Section 3.0 Introduction to Strategic Planning for Stormwater Management Programs

*This section applies the concepts and principles described in **Section 2.0** to the development of a **Stormwater Strategic Plan** that will guide the development and implementation of specific stormwater management plans and programs, and establish a basis for evaluating and updating them. Strategic planning for stormwater managers is best thought of as "strategic problem solving." Managers will identify and prioritize the problems to be addressed by their programs and develop strategies for resolving them. As a part of this process, managers will consider each of the six outcome levels introduced in **Section 2.0**. The general planning process described in this section will provide a basis for the more detailed guidance described in **Sections 4.0** through **7.0**.*

3.1 Background

Stormwater program management can be broadly divided into three phases of activity (**Figure 3.1**):

1. Program planning and modification;
2. Program implementation; and
3. Effectiveness assessment.
4. During the program planning phase, implementation and assessment results will be reviewed to identify necessary changes or refinements for future implementation. These modifications can then be made and the next round of implementation initiated, leading again to renewed assessment and planning.

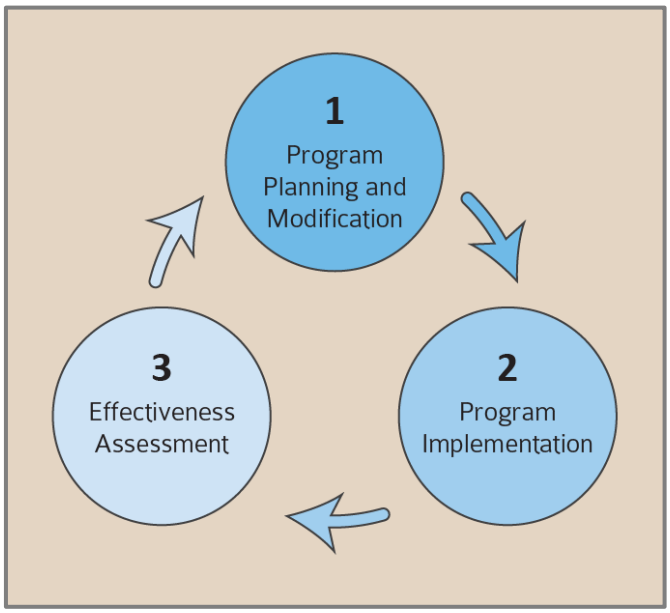


Figure 3.1: The Iterative Program Management Cycle

Over time, the repeated application of this process – each phase continuously informing the next – should result in the improvement of stormwater programs and the achievement of the desired results that they are designed to achieve. Most of the specific guidance provided in this document focuses on program planning with the understanding

that this is where the details of implementation and effectiveness assessment strategies will be considered and incorporated.

This section describes the development of a **Stormwater Strategic Plan** (**SSP**). During this process, managers will identify goals for what will be achieved by the stormwater management program and the strategies necessary to support their attainment. Strategic planning is particularly important to the eventual success of a program because it's during this process that problem conditions are defined, goals are set, and the measures established that will later be tracked and evaluated.

A **Stormwater Strategic Plan** (**SSP**) helps guide the development and modification of a **Stormwater Management Plan** (**SWMP**). The purpose of the SSP is to systematically explore and define the strategies that will be considered and incorporated as a part of a SWMP, and to suggest how program managers might choose some options over others. In essence, SSP development is the process by which the strategic approach and content of a SWMP is developed.

Most municipal stormwater permits require the development of detailed management plans to guide the implementation and evaluation of stormwater programs. These plans can take on a variety of names and forms [Urban Runoff Management Plan (URMP), Drainage Area Management Plan (DAMP), Stormwater Management Plan (SWMP), etc.]. For the purposes of this document, they are collectively referred to as SWMPs. In some cases, a SWMP provides an overarching framework that is both strategic and operational. In others, it is accompanied by additional, more detailed operational plans which describe the programs, activities, policies, or procedures necessary to carry out higher level strategies. There is no standard division of content between strategic and operational plans, so the specific content of each must be determined on a case-by-case basis. Operational plans are not addressed further in this guidance.

Regardless of the specific form and content that a SWMP takes, the purpose of the SSP is to ensure that the SWMP is strategic and adaptive. In some cases, a SSP may be equivalent to, or part of, a SWMP. In others, it may constitute a separate planning process that informs SWMP development.

Development of a Strategic Strategic Plan is divided into three distinct stages.

- Starting with **Planning Preparation (Stage 1)** managers will establish the basic organizational framework necessary to compartmentalize and make sense of the detailed planning tasks that follow (**Section 3.2**).

- During **Strategic Planning (Stage 2)**, managers will identify and prioritize problems to be addressed, identify specific goals for resolving them, and identify program activities needed to drive and evaluate these changes[1] (**Section 3.3**).
- **Strategic Plan Completion (Stage 3)** will provide a roadmap to guide program implementation and evaluation (**Section 3.4**).

Completing this comprehensive process will often require that a wide range of data and information be considered, sometimes exceeding explicit regulatory requirements. The purpose of this process is not to create additional requirements, rather it is designed to help managers more effectively and efficiently meet existing ones.

3.2 Planning Preparation (Stage 1)

Before Strategic Plan development commences, some upfront steps should be completed.

Step 1 Establishing the Strategic Plan Framework

The Strategic Plan Framework addresses two essential sets of issues; scope and content, and organizational structure (see **Tables 3.1** and **3.2**). Given the numerous factors to be considered and their many potential interrelationships, initial assumptions regarding scope, content, and organization will need to be periodically reviewed and updated.

- **Scope and Content -- What should the Strategic Plan contain?**

As described in **Table 3.1**, several factors influence the general content of the Strategic Plan. Without exception, managers will first have to establish applicable geographic and temporal scales for the Strategic Plan and its major elements. Likewise, other factors such as regulatory requirements (usually MS4 permits or TMDLs), existing commitments, and media considerations can influence how specific goals are ultimately carried out.

[1] **Section 3.3** will introduce and explain this process, while additional detailed guidance on its application at each of the six Outcome Levels will be provided in **Sections 4.0 (Source and Impact Strategies), 5.0 (Target Audience Strategies),** and **6.0 (Program Implementation Strategies)**.

Table 3.1: Factors Influencing Strategic Plan Scope and Content

Geographic area. All program goals and activities will apply within defined geographic boundaries. Most Phase I MS4 permit requirements apply jurisdictionally, but some activities are coordinated permit-wide or by watershed. Watershed requirements are increasingly being emphasized to direct resources toward priority receiving water impacts. Municipal stormwater permits often include requirements at multiple scales.

Timeframe. Every management initiative is bounded by one or more applicable timeframe. MS4 permits are issued on 5-year cycles, but implementation timeframes vary. Most outcomes are assessed annually, but some may take decades. Plans should reflect the timeframes necessary to achieve and assess all priority outcomes.

Regulatory considerations. MS4 permits and TMDLs establish performance standards, mandatory program content, and minimum activity requirements (e.g., required inspection frequencies). Other regulatory requirements (CEQA, 401 permits / 404 certifications, Endangered Species Act, etc.) can create constraints or limitations on how these directives can be carried out. An early review of applicable requirements can be useful in setting plan scope and in identifying potential conflicts.

Existing programs and activities. Program planning rarely starts from scratch. Many programs already have ongoing stormwater elements in place; others (used oil recycling, street sweeping, food inspections, etc.) may support stormwater management goals. Even when permit requirements are new, accumulated experience and existing resource commitments can be useful in meeting them.

Media and pathway considerations. Stormwater programs emphasize the impacts of surface runoff on receiving water bodies. Many impacts, though, can be related to other sources and migration pathways (e.g., metals from air emissions or nutrients through groundwater seeps). Sources and pathways that are not immediately within the required scope of a MS4 program should still be considered during planning. In some cases they can help to strengthen management approaches. In others they may help to delineate what is outside the ability or responsibility of a program to control, or define the limit of targeted receiving water quality improvements.

- **Organizational Structure -- How should Strategic Plan content be arranged?**

Organizational structure will determine how individual tasks are compartmentalized and provide a scheme for consolidating and interpreting results. **Table 3.2** lists and provides examples of parameters to consider in establishing this structure. Every Strategic Plan will be unique, but will incorporate each of these parameters to varying degrees. At this stage, organizational structure can only be worked out at a fairly high level, i.e., in no more detail than the identification of sources and/or target audiences. As additional details emerge, this structure will continue to be updated. Two of the parameters – source type and constituent priorities – should be the highest level organizing principles in a Strategic Plan. These will further explored in **Section 4.0**.

Step 2 Compiling Data and Information

In Step 2, managers will gather the data and information needed for strategic planning. Given the range of goals and outcomes potentially under consideration, many sources of data and information are possible (see **Table 3.3**). Since it's not possible to fully anticipate data and information needs up front, managers will need to periodically check back to this step again throughout the strategic planning process.

Data needs will vary according to outcome type, analytical objectives, and program goals. Managers should consider all reasonably available sources, although practical limitations such as relevance, applicability, availability, and cost must be considered. Precedence will normally be given to data that are local and specific to an immediate task or objective.

Table 3.2: Factors Influencing Strategic Plan Organizational Structure

Source Components (or Types)

- New development / redevelopment projects
- Construction sites
- Residential areas
- Municipal sources (streets, parks, fleet maintenance facilities, etc.)
- Industrial and commercial sources (restaurants, auto maintenance, etc.)

*See **Section 4.4** and **Attachment A** for additional discussion of source types.*

Potential Priority Constituents

- Bacteria
- Sediment
- Nutrients
- Metals
- Pesticides
- Trash
- PAHs

Numerous constituents can emerge individually or in combination as management priorities.
*See **Section 4.2** and **Attachment B** for additional discussion of priority constituents.*

Target Audiences

- Residents
- Schoolchildren
- Dog / horse owners
- Developers / project proponents
- Contractors / site workers
- Business operators / employees
- Municipal employees (road crews, maintenance staff, etc.)

Target audiences are the populations responsible for specific source contributions. Since most program activities are directed to them, it's essential that they be clearly delineated.

Target Audience Actions

Pollutant-generating activities (PGAs)

- Spills during materials loading and unloading
- Releases of fluids during vehicle and equipment repair
- Overwatering
- Improper pet waste disposal
- Improper management of food grease

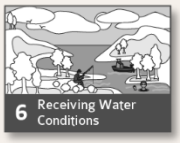
PGAs are the behaviors that contribute pollutants to runoff. Their reduction or elimination is the primary focus of stormwater management programs.

Best management practices (BMPs)

- Integrated pest management (IPM) practices
- Materials substitution
- Smart irrigation controls
- Low Impact Development (LID) practices
- Structural treatment controls

BMPs are the opposite of PGAs. Because they reduce or eliminate pollutant discharges to runoff, substitution of BMPs for PGAs is a key measure of program success.

Table 3.3 Potential Inputs for Strategic Planning

Outcome Level	Examples of Data and Information Resources
 	☑ Receiving water and MS4 monitoring programs ☑ Regulatory agencies and research institutions (SCCWRP, WERF, etc.) ☑ Online repositories, directories, and databases (CERES, SWAMP, etc.) ☑ Published or unpublished research, literature, and technical reports ☑ Special investigations ☑ MS4 maintenance inspections
	☑ Facility or site inspections, monitoring, development plans, etc. ☑ Published research, literature, and technical reports ☑ BMP performance studies ☑ Third party submission of monitoring data ☑ Special studies and investigations ☑ Published or unpublished research, literature, and technical reports
 	☑ Interviews, surveys, tests, and quizzes ☑ Facility or site inspections ☑ Third party submission of compliance data ☑ Special investigations ☑ Published or unpublished research, literature, and technical reports (community-based social marketing studies, etc.)
	☑ Annual compliance reports, source inventories and databases, etc. ☑ Completed effectiveness assessments

3.3 Strategic Planning (Stage 2)

Figure 3.2 illustrates the core elements of a comprehensive strategic planning process for stormwater management programs. **Figure 3.3** lays out the entire process from beginning to end and identifies the sections of this document in which individual planning elements are addressed in greater detail. To complete the process, the core steps shown in **Figure 3.2** must first be completed in "reverse order," beginning with Level 6 and working "backward" one outcome at a time toward Level 2. Results will then provide a basis for conducting the Outcome Level 1 planning steps introduced at the bottom of **Figure 3.3** and described further in **Section 6.0**. This process will apply in its entirety regardless of the choices made about content and structure during Planning Preparation (Stage 1).

