

STORMWATER MANAGEMENT:

Emerging Planning Approaches and Control Technologies

Chapter 3

" SUBWATERSHED PLANNING "

CHAPTER 3

3.1 DEFINITION AND RELATIONSHIP TO WATERSHED PLANNING

The Evolving Definition of Subwatershed Planning

The term "Sub-Watershed Planning" refers to an approach to water resource and land use management that conforms to the boundaries of a subwatershed, and that respects the requirements of the ecosystem within the subwatershed as a fundamental part of the planning process.

This approach reflects an awareness of some of the limitations of previous approaches. Traditional planning for developing areas was based on parcels of land defined by political or development area boundaries. Such an approach neglects the physical reality that stormwater flows according to topography, which only coincidentally corresponds to the definitions of land ownership or government. It also tended to result in a piecemeal approach to drainage planning. Opportunities to plan and manage interactions between properties, or to provide control measures that integrate large areas, tend to be lost as a result. Master Drainage Planning was devised as a response to this, by planning drainage on logical watershed or at least physically reasonable units. Even this advance proved to be limited, however, as increasing interest in ecological issues required that drainage and drainage corridors be resolved in a way which has minimum environmental impact. Subwatershed planning takes the problem further, by taking a broader view that incorporates environmental issues.

There is now a stronger focus on protection and enhancement of the environment, which includes protection of the form and function of the natural environment. This supplements the various water quality indicators that have been used in the past (and still are) with such interests as channel form, habitat, stream cover, and so on. As well, participation in the planning process by the public and by other stakeholders tends to be stronger.

These factors have tended to add to, rather than replace, the general principles of Master Drainage Planning. A consequence of this added range of interest, is an expanded range of required technology. Subwatershed planning tends to be marked by studies and investigations that not only address drainage requirements, but include studies of species, aquatic habitat, terrestrial habitat, and ground water.

The Sub-Watershed Planning process is not yet fully developed. Ecological models are imperfect. The understanding of control measures is still developing. The ability of municipalities and the Province of Ontario to fund the significant capital and operational costs of stormwater and other service facilities is limited, and costs are escalating. Therefore, even though the present state of the art is an effective and useful process, and a substantial improvement on past practice, the

process will no doubt continue to evolve.

The Context

The role of the Sub-Watershed Plan is best understood by considering as it relates to two other major elements in watershed planning, namely the **Watershed Management Plan**, and the **Stormwater Management Plan**. To ensure effective stormwater management, all three components of watershed planning must be completed and be directly related to the municipal planning process.

- **Watershed Management Plans** are comprehensive strategies, developed on a watershed basis, that establish goals and approaches to water management on a broad level. The plan documents the major physical, chemical and biological characteristics of the watershed, and establishes existing and potential water uses. General management methods are evaluated and, and management approaches are selected on a watershed basis.

Watershed Management strategies are linked to municipal Official Plans which set out the objectives and policies that are used to guide development. The Official Plans should contain the stormwater management goals and targets established in the Watershed Management Plan.

- **Sub-Watershed Management Plans** address the requirements for stormwater management on a finer scale of detail. It develops a plan consistent with the Watershed Plan, and further defines stormwater controls in more detail and with a greater representation of specific measures.

This planning level is at the same physical scale as the municipal Secondary Plan (which provides a basis for planning details such as land use and transportation corridors). Developing these two plans simultaneously will promote the optimization of all resources within the sub-watershed.

- **Stormwater Management Plans** are the next level of detailed planning. Stormwater Management should be considered at an early stage in the subdivision design process because it may significantly affect such items as the layout of the lots of the subdivision.

The Stormwater Management plan is the device that sets out measures that will assure the effective implementation of stormwater management facilities when the actual design of subdivision layouts and associated management measures is completed. At the same time, it is at a level of detail such that it can remain responsive to and compatible with the other service needs of a development. Therefore, the Stormwater Management Plan and the

Plan of Subdivision should ideally be developed together or in close coordination.

Thus, the Sub-Watershed Plan provides the link between the services-oriented Stormwater Management Plan, and the goals-oriented Watershed Plan. It pays close attention to ecological function, and balances that function with other servicing objectives including flood protection.

The Benefits

The desirability of Sub-Watershed planning can be considered in more concrete terms than a simple recognition of environmental sensitivity. There are a variety of factors that promote the concept as a valid and distinct part of the planning process.

A Balanced Approach By considering ecological issues according to each watershed, objectives related to habitat and other environmental considerations are developed in terms that are meaningful in the local context. The roles and requirements of the various 'soft' management elements of the system are better understood, and significant issues can be differentiated from less important considerations. Trade-offs among development issues and environmental consequences can be better managed to achieve an effective conclusion.

Communication and consensus. The systematic process involves participation and review by numerous regulatory agencies. Their agency objectives and requirements are thereby incorporated into the Plan. This facilitates the approval process and can reduce the occurrence of inconsistent reviews, lengthy delays, multiple submissions and other consequences of late submission of development plans to the regulatory community. As significant is the public involvement. Early and appropriate public interaction is a material benefit of the process, since values and objectives are better defined, and a consensus easily achieved and accepted.

A comprehensive scope. By assembling and reconciling diverse physical issues in a single document, the chances of encountering problems in subsequent plans and designs are reduced. The developer should not need to deal with conflicting objectives, regulations, or prior plans. These types of problems will have been encountered and reconciled during the generation of the subwatershed plan.

