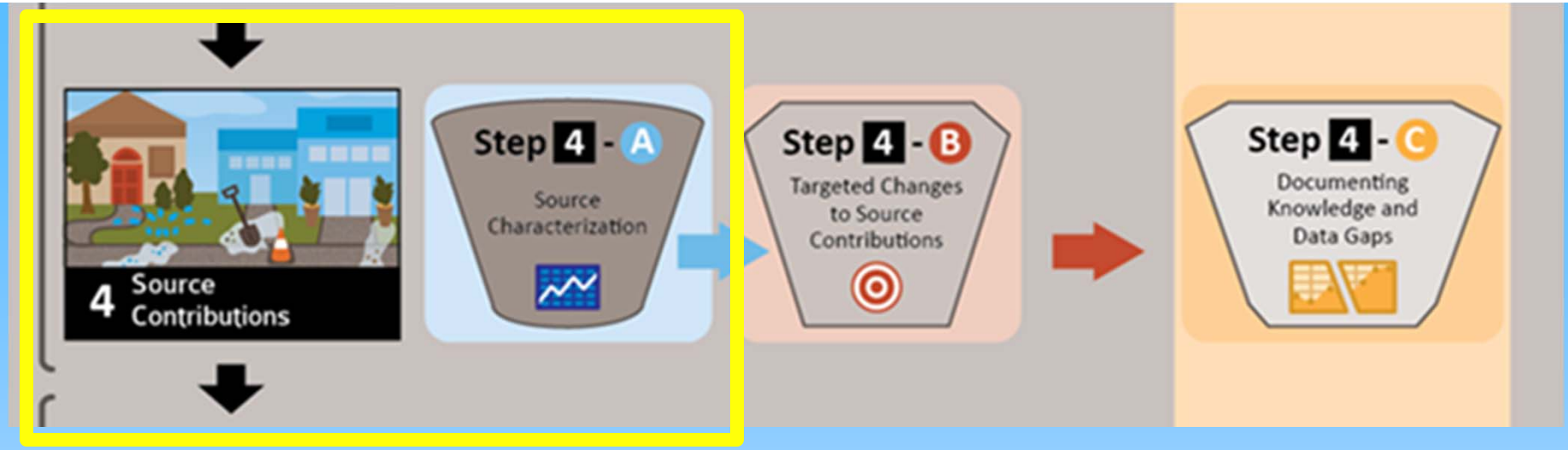
Sources of MS4 Non-Storm Flows from Stormwater IC/ID Inspection and Enforcement Program:

- Over-irrigation
- Broken/leaking irrigation valves
- Vehicle Washing
- Hard Surface Washing
- Pool Maintenance
- Dewatering

MS4 Permit requires non-storm water flows from MS4 to be eliminated

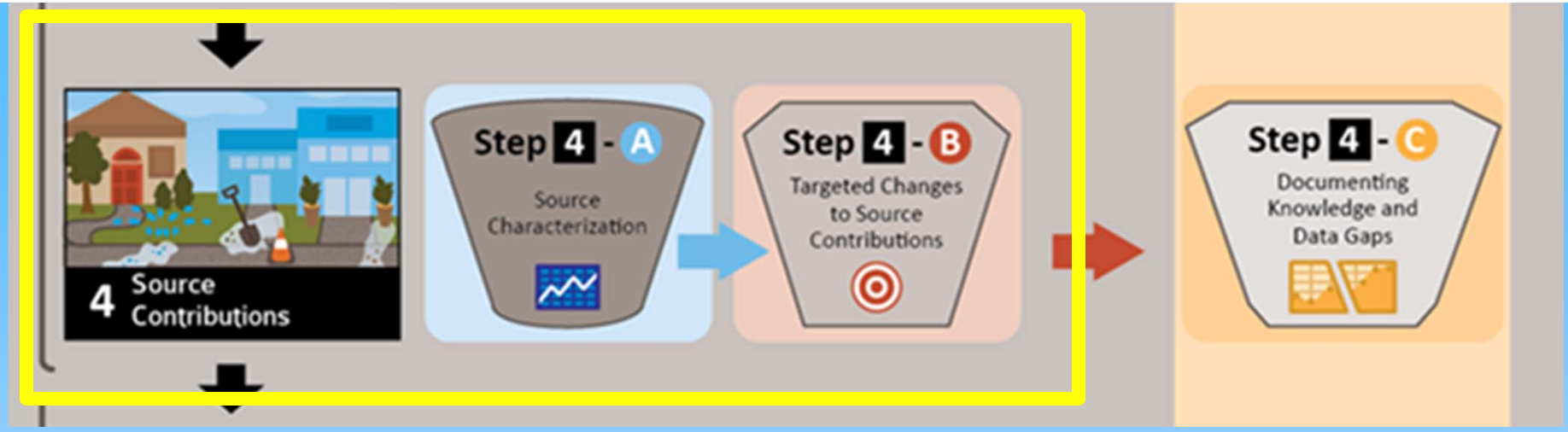
Stormwater Program has **limited MS4 Water Quality Data**