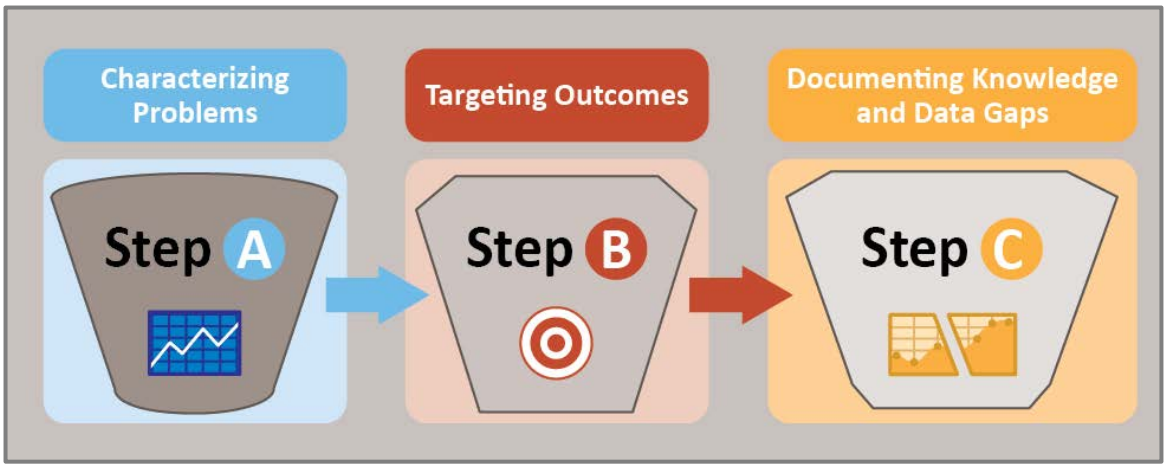


Figure 3.2: Core Strategic Planning Steps (applies to Outcome Levels 2 through 6)

Strategic planning is treated as a "problem solving exercise" focusing initially on identifying and prioritizing problems and then developing strategies for addressing them.

- In **Step A**, existing conditions (or outcomes) are evaluated, first very broadly and then in detail, to determine which of them constitute problems potentially requiring a management response.
- In **Step B** priority problem conditions are reviewed to determine the types of changes that will be sought and to establish timelines for achieving them.
- Another important consideration throughout the planning process is the need to continually identify and document knowledge and data deficits (**Step C**). While this is shown as a discrete step in **Figure 3.2**, it's actually an integral part of the entire planning process. Planning and assessment are often hindered by limitations on data and information availability.

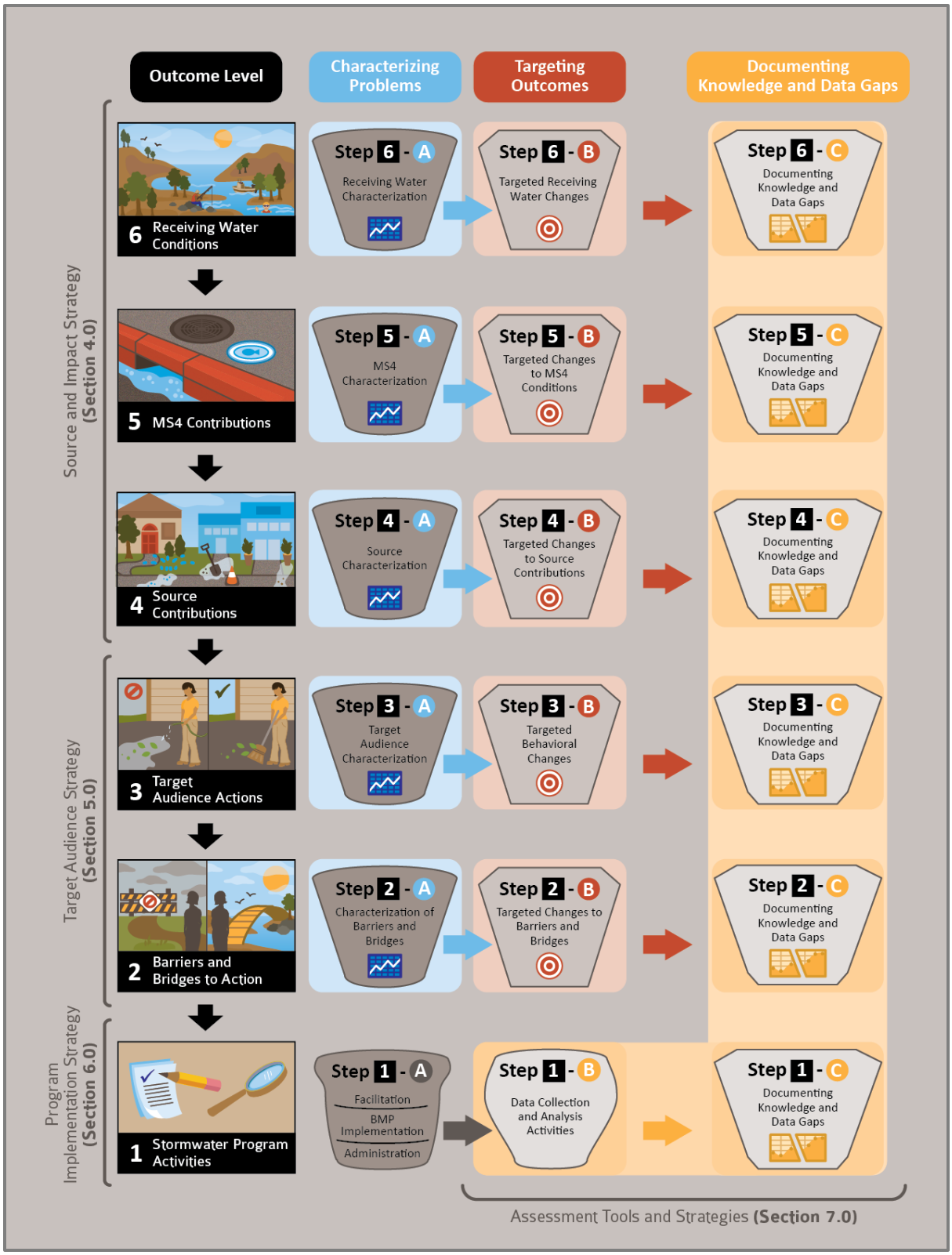
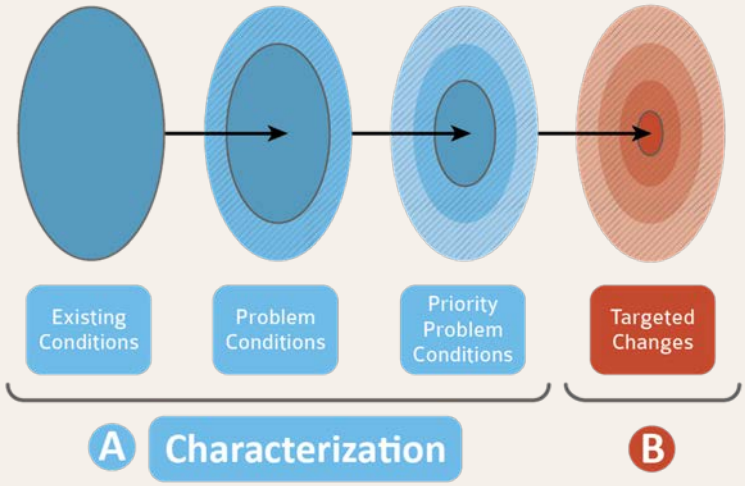


Figure 3.3: Strategic Planning Process Overview

Key Concept 3.1 Prioritization is Essential to Strategic Planning

Prioritization occurs throughout the strategic planning process. Because results are often initially broad and inclusive, a wide range of conditions might seem to be important. In practice, managers are limited by the resources they can bring to bear on any potential problem. Prioritization allows a progressive "narrowing" of results so that they can focus on what's most important. To illustrate, the solid portion of each oval below represents the relative number of potential conditions at various stages of the planning process. As shown, the number of conditions decreases in each successive phase.



Not every measurable condition represents a problem, and not all problems are of equal importance. Managers will need to focus on conditions representing the highest priorities for potential action (See **Step A, Characterizing Problems**). Some of these will likely be targeted for change, and others deferred for future consideration (See **Step B, Targeting Outcomes**).

To resolve uncertainty over time, data and information needs must continually be documented and addressed. This is central to the iterative “hypothesis testing” nature of stormwater management. In practice, a one-size-fits-all approach to strategic planning isn’t possible. Results will reflect individual priorities, data availability, and methodological choices and limitations. Managers may sometimes find it challenging to follow this process in a simple linear fashion. However, because each step sequentially informs the next, they should be followed in the order presented below wherever possible. If individual steps are initially glossed over or skipped, they should be returned to as results accumulate or as new insights emerge.

Step A Characterizing Problems

During characterization, managers explore what is known about existing conditions at all outcome levels, determine which of them constitute problems, and develop priorities for the changes to be sought through program implementation. This work is divided into three tasks as shown in **Figure 3.4** and described below.

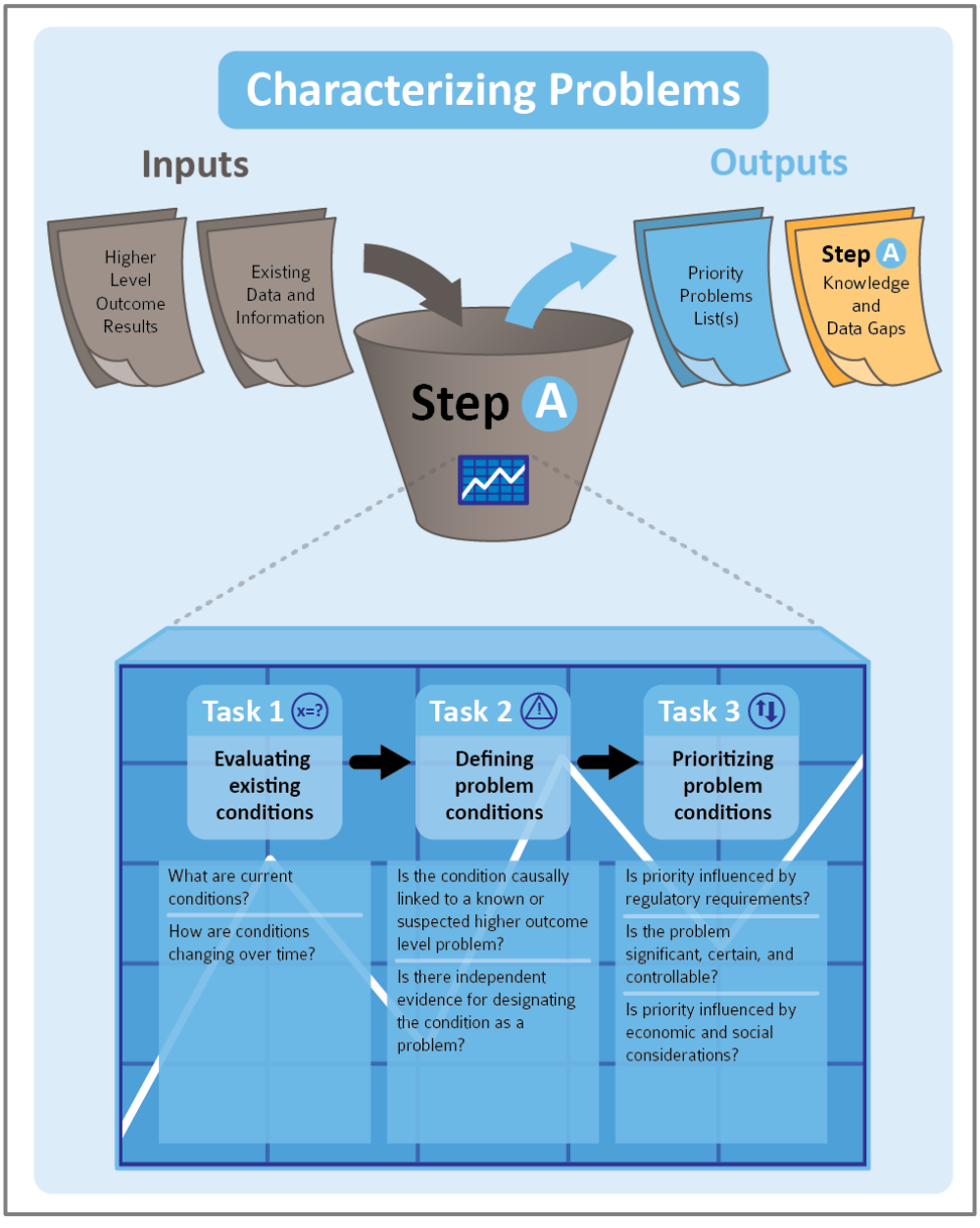


Figure 3.4: General Process for Characterizing Problems

Task 1 Evaluating Existing Conditions

The primary purpose of this task is to establish the factual basis needed for subsequent planning tasks. Available data and information will initially be reviewed to determine what is known at each applicable outcome level. As described above in **Planning Preparation (Section 3.2, Step 2)**, different data sources (monitoring results, source inventories, surveys, etc.) will apply depending on the condition under consideration. This fact-gathering exercise addresses two types of questions.