Savings. Time is money, and a process which is streamlined has an inherent benefit. As well, however, a clear understanding of true environmental values, and appropriate objectives, supports the expenditure of funds for environmental protection in the most effective way.

Long term sustainability. Subwatershed planning promotes a sustainable environment, and therefore also promotes the long-term sustainability of the natural system. Such

things as channel stability, system operation, and long term performance of quality control devices, are all enhanced by the subwatershed planning process. This inherently improves the long term prospects of the service system as well as the natural environment.

Recognition of these factors is substantial, and increasing. The Environmental Assessment Advisory Committee has supported integrated environmental and land use planning in a number of its reports on local planning and approvals. Specifically, the committee suggests identifying the long-term costs of traditional development practices (including subsequent remediation costs) to compare with the costs of conducting preventive, subwatershed planning and implementation.

In summary, it is clear that, in concert with other plans and programs in Ontario, Subwatershed Plans can support the development of a positive regional, economic and social environment in the Province of Ontario. By resolving and streamlining numerous planning requirements, a sound Subwatershed Plan can encourage new development. In turn, that new development will be linked with a healthy and viable natural environment, protected and preserved as an integral part of the development plan, and responsive to the public interest. Taken together, these benefits promote the growth, health and economic stability of the community.

3.2 GOALS AND OBJECTIVES OF THE SUB-WATERSHED PLAN

The benefits and considerations of Sub-Watershed Planning must be stated in terms of clear and specific goals and objectives if they are to be realised in a dependable way. These goals and objectives will be partly a function of the local situation, since the existing Watershed Plan (if any), the developing Official Plan, the physical environment, and the public interest will all play a part in their development. Even so, some aspects will be common to all Sub-Watershed Plans. They must, over the entire subwatershed area:

- **Provide a vehicle for public participation in the planning process.** Public information programs, and methods of responding to public input must be incorporated.
- **Identify and document the areal distribution, status, significance and sensitivity of natural communities.** Major environmental features of the area and their linkages must be addressed, and the factors which govern their sustainability identified. The environmental features considered should include the quantity and quality of surface and ground water, aquatic and terrestrial habitat, fisheries and wildlife communities, and habitat, etc.
- **Identify and reconcile regulatory requirements.** Appropriate agencies must be identified and involved in the planning process at an early stage, and involved in identifying key regulatory interests, if any, in the particular area.
- **Establish management goals and objectives.** Where a Watershed Plan exists, it will provide watershed goals and objectives that must be focused in subwatershed plans. A vision of the area, sensitive to intended uses and to the sound principles of environmental management must be established and translated into concrete goals and objectives. Such

factors as recreational use, water supply, ecosystem support, and stormwater conveyance are considerations in the identification of use.

- **Identify constraints imposed by environmental sensitivity, flood hazard or other physical limitations or features.** Those areas and features which are directly sensitive (such as important habitats) or indirectly sensitive (such as buffer lands or recharge areas) must be identified and defended. Areas constrained from development, and features constraining development, must be identified. Sensitivity must be interpreted not only in terms of Provincial legislation, but in terms of the watershed goals and objectives.
- **Identify lands which are not constrained.** Those lands which do not demonstrate environmental constraints are, from an environmental point of view, developable. Servicing plans will affect this conclusion, but development can occur within unconstrained lands provided that such development is appropriately guided (stormwater controls etc. are still necessary).
- **Assess the short and long term potential for development which may adversely affect the environment.** This will require an evaluation of the consequences of development in those areas not constrained by environmental features. This will establish what mitigation measures will have to accompany development, and may result in identification of added constraints to development.
- **Identify and specify the most effective Best Management Practices (BMPs) for the area.** Based on need, as established in the Watershed Planning process, BMPs types and functional criteria must be selected. This must be expressed with care. At later stages of planning and design information not available during the Sub-Watershed Planning process generally becomes available, and some fine-tuning of the Plan is often appropriate. It is important to avoid over-constraining the area, and run the risk of inadvertently preventing appropriate variations on the theme established by the Sub-Watershed Plan. Therefore, BMPs must at this stage be formulated in terms of intent and performance as much as possible. At the same time, benchmark and basis for comprehensive planning, substantial detail on the location, function, and the sizing of BMPs envisaged in the Sub-Watershed Plan must be provided.
- **Provide an implementation plan.** This must address factors which might affect the sequence of implementation during partial development stages, and must identify control measures which may be particularly critical during implementation.
- **Outline requirements for monitoring programs.** This may include monitoring plans to verify performance or continued sustainability of the critical environmental features or protective measures.
- **Provide technical information** that will assist in the development of Community Plans and the design of subdivisions.

- **Provide effective communication of the Plan and its basis.** The Plan must be communicated fully, including assumptions, methods, and limitations. There may be significant technical detail in such a plan, yet it will have a wide target audience, including general public and scientific participants. For this reason, the need for rigour must be tempered by the need for wide communication. There is often a need to provide simplified summary information which interprets the technical program for a less technical readership.

3.3 THE LINK WITH OTHER PLANNING PROCESSES

General Considerations

At present, there are a number of planning mechanisms in place in Ontario. The process does function, but does not presently proceed in a way which is integrated in a comprehensive way. The Sub-Watershed Plan is comprehensive within its own domain but, as described above, is not fully or necessarily integrated with the Official Plan development or with other planning activity.