Stormwater Program has **limited Water Quality Receiving Water Data**



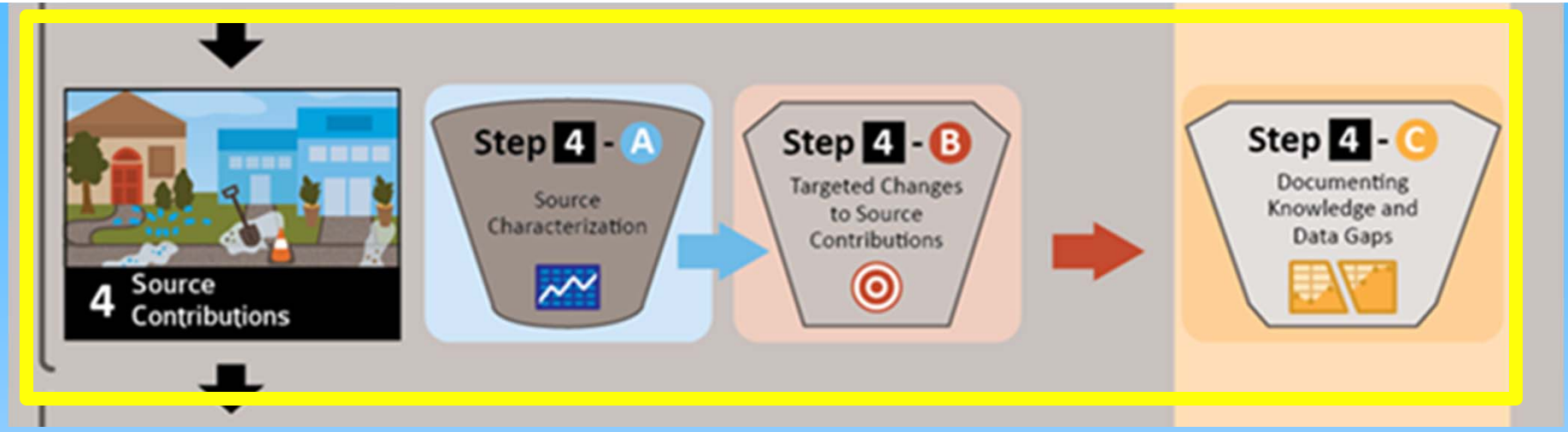
Apply to Single or Set of Priority MS4 Outfalls

- Which drainage areas contribute to greatest sources of non-storm flows?
  - MS4 flow data or use inspection program data
- Which portions of identified drainage areas are the highest priority?
- What are priority sources of non-storm flows within drainage area?

