THE UNIVERSITY OF CALGARY

WATER CONSERVATION CAPACITY BUILDING: AN ANALYSIS OF NEEDS AND IMPLEMENTING STRATEGIES (A CASE STUDY OF HANNA, ALBERTA, CANADA)

by

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled, "Water Conservation Capacity Building: An Analysis of Needs and Implementing Strategies (A Case Study of Hanna, Alberta, Canada)" submitted by Brent H. Swan in partial fulfillment of the requirements for the degree of Master of Arts.

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ABSTRACT

Water conservation capacity building is defined as an increase in the adequacy and effectiveness of local and institutional resources and capabilities to develop, implement, and institutionalize water management strategies which improve the efficient use of water resources resulting in beneficial cost effective reductions in water use and water loss.

This study sought to ascertain the ability of Hanna, Alberta to develop water conservation capacity and to determine the effectiveness of available resources and programs to contribute to building local community water conservations capacity.

Local community personnel directly involved with the water conservation program were interviewed to determine current community water conservation capacity and to identify capacity needs; areas which require attention in order to facilitate conservation management. Technical assistance resource personnel were interviewed to identify available water conservation capacity building resources. Capacity gaps were defined when community capacity needs exceeded local and external resource capabilities.

It was determined that local community water conservation capacity is limited by capacity needs in the

areas of: 1) financial assistance, 2) planning assistance, 3) information and technical resource availability, and 4) coordinated provincial government assistance. Related capacity gaps were found to exist in the areas of: 1) finance and revenue, 2) information resources and planning expertise, 3) water conservation policy, and 4) coordinated provincial government water management assistance and logistical support.

The study recommended the following strategies to facilitate municipal water conservation management capacity building in Alberta communities: 1) locally relevant, user-oriented water conservation management resources be developed, 2) water conservation management should be integrated into existing provincial municipal water supply management assistance programs, 3) a municipal water conservation assistance program should be developed, 4) water conservation assistance activities should be coordinated through a single, lead provincial agency, 5) water conservation should be given a higher profile in provincial and municipal planning and public information and education activities, and 6) regional consolidation of rural community water management systems should be considered.

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INTRODUCTION

BACKGROUND TO THE PROBLEM

RETHINKING WATER MANAGEMENT: THE CANADIAN CONTEXT

Water management is emerging as an urgent environmental issue. Increasing evidence of water scarcity problems has initiated the rethinking of traditional water management practice (e.g. Inquiry on Federal Water Policy, 1984). Canada as a whole exhibits a favorable balance between water supplies and demands. Analysis of Canadian water use, however, indicates a trend of increasing demand among competing industrial, agricultural, and municipal users which may threaten this balance (Tate, 1985). Over the period 1972 to 1981 water withdrawals in Canada increased from 24,057 million m^3 to 37,254 million m^3 (Environment Canada, 1986). Water withdrawals on the Canadian Prairies increased from 5086 million m^3 (1972) to 5342 million m^3 (1981) (Environment Canada, 1986). Total municipal water use (excluding rural domestic water use) increased from 3157 million m^3 (1972) to 4263 million m^3 (1981) (Environment Canada, 1986). Total rural domestic water use is estimated to be 347 million m^3 (1981) with Prairie region water use accounting for 70 million m^3 of this total (Environment Canada, 1986). Regional water scarcity problems have already manifested themselves, due to

increasing demand coupled with variation in the temporal and geographical distribution of water supply (Foster and Sewell, 1981; Environment Canada, 1983). Perceived as a constraint to future development, the prospect of water scarcity has focused attention on maintaining a favorable water supply-demand balance (Sadler, 1983; Environment Canada, 1983; Inquiry on Federal Water Policy, 1985).

Traditionally, Canadian water management has focused on supplying water to meet demands; a strategy of water supply management. Increasing demand and competition for limited water supplies, accompanied by rising economic and environmental costs associated with building and maintaining the water supply management infrastructure, demands a new approach to the management of water resources (MacLaren, 1985; Environment Canada, 1986). An increased emphasis on water demand management (water conservation) has been advocated as a complementary strategy to traditional water supply management practice (Tate, 1984; Robinson and Anderson, 1985). The Federal Review on Implementation of The World Conservation Strategy (Environment Canada, 1984a) has directed attention to the development of a water conservation strategy for Western Canada, to address regional water imbalances. The Final Report of the Inquiry on Federal Water Policy (Pearse, Bertrand, and MacLaren, 1985) advocates the

establishment of a National Water Conservation Program, as a major component in national water management policy. Water conservation management represents a water management policy goal which would result in more efficient utilization of existing water resources and facilitate strategic adaptation to increasingly limited and costly water supplies. Environment Canada (1984b) in a submission to the MacDonald Royal Commission on economic development in Canada calls for integrated approaches to environmental management and economic development facilitating responsible resource conservation to permit sustainable development activity based upon a sustainable natural environment.

Schwass (1985) suggests a need for a National Water Commission to provide state-of-the-art information to achieve improved water management policy and practice. The Science Council of Canada (1986) has initiated a study to formulate policy initiatives, directions, and appropriate institutional mechanisms for managing Canadian water conservation, use, and development. Further research regarding water conservation capacity building is advocated to outline the range of alternatives for developing conservation programs, local and institutional roles and capabilities in program development, and assess the impact of these strategies on local water management demands (Mitchell and McBean, 1985; Tate, 1985).

REGIONAL WATER MANAGEMENT CONSTRAINTS: EAST-CENTRAL ALBERTA

Historically, water resource constraints have been an issue of concern in East-Central Alberta communities [Figure 1] (Burnet, 1951; Palliser Regional Planning Commission, 1984; Morton and MacLock, 1984). This region is part of a larger section of the Canadian Prairies, which are among areas forecast to face serious water deficiencies in the future [Figure 2], unless water management strategies are implemented which will balance projected supply and demand (Foster and Sewell, 1981; Canada West Foundation, 1982; Environment Canada, 1983; Pearse, Bertrand, and MacLaren, 1985). Water resources in this region are limited, average annual precipitation is 300 mm, and variably distributed (Palliser Regional Planning Commission, 1982a). Resultant constraints on surface and groundwater resources, which constitute community water supplies in this region, have led to perceptions of the variable water supply as a major constraint to development in East-Central Alberta communities (McDonald, 1982; Fenwick, 1984; South Saskatchewan River Basin Planning Program, 1984b).