Since the same physical systems are approached and addressed by these various planning activities, the potential for circular interaction is real. A land use planning decision can affect a variety of watershed planning issues; the converse is also true. Therefore, if the land use and watershed planning issues are not concurrent, or linked, they may be incoherent. To avoid this, the Sub-Watershed Plan is often required to undertake some sort of evaluation of land use planning issues in order to complete its direct objectives. Assumptions on demographic change or population growth patterns are basic to the Sub-Watershed Plan. If not already available, these issues must be either fully completed or at least functionally addressed as a part of the Sub-Watershed Plan.

In any particular location, a review of the state of the various possible planning activities is a necessary first step in Sub-Watershed Plan development. This is the only way to determine what information is available, what is being developed, and what will be required on an acceptable interim basis in order for the Sub-Watershed Plan to proceed.

It is noted that variability between locations can be substantial, so no completely general rule can be formulated. Municipalities have the legislative authority and political responsibility to undertake comprehensive land use planning which considers environmental issues. Generally, the result is that Sub-Watershed plans will not be the major or only determinant of land use. They most likely will affect the determination of lands not constrained by environmental issues, and may affect the density of development. The actual development forms and land uses will be strongly affected by other factors, including transportation, service and other requirements.

An attempt should be made to integrate activity, if only on an information exchange basis. The existence of Sub-Watershed Plan evaluations of natural features and opportunities should be communicated to the affected municipalities. In return, developers of the Sub-Watershed Plan should seek out other planning, analysis or design activity which has defined service routes, corridors or other relevant plans. Ideally, servicing studies should lag behind the Sub-Watershed

Plan elements that identify environmental constraints and opportunities.

The Environmental Assessment Process

Particular attention must be paid to the concurrent requirements of Environmental Assessment (EA) Act. As the Subwatershed Plan deals with substantive environmental issues and may incorporate major facilities, it may require implementation of facilities or practices falling under the EA Act. In that event, the Plan must meet the requirements of the EA Act before any other provincial or municipal approvals for the project may be issued. This possibility must be considered at the time the Sub-Watershed Plan is formulated.

Fortunately, it is commonly recognised that the process required by the EA Act is not incompatible with many of the principles of the Sub-Watershed Planning process. If specifically targeted during development of the Plan, it may be that the EA Act requirements can be substantially met or supported by the Planning process.

A review of the state intent of the EA Act makes it clear why this is so as a general principle. The EA Act was established "to provide for the protection, conservation and wise management of the environment through planning and informed decision making." Successful planning under the EA Act consists of five key features: consultation with all affected parties; consideration of a reasonable range of "alternatives to" the undertaking and "alternative methods" of implementing it; consideration of all aspects of the environment; systematic evaluation of the net environmental effects of each alternative considered; and provision of clear, complete documentation. Although the two processes are not complete substitutes for each other, they are in a broad sense complementary.

EA requirements as they relate to Sub-Watershed Plans will vary depending on the proponent and the type of project(s). Depending on scale and nature, some projects resulting from the Sub-Watershed Planning process may be exempt from the EA process. In some cases, a particular project may require an individual Environmental Assessment, which can be a major undertaking. Alternatively, the Class Environmental Assessment (Class EA) process may provide a basis for approval. In fact, experience suggests that the majority of projects resulting from Sub-Watershed Plans will fall under this category (for example, see "Class EA for Municipal Sewage and Water Projects" (Municipal Engineers Association, 1993; or, "Class EA for Water Management Structures", The Association of Conservation Authorities of Ontario (CAAO), 1992).

The EA process in any form can be a substantial activity. Consideration should be given to this issue at an early stage in the development of the Plan. Given the potential complexity of the EA process, special advice on this issue should be sought.

3.4 THE TECHNICAL ELEMENTS OF SUB-WATERSHED PLANNING

3.4.1 An Overview of the Process

Experience suggests that an effective way to proceed with development of the Sub-Watershed Plan is to stage the work. This allows the planner to attempt to effectively integrate technical components of the Sub-Watershed Plan study, with other information gathering and planning activities.

For example, seeking to gather all data which might be required for all purposes is a useful ideal, as it implies that information gathering can be coordinated to reduce cost and improve results. The risk is that the time frame for development of the Sub-Watershed Plan may be hindered. However, this must be weighed against the benefits of being able to make decisions with a full awareness of related watershed issues.

It is suggested that, in general, two phases be identified. Many breakdowns of the effort of Sub-Watershed Plan development could be devised. This is not key; it is the attention to a logical sequence that is important. As envisaged here, the first of two phases is oriented towards identification of needs, and the second towards development of a plan. A major point should be made here. A hallmark of instances where an accepted Sub-Watershed Plan is difficult to achieve is that there is inadequate attention to 'Phase I' activity. Poor information, and particularly a poor vision of the objectives for the watershed, will lead to a study that proceeds smoothly up to the point where it is near completion but collapses at that point. The unsound basis for the Sub-Watershed Plan becomes evident under public and regulatory scrutiny.

Phase 1 essentially gathers together all factors that will enable analysis to proceed, but undertakes relatively little direct analysis. The complexity of Phase 1 work depends on whether watershed plans or other relevant environmental planning studies have been completed. In particular, a valid Watershed Plan will provide substantial information and definition to support the Sub-Watershed Plan. Without this, the essential aspects of a Watershed plan may have to be developed in order to complete the Sub-Watershed Plan. Either way, Phase 1 should:

- gather all data, if necessary identifying required monitoring
- establish goals and objectives for the Sub-Watershed
- identify environmental constraints
- identify major opportunities for management and control
- establish review requirements for the development of the Plan

Phase 2 is the activity which actively develops and tests a Sub-Watershed Plan. It identifies the final product, including:

- areas to be protected
- characteristics of development areas
- management practices for open space areas
- BMP programs to mitigate impacts of development
- an implementation strategy

Typically, the process is carried out by a consulting team with specialised skills in the area of Sub-Watershed Plan development. Academic support for special areas of investigation is

common. A Steering Committee, representing the joint interests of regulatory, municipal and sometimes public representatives will normally be struck, to provide a basis for regular review and approval of the conduct of the study leading to the Sub-Watershed Plan.