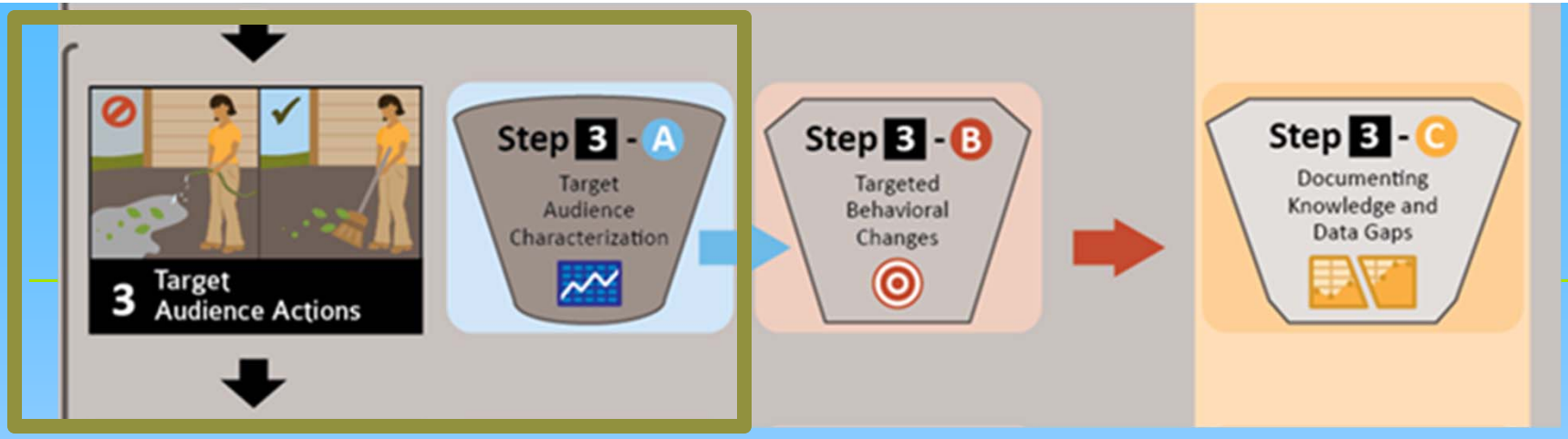


What changes will be targeted for each priority source and how will it be measured?

- Reductions in non storm flows in priority drainage areas.
  - Measured reductions of dry weather flows from residential and commercial land uses within high priority areas



- What data is still needed for characterization and targeting outcomes?
  - What baseline data is available on dry weather flows from targeted land uses?
  - What non-storm flow data is needed from MS4 outfall monitoring to better prioritize drainage areas?
  - What are contributions from other potential sources and how do they compare to targeted sources?



Who are the target audience responsible for each source contribution?

What specific behaviors are contributing to priority source contribution?

- Commercial/Residential Property owners –Over-irrigation in landscaped areas
- Landscape Contractors –Poor maintenance of irrigation systems
- Residences & Commercial Operators - vehicle and hardscape washing

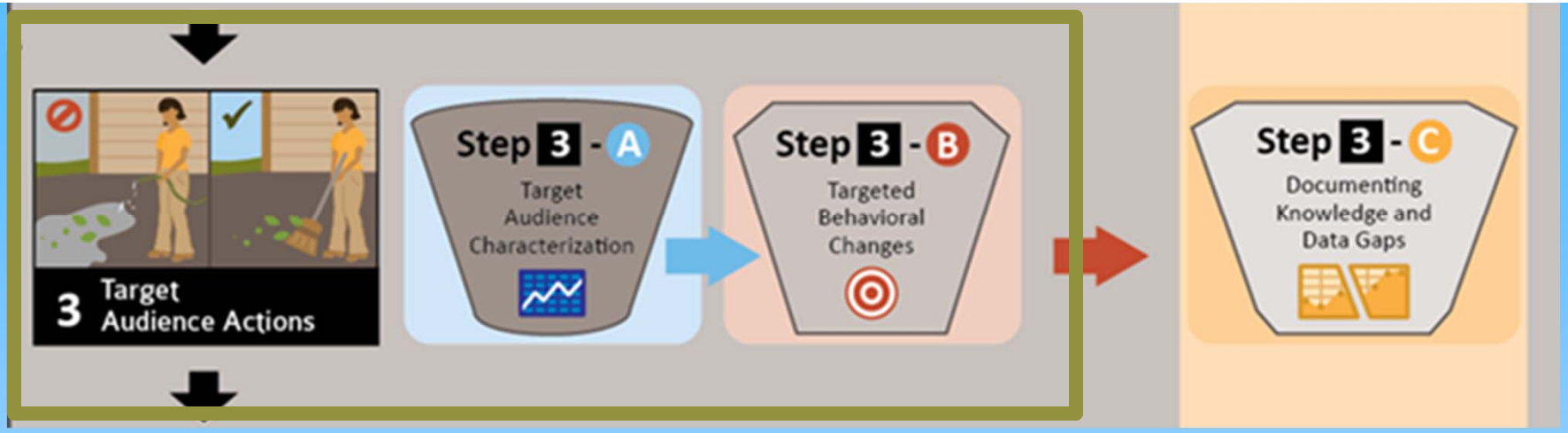
Case Study 2: Assessment of Level 3-Target Audience Actions