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**

Question 1 What are current conditions?

Current conditions provide a snapshot of how things look, either at the time of measurement or generalized over a defined period (a reporting year, the wet season, etc.). They describe only what is known about a particular condition (or set of conditions) rather than extrapolating beyond the data at hand. For example, what is the upper 90th percentile concentration of nitrates in the lower San Diego River during dry weather? Or how well do construction workers understand the proper application of a silt fence? Or how do bacteria levels vary across a defined group of MS4 outfalls? Current conditions describe what we know and establish the measurability that will later be needed for interpretation of change and success in meeting established goals.

Several parameters should be considered in characterizing conditions. The **nature** of the condition refers to its general characteristics or attributes, and **magnitude** describes its dimension or scale. Together, nature and magnitude provide a basic description of each condition, but it's also important to consider how they vary in time and space. **Variability** refers to how spread apart the measurements in a distribution are, or how they vary from each other temporally or spatially. **Temporal variability** describes how often or

frequently the condition occurs or how it varies over time, whereas **spatial variability** describes its physical patterns of dispersal (within a population, receiving water, etc.).

A wide range of descriptive statistics can be used to describe current conditions. These include, but are not limited to, yes/no determinations, single values, simple counts, central tendency (mean, median, etc.), measures of spatial variability, and confidence intervals. Several descriptive statistics can also be used together to provide a more comprehensive understanding of existing conditions. Managers should be extremely cautious about using single or average values alone to describe outcomes above Level 1. For strategic planning and assessment, analytical focus is normally on populations of outcomes rather than single ones, and variability within these populations can have important implications for program design. Variability refers to refers to how spread apart the measurements in a distribution are, or how they vary from each other temporally or spatially.

Figure 3.5 illustrates a standard normal distribution that might apply to almost any outcome, for example numbers of dog owners on the y-axis and the frequency of BMP implementation on the x-axis. In this simple example, BMP implementation by low performers would be represented on the left tail, high performers on the right, and everyone else in between.

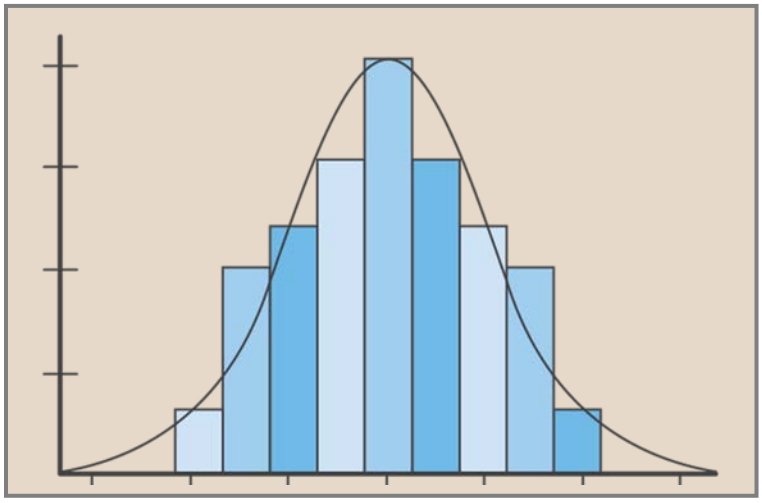


Figure 3.5: A Normally Distributed Population of Outcomes

As will be described later, there are important reasons for considering not only the differences in the characteristics of these sub-populations, but also the area under the

curve represented by each. **Section 7.0** provides a more detailed discussion of potential data analysis tools and approaches.

Question 2 How are conditions changing over time?

It's easy to think of an existing condition as a single measure captured at one point in time. To use one of the examples mentioned under Question 1, the upper 90th percentile concentration of nitrates in the lower San Diego River on April 13, 2004 is measured as 9.2 parts per million. Since most measurable conditions are normally not static, it would be unrealistic to assume that the same value would be obtained if we sampled again in a week, a month, or a year. So it's important to understand if and how conditions are changing. **Trends** are increases, decreases, or other discernable changes in the magnitude, prevalence, or distribution of a condition over time. Trend estimation can be used to make and justify statements about tendencies in outcomes, such as nitrate concentration, by relating their measurement to the times at which they occur. The general goal of trend analysis is to look at data over time to understand whether and how changes are occurring (e.g., how have nitrate concentrations changed over the past 10 years? Or is the distribution of exceedances in the MS4 increasing or decreasing over time?).

Managers are often interested in knowing whether a parameter is increasing or decreasing over time. A range of approaches are available for doing so. The simplest is to fit a straight line with the outcome data plotted vertically and time plotted horizontally, however other options such as a least-squares fit are also frequently utilized. **Figure 3.6** provides an example of a trend analysis for turbidity in the Sweetwater and Tijuana Rivers. Trend analysis can be a very powerful tool for interpreting a wide variety of outcomes.

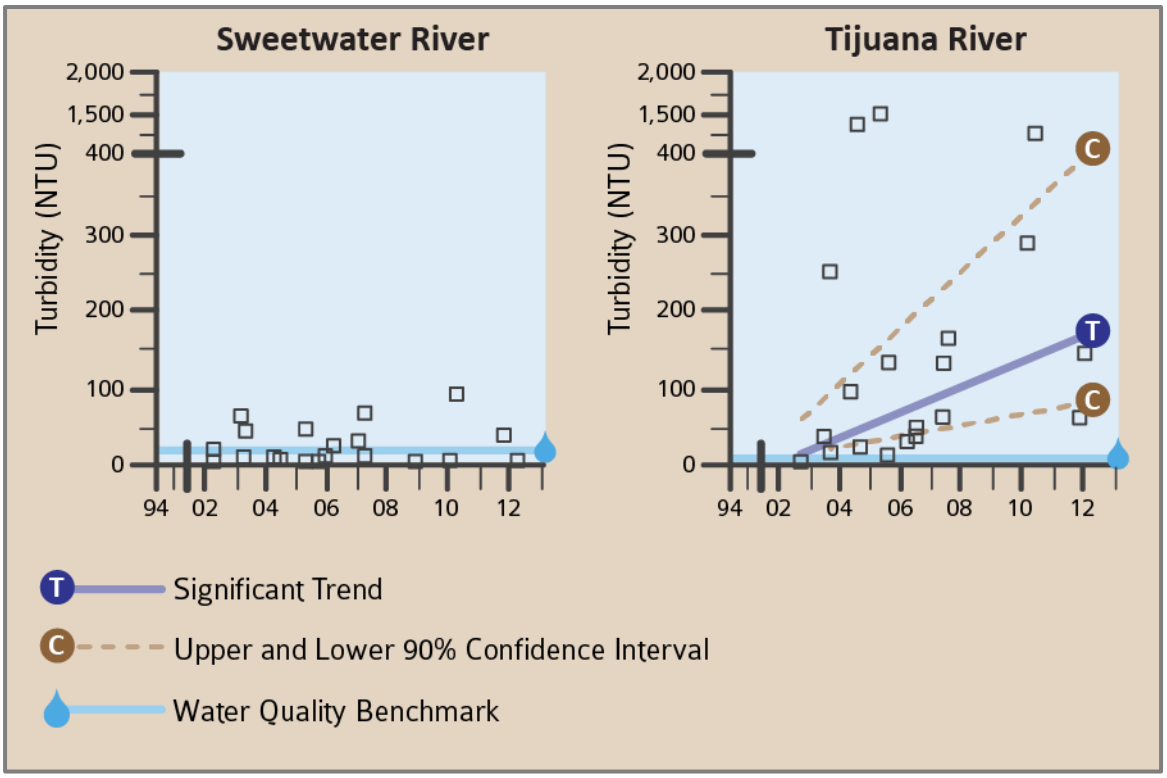


Figure 3.6: Example of Trend Analysis

The primary output of **Task 1** is the documentation of a range of existing conditions. A second important output will be the identification of knowledge and data gaps associated with **Task 1** completion. These gaps are discussed further under **Step C** below. Since there are no specific limits on the scope of Task 1 results, they can be very broad. **Task 2** below will focus on narrowing the range of conditions to those which represent problems. Discretion will be needed in determining how many conditions can be further considered – this requires that managers estimate the resources needed to address targeted problems, and limit the number that can be evaluated within these limitations.

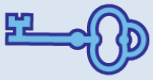
Figure 3.7 provides a Review Checklist to guide managers through Task 1 completion. **Table 3.4** adapts both **Task 1** questions individually to Outcome Levels 2 through 6. These more specific questions form the basis of the guidance provided in **Sections 4.0** and **5.0**.

Task 2 Defining Problem Conditions

A problem condition can be thought of as the difference between how something is now and how we would like it to be in the future. In practice, such differences are usually not obvious or easily discerned, so it will take some additional effort to decide which of the broad range of existing conditions identified in **Task 1** should be treated as "problem

conditions". In contrast to the evaluation of existing conditions, the determination of problem conditions will often be highly interpretive.

It's not unusual for managers to equate problem conditions with receiving water impacts. However, for problem definition to be useful in program planning, managers must adopt a broader definition that includes measurable conditions at all levels between 6 and 2. That is, any condition that has a direct or an indirect role in causing a receiving water impact must be considered as part of the problem definition equation. In evaluating the problem potential of any identified condition, two lines of questioning are helpful.



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** 

Review Checklist

Step A Task 1
Evaluating Existing Conditions

Apply this task very broadly across Outcome Levels 6 through 2, one at a time. The purpose is to provide a "snapshot" of what is currently known at each Outcome Level.

- ✓ **Compile existing data, information, and results applicable to the Outcome Level. Consider the following questions:**

  Question 1: What are current conditions?

  Consider nature, magnitude, and temporal and spatial variability.

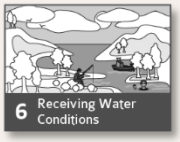
  Question 2: How are conditions changing over time?

- ✓ **Consolidate results into one or more summary lists of existing conditions. Categorize results as determined appropriate (by condition type, etc.).**
- ✓ **Compile supporting documentation for listed conditions.**
- ✓ **Select the conditions in the summary list(s) that will be further evaluated as potential problems in Task 2. Consider "back-up" lists for future evaluation as necessary.**
- ✓ **Document the critical data and information gaps identified during Task 1 completion.**

NOTES

Figure 3.7: Review Checklist for Evaluating Existing Conditions

Table 3.4: Outcome-specific Questions Guiding Evaluation of Existing Conditions

	Question 1. What are current conditions?	Question 2. How are conditions changing over time?
 See Section 4.2	• What are current receiving water conditions?	• How are receiving water conditions changing over time?
 See Section 4.3	• What are current MS4 conditions?	• How are MS4 conditions changing over time?
 See Section 4.4	• Which drainage areas contribute pollutants and flows to MS4s? • Which sources contribute pollutants and flows to the MS4? • What are the current flow and pollutant contributions of drainage areas and sources?	• How are drainage area and source contributions changing over time?
 See Section 5.2	• Which target audiences are associated with priority source contributions? • What are the behavioral patterns of target audiences? • What are the characteristics of target audiences?	• How are behaviors changing over time?
 See Section 5.3	• What factors influence priority target audience behaviors?	• How are influencing factors changing over time?

The first question follows the general supposition employed throughout this document that linkages exist between individual outcomes. In particular, that the existence of a problem condition at any given level implies the existence of at least one "causal" problem condition at the next lower outcome level. In theory, problem statements are strongest when they reflect such a linkage, and pending the resolution of Question 2, may be discarded if not proved relevant.

The second question acknowledges the practical reality that these linkages are difficult to establish, and that problem conditions must therefore often be identified through other "independent" lines of evidence. In both cases, experience and judgment play a critical role.

Question 1 Is the condition causally linked to a known or suspected higher outcome level problem?

Throughout strategic planning, analysis will build on the results obtained at each previous outcome level (Level 3 will be informed by 4, 2 informed by 3, etc.). When an individual problem condition is known or suspected, managers should look to other outcomes at the next lowest level as potentially causing or contributing to it. When these linkages are established, the "causative" conditions will also be implicated as problems (see **Key Concept 3.3**).