3.4.2 Defining the Sub-Watershed Boundaries

Although it is possible to accurately define drainage basins of various sizes according to topography, there is no standard way of establishing subwatershed boundaries as they relate to planning. Physically, a watershed and sub-watershed are distinguished more by a choice of scale than by any truly defensible scientific definition. Any drainage basin could be viewed as a watershed at some scale. Realistically, Watershed plans tend to be at a scale that encompasses several municipalities, or areas of that extent, while Sub-watersheds tend to encompass one or more sub-divisions. There are a variety of factors leading to a definition of the Sub-Watershed area:

- the location and extent of proposed development activities
- the existence and nature of sensitive downstream water-related natural features, uses, conditions or hazards
- available watershed plans specifying subwatersheds for study
- an agreement on boundaries with regulators

Once the general scale of the problem is established, the physics of the problem provides a more precise definition. The most downstream point in the receiving water tends to define the total sub-watershed area. Even there, the definition of the study area may require care, as a consequence of developing technology. The hydrogeologic system is now a common interest in Sub-Watershed Planning. The boundaries of that system may not follow the precise alignment of the limits of the hydrologic system. Therefore, the physical limits of the sub-watershed planning area may extend beyond the topographically defined basin area.

3.4.3 Information Gathering

The techniques in analysis, and the particular site topography, will affect information requirements to some degree. For example, mapping contour intervals will be different in areas of high relief than in areas which are flat. Therefore, development of the Sub-Watershed Plan requires that the steps and methods in analysis be identified. At the outset, a general principle should be followed. If information may change a decision, it is required. If it will not, reconsider its necessity. Information for its own sake is not a valid undertaking, but experience shows that it is a common result. Response to public interest, lack of forethought (especially in terms of model requirements), measurements taken 'just in case', and other factors are all common contributors to this. Since information gathering is also an expensive undertaking, this should be discouraged.

- Drainage systems and patterns
- Geomorphology
- Geology and soils
- Aggregate resources
- Hydrogeology
- Water quality trends
- Agricultural practices
- Fish and wildlife
- Storm water management facilities
- Flooding trends
- Infrastructure and services
- Housing needs
- Erosion sites
- Waste disposal sites
(active, proposed, closed)
- Existing and proposed land use
- Planning designations
- Recreational uses
- Transportation corridors
- Water use/taking/conservation
- Discharge/recharge areas
- Precipitation/climate patterns
- Baseflow/flow records
- Riparian vegetation/woodlots
- Wetlands
- Hazard lands
- Pollution sources (point, non-point)
- Channel alterations
- Environmentally Significant Areas/
Areas of Scientific and Natural Interest

A comprehensive base map, at a 'manageable' scale, is a highly useful device. Comprehension is very much facilitated if a 'birds eye' view of the area can be presented. Numerous detailed maps may supplement this overview. At the same time, the profuse detail in the development of a Sub-Watershed Plan makes it difficult to have everything on one figure. A logical grouping of information assists in separation of data into related groups, as shown in table 3.2. A caution is made, however, that this will not lead to solving the problem in a segregated way. The essence of the Sub-Watershed Plan is its ability to inter-relate the various aspects of the plan. It is noted that GIS can be a powerful tool in this area, since the flexible rendering and contrasting of information is a strength of that technology.

TABLE 3-2. Suggestions for Overview Mapping in a Subwatershed Plan.

RESOURCE FEATURES	DETAILS TO BE MAPPED	SOURCES OF INFORMATION
Aquatic Resources	<ul style="list-style-type: none"> • Surface water sampling stations • Fish and invertebrate collection stations • Display all main stem and tributary drainage features including intermittent or ephemeral streams • Map riparian zones based upon aerial photography • Identify springs, kettle lakes and recharge areas 	<p><u>Primary</u></p> <ul style="list-style-type: none"> • MOEE/MNR/CA (MNR district fish management plans) water quality studies or fisheries inventories • Aerial photographs • Field visits <p><u>Supplementary</u></p> <ul style="list-style-type: none"> • Scientific literatures • Local anglers/naturalists
Soils and Geology	<ul style="list-style-type: none"> • Soil types/classifications • Indicate drainage characteristics (e.g., well drained, moderately drained, poorly drained) using hydrologic soil groups 	<p><u>Primary</u></p> <ul style="list-style-type: none"> • OMAF reports and maps • MOEE well records • Conservation authority • Ontario Geological Surveys • MNR - District plans • Engineering Consulting Reports
Erosion Sites	<ul style="list-style-type: none"> • Depict the location of any known erosion hazards to structures and life as well as the instream environment 	<p><u>Primary</u></p> <ul style="list-style-type: none"> • Conservation authority inventories and work programs