Current water resource management policies in the Province of Alberta and the South Saskatchewan River Basin dictate that water resource constraints should not be a limiting factor to development. The basic objective of

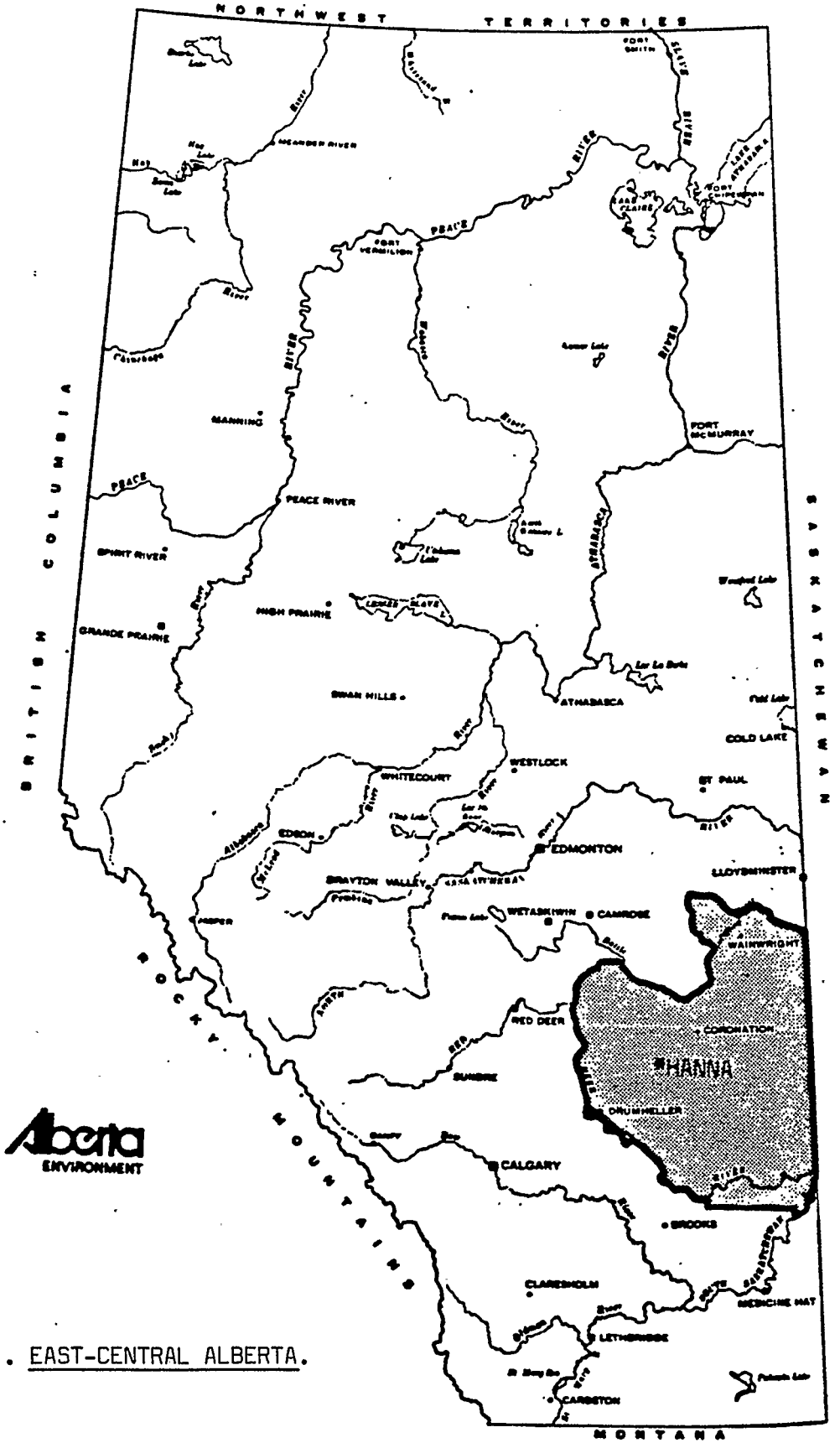
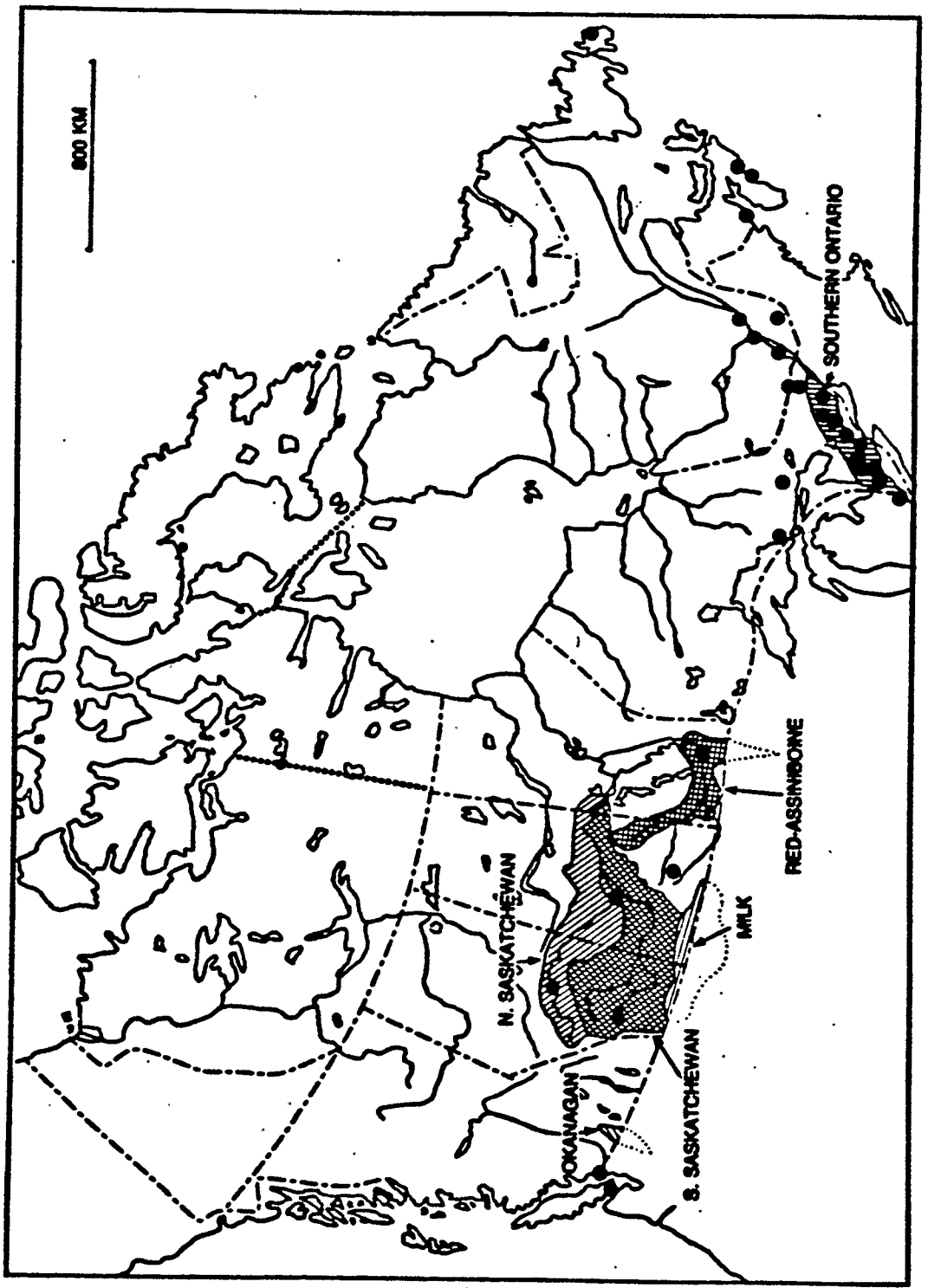


FIGURE 1. EAST-CENTRAL ALBERTA.

FIGURE 2. POTENTIAL WATER-DEFICIENT REGIONS IN CANADA.



Source: Harold D. Foster and W.R.D. Sewell, Water: The Emerging Crisis In Canada. 1981. Ottawa: Canadian Institute For Economic Policy. p.18.

water management principles in Alberta is to manage the resource in support of the overall economic and social objectives of the Province. The Government's commitment to a program of balanced economic growth, the welfare of Albertans, and the present and future quality of life are the overriding considerations in water management. Provincial water policy advocates managing resources in support of development through the following objectives: 1) reducing variations in natural supply; augmenting supply when necessary, 2) promoting efficient water utilization, and 3) reducing consumption (demand) and water loss (Alberta Environment, 1983; South Saskatchewan River Basin Planning Program, 1984a).