Consider the case of a MS4 outfall discharge with average chronic copper concentrations of 5.2 µg/L (Level 5). The outfall is known to discharge to a receiving water with demonstrated exceedances of water quality standards for copper (an outcome level 6 problem). Because of its implicit causal relationship to the receiving water problem, the outfall discharge might reasonably be concluded to represent a "linked" problem condition. To use a completely different example, a “low” level of knowledge regarding a pollutant-generating activity in residents (e.g., overwatering) could be considered a problem because it contributes to an overwatering behavior. In both examples, we’re less concerned about the actual magnitude of the lower level condition than the fact that it’s potentially contributing to a problem condition at the higher level.

Where linkages between outcomes are suspected, managers should focus on confirming or strengthening them over time. One approach is to "experiment" through targeted implementation. In this case, a change in a measured outcome (e.g., levels of a targeted behavior) might be targeted with a goal of testing the hypothesis that a resultant change will occur in the higher level outcome (i.e., the "dependent condition"). For example, a hypothesis that power washing practices contribute to dry weather discharges in a given area could be tested by implementing a program of control measures directed at power washers. By tracking outcomes at both levels, measurements can be used to experimentally demonstrate a linkage between two separate problem conditions. This is a typical approach for pilot projects, but it can also be part of normal program

implementation when data collection approaches are designed to explore linkages (see **Section 7.0**).

Ideally, our understanding of individual problem conditions and the relationships between them will become increasingly certain over time. However, because this may never be the case for many measured conditions (see **Key Concept 3.5**), it's important to consider other lines of evidence.

Question 2 Is there independent evidence for designating the condition as a problem?

Question 1 focused on a situation where previously-established higher level problem conditions provide a point of reference for defining other causally linked problem conditions. As managers work through each outcome level in order, they'll find considerable variability in the degree to which specific problem conditions and the linkages between them are understood. Because this knowledge base is often incomplete, managers will sometimes need to look elsewhere for other frames of reference in interpreting problem conditions. That is, problems will sometimes have to be defined independently of other outcome levels.

Using the example that was just described, the same level of copper is measured at the outfall, but this time there is no evidence that the receiving water is impacted by copper. In considering whether or not the outfall condition might still represent a problem, the manager must now look to other independent evidence. For example, does the discharge itself exceed an established regulatory benchmark? Are copper concentrations outside the norm or higher than at outfalls in other similar drainage areas or land uses? Has experience shown similar levels to be problematic elsewhere?

Clearly there is an even more important role here than in Question 1 for experience and best professional judgment. Managers will need to be thorough in identifying and exhausting available lines of evidence. In many cases, problem designation will be based solely on a judgment that a particular change (e.g., a higher level of understanding) would represent an improvement. Such determinations are made every day by managers for very good reason. Over time, as increased measurability and targeted implementation allow the validation of working assumptions, the types of structured linkages suggested in Question 1 can be further explored.

On completion of problem definition, managers will have a list (or lists) of Outcome Level 2 through 6 problem conditions. This delineation should be considered provisional, and may need to be updated as other planning steps are later completed. Whether or not a particular judgment or hypothesis turns out to be correct can only be determined through ongoing implementation and evaluation. A second important output will be the identification of knowledge and data gaps associated with Task 2 completion. These gaps are discussed further under **Step C**.

Figure 3.8 provides a Review Checklist to guide managers through Task 2 completion. **Table 3.5** shows how Questions 1 and 2 are applied at each outcome level. These questions form the basis of the guidance on problem definition provided in **Sections 4.0** and **5.0**. In some instances managers will find that problem conditions are already known (such as for TMDLs), and may question the need for further evaluation. However, these general approaches may still be useful as a "reality check." It can often turn out that our understanding of problem conditions is less certain than initially thought.

Review Checklist

Step A Task 2
Defining Problem Conditions

At each Outcome Level, apply this task individually to each Task 1 condition selected for further evaluation. The purpose of this task is to determine which of these conditions should be designated as problems.

- ✓ **For each identified condition, consider the following questions:**

  Question 1: Is the condition causally linked to a known or suspected higher outcome level problem? If no, or if unknown, continue to Question 2.

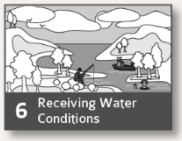
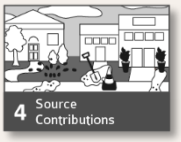
  Question 2: Is there independent evidence for designating the condition as a problem?

- ✓ **Document known or suspected problem conditions for the Outcome Level.**
- ✓ **Consolidate results into one or more summary lists. Categorize results as determined appropriate (by problem type, known versus suspected, etc.).**
- ✓ **Document all data and information gaps identified during Task 2 completion.**

NOTES

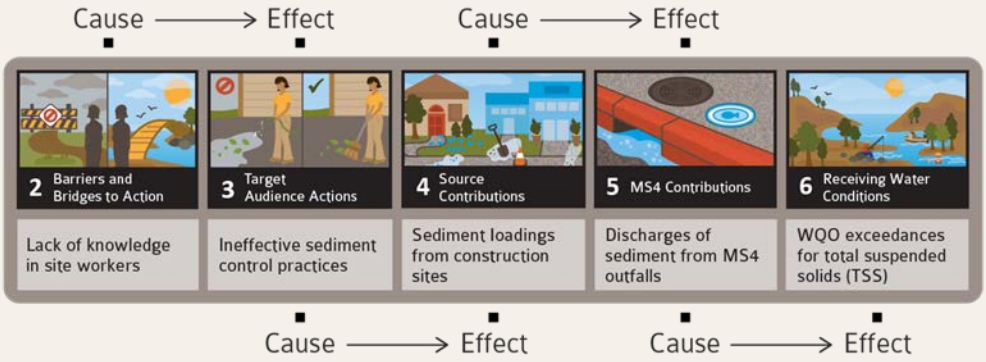
Figure 3.8: Review Checklist for Defining Problem Conditions

Table 3.5: Outcome-specific Questions Guiding Problem Definition

	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?
 See Section 4.2	• Does the receiving water condition represent a known or suspected beneficial use impact?	• Is there independent evidence for designating the receiving water condition as a problem?
 See Section 4.3	• Does the MS4 condition contribute to a receiving water impact?	• Is there independent evidence for designating the MS4 condition as a problem?
 See Section 4.4	• Is the drainage area or source contribution causally linked to a known or suspected MS4 or receiving water problem?	• Is there independent evidence for designating the drainage area or source contribution as a problem?
 See Section 5.2	• Is the behavior causally linked to a known or suspected source contribution?	• Is there independent evidence for designating the behavior as a problem?
 See Section 5.3	• Which influencing factors are barriers?	• What is the collective influence of identified barriers?

Key Concept 3.2 Problem conditions are "causally" linked

Section 2.0 introduced a fundamental principle that outcomes are sequentially linked in "chains" of cause-and-effect relationships, with the final element in that progression being receiving water conditions. This relationship is very simply illustrated below.



These linkages are particularly important for the evaluation of problem conditions. If any condition truly represents a problem, it must be assumed to exist both as a cause of at least one "higher level" problem and an effect of one or more "lower level" problems. Outcome Levels 2 (cause only) and 6 (effect only) are exceptions because they represent the ends of the sequence.

In this example, working backward from outcome level 6, the first problem statement (or "effect") is a receiving water impact manifested as persistent exceedances of water quality objectives for total suspended solids (TSS). The immediate cause of this is implicated as discharges of sediment from one or more MS4 outfalls (Level 5) to the receiving water. Each outfall discharge is in turn due to sediment loadings from watershed source, in this case construction sites (Level 4). Since these loadings should not occur if adequate preventive measures were in place, ineffective sediment control practices (Level 3) are also implicated as a cause. Likewise, the fact that site workers are engaging in pollutant-generating rather than best management practices indicates the existence of one or more barriers to correct action (Level 2).

As a strategic design consideration, the existence of these linkages implies that the resolution of a problem condition at one outcome level will contribute to the resolution of problem conditions at each higher numbered outcome level.

It should be noted that the example described here is very simple. In practice, managers will encounter a much higher level of complexity (e.g., pollutant sources and their relative contributions may be unknown). Additional issues to be considered in the design and interpretation of linked approaches are described in **Key Concepts 3.4** and **3.5**.

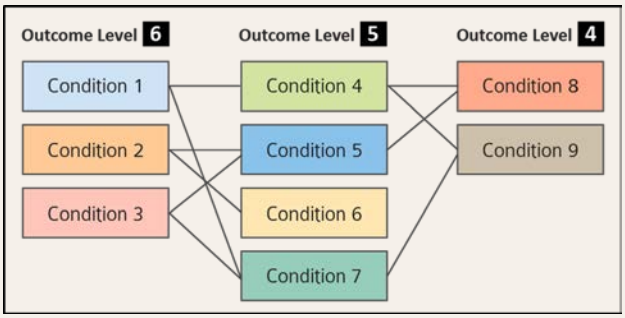
Key Concept 3.3 Relationships between conditions resemble webs more than chains

Key Concept 3.2 presented a very simple example of sequential linkages between single problem conditions. In reality, these might involve any of the scenarios below.

A	B	C	D
Single Problem	Single Problem	Multiple Problems	Multiple Problems
⇩	⇩	⇩	⇩
Single Problem	Multiple Problems	Single Problem	Multiple Problems
(One-to-One)	(One-to-Many)	(Many-to-One)	(Many-to-Many)

Relationships between outcomes in a typical stormwater management scenario are much more likely to exist in complex webs than simple chains. Natural systems are complex and non-linear. However, our models of them are relatively simple, and tend to be linear. For example, a single MS4 discharge might receive contributions from hundreds or thousands of individual sources, varying with time. Or multiple education activities might address the same intended behavioral change in a target audience, and only some of them to any effect. In both cases, it can be difficult to determine how any individual outcome is actually causing an observed effect or a desired change. Moreover, this effect can be multiplied as analysis moves through successive layers of Outcome Levels. While this shouldn't discourage managers from evaluating linkages, it should underscore the need for focusing resources on the highest priority outcomes first.

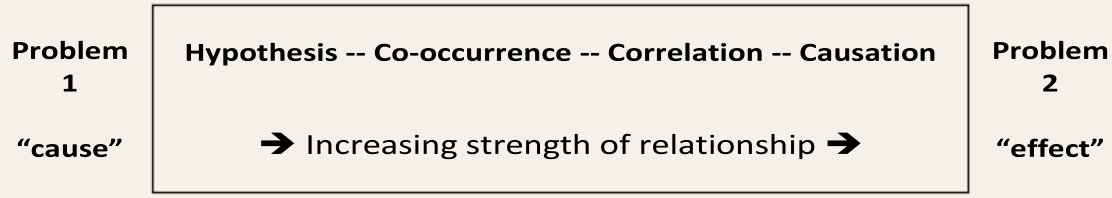
This document deals almost exclusively with Single-Single relationships (Scenario A), with the understanding that scenarios B, C, and D are more likely to be encountered in the real world. Managers will have to decide how to apply specific methods and approaches to their own unique assessment situations. In doing so, the development of "**outcome maps**" is highly encouraged. As illustrated in the example below, visual representations of the linkages between problem conditions can be extremely valuable.



Whether formally included in program plans, or just conducted as a white board exercise, outcomes mapping can be an essential tool in making sense of the inherent complexity of stormwater management approaches.

Key Concept 3.4 Linkages exist in different stages of certainty

The concept of sequentially linked outcomes is especially salient with respect to the evaluation of problem conditions. As a conceptual basis for planning, understanding relationships between problems is fundamental. In practice, it can be very difficult to do with confidence.



This figure illustrates a continuum in the establishment of linkages between conditions. As shown, relationships are initially often hypothetical or speculative, particularly during the program planning stages. For example, one might ask "if a particular level of mass media coverage (television, radio, etc.) is employed, what level of change in awareness could be expected in a target audience? Hypothesizing is a necessary and central part of the iterative process. Without it, the learning process that drives stormwater management programs would not be possible. But it's also important that relationships between outcomes become increasingly certain over time.

As implementation experience increases and data become more available, relationships can be strengthened. Initially this may involve documenting the co-occurrence of outcomes, i.e., separate outcomes occurring in sequence or within the same period of time.

Co-occurrence is simple to demonstrate (it can be based on single occurrences or samples), but limited in its explanatory value. It does not imply any form of relationship between outcomes, but may form a basis for further exploration.

Correlation is similar to co-occurrence except that it involves some degree of statistical support. Once sufficient sample sizes are established, outcomes can be correlated. This is an important step toward establishing causation since causal relationships must also always be correlative (unfortunately, the reverse is not true). In practice, moving from correlation to causation can be extremely difficult, and will not always be possible.

As outcomes are evaluated, it's important to keep in mind where each relationship is in this continuum. While it may often not be possible to move to a higher level of certainty, it should always be an objective.