Target Audience Behaviors:

- Over-irrigation
- Maintenance of Broken/leaking irrigation valves
- Vehicle Washing
- Hard Surface Washing
- Pool Maintenance
- Dewatering

Target Audience:

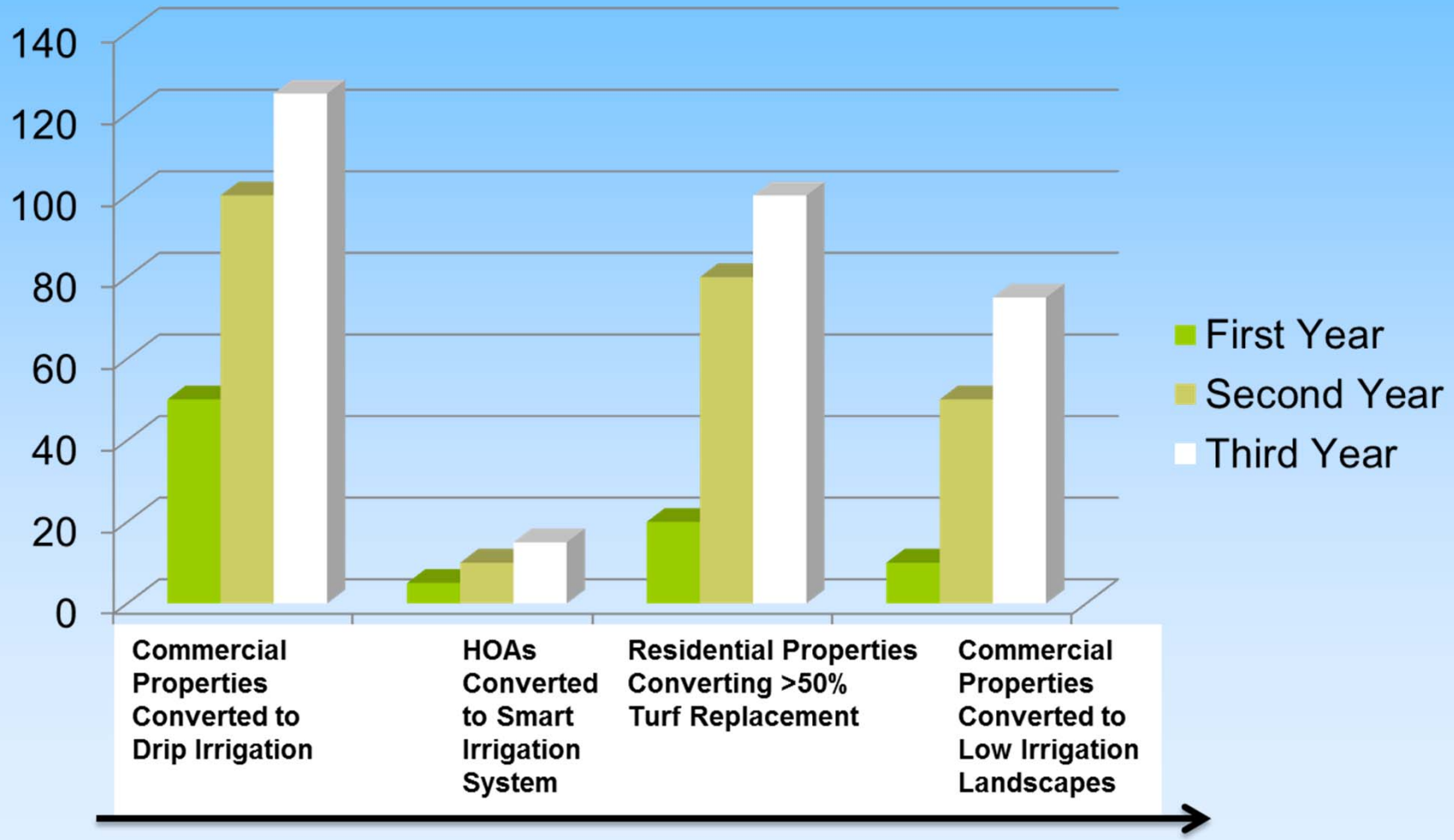
- **Residences** with Landscaped Areas requiring irrigation
- **Commercial** owners with Landscaped Areas requiring irrigation
- **Landscape Contractors** providing irrigation system maintenance