Several studies (Alberta Environment, 1981; Tate, 1981; Elton, 1983; Godwin, 1984; Gehrels, 1985; Alberta Water Resources Commission, 1986) have recommended the application of water conservation management practices to utilize more effectively existing water supplies in this region to meet demands. Such an approach is considered an integral component in a comprehensive water management strategy which would stimulate and sustain development while facilitating strategic adaptation to chronic water deficiencies in East-Central Alberta. To date, research has indicated that water management projects are generally contributing, but not determining, factors in community growth and

economic development (Carson, Rivkin, and Rivkin, 1973; Butcher, 1974; Johnson, 1974). However, in areas of critical supply constraint, when water demand outstrips supply, water can be a critical limiting factor affecting community development (Abruzzi, 1985).

If water management strategies are to contribute to local development they must be emphasized in long-term planning activities for the region. Research is needed to determine the ability of local communities and institutional resource networks to develop and implement water conservation strategies and to assess their effect in this region (Elton, 1983; Ashton and MacDonald, 1984; Alberta Water Resources Commission, 1986).

WATER CONSERVATION MANAGEMENT INITIATIVES: THE CASE OF HANNA, ALBERTA

Water resource constraints have been a chronic issue of concern in Hanna, Alberta (pop. 3,000) since it was established in 1912 (Burnet, 1951). Residents have waged a constant struggle in adapting to a variable, yet restricting resource. Hanna's inadequate water supply is a local problem caused by a lack of an assured supply of water that is close to the town. Subject to the vagaries of a dry, drought prone climatic regime, the Town's three water supply reservoirs were dependent upon surface runoff

collection. Recent population growth, attributable to construction of the nearby Sheerness Thermal Power Plant and Hanna's increasing role as an agricultural and government service center, placed further pressure on an already constrained water resource supply base which has been severely affected by drought conditions in recent years. Issues of declining water quantity and quality have manifested potential limits to future growth, development, and quality of life considerations in this region which continues to experience slow population growth (Woods Gordon, 1981; Palliser Regional Planning Commission, 1986).

In response to these conditions the Town of Hanna initiated development of a local water management strategy to establish a stable water supply as a basis to promote and sustain development. The two main elements of this strategy were: 1) development of water conservation management capacity to utilize more efficiently existing supplies, and 2) develop an assured water supply by pursuing the establishment of a pipeline from the nearby Red Deer River via the Sheerness Power Plant (24 kilometres from Hanna).

This study will focus on the water conservation management initiative for two reasons. First, Hanna represents a unique research opportunity, as it is the first Alberta

community to attempt to develop and implement a comprehensive water conservation management program. Application of water demand management strategies in this region offers an opportunity to analyze the ability of a local community to build water conservation management capacity, as a response to regional environmental constraints; to determine water conservation measures appropriate to rural community contexts; and to measure effects on the community's water resource demands and contributions toward development. Second, water demand or conservation management is a relatively new concept in terms of comprehensive municipal application. Therefore, it does not benefit from a well established comprehensive planning and funding technical assistance support system, as do water supply management initiatives. These conditions result in a unique research opportunity to assess the current availability and effectiveness of technical assistance resources and the ability of the resource network system to facilitate water conservation management at the local community level.

STATEMENT OF THE PROBLEM

The study of capacity building is concerned with understanding and improving local problem solving processes to develop policy and practice which generates sustainable and appropriate change. Water supply constraints facing

East-Central Alberta communities are well documented. Advocacy of water conservation management strategies, as a component in an emerging comprehensive water management scheme, is receiving increasing consideration in response to this situation. However, the complex issue of building or implementing water conservation management capacity in local communities and institutional technical assistance resource systems (ie. government agencies and private consultants) has not received adequate research attention.

Water conservation management capacity building, for the purposes of this study, is defined as an increase in the adequcacy and effectiveness of local and external resource capabilities to develop, implement, and institutionalize water management strategies which improve the efficient use of water resources resulting in beneficial cost effective reductions in water use and water loss.

Capacity building is constrained by the ability to determine and implement the organizational requirements, roles, tasks, resources, and strategies needed to support specific management activities (Williams, 1980). In this context, rural community water conservation management capacity building is constrained by two complex interrelated problems: 1) the ability of local communities to develop capacity building management capabilities, and 2)

the capacity of institutional resource systems to provide appropriate technical assistance to develop and implement water conservation management practices. Therefore, the main reasons for studying capacity building are to: 1) ascertain a community's current capacity to achieve given objectives, and 2) determine the effectiveness of specific resources and programs in building management capacity (B.W.Honadle, 1981b).

THE COMMUNITY CAPACITY BUILDING MANAGEMENT PROBLEM

Local communities are constrained by what Warren (1978) calls the "community problem", the inability to organize resources effectively to cope with increasingly complex problems. Similarly, other researchers have referred to this situation as a "capacity building gap" (Farmer, et al., 1978; Brown, 1980) or as the "human gap" (Botkin, Elmandjra, and Malitza, 1979). This inability to marshall resources to solve local problems stems from the general conditions existing within a local rural community context: isolation, low population density, lack of mobility, fiscal constraints, lack of expertise and human resources, parochial perspective, resistance to innovation, and lack of ancillary services (Brown, 1980; B.W.Honadle, 1983; Reid, 1986). Whether viewed in terms of local problem solving resources, organizational capability or

access to skill and knowledge for resolving local issues, rural areas will exhibit capacity building gaps to varying degrees (Tweeten and Brinkman, 1976; Lassey, Horn, and Lovrich, 1981). Mechanisms to effectively link external technical assistance resources with rural community problem solving needs have been lacking (Hobbs, 1980; Dillman and Hobbs, 1982). This problem is exacerbated by the increasing complexity of problems facing rural communities in modern society and the requisite specialized skills and knowledge to resolve them (Bradshaw and Blakely, 1979). Hickey (1982) advocates further research which focuses on linkages between the local community and its problem solving environment in order to understand the dynamics of rural community capacity building.

Capacity building is concerned with improving the adequacy and effectiveness of local community capabilities and resources to respond to the needs or problems of the community (Farmer, et al., 1978). Successful capacity building depends on the local community building upon and utilizing its resources and linking with external resources as needed, to solve local problems (Hickey, 1982; Maxwell, 1984; Korten, 1984). It is apparent that the capacity building process operates at two interconnected levels: 1) at the local community level to solve problems and make continuing adjustments to the larger environment, and 2) at

the external technical assistance resource level (i.e. senior government agencies, consultants, extension service) which provide appropriate assistance needed to make the local community efforts effective (Powers and Moe, 1982). Deepening trends in fiscal retrenchment and decentralization of government services has resulted in burgeoning pressure on local communities to enhance their ability to solve local problems through increased local action to obtain and utilize needed technical assistance (Gamm and Fisher, 1980). Within the Province of Alberta, Ironside (1984) has identified a need for a more coordinated approach to local development and planning, and advocates that the role of regional planning commissions be strengthened to ensure effective translation of policies into specific development projects in particular communities. Similarly, Blakely and Bradshaw (1982) expect the traditional role of technical assistance providers will expand to include an enhanced function to coordinate and facilitate community problem solving capacity building. Spiegel (1980) advocates that research related to community development capacity building activities should focus upon determining what types and forms of assistance communities find useful and develop user-oriented resource systems accordingly.