	<ul style="list-style-type: none"> • Indicate the type of erosion, locations, extent, and course(s) 	<ul style="list-style-type: none"> • Aerial photos • Walking surveys will be required in almost all cases to confirm earlier inventories, unless inventory is very recent
Forest Resources/ Woodlots	<ul style="list-style-type: none"> • Boundaries of woodlots, hedgerows • Show extent of forest cover in riparian areas • Composition (main tree species) • Ownership (public or private) • Representatives, i.e., unique, common, high quality for county/townships, etc. 	<p><u>Primary</u></p> <ul style="list-style-type: none"> • MNR forest resource inventory mapping • MNR/CA designations of ESAs and ANSIs • Aerial photographs • Boundaries on OBM 1:10,000 mapping <p><u>Supplementary</u></p> <ul style="list-style-type: none"> • Field checks • Naturalist groups • Scientific literature

3.4.4 Establishing Constraints and Opportunities

The environmental sensitivities defined for the area constitute constraints, either directly or indirectly. For example, wetlands themselves are sensitive and constitute direct constraints. The necessary buffer space around those lands constitute indirect constraints. Other constraints include existing development patterns, transportation corridors, or utilities that might impede or influence development patterns.

Opportunities include locations where drainage patterns favour efficient location of BMPs, where mitigation of existing damage would be a simple and effective part of the Sub-Watershed Plan, or where other factors that would be a positive part of the Sub-Watershed Plan can be identified.

Key features that are often associated with constraints or opportunities include:

- aquatic and terrestrial ecosystems and habitats
- wetlands
- watercourses, including channels, floodplains and valleys
- fisheries and wildlife
- topography and soils
- natural and cultural heritage systems

Substantial review of these constraints and opportunities is important, since they will be fundamental to the Sub-Watershed Plan.

3.4.5 Analyses

Technical analyses are carried out to provide assessments of factors that cannot be directly measured. This includes projections of hydrologic and other impacts of future development, BMP performance and so on. In essence, technical assessments perform two functions. They provide estimates of information which cannot be measured (through cost or because it does not yet exist), and they support solution identification (seeking of optima, GIS presentations, financial calculations etc.). Other modules in this series examine the technologies involved in some of these assessments, and are not dealt with in detail here.

In general, it is important to recognise the multi-disciplinary expertise that is required from various branches of the scientific and engineering community in the development of the Sub-Watershed Plan. Present approaches require hydraulic and hydrologic analysis, groundwater analysis, biology, engineering, planning, financial, legal, and public relations skills as a normal minimum. A developing trend is to recognise that a key to the process is a professional skilled in the interpretation and integration of these various and diverse disciplines.

Rapid evolution of the technology is evident in a number of necessary technical areas. Even recent studies tended to concentrate on hydrologic approaches based on single event surface runoff models. Current approaches require continuous simulation and increasingly require a substantial assessment of groundwater response. Snow melt effects can be an important part of the study, where previously the problem was focused on summer event conditions. Other examples can be cited. The key is to recognise that successful development of the Sub-Watershed Plan rests on successful response to developments in technology.

3.4.6 Identification and Selection of Management Options

The analysis of potential impacts of development, and the interpretation of those impacts in terms of environmental constraints, defines the need for management. The opportunities for various management options (limited by the physical system), define the possible range solutions.

For example, one may consider results of post-development flood analyses. Flood-susceptible structures represent a constraint, and increases in surface runoff would require management. Options for management of the problem might include hydraulic improvement, peak flow control, or other measures. This information can be used to establish the level of quantity control which must be provided to accommodate development.

Analysis of the ecosystem may identify certain valleys as sensitive habitats which become constraints. Changes in flood characteristics would likely require management. Volume attenuation, peak attenuation, or habitat replacement may be management options.

Other ecosystem assessments might identify certain wetlands as sensitive to changes in the groundwater water table, and therefore constraints to development. Management options might include recharge maintenance in the development area, re-location and rehabilitation of the wetlands, or enhanced recharge near the wetlands.

Development of the alternative options in consistent sets of alternatives is the process of solution generation. Choosing the 'best' solution, which is likely to be a compromise, is the challenge.

Alternative plans should be evaluated on the basis of criteria developed for the subwatershed. Evaluation criteria will include such factors as:

- responsiveness to watershed goals and objectives,
- cost-effectiveness,
- ease of implementation,

- maintenance needs,
- safety,
- aesthetics,

and so on. Alternatives should be presented to the Steering Committee, if it exists, and to the public at this stage, at length.

Once the process of review and selection has been completed, the basis of all the information and comments gathered, a preferred subwatershed plan is drafted. The plan includes mapping of areas of preferred land uses and those for which certain practices or structures are proposed. The final step in plan development is review and adoption by all agencies and the public.

3.5 THE PROCEDURAL ELEMENTS OF SUBWATERSHED PLAN DEVELOPMENT AND IMPLEMENTATION

This section describes the steps which should be followed in organizing and managing the development of a Sub-Watershed Plan. This framework is intended to assist coordinating agencies, and especially the project coordinator. It provides information on why and how these studies are started, what issues are to be addressed, and the timing of various activities.

Sub-Watershed Plan development can be divided into three stages:

- Setting the Stage
- Aligning the Interests
- Preparing the Plan
- Adopting the Plan

3.5.1 Setting the Stage

In the more rapidly urbanizing watersheds of southern Ontario, staff of conservation authorities and municipalities commonly face pressures to provide answers to agencies, supplying information and fulfilling study requirements, and to provide input into the review and approval of development plans. In these areas, development pressures can generate concerns for the protection and management of the natural environment. Generally, local governments largely welcome and promote land development and they see the subwatershed/watershed planning process as an effective way of accommodating the apparently conflicting demands of environmental protection and urban development/land uses in an expedient manner.