- What behavioral changes will be targeted to reduce or eliminate priority source contributions?
  - Decrease in pollutant generating activities –over-irrigation, poor maintenance of irrigation system, vehicle washing
  - Implementation of BMP – non-structural – enforcement of non storm flow prohibition – structural – drip irrigation, smart irrigation systems, leak detection

Step B Targeting Outcomes

Tools to Measure Targeted Change – Targeted Sources & PGAs

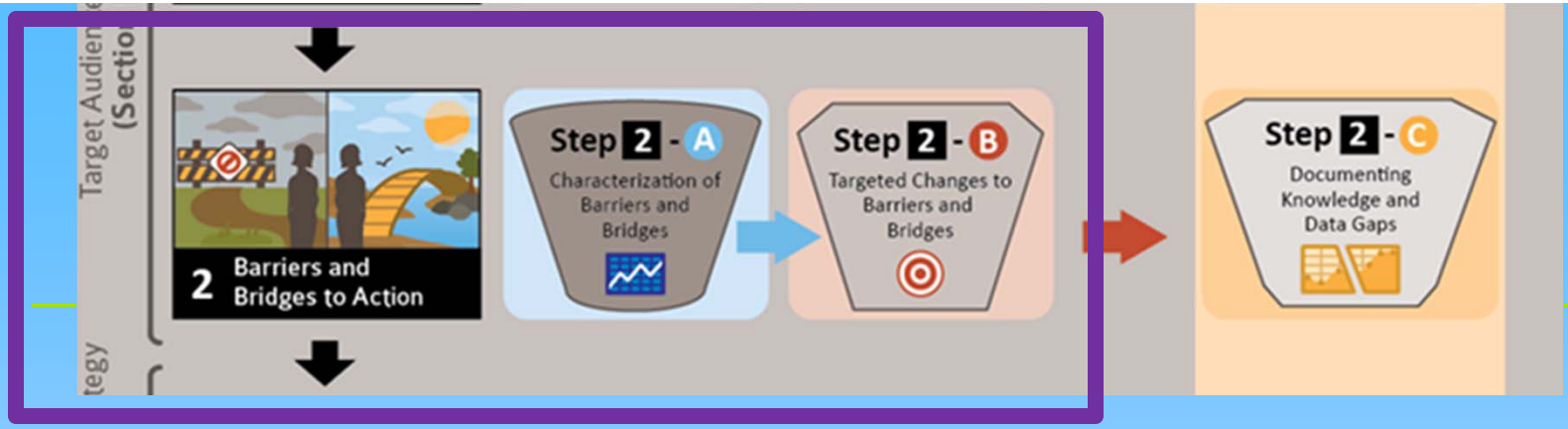


Apply to each priority behavior

- What are the factors that favor the implementation of pollutant generating activities (PGA)?
- Which of these barriers is contributing to priority PGA's?