Advances in capacity building management will require

the development and nurturing of productive collaborative relationships between these two problem solving levels, in order to bridge the rural community capacity building gap problem (Farmer, et al., 1978; Lassey, Horn, and Lovrich, 1981; Findlay, 1981; Findlay, Gilmore, and Cebotarev, 1981). Toward this end, this study seeks to investigate components of local community water conservation management and evaluate current capacity building strategies in order to recommend appropriate mechanisms to meet community capacity building needs and bridge existing water conservation management capacity building gaps.

THE WATER CONSERVATION MANAGEMENT CAPACITY BUILDING PROBLEM

Water conservation management capacity building is a specialized management issue. Water conservation management is defined as the application of water management strategies (generally some combination of education and information programs, technical devices, pricing and metering components, and regulatory mechanisms) which improve the efficient use of water resources resulting in beneficial cost effective reductions in water use and water loss (American Water Works Association, 1981; Baumann, Boland, and Sims, 1984). Increasingly, water conservation is being considered as a component in the development of comprehensive water management strategies (Milliken and Taylor,

1981; Robinson and Benninger, 1983; Mather, 1984; Denver Water Department, 1986; Seattle Water Department, 1986).

Water conservation research has progressed to the point where: the need to consider water conservation options has been demonstrated (e.g. Foster and Sewell, 1981; Robinson and Anderson, 1985; Pearse, Bertrand, and MacLaren, 1985); the benefits of water conservation strategies have been substantiated (e.g. California Department of Water Resources, 1984c; Brown and Caldwell, 1984; Seattle Water Department, 1986); and the methodological processes of developing and implementing water conservation strategies are emerging (e.g. Ashton, Howard-Ferreira, and Bond, 1979; California Department of Water Resources, 1978; American Water Works Association, 1981; New England River Basins Commission, 1981). Water conservation management research is emerging from a research and development phase into an information dissemination, program development and implementation phase (Sawyer, 1984; Debo and Rogers, 1984). Transition to the information dissemination and utilization phase is constrained by several barriers or water conservation management capacity building needs and gaps.

The purpose of this study is to investigate local community water conservation management capacity needs and gaps and recommend ameliorative strategies to facilitate future water conservation management capacity building

activities in the Province of Alberta. Therefore, discussion of current water conservation management practices is limited, at this point, to a brief overview of water conservation management capacity literature. An indepth review of the current state of municipal water conservation management is provided in Appendix A for those readers desiring further background information regarding the rationale for considering water conservation, procedural steps for planning and implementing local water conservation programs, and the range of water conservation management methods which have proven effective in reducing municipal water use and water loss. Furthermore, the Appendix functions to provide background information necessary for interpretation of the Hanna water conservation management program case study.

Although the basic mechanisms for water management decision making are in place (Thompson, 1983), several factors inhibit this system from effectively coordinating water conservation management activities. Benninger (1984) suggests the main constraints to water conservation capacity building are not technical but organizational and ideological in nature.

A general lack of awareness of water conservation management options, benefits, and implementing strategies exists among the general public and water management

decision makers (DeYoung and Robinson, 1984; Robinson, Fitzgibbon, and Benninger, 1984; Debo and Rogers, 1984; Sawyer, 1984). This trend stems from the traditional subsidized supply oriented approaches to water management (Tate, 1984) which have transformed water into an under-priced commodity (Mitchell, 1984) resulting in a pervasive but inaccurate perception of cheap, limitless water supplies (Foster and Sewell, 1981). Consideration of water conservation alternatives is often forestalled by a pro-development bias which fails to comprehend the potential contribution of conservation initiatives to local development (International Union For The Conservation Of Nature And Natural Resources, 1980; Jacobs, 1981; Tate, 1984; Public Advisory Committees to the Environment Council of Alberta, 1986). Tate (1984) also identifies a political bias which favors high profile water supply options over low profile conservation initiatives. Lack of dissemination of existing water conservation information (Sawyer, 1984; Schwass, 1985) and poor or nonexistent funding levels also constrain implementation (Robinson and Benninger, 1983). Current water conservation dissemination and utilization constraints are considered such a serious problem that the American Water Works Association's Water Conservation Management Committee was formed in 1984 to facilitate the implementation of existing

water conservation knowledge (Menard, personal communication, August 14, 1986).

In a national context, Robinson and Anderson (1985) suggest that improved water conservation management will require improved interdepartmental coordination, re-focussing supply oriented technical assistance, additional research and extension education, development of conservation pilot programs and projects, increased public education, and increased intergovernmental support of water conservation initiatives. Mitchell and McBean (1985) advocate the development of demonstration programs to facilitate understanding of demand management strategies and permit systematic assessment of their effectiveness.

Failure of appropriate institutions and organizations to forge effective linkages and develop more coordinated approaches for distributing the skills and knowledge necessary to take advantage of existing practical solutions, is often cited as a constraint to effective local resource management in general (Matthews, 1976; Keith and Francis, 1980; Clark, 1981), and in rural water resource management specifically (Sargent, Mann, and Neiman, 1981; Korsching and Nowak, 1983). Hodge and Qadeer (1983), in an extensive survey of Canadian towns and villages, found water and sewage services to be a consistently expressed priority need in small communities (pop. 1,000-10,000). Hickey

(1982) found that small rural communities lacked the expertise to plan large engineering capital projects, such as water management activities, and therefore were in need of technical assistance. Lee (1981a) confirms that small rural communities are dependent upon senior governmental assistance for water resource management and suggests that the needs of these communities must first be determined before appropriate assistance can be delivered. Francis (1982) forecasts that expanding water shortages in rural regions will require increased attention focused upon developing and disseminating water conservation management strategies if a rural water shortage crisis is to be avoided.

The problem of developing appropriate programs in a rural context is especially pronounced due to the complexity of the interdisciplinary components of comprehensive water conservation programs (Maier, DeZellar, and Miller, 1981; Winkler, 1982). Coordinated water conservation management initiatives are essential to program success; as water conservation strategies must be tailored to local needs (Minton, Williams, and Murdock, 1979; Lord, Chase, and Winterfield, 1983; Postel, 1985). Siegrist (1983) stresses that water conservation management success is dependent upon local administrators being familiar with program requirements and operations. In rural communities,

water management decisions are often made by local personnel who are not professional water managers, yet must contend with local water problems as part of their duties. Burke (1983) notes a lack of water resource management training at the local community level and advocates increased training activity utilizing methods and materials appropriate to this context.

Water conservation management research has been underrepresented in Canadian water management research (Mitchell and McBean, 1985; Tate, 1985). Several authors (Sawyer, 1984; Robinson, Fitzgibbon, and Benninger, 1984; Robinson and Andeson, 1985; Mactavish, 1985; Pearse, Bertrand, and MacLaren, 1985; Alberta Water Resources Commission, 1986) have recognized the need to stimulate and coordinate information dissemination and utilization through the development of mechanisms which will facilitate water conservation management capacity building and suggest research activity be directed toward this goal. Toward this end, this study will investigate the water conservation management capacity building problem in Hanna, Alberta to improve understanding of water conservation management capacity, how to build it, to use scarce capacity building resources wisely, and to evaluate the impact of capacity building so that future program activities can be more effectively implemented and institutionalized within an acceptable contextual framework.