Either a watershed plan, if there is one, or an Official Plan may endorse and/or recommend the development of a Sub-Watershed Plan. In the latter case, the Official Plan should clearly identify the need for subwatershed plans to be developed in support of proposals for land use change.

At this stage, a number of actions can be taken to establish the framework for developing the Sub-Watershed Plan.

- **Establish and secure agreement among stakeholders on the need** for a Sub-Watershed Plan. Obtain commitments from parties and agencies for participation, support, adoption and implementation of the plan.

- **Identify the apparent main issues or concerns** in the subwatershed. Although key issues may not always be immediately apparent, the general character of the subwatershed area will be known in most cases. An overview report may be helpful in focusing this information. It may include the presence, features and status of:
 - watercourses and valleys (channels, buffers)
 - downstream flooding and/or erosion problems/hazards
 - water quality
 - fisheries potential (cold or warm water)
 - wetlands
 - Environmentally Significant Areas or Areas of Natural or Scientific Interest
 - woodlots
 - recreation opportunities
 - agricultural land uses
 - land development proposals
 - water-takings, water uses, water conservation
 - ground water recharge/discharge areas, baseflows
 - municipal servicing needs

This ability to document the main features of the watershed is useful during the early discussions of the Sub-Watershed Plan. One should not be concerned, at this point, with overlooking issues or concerns in the study area which may prove important at a later stage. These issues will be more firmly established during subsequent stages of plan development.

- **If possible, establish an appropriate coordinating agency.** The local conservation authority is generally the agency most suitable for coordinating the preparation of a Sub-Watershed Plan, particularly where the subwatershed crosses municipal boundaries. An upper tier (regional) municipality or, in the case of a small subwatershed, totally contained within its boundaries, a local municipality may undertake coordination. In municipally unorganized areas, and in areas outside of conservation authority jurisdiction, MNR and MOEE may take a lead role.

- **Determine funding responsibilities.** All parties should establish the extent of funding that will likely be required, the extent to which each party could contribute, and possibilities for phasing the undertaking. The phasing of subwatershed plan development may allow for cooperative sharing of costs among government agencies and the development community by spreading fiscal demands more comfortably over time. It also allows for prioritizing issues needing attention, and thus, for better estimation of costs.

3.5.2 *Aligning the Interests*

Once the basic information that defines the early understanding of the problem has been generated (i.e. the stage has been set), there should be a careful attempt to identify the individuals and interests that must be involved or addressed during the course of the study. A major part of this process is in the striking of a Steering Committee, with the mandate to review study progress and advise on policy issues that affect the technical conduct of the Sub-Watershed Plan. During this process, and after the identification of a Steering Committee, the Terms of Reference for the study must be firmed up. As well, a team to conduct the technical activity must be identified. Following are some key actions:

- **Select a qualified Project Coordinator.** This individual is the focal person, relating the Steering Committee, agencies, and consultant to each other and to other parties to the process. Selection of this person is a key factor for ensuring the success of the subwatershed planning process. Critical strengths of the position are:
 - **A basic understanding of the issues.**
 - **Multi-agency perspective.** Each agency's mandate and issues of concern should be understood.
 - **Effective leadership and communication** skills are needed for the coordinating role of linking technical experts, planners, stakeholders and the public.
 - **Ability to anticipate and resolve conflicts.**
 - **Project management** skills to ensure that budgets and schedules are maintained.
 - **Agency support**, i.e., time and resources to do the job.
 - **Ability to facilitate timely input** from the public and non-government organizations.
- **Establish a Steering Committee.**

A steering committee should be defined to provide review and policy guidance, during the course of the study, to guide the Project Coordinator. Steering Committee members should:

- effectively represent their organization
- have the authority to commit to the plan
- be willing to negotiate to resolve conflicts
- commit time and effort where required to meet deadlines

This last point is key. An unfortunate event is the periodic change in composition of steering committee members. Continuity, particularly in the critical review agencies, is a highly important contributor to effectiveness. Section 3.6 addresses Steering Committee function in more detail.

- **Confirm physical limits.** The project coordinator, in consultation with the Steering Committee, should confirm or redefine previously identified boundaries of the subwatershed.
- **Complete/Expand the Data Base Overview.** A key step in beginning the plan development process is a review of existing data. The project coordinator should expand the initial subwatershed overview with relevant resource information from other involved agencies. This does not have to be an exhaustive inventory of data, but rather an assembly of some of the most relevant information. Examples, with sources, of this information are:

Ministry of Environment and Energy - air, surface and ground water quality, existing and proposed landfill sites, past/present studies, sewage treatment plants best management practices

Ministry of Natural Resources - floodplain management fisheries, wildlife, wetlands, Areas of Natural and Scientific Interest (ANSIs), provincial parks, Crown lands, forest and aggregate resources, unstable slopes, geological maps

Local Municipality - proposed development plans showing limits of development; regional and local environmental, ground water studies, existing environmental provisions, transportation and servicing infrastructure

Regional Municipality - regional/county knowledge of ground water, transportation, infrastructure, Environmentally Sensitive Areas (ESAs)

Ministry of Transportation (Ontario) - provincial roads, existing and proposed drainage systems

Management Board Secretariat - government lands, proposed land uses

Ministry of Northern Development and Mines - mines, mine tailings ponds, development areas, geological maps

Ministry of Culture, Tourism and Recreation - natural/cultural heritage areas

Ministry of Housing (Regional Housing Programs Offices) - housing policy statements and objectives for local areas