Case 1: Target Audiences/ Barriers and Bridges

Level 3 – Target Audiences and Behaviors	•Residences; Commercial Property Owners; Landscape Contractors • Over-irrigation • Maintenance of Broken/leaking irrigation valves • Vehicle Washing • Hard Surface Washing • Pool Maintenance • Dewatering
Level 2 - Barriers & Bridges	**Personal Factors (awareness, knowledge, attitudes)** • **Barrier - Lack of knowledge of over irrigation** • **Barrier - Indifference to changing irrigation practices** **External Factors (regulatory, financial, social)** • **Barrier – Cost of replacing irrigation system** • **Bridge – Drought awareness & rising cost of water** • **Bridge - Non-Storm Water Prohibition**



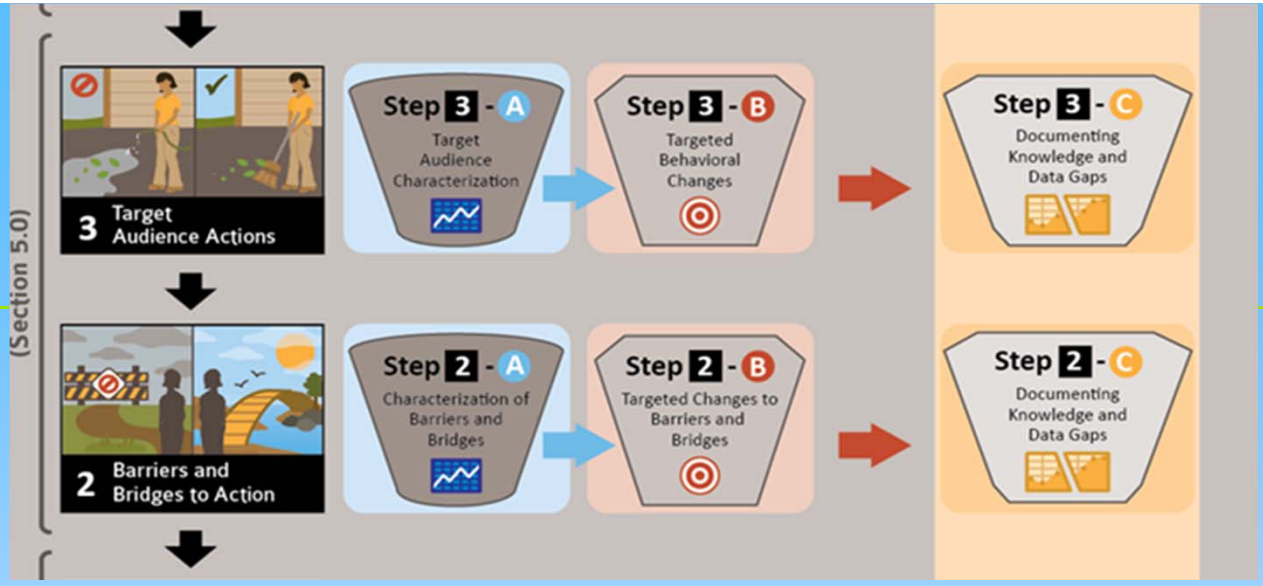
Apply to each priority behavior

- What bridges are necessary to address priority source contributions? PGA – over-irrigation
  - Drought Awareness – education - connection to over-irrigation
  - Rising cost of water – education - connection to over-irrigation
  - Non storm flow prohibition in MS4 Permit – enforcement of PGA
  - Rebates for More Efficient Irrigation System or Turf Replacement - Incentives
- What are the metrics to measure success?