PURPOSE OF THE STUDY

To reiterate, the study of capacity building is concerned with understanding and improving local problem solving processes to develop policy and programs to guide sustainable and appropriate change. This case study is concerned with investigating the process of developing and implementing a comprehensive water conservation management program in Hanna, Alberta, over the period 1982 to 1986.

The primary purposes of this study are to: 1) ascertain the current capacity of Hanna, Alberta to develop a water conservation management program, and 2) assess the effectiveness of available technical assistance resources, programs, and implementing strategies in building local community water conservation management capacity. Specifically, the objectives of this study are to:

1) Ascertain the community's current capacity to reach water conservation management goals.
2) Define community water conservation management capacity needs. These are areas which require attention in order to facilitate program development, implementation, and management.
3) Identify water conservation management capacity gaps. A gap occurs when community capacity needs exceed local community and external resource system capabilities.

4) Recommend strategies that could ameliorate gaps and facilitate future water conservation management capacity building activities.

These objectives will be realized through a case study description of water conservation management capacity building initiatives in Hanna, and an analysis of water conservation management capacity needs, gaps and strategies based upon the case study data.

THEORETICAL FRAMEWORK

Water conservation management capacity building, for the purposes of this study, is defined as an increase in the adequacy and effectiveness of local and institutional resources and capabilities to develop, implement, and institutionalize water management strategies which improve the efficient use of water resources resulting in beneficial cost effective reductions in water use and water loss.

The study attempts to define the current ability of the local community to attain its water conservation management objectives. The community water conservation program will be analyzed within a conceptual capacity building framework developed by Beth Walter Honadle (1981a,b, 1986), which delineates the sources of capacity in effective organizations or communities. Honadle's framework identifies

capacity as the community's ability to: identify problems, anticipate and influence change, make informed policies based on the best available knowledge to deal with those problems, develop programs to implement policies, attract and absorb financial, human, information, and capital resources effectively to operate those programs, manage those resources well, and evaluate program outcomes and current activities to guide future action.

Attention is focussed on identifying community capacity building needs and how technical assistance resources provided by government departments and agencies, regional planning commissions, and the private sector could be more effectively utilized at the local community level. It is suggested that where local and institutional resource capabilities are not adequate or effective in meeting community needs, a capacity gap exists. The study attempts to define these capacity building issues from the perspective of local community personnel and from the viewpoint of the institutional resource system members. Finally, based on an analysis of capacity building needs, gaps and causes, the study will recommend strategies designed to bridge existing gaps and facilitate water conservation management capacity building activities.

The basic philosophy underlying this study maintains that sustainable local community resource management is

dependent upon improved local problem solving capacities to respond to complex environmental issues and rapid change. Rural communities must develop the ability to adapt strategically to a constantly changing, yet restricting environment. Community resource management change efforts must be adapted to local environmental constraints (Dunlap and Catton, 1979a, b) or they will result in maladapted development (Catton, 1980; Findlay, Gilmore, and Cebotarev, 1981; Jacobs, 1981). Progress toward ecological adaptation requires that local resource management decisions be based upon the best available knowledge and skills and operate within a framework of environmental and institutional factors which influence local decision making capabilities (O'Riordan, 1971; Rowe, et al., 1978; Ruddle and Rondinelli, 1983).

Rural communities often lack the necessary knowledge and skill components to organize and effectively cope with specific problems (Warren, 1978; Sokolow, 1981). Overcoming capacity building deficiencies requires that rural areas develop vertical linkages with the necessary external institutional resource systems (Lassey, Horn, and Lovrich, 1981; Finlay, 1981; Maxwell, 1984). Organizing to obtain and utilize resources is the key mechanism through which human systems strategically adapt to environmental constraints (Bennett, 1976). Hobbs (1980) indicates that in

the rural sector such linkage structures are lacking. Major institutional constraints to effective capacity at the local level are: limited access to resources, lack of usable information, and failure to provide technical assistance support (Williams, 1980). Such conditions result in inefficiencies at the local operational level.

It is assumed that progress must proceed from a sound base of continually updated knowledge and skills which are coordinated in a manner that is responsive to user needs (Holzner and Salmon-Cox, 1984). Knowledge systems can be conceptualized as consisting of communication networks and problem solving processes. Knowledge systems consist of resource systems and user systems which function as independent problem solving entities yet are linked through resource - user problem solving dialogue which results in a transactive mutual understanding of problems and generation of appropriate solutions (Havelock, 1986a, b). Effective use of knowledge systems for the improvement of capacity building policy and practice requires that major gaps between institutional resource systems and knowledge users be identified and bridged in order for appropriate knowledge to be brought to bear on specific problem issues. Capacity building depends upon the development of transactive problem solving linkages between the appropriate resource systems and the local user system resulting in

generation of appropriate solutions and sustainable implementation (Zaltman, 1979; Trist, 1980; Dervin, 1983; Korten, 1984; Kyler, 1984).

Conceptually, community capacity needs and institutional resource capabilities are closely related. When the community perceives a capacity need, the external technical assistance resource system would have demands placed upon it and would expectedly respond with its available resources. If local and external resource systems fail to respond to the community capacity need, a capacity gap exists.

This study assumes that a sufficient technical knowledge resource base exists from which to develop water conservation management strategies. Whether sufficient organizational resource capability exists to facilitate water conservation management capacity building is an issue requiring further research.

The overall purpose of this study, therefore is to assess the ability of the local community to build water conservation management capacity; identify community capacity needs; determine the effectiveness of the resource system to meet community capacity needs; define capacity gaps and suggest causes; and recommend ameliorative strategies which would facilitate future water conservation management capacity building activities.

SIGNIFICANCE OF THE STUDY

1. Regional water shortages are emerging as increasingly serious problems, especially in East-Central Alberta communities. This study will seek to investigate the potential impact of water conservation management to extend existing water supplies and contribute to community development capacity in this region.

2. Currently, no comprehensive provincial assistance programs exist to specifically support the planning, development, and implementation of municipal water conservation management programs. It is believed Hanna represents the first Alberta community to pursue development of a comprehensive water conservation management program. Therefore, this study will investigate the ability of a local community to develop and implement water conservation programs and the capability of the institutional resource network to provide appropriate technical assistance.

3. Capacity building is becoming a critical issue in community development management. Current trends in fiscal retrenchment, government assistance cutbacks, and decentralization of services requires research to understand strategies which assist local communities to increase their competence to manage local problems with increasingly scarce resources.

4. Applied research with the capacity building concept is required. This study will utilize Beth Walter Honadle's capacity building framework as a heuristic analytical method to assess local community water conservation management capability.

5. This study seeks to investigate processes of collecting, disseminating, and utilizing information in ways useful to environmental problem solving. The study utilizes a user perspective, focusing on resource users and resource providers, resulting in the generation of theoretically grounded knowledge to guide the development of more effective capacity building strategies.

6. The study provides practical research in support of provincial water policy objectives and responds to water conservation research needs identified by the Inquiry On Federal Water Policy and the Alberta Water Resources Commission. Furthermore, this study responds to the aims of the World Conservation Strategy which has been adopted at the Federal level and the prospective Alberta Conservation Strategy.