Ministry of Agriculture and Food - significant farm lands, municipal drains, land stewardship projects, soils reports, agricultural land use mapping

Conservation Authority - Environmentally Significant Area designations, erosion site inventories, flood and fill line designations, shoreline management, existing master drainage plans, watershed plans, conservation areas

Universities and Community Colleges - special studies, technical expertise, research or masters thesis

Special Interest Groups - specific reports or inventories, e.g., Federation of Ontario Naturalists, Ontario Federation of Anglers and Hunters, Ducks Unlimited, Trout Unlimited, Conservation Council of Ontario

- **Tour of Subwatershed.** Tours can provide field verification of the existing knowledge base, clarification of various issues, and identification of areas of special concern.
- **Develop Preliminary Goal Statements.** Through the perspective gained by touring the subwatershed, and knowledge of the key resource features, the project coordinator should develop a set of statements for the subwatershed. Goal statements should be simple and measurable. It should be understood that as public input and other information arrives, during the early stages of the study, the major goals should be reviewed and ratified.
- **Terms of Reference.** The Terms of Reference will clearly identify the goals and objectives, the work program, the project schedule and the expected product. Terms of References for watershed/ subwatershed studies have been prepared for a number of projects in southern Ontario (generic Terms of Reference e.g. Region of Waterloo).
- **Steering Committee Study Startup Meeting.** At this point, there will already be identified a draft study area boundary on established knowledge base, key subwatershed issues, a preliminary set of goal and objective statements for the study area, study budget needs, and draft Terms of Reference. The Steering Committee must reach agreement on each of these items at this stage, prior to presentation to other interest groups and the public.
- **Start Public Involvement.** The project coordinator and Steering Committee members should determine key public interest groups in the subwatershed, including ratepayers groups, naturalists clubs, sporting groups and others. The early, effective, and continued involvement of public is one of the most important tools for achieving the support needed to develop and implement the plan. The project coordinator should carefully consider how and when the public should be involved in this process.

- **Identify Funding Alternatives and Budget Needs.** Funding support for development of the plan should already be established by this point. The project coordinator should define the specific budget needs, identify potential partners, and negotiations should begin to secure project funding for implementing the plan.
- **Select Project Consultant.** *Requests for Proposal* are sent out to qualified environmental engineering firms and scientific and planning firms of specialized expertise relevant to the study goals and objectives. These proposals are received and reviewed by the Steering Committee according to an evaluation procedure usually adopted by the Steering Committee. A consultant or consortium of consultants is then selected to undertake the study.

3.5.3 Preparing the Plan

The steps in section 3.4 in fact outline the basic requirements of the technical activity that leads to a plan. Briefly, these are:

- **Define Data Requirements and Collection.**

Recognising that not all studies have to be "cadillac," big-dollar studies, and tying the information gathering into the analyses required for the study, the data requirements of the study should be addressed. The information needed to conduct the study and to develop planning methodologies will be established in consultation with the consultant, public and agencies under the guidance of the Steering Committee.

- **Prepare the Plan.**

The available data is used to develop a number of strategies from which a preferred alternative is selected and recommended for adoption as the SWM Plan. The various agencies and the Steering Committee provide review and guidance throughout this process.

3.5.4 Adopting the Plan

When all stakeholders agree on a Sub-Watershed Plan, the coordinating agency works with participating agencies to coordinate implementation of the plan. As noted, in section 3.4, the questions of affordability, cost/benefit and potential negative consequences of the measures proposed in a subwatershed plan will have been reviewed and agreed to by this point.

Adopting the plan, as experience shows, must be more than accepting and approving the Sub-Watershed Plan document. Aggressive commitment, by the key municipality or agency, is the

factor that will make the Sub-Watershed Plan a reality, or relegate it to the realm of 'another study'.

In large measure, the ease with which the plan is adopted will depend on the effectiveness of the preceding stages in the process of developing it. The responsibilities for implementation and the provision of operating costs now fall to participating agencies.

3.6 THE STEERING COMMITTEE

Composition

For best results, as demonstrated in previous watershed planning efforts, the Steering Committee should be small, say, 6 to 12 people, and should consist of representatives from the core agencies, including both lower and upper tiers of affected municipalities, the local conservation authority, and the Ministry of Natural Resources and the Ministry of Environment and Energy. Other agencies, developers and/or members of public interest groups may also be appropriate participants on the Steering Committee, and, on the basis of their mandates, may become involved at certain decision points.

Municipal planning and public works departments should both be represented by senior level staff; representatives of departments such as parks, recreation, engineering and environment could also play a part as appropriate.

Consistent participation by knowledgeable Steering Committee members is a vital part of the smooth functioning of the study.

Actions

The Steering Committee should convene at the outset of the process to discuss:

- specific concerns and interests in the subwatershed
- available and needed data base
- land use assumptions within the subwatershed for hydrologic analysis
- confirmation of subwatershed boundaries
- municipal servicing needs, expectations and priorities
- subwatershed resource management objectives, tailored to suit individual subwatershed conditions

Once the study is in process and the study team has a good understanding of the natural systems within the subwatershed, the Steering Committee should discuss significant issues with the team,

as required by the team, to provide guidance on policy implications. Appropriate interaction points include reviews of:

- the assembly of existing natural features, processes and water-related linkages
- opportunities for protection, enhancement, rehabilitation and development (integration of resources management objectives and municipal needs/priorities with existing natural features, processes and linkages)
- prioritization of watershed goals
- the selection of criteria or targets
- identified opportunities and constraints
- the long list of alternative plans
- the selected alternative

Other Steering Committee activity, for example in the public participation programs, may also arise.