Task 3 Prioritizing Problem Conditions

In **Task 2**, managers determined which of the many conditions identified in **Task 1** represent problems. At this point, quite a number of actual or suspected problems may have emerged. Since not all of them will be equally important, additional analysis will help to focus limited resources where they're most needed. Prioritization will allow managers to decide which of the individual problem conditions identified in **Task 2** should be given the highest importance for directed action or additional study. This does not mean that lower priority problems will be ignored, but they may need to be addressed later as time and resources allow.

A general framework for evaluating problem conditions is presented in **Figure 3.9** and described below. Several specific prioritization criteria are introduced, as well as a specific ordering for their consideration that is guided by two questions.

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? **Question 2:** What is the relative importance of each problem condition?	**Priority Problem Conditions**

As shown, problem prioritization consists of two primary steps. First a rating must be assigned to each problem condition. Establishing a "value" for each condition provides a basis for differentiating between them. Once ratings have been assigned, they can be reviewed together to determine their relative importance. For each step, managers are encouraged to establish a clear decision-making process up front. The guidance below describes general parameters, but specific details should be determined by the managers conducting the prioritization. In some cases it may be appropriate to utilize professional staff exclusively, while in others a more extended group process may be preferable. Depending on the situation, public participation can be vital to establishing support for proposed priorities. It may often be pragmatic to involve stakeholders or the public during prioritization rather than seeking their approval afterward.

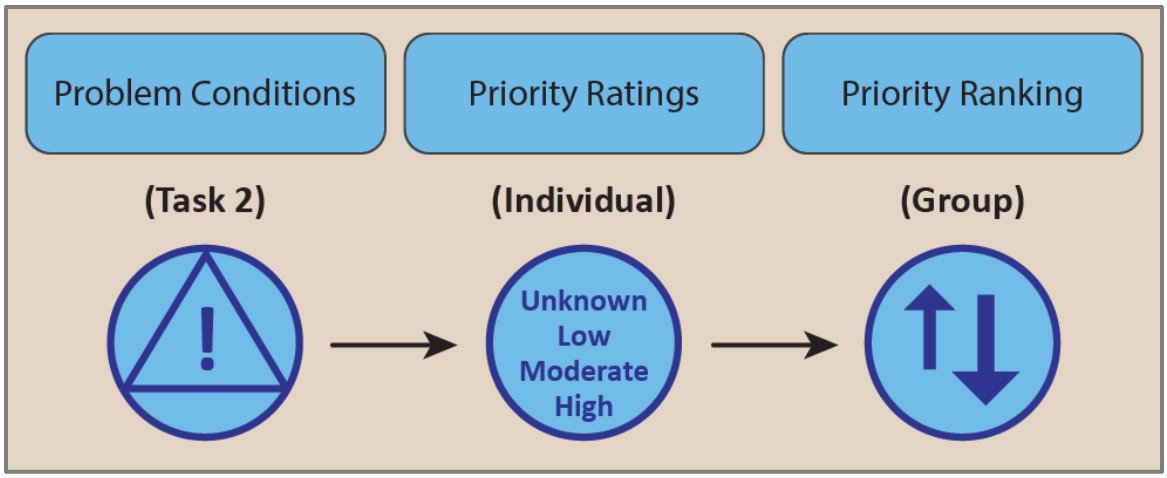


Figure 3.9: General Framework for Prioritizing Problems

Question 1 What is the priority rating of each problem condition?

The establishment of priority ratings entails three successive review tiers. At the conclusion of each, managers can review provisional results and decide whether or not to continue to the next. Given the potentially large numbers of outcomes that might need to be rated in some instances, this can be important in avoiding unnecessary effort. **Regulatory Screening** (Tier 1) is conducted first because these factors often leave little room for discretion or judgment. Where specific priorities are established by permits or other regulatory means, additional review may be unnecessary. During **Technical Review** (Tier 2), managers will take a closer look at the nature of the problem itself. This review is often sufficient to show that a problem is not a priority for action or further investigation. Where a problem still presents as a priority after these first two rounds, managers should continue to the **Sustainability Review** (Tier 3). This review builds on Tier 1 and 2 results by adding in economic and social considerations. As described in **Key Concept 3.5**, this approach follows the principles of sustainability used in a variety of other disciplines.

The rating criteria described here are fairly general, so managers may find that other, more specific criteria better suit their purposes. They may also find that it makes sense to assign specific weightings to particular criteria or to consider them in a different order.

Readers should note **Figures 3.10** through **3.12** below each culminate in the assignment of an overall rating at that respective Tier. The rating designations shown (H, M, L, U, etc.) are for illustration only, and are not intended to imply the use of any particular rating scheme. Managers might just as well use numeric, alphanumeric, or other priority designations, depending on their preferences and needs.

Tier 1 Regulatory Screening

The first objective of the rating process should be to determine the potential influence of regulatory factors. **Figure 3.10** provides an overview of the regulatory screening process.

Figure 3.10: Tier 1 Regulatory Screening[2]

The regulatory drivers most typically influencing or directing priorities will be MS4 permit conditions (e.g., mandated receiving water or source priorities), Total Maximum Daily Loads, and 303(d) listings. Even where priorities are not explicitly mandated, they may later materialize as requirements are interpreted during program implementation or when seeking approval of program approaches from permitting authorities.

While regulatory drivers will often elevate the priority rating of a problem, some can be limiting. For example, compliance with other state and federal laws (e.g., CEQA, 401 permits / 404 certifications, Endangered Species Act, etc.) can create constraints on the details of how or where a program can be directed. Likewise, if a business is already heavily regulated by other existing initiatives (hazardous materials, fire code, etc.) it might simply not warrant the same level of attention as other less regulated source types.

Limitations on the specific statutory responsibility and control of MS4 programs should also be considered. Numerous environmental and water quality problems can exist in areas impacted by urbanization, but not all of them are within the scope or responsibility of a program. Many can or should be addressed under separate discharge permits or other programs. Problems originating from sources that are external to MS4s, or that are separately regulated, may often be excluded as priorities.

[2] S = Strong, M = Moderate, W = Weak, N = None, U = Unknown. These are examples intended to illustrate potential rating designations.

It's important to note the direction of the regulatory influence since some requirements and constraints can affect priority in opposite ways. Likewise, if multiple regulatory factors are identified, their collective influence will need to be considered.

This initial review will provide an early indication of whether or not additional review is needed at Tiers 2 and 3. If a priority rating is clearly established at this point, and there is no ability to modify it, managers may decide to forego additional evaluation and assign an Overall Priority Rating based on the Tier 1 Screening. It's also important to recognize that in some instances regulatory review will indicate priorities that are not supported through the subsequent evaluation of other prioritization criteria. When conflicts arise, there will be no easy way to resolve them. Compliance must be maintained with legal and regulatory obligations, but managers may sometimes also need to advocate for flexibility or regulatory change.

Tier 2 Technical Review

Tier 2 is a technical characterization. It addresses the problem condition itself rather than its relationship to other external factors. This entails a review of three separate types of criteria; significance, certainty, and controllability (**Figure 3.11**).

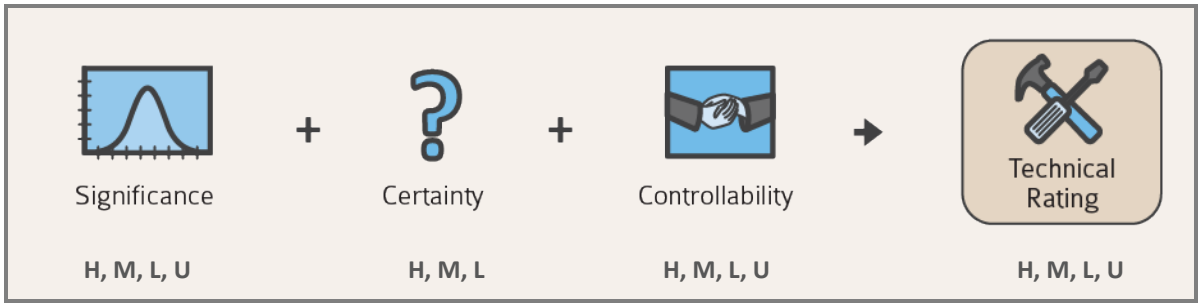


Figure 3.11: Tier 2 Technical Review[3]

Each of these criteria can affect the priority rating independently or in combination, but a problem condition that is significant, certain, and controllable is much more likely to warrant the commitment of program resources than one that is not.

- **Significance** is the importance or meaning of something, in this case a problem condition. Determinations of significance will normally reflect the nature, magnitude, prevalence, and distribution of the condition. Nature describes what a problem is (e.g., elevated bacteria levels, overwatering, etc.), while magnitude, prevalence, and

[3] H = High, M = Moderate, L = Low, U = Unknown. These are examples intended to illustrate potential rating designations.

distribution address its relative severity (e.g., how often, by how much, and where a water quality objective is exceeded). Given the range of potential considerations affecting significance, considerable discretion will be needed in completing this portion of the review.

- **Certainty** refers to the confidence with which a problem condition can be stated. Understanding of problem conditions will often reflect different degrees of certainty. Certainty is a critical consideration because managers will generally not want to expend significant program resources toward a problem that is not well-established. It also gives a general indication of the type of management actions that may be appropriate for a given problem condition (implementation of control measures, continued monitoring, confirmation, etc.). This will be extremely important later as program implementation strategies are selected (**Section 6.0**). Ideally problem conditions will reflect a high level of certainty, but many are likely to be either suspected or unknown (see **Key Concept 3.4**).
- **Controllability** refers to the potential for a program to prevent or eliminate an identified problem condition. A problem that does not have a reasonable chance of being successfully controlled will not likely be a priority for resource commitments. Controllability as a rating factor must address both technical and practical questions. First, do feasible control measures exist or can they be developed to address the problem? And second, what is the ability or responsibility of MS4 programs to conduct or impose available control measures? It will often be the case that technically feasible controls exist to address a particular problem condition, but that they are beyond the ability or scope of a program to reasonably impose. In this respect controllability is often closely related to economic feasibility as described further below.

In practice, managers may be challenged to decide which, if any, of these criteria should be given a higher weighting. In the absence of a specific rationale for doing so, they may want to assume an equal weighting. On completion of the Technical Review, managers will decide whether or not a problem condition should receive further review. In cases where a higher priority rating has been confidently established based on Tier 1 or Tier 2 results, additional analysis may not be needed.

Tier 3 Sustainability Review

The remaining factors described below will provide a practical context for completing the rating process. As shown in **Figure 3.12**, two sets of considerations, economic and social, can be considered together to provide a combined Sustainability Rating. Managers may also elect to develop separate ratings both for economic and social factors; however this example illustrates only the development of a combined rating.

Figure 3.12: Tier 3 Sustainability Review

This review follows closely on the concept of sustainability advocated in various other disciplines (see **Key Concept 3.5**).

- **Economic factors** are essential because every problem has associated costs. Consider the economic burden of beach postings or closures to a coastal city. Ultimately every potential action will also come at a cost that must be balanced with the implications of non-action and the impact to managers' ability to expend resources on other problems. Specific costs may be borne by the MS4 program, target audiences, or society at large. At this stage, analysis will focus on the potential economic impact of the problem condition more so than the costs of potential solutions. Managers' understanding of the latter is likely to be limited during prioritization because specific objectives for change have not yet been established. These costs can be worked out more fully during the establishment of targeted outcomes.
- **Social factors** are those related to society at large or specific segments within it. Perceptions and opinions regarding specific problem conditions, as well as acceptance or resistance to control measures that might be proposed, can be important to prioritization. Although the public may often be unaware of many of the details of a MS4 program, they expect to utilize and enjoy receiving waters, and they play a role in the control measures instituted to protect them. Conversely, problem conditions that are not important to the public may be lesser priorities for resolution.

Overall Priority Rating

As shown in **Figure 3.13**, Tier 1, 2, and 3 results can now be considered together to determine an Overall Priority Rating for each priority problem condition. Each rating will be assigned individually, and has nothing to do with the respective priority of any other condition. Managers must now decide how heavily each of the three sets of results will influence the Overall Priority Rating. Assigning weightings to regulatory, technical, economic, and social factors can be especially challenging given their fundamental differences. Equal weightings are assumed here, but only for illustration. Managers opting to weight individual review factors differently will need to rely on their experience and judgment in doing so. They may also choose to substitute quantitative criteria or methods. However, in most cases qualitative methods are appropriate.