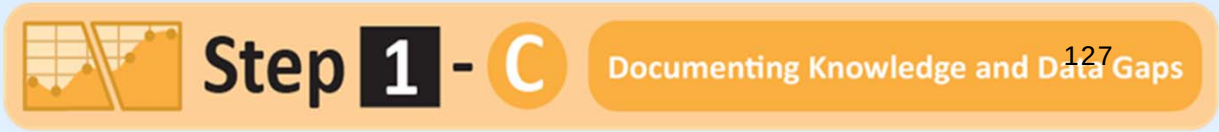
Step B Targeting Outcomes

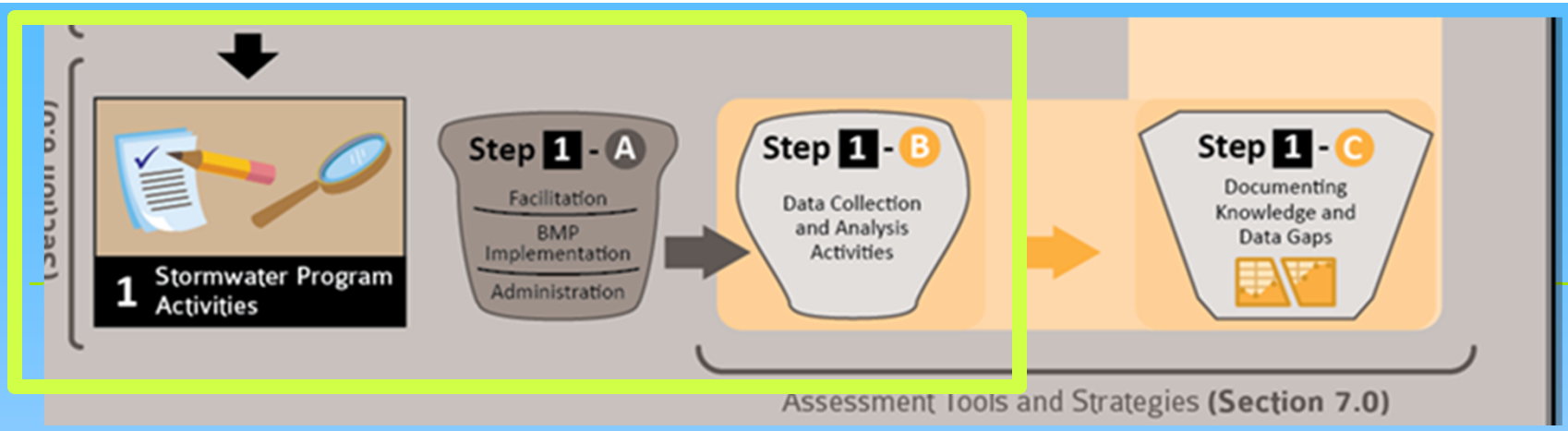
Case 1: Step B Targeting Outcomes

Level	Interim Targeted Change	5 Year Timeline- Measurement of Targeted Change
3 – Target Audience	• % of Residences for target area that implement turf replacement • Number of residences that use more efficient irrigation system	• Based on number of application for residential turf replacement • Number of commercial properties that have applied for green business program that provides rebates for more efficient irrigation systems • Based on applications for rebates for smart irrigation systems, turf replacement, drip irrigation upgrades
4 – Bridges & Barriers	• Increased in awareness of connection between drought and over-irrigation • Increase knowledge of non-storm water prohibition	• Surveys of residences in targeted areas on awareness of connection between drought and over-irrigation • Surveys of commercial properties knowledgeable about non-storm flow prohibition and enforcement actions • Number of enforcement actions that have been cited and addressed.

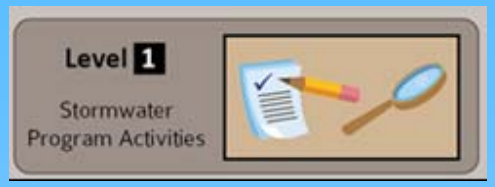


- What data is still needed for characterization and targeting outcomes?
  - What bridges are most effective in changing behavior in over-irrigation?
  - Are there other behaviors and barriers that contribute to over-irrigation and other PGS that have not been identified, prioritized and targeted?