7. This study is interdisciplinary in nature. Interdisciplinary research is distinguished by the coordination of related disciplines by a higher level concept (Kendall and Mackintosh, 1979). This research utilizes the conceptual framework of capacity building to coordinate the contributions of each related discipline. The concept of capacity

building coordinates the disciplines and corresponding sub-disciplines of sociology (community; human ecology), geography (resource management, environmental perception), education (problem solving; knowledge production, dissemination and utilization; environmental education), and public administration and planning (program management; planned change) focussing their intellectual powers on the problem of local community water conservation management.

8. The 1982-1986 timeframe of this study has allowed the opportunity to evaluate the longitudinal impacts of the water conservation management program initiatives implemented in Hanna, Alberta; thereby, providing reliable indications of the long term capacity of the community to sustain the program, evaluate program impacts, and identify implications for future community water conservation management capacity building activities.

ORGANIZATION OF THE STUDY

This chapter has outlined the background to the water conservation management capacity building problem. The ability to organize resources to effectively cope with water conservation management program development and implementation, is at the core of this problem. The study is concerned with defining and outlining this ability within a theoretical framework which views capacity

building efforts as depending upon developing appropriate organizational relationships to adapt to environmental constraints in a sustainable manner.

Chapter 2 will provide a comprehensive review of the theoretical and empirical literature related to the capacity building concept. Common definitional elements of the capacity concept will be outlined and further developed within the analytical capacity building framework developed by Beth Walter Honadle in order to define representative components of capacity. Factors which influence capacity building activities will be reviewed to develop an understanding of capacity building constraints and potential capacity building strategies to overcome barriers.

Chapter 3 will provide the methodological background for capacity building research. The case study method and design will be defined and outlined. Furthermore, data needs, instrumentation, data collection and analysis will be operationalized.

Chapter 4 will present a descriptive case study analysis of the capacity building process at Hanna, Alberta. The ability of the community to anticipate change, develop and implement policy and program elements and procedures, acquire and manage relevant resources and evaluate program impacts will be discussed. Community water conservation management capacity building needs,

capacity building gaps and causes, and recommended ameliorative strategies to facilitate future water conservation management capacity building activities will be outlined and discussed.

Chapter 5 will review major study issues, summarize research findings and present recommendations and conclusions. Future research directions will be suggested.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

The primary purpose of this study is to determine available local and institutional resource capabilities to develop local community water conservation management capacity, identify capacity needs, determine capacity gaps, and recommend strategies to facilitate future water conservation management capacity building activities.

This chapter begins by reviewing the literature related to the concept of capacity - the ability of local communities to manage their problems. A variety of capacity definitions will be reviewed to illustrate the different goals and purposes this activity can represent within differing contexts.

Beth Walter Honadle's capacity building framework will be introduced and outlined as a problem solving management system capable of clarifying the capacity concept and facilitating analysis of community and organizational capabilities.

Organizational factors which influence capacity building activities and current capacity building strategies will be reviewed to develop an understanding of capacity building constraints and potential capacity building strategies to overcome barriers.

MANAGEMENT CAPACITY BUILDING

DEFINING CAPACITY

A range of capacity definitions exist within such diverse disciplines as management, public and development administration, education, community development, and natural resource management. However, several common definitional elements emerge from the varying goals and purposes of capacity builders in the literature. The following section will review the elements of the capacity concept in relation to the definitional elements of establishing sustainable development, maintaining local autonomy within technical assistance relationships, developing and maintaining problem solving information systems, and institutionalizing change within appropriate contextual structures; thereby clarifying the goals and purposes of capacity building activity.

Sustainable Development. A key element of capacity is the establishment of self-sustaining change relationships in communities and organizations. The concept of local capacity, while meaningful, is often elusive as it is determined, at any point in time, as resulting from the interaction of community goals or expectations, community resource availability and the nature of community problems and potential solutions (Gargan, 1981). George Honadle

(1981) views the objective of the capacity building imperative as the strengthening of local institutions and organizations so that they can absorb new resources and utilize them to sustain development dynamics after the initial external assistance has been exhausted. Ross (1967) suggests that change emerges as a community perceives the need for change and as it develops the will and capacity to make changes it deems desirable. Development of a specific project is less important than development of the capacity of the community to establish that project (Ross, 1967).

Lenz (1980:226) defines strategic capacity as "the capability of an enterprise to successfully undertake action that is intended to affect its long-term growth and development."

In a similar vein Anthony Brown writes of capacity building:

> The primary goal of this approach is to develop the capacity of rural areas and the government jurisdictions within them to manage their own affairs, and to effectively protect and promote their interests and decrease their vulnerability to disruptive changes coming from without (Brown, 1980:21).

Burgess (1975) states that the purpose of capacity building is to strengthen the capability of an organization to mobilize resources to provide services in response to community needs through an enhanced ability to develop policy, implement programs, and manage resources to sustain or improve socio-environmental conditions which influence the quality of life in a community.

Local Autonomy and External Technical Assistance. An issue in defining capacity is the relationship between achieving locally desirable goals and consideration of acceptable performance standards and external assist- ance.

Lindley (1975:797) suggests that the function of capacity building is "to enhance the capability of local governments to perform intelligently and efficiently under their own direction." Gamm and Fisher (1980:55) view community development capacity building as "helping the community build internal resources to carry on its developmental plans with a minimum of outside assistance."

However, small rural communities will require assist- ance and will have to, on occasion, accommodate outside vested interests. Accordingly, Ann Macaluso states that capacity building reflects:

> aid provided by a source, upon request, to a recipient, which is oriented toward solving problems which are identified by the recipient but beyond its immediate capacity to resolve (B.W.Honadle, 1986:12).

Gargan (1981:652) considers capacity simply as an organization's "ability to do what it wants to do." Such a conception of capacity building raises the spectre of development activities which may not be sustainable nor in the common interest. Beth Walter Honadle (1986) suggests this problem can be avoided by developing local goals in

adherence with minimal standards expected in specified management issues and utilizing external resource support as needed to assist communities to realize their objectives.

Problem Solving Information Systems. Central to capacity is the expansion of expertise and the ability to acquire and utilize information. Improving capacity usually requires the expansion of expertise and the ability to acquire and use information (Sokolow, 1981). Biller (1971) maintains that the concept of capacity denotes adaptive problem solving capability. Capacity building has been conceptualized as the development and utilization of user-responsive problem solving information systems (Graeber, et al, 1984; Tennessee State Department of Education, 1985). Capacity building has been defined as a boundary-spanning activity; a problem solving resource system - user system dialogue which results in an organization exchanging information or resources with other organizations in its environment (G.Honadle, 1981; Beyer and Trice, 1983; Havelock, 1986a). Powers and Moe (1982) approximate this view of capacity building as a community development process which operates at two interrelated levels: 1) at the local community level to solve problems and make continuing adjustments to the larger environment,

and 2) at the external technical assistance resource level which provides assistance needed to make the local community efforts effective.

Chin and Benne view the improvement of system problem solving capabilities as a process of planned change:

> the problem-solving structures and processes of a human system must be developed to deal with a range of socio-technical difficulties, converting them into problems and organizing the relevant processes of data collection, planning, invention, and tryout of solutions, evaluation and feedback of results, replanning, and so forth, which are required for the solution of the problems (Chin and Benne, 1985:34).

Judah Drob similarly defines capacity building as the ability to:

> build capacity of state and local governments to determine needs; seek solutions; process information; change priorities, programs, and procedures; provide feedback; and modify behavior on the basis of evaluation (B.W.Honadle, 1986:1).