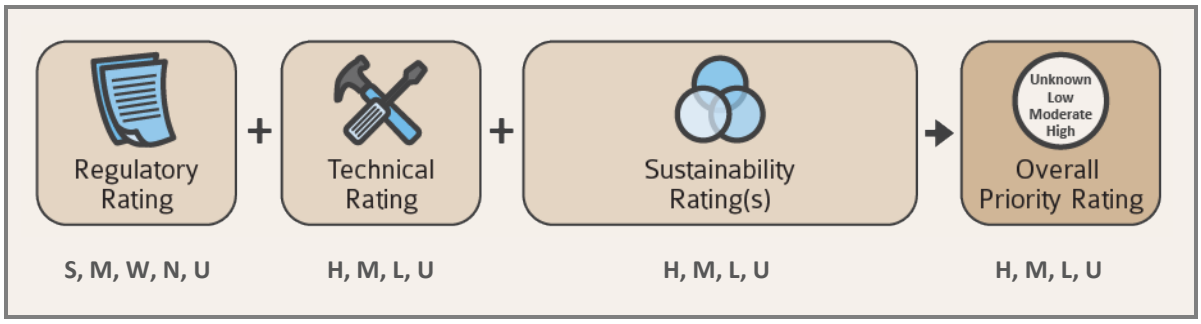


Figure 3.13: Establishing an Overall Priority Rating for a Problem Condition[4]

Question 2 What is the relative importance of each problem condition?

For individual ratings to be useful in supporting decision-making, they must be compared to determine their relative importance. This is expressed as a ranking for each priority problem condition. Two options are illustrated in **Figure 3.14**. Identified problems can either be put into a ranked order or grouped by their priority ratings. Establishing ranked orders consists of lining up the applicable problem conditions for each receiving water or segment from highest priority to lowest, with the higher priorities normally constituting the greater management priorities. In many instances, problem conditions will have "tie scores". Rather than conducting further analysis to differentiate between them, managers may want to consider grouped rankings.

[4] This example shows a single Sustainability Rating that reflects both economic and social considerations. Another option would be to generate distinct Economic and Social Ratings (i.e., Regulatory + Technical + Economic + Social Ratings → Overall Priority Rating). Neither of these options is right or wrong, and which of them is chosen would likely depend on the availability and quality of social and economic data. For simplicity, a combined Sustainability Rating is utilized throughout the remainder of this document.

↑ Increasing Priority ↑	RANKED ORDER EXAMPLE	GROUPED RANKING EXAMPLE
	1. Problem A (High Priority Rating) 2. Problem B (High Priority Rating) 3. Problem C (Moderate Priority Rating) 4. Problem D (Low Priority Rating) 5. Problem E (Low Priority Rating) 6. Problem F (Unknown Priority Rating)	**GROUP A** (High Priority Rating) • Problem A • Problem B **GROUP B** (Moderate Priority Rating) • Problem C **GROUP C** (Low Priority Rating) • Problem D • Problem E **GROUP D** (Unknown Priority Rating) • Problem F

Figure 3.14: Potential Options for Ranking Problem Conditions

On completion of problem prioritization, managers will have narrowed their initial inventory of problem conditions to a more focused Priority Problems List. They must next decide which of these conditions will be targeted for change in Step B. It's important to keep the qualitative nature of this exercise in mind. Its purpose is only to provide an informational basis for the comparison of different types of problem conditions. Rating and ranking systems, no matter how sophisticated, cannot replace the role of judgment in evaluating results.

Because of the uncertainty associated with most prioritization steps, knowledge and data gaps will also be an important output at this planning stage as well. For each problem condition reviewed, additional data and information may need to be collected as necessary to explore any or all of the specific evaluation criteria described. Managers may initially find that data and information relating to the economic and social aspects of a problem condition are difficult to identify or obtain. In the absence of applicable experience and data, analysis of these factors may be constrained. Data and information gaps should be carefully documented and later considered in the development of data collection strategies.

Figure 3.15 below provides a Review Checklist to guide managers through Task 3 completion. **Table 3.6** also shows how the three guiding questions are applied at each individual outcome level. These questions form the basis of the additional guidance on problem prioritization provided in **Sections 4.0** and **5.0**.

Key Concept 3.5 Sustainability and the triple bottom line

Sustainability is the practice of exploring the interconnections among economy, society, and environment to bring about the best solutions for people and the environment now and in the future. There are as many specific definitions of sustainability as there are groups trying to define it, and each may be useful in different situations and for its own purposes.

The phrase "the **triple bottom line**" (or TBL) was first coined in 1994 by John Elkington, the founder of a British consultancy called SustainAbility. He argued that companies should be preparing three separate bottom lines, often referred to as people, planet and profit. . The first is the bottom line of a company's "people account"—a measure in some shape or form of how socially responsible an organization has been throughout its operations. The second is the bottom line of the company's "planet" account—a measure of how environmentally responsible it has been. The third is the traditional measure of corporate profit—the "bottom line" of the profit and loss account. The concept of TBL is now used in a wide variety of disciplines, including environmental and resource management.

In the context of stormwater strategic planning, sustainability means that decision-making is guided by a balance of environmental, economic, and social considerations. There are three critical points in the planning process where this is imperative; first during the prioritization of problems (**Step A Task 3**), again during the targeting of end-state conditions (**Step B Task 1**), and finally in the selection of program strategies (**Section 6.0**). The reason for this is that all three processes require complex and sometimes controversial decisions to be made in support of potentially significant resource commitments. Rather than doing so purely on technical grounds, a sustainability approach can guide managers toward priorities and solutions with the best chances of economic feasibility and social acceptance. It should be noted that each of these processes substitutes "technical" for "environmental" factors. This is because the range of outcomes considered by stormwater programs is broader than just environmental (water quality) outcomes.

Review Checklist

Step A Task 3
Prioritizing Problem Conditions

At each Outcome Level, apply this task individually to all problem conditions identified in Task 2. Its purpose is to rate and rank the priorities of problem conditions.

Question 1: What is the priority rating of each problem condition?

✓ **Tier 1: Regulatory Screening** **REGULATORY RATING_____**

- Identify regulatory requirements affecting priority.
- Identify regulatory constraints affecting priority.
- Assign a Tier 1 Rating. If an Overall Priority Rating can be assigned based solely on regulatory criteria, stop and document. If not, continue to Tier 2 Review.

✓ **Tier 2: Technical Review** **TECHNICAL RATING_____**

- Evaluate the significance of the problem.
- Evaluate the certainty of the problem.
- Evaluate the controllability of the problem.
- Assign a Tier 2 Rating. If an Overall Priority Rating can be assigned based solely on technical criteria, stop and document. If not, continue to Tier 3 Review.

✓ **Tier 3: Sustainability Review** **SUSTAINABILITY RATING_____**

- Identify economic factors affecting priority.
- Identify social factors affecting priority.
- Assign a Tier 3 Rating. If desired, consider separate ratings for economic and social factors.

✓ **OVERALL PRIORITY RATING_____**

- Jointly consider the results of Tier 1, 2, and 3 reviews to assign an Overall Priority Rating for each problem condition.

Question 2: What is the relative importance of each problem condition?

✓ **Priority Rankings**

- Assign relative rankings to all identified problem conditions. Consider as appropriate ranked order and group ranking approaches. Consolidate individual results into one or more ranked lists for consideration in Step B.

✓ Document all data and information gaps identified during Task 3 completion.

Figure 3.15: Review Checklist for Prioritizing Problem Conditions

The establishment of targeted outcomes is the first critical step toward the development of the control strategies needed to resolve identified problems. Up to now, planning has concentrated on identifying and prioritizing problems. From here forward, the focal point will be to identify desired changes and to develop specific strategies for achieving them. Targeted outcomes will define what a control strategy is designed to achieve, and in turn how specific actions can be directed to facilitate these changes.

Targeting starts with the list of Outcome Level 2 through 6 priority problem conditions identified above in **Step A**. For each identified priority problem, managers should consider establishing one or more targets. There is no simple formula for setting these targets. Depending on the outcome, this can be one of the most uncertain and speculative parts of the planning process. That said, managers should not shy away from setting specific targets, in fact they are necessary. In addition to helping to direct programs toward the resolution of problems, targeting establishes a context for establishing measurability, interpreting results, and evaluating success over time.

Figure 3.16 provides an overview of a general process for targeting outcomes. It consists of three general tasks. First, managers will establish the end-state conditions they believe are necessary to define success. Once this long-term vision is defined, they'll concentrate on defining the roadmap needed to get there. Interim milestones will help to direct efforts and provide feedback for making adjustments along the way. Finally, managers will review these end-state and interim targets with an eye toward their measurement and assessment. The upfront identification of applicable data requirements will ensure that outcomes are measurable and that managers are able to evaluate them once implementation phase data become available.

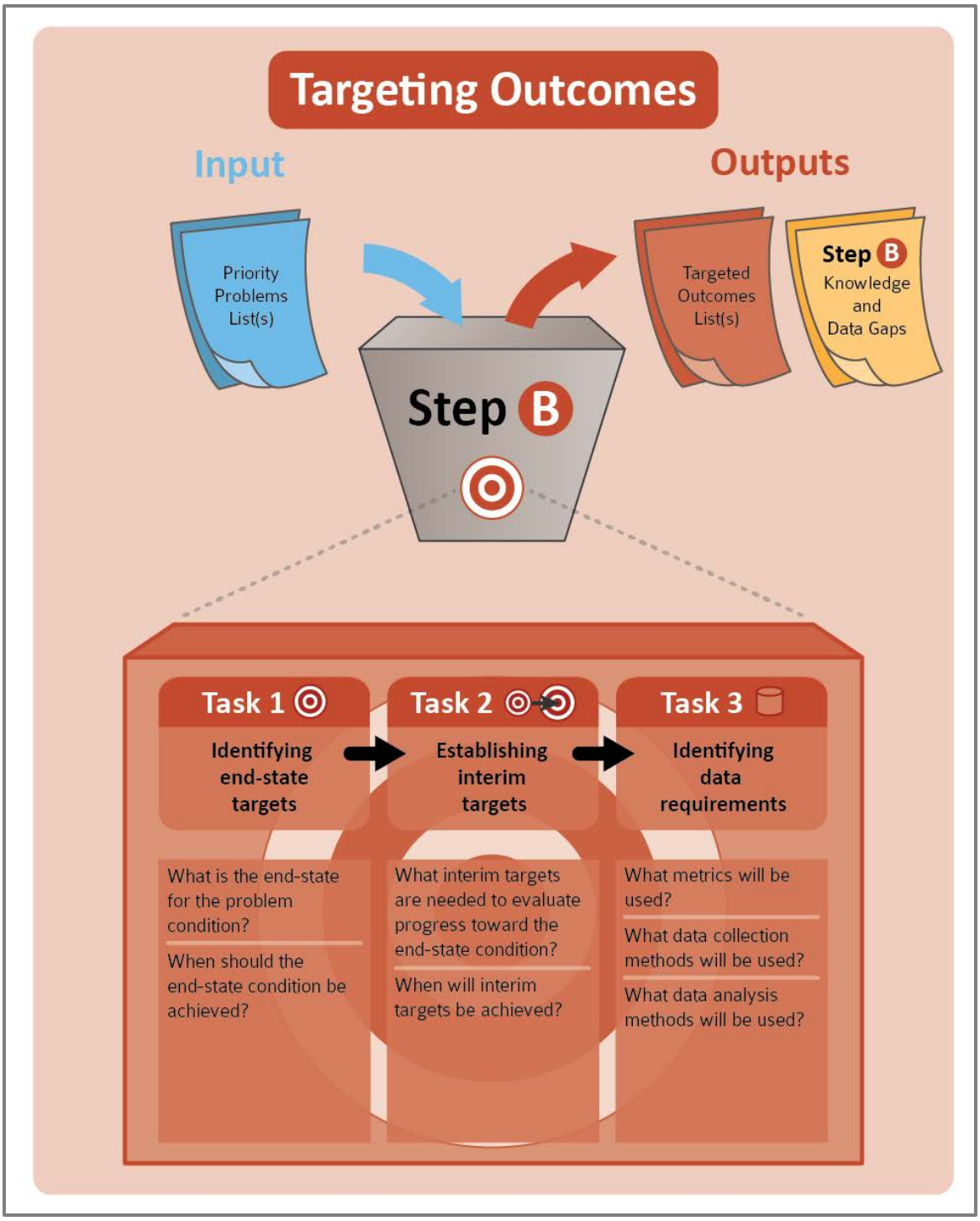


Figure 3.16: General Process for Targeting Outcomes

Task 1 Identifying end-state targets

In Step A, managers defined the nature and magnitude of individual problem conditions. Under Step B, managers will focus on defining the changes to be sought in those conditions. It addresses two general questions.

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**

Question 1 What is the end-state for the problem condition?