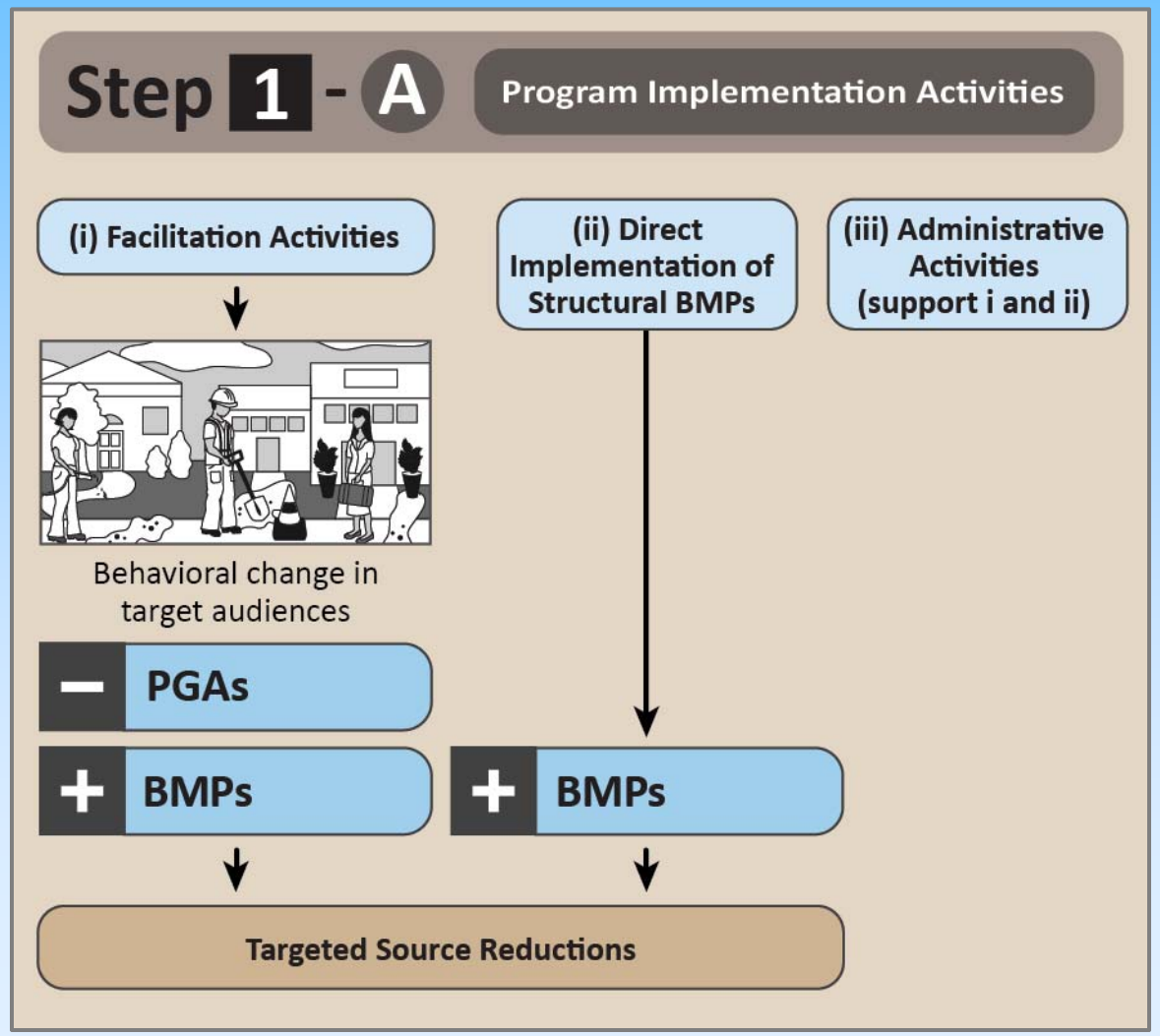




- What facilitation activities will be targeted to reduce or eliminate priority PGAs in target audience?
  - Establishment of Rebate System to incentivize residents and commercial properties to convert landscaping & irrigation system
  - Expand Education and Outreach to increase awareness of non-storm flow prohibition, enforcement program and rebate incentive program.
  - Increase Enforcement and Fines for Over-irrigation
- What program data collection, management and reporting is needed?



Level 1 Outcomes



Case 2: Importance of Program Effectiveness Assessment

- Allows program managers to assess effectiveness of programs at multiple outcome levels – different metrics, timelines, interlinked outcomes
- What's more successful: education, enforcement or incentives? Or is it the combination that is most effective?
- What structural BMPs will ultimately be needed where more cost effective non-structural hits limitations? Most successful runoff reduction program will be 30-50% effective.

Questions?

Thank you!

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