Korten (1984) extends the view of capacity building as a planning-learning process operating through a strategic organization in which environmental surveillance and response capacities are linked and distributed throughout. Capacity building should stress the development of local problem solving processes which are able to generate appropriate solutions to small community problems (Blakely and Zone, 1976; Sokolow, 1981). The objective of capacity

building is to foster community problem solving systems that are responsive to local needs, yet neither totally dependent on external assistance nor so independent that they forego the benefits of exchange with other organizations.

Institutionalizing Change. Another focus of capacity concerns the development and maintenance of appropriate environmental change systems. Chin and Benne maintain that:

> the human parts of the system must learn to function collaboratively in these processes of problem identification and solution and the system must develop institutionalized support and mechanisms for maintaining and improving those processes (Chin and Benne, 1985:34).

Robert Hawkins (1980) concludes that capacity building is concerned with the selection and development of institutional arrangements that increase the ability of rural communities to produce more responsive and efficient public services. Sokolow (1981) contends that most definitions of capacity deal with the capability of rational management and planning processes. The Tennessee Municipal League (B.W.Honadle, 1986) defines capacity as "know how" that is built into the organizational structure on a continuing basis. Korten (1984) suggests that the main task of management in a strategic organization is not decision-making but rather the development and maintenance of an

institutional capacity for strategic action. B.W. Honadle (1981a) states that capacity building means institutionalizing or embodying strengths and procedures in an organization. Havelock (1969:11-20) defines capacity as systematic "capability to retrieve and marshall diverse resources". Havelock (1969) further states that capacity is highly correlated to factors of: wealth, power, size, centrality, intelligence, education, experience, cosmopol- itaness, mobility, and the number and diversity of linkages to resource system contacts, all of which contribute to the ability of communities or organizations to institutionalize development.

Capacity building is often associated with the systematic utilization of problem solving systems. The Match Institution (B.W.Honadle, 1981a) defines capacity building as an improvement in the ability of local personnel to make informed decisions based on analytical material and program information capable of describing objectives and providing direction. The Charles F. Kettering Foundation (B.W. Honadle, 1981a) views capacity building as the capability to make decisions and utilize resources by learning to use techniques and models developed for application to specific problems or systems.

Bremer (1984) differentiates between "internal capacity building" and "process capacity building". The former

representing the ability of local organizations to carry out desired activities, while the latter represents in the absence of internal capacity, the ability to get required activities done by other organizations. The transfer and use of proven management techniques is a form of capacity building which has been referred to as "capacity sharing" (Warren and Warren, 1986).

However, capacity building is more than a transfer of resources; it is a learning process. Korten (1980) suggests that capacity building is a learning process in which the community: 1) learns to be effective; develops working policies and programs, 2) learns to be efficient; stabilize and routinize activities, and 3) learns to expand; expand organizational and operational capacity to a larger scale. Korten (1980) states that the capacity building learning process is dependent upon a well developed responsive and anticipatory adaptation capacity which plans with people; links knowledge building with action; and evaluates activities to guide performance. George Honadle (1981) concludes that capacity builders need to look beyond the implantation of physical infrastructure and focus on the role of organizational or institutional capacity as a means of ensuring that investments lead to sustainable development.

In brief, capacity is a difficult concept to define. Definitions of capacity vary in the extent to which they specify the activities that should be performed versus the results that are sought. Hence, the capacity building process is concerned with improving organizational strategies to acquire and utilize necessary resources for enhanced local problem solving management.

However, progress in the design, implementation, and evaluation of capacity building programs has been constrained by the lack of conceptual clarity and understanding of the functions and operations required of capable systems. In an effort to overcome this conceptual shortcoming, Beth Walter Honadle has developed a general capacity building framework which describes what capable management should involve.

The B.W. Honadle Capacity Building Framework

Beth Walter Honadle (1981a) has decried the absence of a consensus definition of the capacity building concept which is functional and operational. Existing definitions lack conceptual clarity and fail to specify what is to be built in the capacity building process. In response to this situation, B.W. Honadle (1981b), utilizing a systems perspective, states that a capacity building framework should reflect: 1) an organization's need to respond to

environmental influences that could assist or constrain it, 2) a process to improve the long-term ability of an organization to solve problems, and 3) an analysis of the organization's ability to develop, implement, and manage programs and evaluate outcomes to guide future action. Such concerns are central components in optimal problem solving systems. Havelock and Huberman (1978:69) state that an optimal system or framework: 1) is highly interconnected (allowing a free and rapid flow of information, services and materials), 2) is highly cohesive (reflecting common purpose and interdependence), 3) is user-needs sensitive (responsive to the ongoing and emerging needs of its members), 4) efficiently utilizes resource inputs (from the immediate and remote environments), 5) maintains active dialogue with other systems, 6) develops an effective problem solving configuration, 7) exhibits a learning capacity (to reorientate objectives and strategies), and 8) is open to change based on assessment of environmental change and problem solving barriers. Honadle's framework generally incorporates each of the criteria delineated for optimal problem solving model characteristics.

Beth Walter Honadle (1981a, b, 1986), as a means of clarifying the purposes and impacts of capacity building activities, has developed a conceptual framework which outlines essential actions performed by organizations

exhibiting capacity; thereby providing an analytical guide for the development and assessment of capacity building processes. Elements in this framework are: definitional characteristics, administrative practices, institutions, and organizational requirements (B.W.Honadle, 1981a).

Beth Walter Honadle (1981a, b, 1986) defines capacity as the ability to:

- o anticipate change;
- o make informed decisions about policy;
- o develop programs to implement policy;
- o attract and absorb resources;
- o manage resources; and
- o evaluate activities to guide future actions.

Administrative practices may consist of various administrative routines, procedures or programs necessary to implement the capacity building activities (B.W.Honadle, 1981a).

Institutionalizing or establishing procedures in an organization is an integral element in the capacity building process. For example, the presence of professional administrators, planning bodies, programs and program coordinators may be indicative of institutionalized capacity (B.W.Honadle, 1981a).