End-state conditions describe a "no problem" state. Once achieved, they can be considered to represent long-term success for the particular outcome under consideration. For each priority problem condition identified, managers must define what they consider long-term success to be. That is, under what circumstances would the condition no longer represent a problem?

Approaches to evaluating end-state conditions are very different than those employed for existing conditions. End-state conditions are focused primarily on defining long-term success. From a planning perspective, they provide the "goal post" for each priority outcome. There is no simple or straightforward approach to defining them. The discussion below describes several general approaches that can provide structure in identifying these conditions. As described, targeting starts with the establishment of provisional targets followed by a review of initial results using many of the same general considerations discussed previously during problem prioritization. While many of the details change from one process to the next, this continuity underscores the importance of these factors as core planning considerations.

General Approaches to End-state Targeting

Four general approaches to setting targets are described below. Any management approach will likely rely on all of them to some degree, with each applying in different circumstances.

Targeting to Regulatory Requirements

Regulatory requirements should also always be considered when setting targets. Since permits and other regulatory directives often leave little room for interpretation, compliance with them must be maintained. For example, if a TMDL requires compliance with Water Quality Based Effluent Limits (WQBELs), the program must be designed to achieve them. This is true in any case where a target is explicitly or implicitly defined in a permit or TMDL.

Targeting to Higher Outcome Levels

This approach involves establishing targets in relation to desired changes in higher level outcomes. For example setting a target for behavioral change (Level 3) that is designed to achieve a source reduction (Level 4); or targeting a group of source reductions (Level 4) to collectively achieve a specific improvement in MS4 discharge quality (Level 5). As previously discussed, problem conditions are assumed to be sequentially linked in "chains" (or "webs") of cause and effect relationships. It follows that changes in these conditions are also sequentially linked, and that managers will benefit from exploring the potential implications of "dialing" a particular outcome up. This "upward targeting" approach centers around the relationship of two variables. The lower level outcome can be considered an independent variable and the higher level outcome a dependent variable. Or to put it another way, a change in a "causal" outcome can be targeted to achieve an "effect" in the other outcome. Where relationships between the two outcomes are well-understood, or can be reasonably hypothesized, this should be the approach of choice. In practice, this is often not the case, so other approaches must be considered.

Targeting to Resources

Every MS4 program is subject to resource limitations. Normally programs cannot be resourced to achieve all priority outcomes, so decisions must be made about how much and how quickly they can be achieved. Individual targets must always be established within the context of overall resource availability. For example, how much

training or outreach can be conducted with existing staffing? Or how many structural BMPs can be constructed and maintained? It's important to emphasize that targeting to resource availability may often not be sufficient for meeting explicit regulatory requirements, or to satisfy the expectations of regulators or third parties.

Targeting to Learn and Adapt

As emphasized throughout this document, managers often lack the knowledge base needed to understand the types and amounts of change that can be achieved. Or the potential implications of a specific action or change will be unknown. As such, the certainty needed to pursue any of the previous three targeting approaches may be lacking. In many cases, programs or initiatives must be implemented with a general objective of learning through experience. This "trial and error" approach relies heavily on establishing and exploring assumptions or hypotheses, accumulating experience through ongoing implementation, and making adjustments through an adaptive management process. This is not to say that other approaches lack a focus on learning; just that sometimes an active learning process must precede the establishment and refinement of targets. Given that linkages between many outcomes may never be confidently established, this allows managers an important means of better defining achievable targets over time.

One approach might be to implement a program according to a specific plan of action (Level 1) and to monitor for potential changes at one or more other outcome levels. For example, if a particular set of activities is directed to reducing loadings of a pollutant in a watershed area, managers might also seek to determine whether or not specific changes are occurring in downstream receiving waters over time. By setting "experimental" targets and tracking measurements for both types of outcomes, they can learn more about each outcome individually, and work toward the establishment of linkages between them over time. There is conceptually little limit to the range of targets that can be addressed experientially. The critical unifying factor is increasing **measurability**. Only by committing to the measurement of individual outcomes, and to using data to answer specific, directed questions, can managers actively support an adaptive management process. As measurability increases over time, basic assumptions about relationships between outcomes can be replaced with **working hypotheses** that can in turn be refined and further explored.

Sometimes managers will want to explore changes in **individual outcomes** regardless of their expected effects on other outcomes. This allows them to proceed with targeting outcomes even where linkages between them are not well understood. One variation on this approach is the establishment of **stretch targets**. Managers will often have a good idea of what they've been able to accomplish in the past, and therefore where they might seek additional improvements. For example, they might target a 10% increase in knowledge of the difference between sanitary sewers and storm drains in residents; or a 5% reduction in discharge violations at construction sites. These targets give managers a means of "stretching" to see what can be done cost-effectively or within available resource commitments. In doing so, they can continue to actively learn while pursuing increases in measurability that might later be used to explore linkages. It is likely that some of the most significant program achievements will be obtained using this approach because it can be iterated more simply and quickly, and does not depend on the establishment of relationships which may eventually turn out to be incorrect.

In theory, as individual targets are "lined up" across multiple outcome levels, they will provide the linkages necessary to connect program implementation to receiving water improvements. Given the number and complexity of relationships between individual outcomes (see Key Concepts 3.3 and 3.4), this can be difficult to achieve. Nonetheless, it remains an important design principle that should be followed wherever possible. This might start with simple qualitative linkages (e.g., a constituent match between a specific source type and a receiving water exceedance). Over time, as targeted implementation proceeds and measurability increases, these relationships can be strengthened and quantified. Given, however, that some linkages may never be established, managers should also pursue a general goal of demonstrating improvements across a variety of outcome types.

Potential Review Factors

Regardless of which general approaches are taken, the initial list of targets generated should be considered provisional, and reviewed and revised as needed. Reviews should include a consideration of any potential regulatory, technical, economic, or social factors that may affect the feasibility or desirability of attaining the target (**Figure 3.17**).

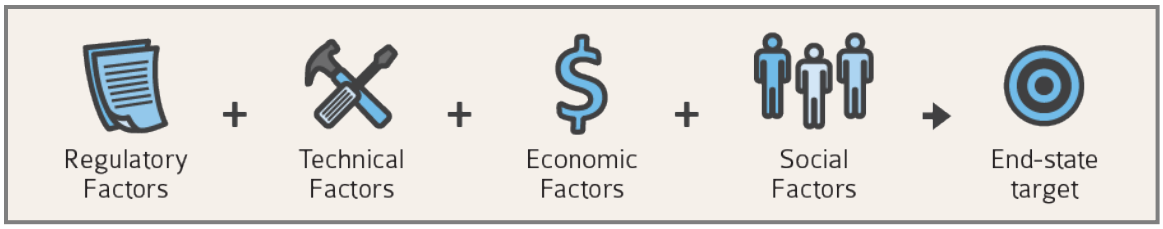


Figure 3.17: Factors Relevant to Setting Targets for Outcomes

Since these factors were already introduced above during problem prioritization (Step A Task 3), readers are referred to that general discussion for additional background. They are reminded, however, that the application of these factors during targeting is for a fundamentally different purpose. Whereas the former process was intended to establish the priority of a problem condition, the purpose here is primarily to define the magnitude of the change to be sought. Because of this, some differences exist in the application of these criteria, particularly with respect to potential cost implications. As noted above, a variety of costs may apply to the MS4 program itself, to target audiences, or to society at large. Given that the resources to be applied to potential solutions are always limited, measures of efficiency and benefit should also be considered. These include cost-benefit, cost-effectiveness, and return on investment (ROI).

Table 3.6 provides a list of potential review questions that might be considered.

Question 2 When should the end-state condition be achieved?

Every targeted change in conditions should specify a timeframe. Without this, it's impossible to assess whether or not a program is making reasonable progressing toward it. As noted above, some timeframes will be established by permit or TMDL requirements. Where there is discretion, managers should pay particular attention to the time needed to realistically achieve the type of change targeted. This should include both the time needed to fully implement control measures, and the additional time needed for resultant changes to occur. **Figure 3.18** provides a comparison of the timeframes generally needed to achieve different outcome types.

Table 3.6: Potential Review Questions for Evaluating Provisional End-state Targets

Regulatory Considerations

- Is the target legally required (explicitly or implicitly)?
- Do legal or regulatory restrictions apply to acheivement of the target?

Technical Considerations

- Is the target technically feasible and acheivable?
- Are potential control measures and technologies readily available?

Economic Considerations

- Is achieving the targeted change economically feasible and efficient?
- What are the costs of achieving the change? Are they one-time or ongoing? Who pays for them? Will it create or eliminate jobs?
- Can the targeted change be achieved cost-effectively?
- How do identified costs compare to the expected benefits of the change?
- What is the return on investment (ROI)?

Social Considerations

- Who is affected by the proposed change?
- Who might support or oppose the change? Why?
- Are there environmental justice issues associated with making or not making the proposed change?
- Is the change socially acceptable or supported?

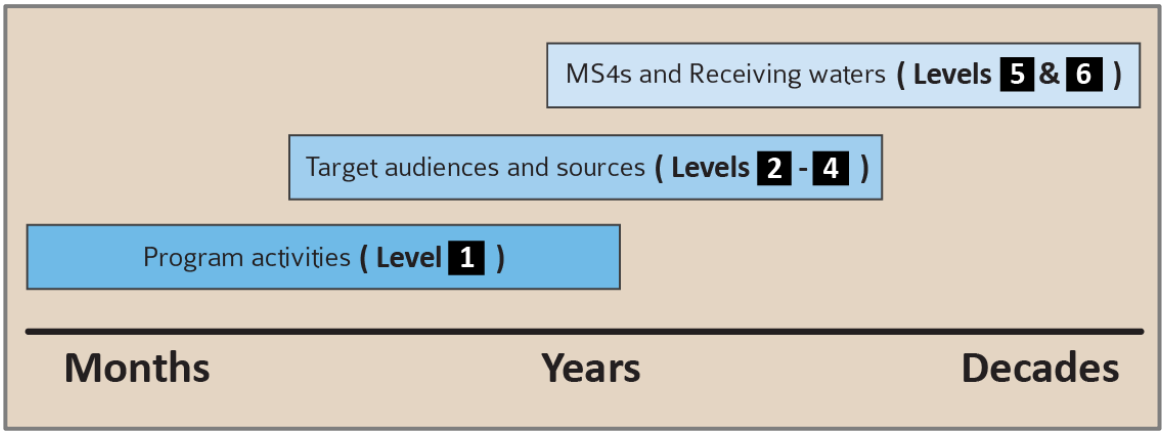


Figure 3.18: General Timelines Needed for Achieving Targeted Outcomes

Although not to be taken literally, this figure illustrates a general principle that timeframes for change are inversely related to the level of control exerted by a program. That is, they will be shortest for the outcomes that managers directly control (their own program activities) and increase from left to right with higher outcome levels. It's also important to consider the timeframes needed to measure the change. Even though a target may be achievable within a given number of years, the variability of sampling results can sometimes make it difficult to obtain reliable measurements of change within the same period.

Task 2 Establishing interim targets

Every targeted end-state condition will have a timeframe associated with it. Since many changes can take years, decades, or longer to achieve, a course of action will normally need to be set for incrementally achieving them. The concept of interim targets should already be familiar to many managers since they're routinely required in TMDLs, and many MS4s permits are increasingly setting specific timelines for achieving change.

The establishment of interim targets follows the general questions below.

Step B Task 2 Key Questions
Establishing Interim Targets

Inputs	Key Questions	Outputs
End-state Targets	**Question 1:** What interim targets are needed to evaluate progress toward the end-state condition? **Question 2:** When will interim targets be achieved?	**Interim Targets**

Question 1 What interim targets are needed to evaluate progress toward the end-state condition?

Interim targets are the milestones on the road to achieving end-state conditions. As stated, most targeted end-state conditions are likely to take years or decades to achieve, if at all. In the meantime, managers need to know if their efforts are properly directed and if satisfactory progress is being made. Interim targets can provide this structure and feedback.

Figure 3.19 illustrates the relationship of interim and end-state targets. In this example, four interim targets have been established. By designing implementation strategies to incorporate feedback through the assessment of interim targets, managers will provide themselves the opportunity to learn and adapt as they go.