3.7 MONITORING PROGRAMS

A Sub-Watershed Plan cannot be considered complete until its monitoring program is established. Monitoring programs should be designed to:

- assess environmental changes in the subwatershed, possibly tracking the health of the subwatershed relative to earlier baseline information
- evaluate compliance with the plan's goals and objectives, and
- provide information which will assist custodians of the plan to implement and update it.

The monitoring program should be presented as part of the implementation plan for the Sub-Watershed Plan.

Custodians of the subwatershed plan have the responsibility for undertaking the monitoring program and ensuring that the information generated is used effectively. A multidisciplinary team will be required to establish an appropriate monitoring program for the subwatershed and to advise the plan's custodians of how to carry it out and how to interpret and apply the findings. Successful monitoring programs have used protocols for inter-agency transfer of information and results have been incorporated into updates of regulations, bylaws and maintenance schedules.

Monitoring programs must be practical and cost-effective to be funded in the first place or to accommodate budget constraints over the life of the plan. Monitoring programs must also be simple and verifiable, so they are little affected by staff changes.

Effective monitoring programs do not have to include extensive field studies or exhaustive laboratory scans for pollutants. Field inspections by experienced staff can be used effectively to identify whether or not the plan is working, e.g., stream banks are stable and well vegetated, trout are being caught, the beach downstream of the subwatershed remains open. An added advantage is that these staff surveys are more likely to get done, and their findings are more readily

interpreted.

Monitoring programs for subwatershed plans have to consider the rate and pattern of development within the subwatershed. For example, high growth scenarios experienced in rapidly expanding urban centres will require different environmental response monitoring strategies than those for subwatersheds where the level of development is not only smaller, but spread over a much longer period of time.

3.8 PUBLIC PARTICIPATION

The purpose of public participation in any planning or decision-making process is to allow for an exchange of ideas between the planning team and the stakeholders, so that controversy can be minimized or avoided, and knowledge of stakeholder needs improved. Increasingly, provincial and municipal agencies recognize that public participation in the development of plans or projects affecting the public is a key determinant of the success of these undertakings.

Beyond communication of needs and interests, the public can be a valuable source of information. Interest groups and the public at large can provide valuable insights and information, often bringing new ideas and a sound understanding of local conditions and aspirations. Drawing people into the planning process at an early stage can make this information available when needed.

Several key elements common to any successful public participation strategy can be identified. This participation should be managed, so that representative opinions are identified. The fact that the public represents a very large mass of individuals makes this difficult. It is important to gain access to a consensus, and strongly polar opinions may not fully reflect that requirement. As well, there must be opportunities for the larger mass of people to understand the Sub-Watershed Plan process, and communicate their interests to the study team. Both aspects must be respected, and must be seen to be taken seriously.

There are many ways to reach the public and gather their concerns and insights.

- **Printed materials**, such as brochures, flyers, fact sheets and newsletters are effective ways of informing people about the subwatershed planning process.
- **Displays** at local shopping malls, fairs, or public meetings are an excellent method of educating the public and generating "feedback" on a one-to-one basis.
- **Field trips** can be very effective in illustrating subwatershed issues to an interested public.
- **Public meetings** are important ways of generating public discussion and even debate about key watershed issues; adequate advance notice is required as well as a broad enough scope of stakeholders.
- **Public opinion polling** is a fairly successful method used in the U.S. for gathering public

attitudes about water management issues.

The appropriate method will depend on the details of the study, and the level and nature of public interest. Conduct of an effective public information program is a special skill, and an important consideration in the composition of the study team.

Without public support and endorsement, many of the best-planned and engineered projects can founder in limbo, face stringent criticism and opposition, implemented poorly, or never be implemented at all. Countless examples over recent years demonstrate the importance of "buy-in" from the public. The Great Lakes Remedial Action Plan process has public involvement as an integral part of every stage of RAP development. Public Advisory Committees made up of local stakeholders participate in identifying the problems, developing feasible solutions, and assigning and accepting responsibility for actions and funding.

3.9 FUNDING

Subwatershed Plans vary widely in scope and kinds of activities required, and many jurisdictions and agencies are likely to be involved in this work. Since there is no Provincial mechanism targeted at funding this specific requirement, those participating in plan development and implementation need to be innovative in securing new and various funding sources and in properly scoping the nature, timing and extent of the work involved.

- Funding support for the many subwatershed planning initiatives completed or begun over the last two or three years has come from local and regional municipalities (directly or through conservation authority levy), developers and provincial agencies (MNR transfer payments to CAs). The relative contributions of the partners varies widely on the basis of local circumstances. A principal factor influencing private sector funding participation has been the presence of major development interests and pressure for development approvals.
- Although the mechanics of the process may be problematic, a well-designed approach to planning at the subwatershed level should allow cost savings for the development community, and in principal generate funds that can be used for subsequent studies associated with individual development proposals.
- Ongoing work that can be "re-profiled" might contribute to the needs of the subwatershed plan. For example, in areas where a significant portion of the subwatershed is already extensively developed, spending on remediation and redevelopment planning could be combined with planning efforts focusing on the

developing areas. Participants are encouraged to make study costs "affordable" by a realistic scoping of study needs, phasing plan development, sharing available information and drawing on experience from other subwatersheds.