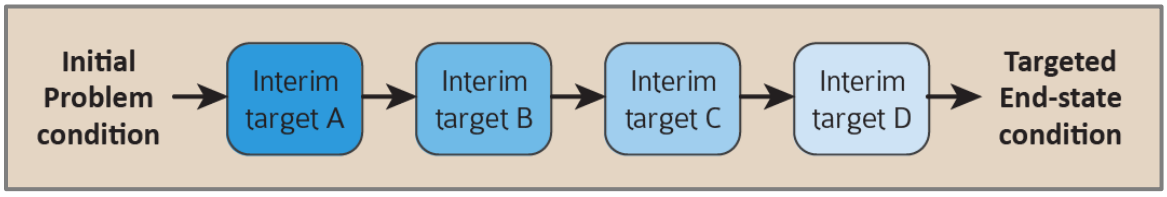


Figure 3.19: The Role of Interim Targets in Achieving End-state Conditions

Interim targets should reflect the time it takes to "ramp up," refine, and fully implement the programs expected to drive targeted changes. Once initial changes have occurred, other higher level changes (behavioral changes, load reductions, etc.) will also take time to occur in response. There may also be a point at which maximum gains can be expected and the achievement of steady state conditions after that. Interim targets should establish milestones along the way necessary to realistically anticipate critical events in the implementation curve, and to make adjustments in response to results.

Question 2 When will interim targets be achieved?

At first glance, **Figure 3.19** may seem to imply a linear progression toward end-state conditions, but this is rarely the case. In some cases, changes may start slowly before control strategies are firmly established. In others, they may be more pronounced early on, with diminishing returns observed later. Although it's difficult to accurately forecast schedules for targeted change, the use of interim targets should realistically reflect real world conditions. Likewise, they should be adjusted along the way in response to experience and feedback.

On completion of this process, managers will have identified the targeted conditions they hope to achieve as a result of program implementation. These targets will later be considered for inclusion in the Source and Impact Strategy described in **Section 4.0** and the Target Audience Strategy described in **Section 5.0**. Given the numerous assumptions that must be made in the development of targets, knowledge and data gaps will also be prominent during this planning stage.

Task 3 Identifying data requirements

Now that targets for change have been identified, managers will need to identify how each outcome will be measured, what data are needed to allow measurement, and how these data will be collected and analyzed.

It is critical that each of the questions below be addressed for every targeted outcome addressed in Step B. Where the establishment of data requirements cannot be satisfactorily addressed up front (e.g., there's no available option for collecting the desired data), they may need to be documented as knowledge or data gaps (**Step C**).

Question 1 What metrics will be used?

This question addresses how managers will know when a targeted outcome has been achieved. Metrics are the unambiguous expression of an outcome. Up to now, outcomes have been discussed at a fairly general level ("a decrease in copper concentrations," "an increase in the percentage of workers understanding a specific concept," etc.). Before moving to implementation and assessment, it's necessary to convert these targets into very specific, measurable terms. In general, this means a more specific formulation of the

outcome statement and the assignment of units of measure or assessment. This concept will be explored further in **Section 7.0**.

Question 2 What data collection methods will be used?

This question addresses how data will be collected to allow a condition or result to be tracked or assessed. **Table 3.3** provides a general listing of potential resources for collecting data and information by outcome level, and **Section 6.0** introduces a variety of data collection activity types typically used by stormwater programs. Data collection options are also explored further for each outcome level in **Sections 4.0**, **5.0**, and **6.0**. **Section 7.0** will also further explore data collection objectives and options. While managers may often have a very good idea of how data will be collected, it's prudent to stop and make sure that this is true for each identified outcome.

Question 3 What data analysis methods will be used?

The last consideration for any targeted outcome is how the data that are collected will be evaluated. As above, specificity is absolutely critical. Managers may often have a better idea of how they'll collect data than what they'll do with it. Failing to identify specific analytical approaches up front is a common mistake that can severely limit the explanatory value of data. Moreover, the choice of analytical method can dictate what specific metrics should be used, how the data should be collected, and the quality of the result. **Section 7.0** further explores data analysis objectives and options.

Figure 3.20 below provides a Review Checklist to guide managers through Step B completion.

Review Checklist

Step B Tasks 1, 2, and 3
Targeting Outcomes

At each Outcome Level, apply this task individually to all conditions selected for targeting in Step A Task C (Prioritizing Problem Conditions). Its purpose is to identify specific targets for change in problem conditions.

✓ **End-state Targets (Task 1)**
Consider the following questions:

Question 1: What is the end-state for the problem condition?
Select an approach type for establishing provisional targets. Apply and review each provisional target and revise as necessary.

Question 2: When should the end-state condition be achieved?
Consider the time needed to fully implement control measures and for resultant changes to occur, and the timeframes needed for measurement.

✓ **Interim Targets (Task 2)**
Consider the following questions:

Question 1: What interim targets are needed to evaluate progress toward the end-state condition? Consider milestones in the implementation curve, and the need to evaluate incremental progress.

Question 2: When will interim targets be achieved? Consider the time needed to fully or partially implement control measures and for resultant changes to occur, and the timeframes needed for interim measurement.

✓ **Data Requirements (Task 3)**
For each end-state or interim target, consider the following questions:

Question 1: What metrics will be used?
Question 2: What data collection methods will be used?
Question 3: What data analysis methods will be used?

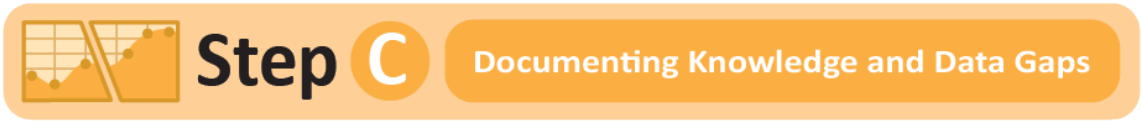
✓ **For each priority outcome, document interim and end-state targets, and the data requirements necessary to track and evaluate them.**

✓ **Compile one or more lists of targeted changes for each outcome level and supporting documentation for listed conditions.**

✓ **If a priority outcome is not or cannot be targeted, document the reason.**

✓ **Document all Step B data and information gaps.**

Figure 3.20: Review Checklist for Targeting Outcomes



Uncertainty is an unavoidable feature of stormwater management. As described throughout this section, every major planning step involves some degree of speculation. Knowledge and data deficits will therefore continually be revealed as planning progresses.

As an example, elevated bacteria levels in receiving waters and MS4s are determined to be a problem condition. In response, restaurants are implicated as contributing sources and program activities directed to mitigating specific pollutant-generating activities (food grease disposal and outdoor rinsing of floor mats) at those facilities. In the absence of supporting data and information, two critical assumptions have been made; first that these facilities are significant sources of bacteria, and second that these specific practices are the causes of these discharges. Stormwater management is largely a hypothesis testing endeavor, and assumptions are a necessary part of that approach. As indicated, it would simply be impossible to move stormwater programs forward without them.

Uncertainty can never be an excuse for inaction, but managers should also be cognizant of the need to treat critical assumptions as provisional hypotheses, and to gather the data and information necessary to refine and replace them as necessary. To allow their eventual resolution, knowledge and data gaps should be documented throughout the planning process, and strategies developed for addressing critical gaps through targeted data gathering initiatives (monitoring, special studies, implementation tracking, etc.; see **Section 7.0**).

Figure 3.21 illustrates a general process for documenting knowledge and data gaps. As previously indicated, this idealized process shows the identification of gaps as discrete planning steps. In reality, this review should be ongoing throughout the entire planning process.

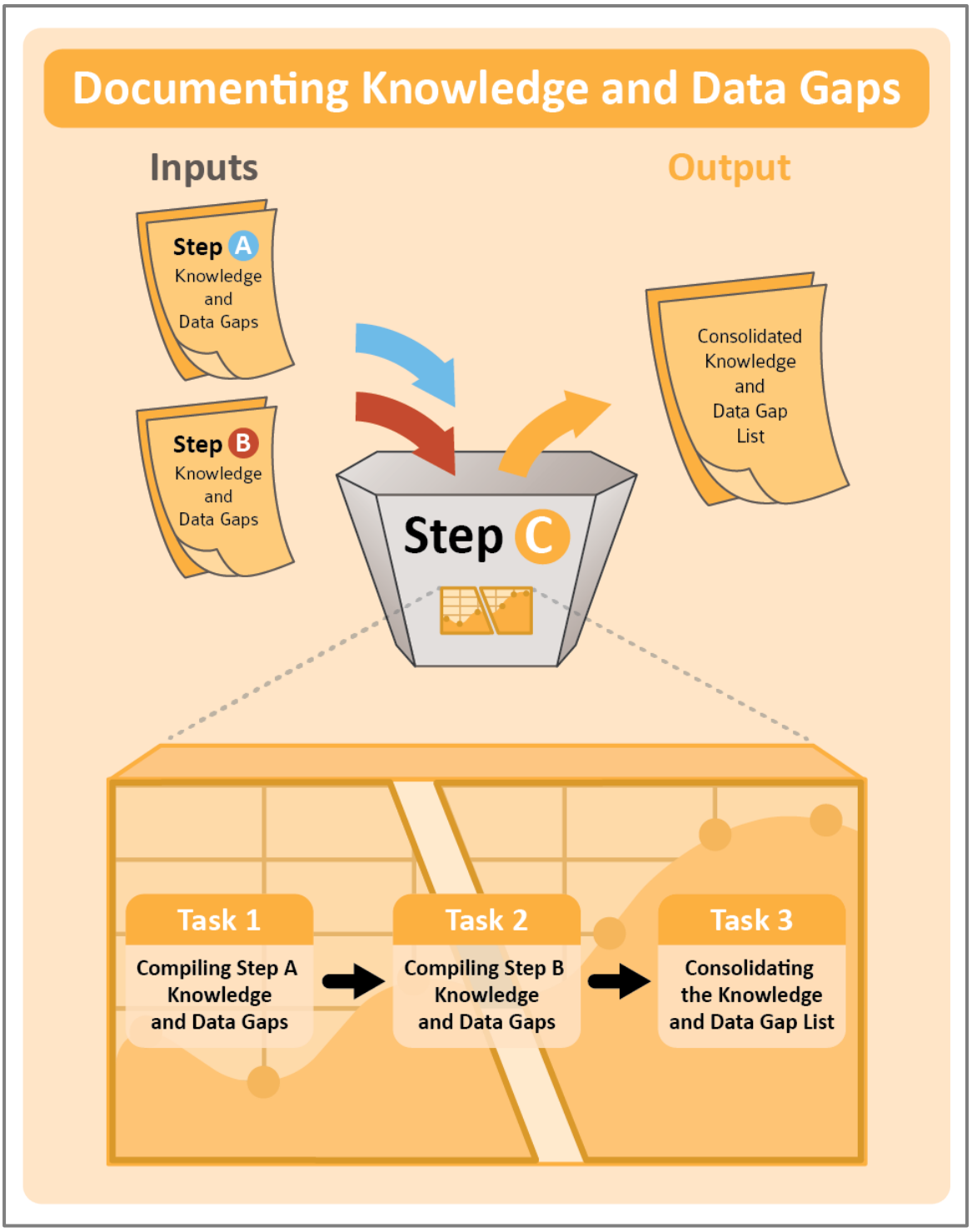


Figure 3.21: General Process for Consolidating Knowledge and Data Gaps (Step C)

3.4 Stormwater Strategic Plan Completion (Stage 3)

The final stage of the strategic planning process is Plan Completion. This is where all of the individual elements described throughout this document are pulled together, reviewed, revised, and finalized. All Stormwater Strategic Plans will be different depending on their unique needs and circumstances, but each of the elements listed in **Table 3.7** should be considered for potential inclusion.

Table 3.7: Potential Stormwater Strategic Plan Content

Element	Explanation
Source and Impact Strategies	Addresses Outcome Levels 6, 5, and 4, the physical component of stormwater management. Managers consider a variety of parameters to evaluate sources, MS4s, and receiving waters. See **Section 4.0**.
Target Audience Strategies	Addresses Outcome Levels 3 and 2. They focus on understanding who is responsible for identified source contributions, and which specific behaviors are contributing to them. Managers need to know what each identified target audience should be doing differently, and to have a clear understanding of the influencing factors standing in the way of these changes. See **Section 5.0**.
Program Implementation Strategies	Addresses Outcome Level 1. Their focus is on the selection and targeting of specific program activities necessary to facilitate changes in target audiences, and to provide the feedback necessary to track and evaluate the range of outcomes addressed by the Strategic Plan. See **Section 6.0**.
Assessment Tools and Strategies	Addresses all Outcome Levels. They identify the strategies and approaches needed to support ongoing characterization of conditions, to evaluate change or success, and to identify and address data and information gaps. See **Section 7.0**.

A comprehensive planning and assessment strategy will typically address a wide variety of individual outcomes, but their selection will ultimately reflect the specific details, priorities, and assessment objectives of each Stormwater Management Program. It's critical that readers understand that Stormwater Strategic Plans are not likely to actually be organized according to these four elements. The overall organization of any strategic plan is much more likely to follow broad source categories. However, each of these elements will have differing degrees of applicability within the specific components of this broader organizational scheme.