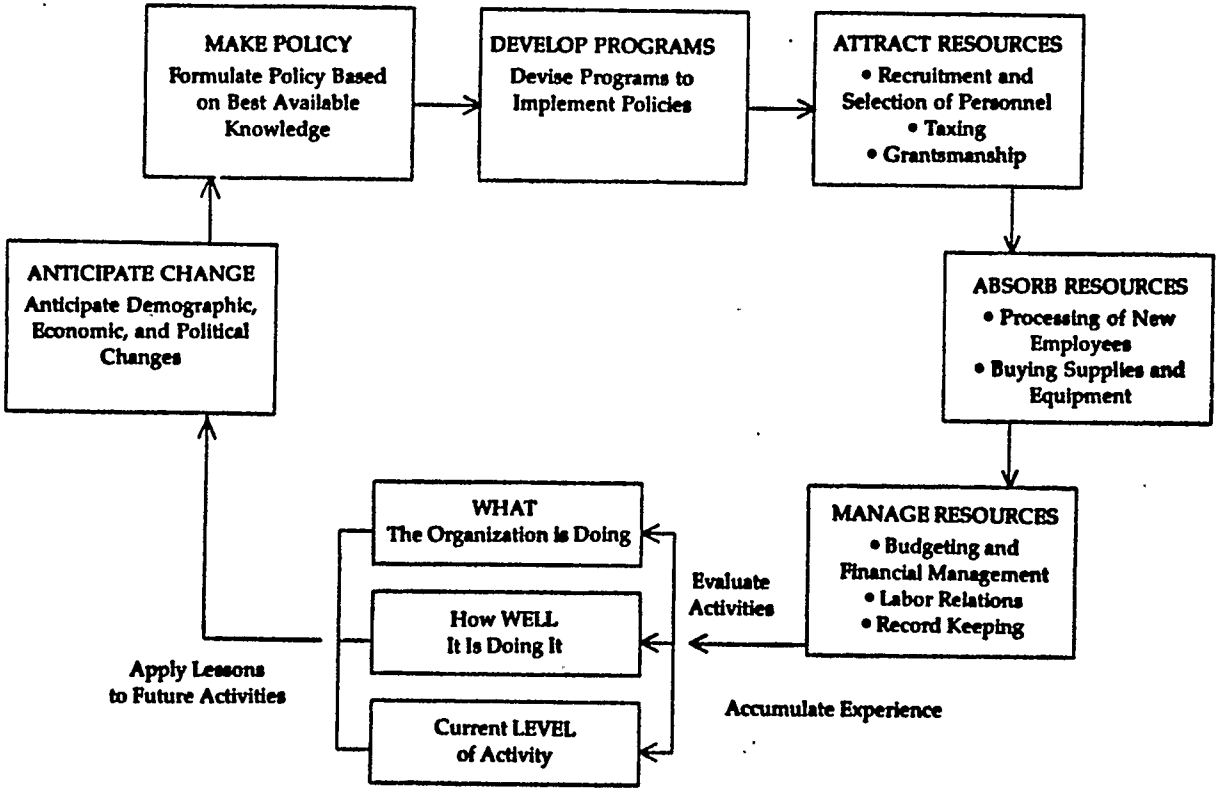
Organizational requirements of capacity building may be represented by an organization's ability to: link

effectively with other organizations and resources, develop problem solving processes, coordinate disparate functions and develop mechanisms for institutional learning (B.W. Honadle, 1981a).

Taken as a whole, the components of Honadle's capacity building framework comprise management capacity. These activities are intentionally general in order to accommodate the requirements of specific issues, programs, communities or organizations. Figure 3 is a schematic illustration of how the framework operates as a theoretical system. Beth Walter Honadle (1981b) envisions the capacity building framework as an iterative problem solving system. As a system, a community in response to a problem, must organize itself to attract resources from its proximate and remote environments and convert these resources into appropriate solutions, which are evaluated in terms of their ability to resolve the given problem. Information gained from the evaluation process is utilized as feedback, a new resource input, which the system utilizes to modify its future activities. Thus, the frame- work represents a cybernetic system governed via inform- ation flows (B.W.Honadle, 1981b).

Although most communities may not perform each of these activities well, the more of these functions a community can perform and the better it performs them, the more

FIGURE 3. A CAPACITY BUILDING FRAMEWORK.



Source: Beth Walter Honadle, "A Capacity-Building Framework: A Search For Concept and Purpose," Public Administration Review., 1981(41)(5):578.

capacity that community will exhibit. Each of these activities will now be discussed in greater detail to illustrate the organizational requirements inherent in capacity building operations based upon B.W.Honadle (1981a, b, 1986).

Anticipate and Influence Change. The ability to anticipate and influence change is an essential element of a community's capacity. The ability to collect information and use it for problem solving is essential to the capacity building process. Without the abilty to anticipate change, a community is incapable of influencing its future except by default. Capacity building functions to enhance a community's abilty to adapt effectively to a constantly changing, yet restricting environment. A community needs to monitor demographic, social, economic, political, and environmental trends in order to anticipate and identify factors which will impact on local needs and influence future decisions. Advance knowledge of issues affecting the community contributes to a strategically adaptive capability to understand and influence issues to ensure that local needs and interests are adequately represented within a constantly shifting environment.

Make Informed Decisions About Policy. Once a problem has been identified, a community needs to develop appropriate policy based on the best available information.

Capable communities will develop suitable policies in support of anticipated change. Policy serves to clarify and articulate community and social values and to develop priorities and establish goals designed to meet community needs and interests. The capacity building policy development process is concerned with the performance of information gathering and appraisal functions necessary to formulate policies which provide direction to the development, operation, and evaluation of programs that are related to sustaining or improving the socio-physical environment conditions that affect the quality of life in the community.

Develop Programs To Implement Policies. Program development can be conceptual- ized as a specific plan of intended proceedings to imple- ment policies. Programs must reflect general policy guide- lines and be responsive to changing environmental condi- tions. Furthermore, a community must seek to sustain or enhance program management conditions that influence the capacity of the community to deliver services or otherwise perform its operations. Policy implementation may be reflected in a variety of programmatic procedures depending upon the community's needs, internal capabilities and access to external assistance resources.

Attract And Absorb Resources. Another element of community capacity is the ability to attract and absorb problem solving resources. Resource availability is information which should be utilized in anticipating change and in policy and program deliberations. Having opted for specific programs, the community must acquire and utilize resources to develop and implement the programs. Resources may consist of personnel, revenue, information, grants, regulations, external assistance (government or private), community support, technology, or other inputs which result in the production of community services. The community must also be able to assess its own resources and evaluate alternative sources of assistance to meet its capacity building needs.

A community may lack the necessary time, staff, expertise, or administrative structure to incorporate given resources or procedures into its operations. Resources must be appropriate to the community context in which they are applied. Therefore, the capacity of a community to develop mechanisms to attract and absorb resources is a critical variable in the capacity building process.

Manage Resources. Assuming that a community has the ability to attract and absorb resources, it needs the capacity to manage them. Resource management functions to ensure maintenance of operational tasks related to policies

and programs, as well as the maintenance of a capacity for adaptation and compliance with environmental constraints. Effective resource management requires the development and maintenance of physical, human, information, time, financial, and other resource bases that are responsive to the demands of policy and program components of the organization and comply with established administrative and regulatory procedures. Resource management is related to the core tools and support functions of management and the routine requirements of organizational maintenance. Thus, capacity building should endeavour to develop appropriate planning, organizing, staffing, directing, coordinating, reporting, budgeting, and other administrative procedures. In essence, capable management enables a community to convert resources into effective and appropriate solutions to local problems.

Evaluate Performance To Guide Future Actions. Finally, a capable community consciously evaluates its activities. A critical element of capacity is the ability to anticipate and influence change. Therefore, a community needs to evaluate its continuing activities in order to learn from its experiences and apply these lessons to future activities. Evaluation should entail a critical assessment of: 1) what the community is currently doing, 2) how well it is doing it, and 3) whether the current level of activity is

appropriate (B.W.Honadle, 1981a). These assess- ments are determined in reference to the specific capacity building procedures utilized and in relation to the goals of the community capacity building activities. Continual analysis of accumulated experience provides valuable information regarding the effectiveness of specific programs in achieving their capacity building purposes and provides management feedback to adjust performance levels and guide future decisions.

In conclusion, the purpose of capacity building is to assist local communities to manage their own problems better. Therefore, capacity building is a management problem, which suggests the need to develop appropriate mechanisms to transfer necessary management resources from the technical assistance resources system in response to local community needs. The following section will address some common rural community capacity needs, outline problems in transferring technical assistance or capacity building resources and review strategies which have proven effective in building capacity.

BUILDING CAPACITY

Capacity building activities are synonymous with a variety of management improvement techniques (technical assistance, community or organization development, grants-manship, training, consulting, demonstration or pilot

projects). The basic aim of these activities is to improve the ability of communities and organizations to manage their problems. This section seeks to further the understanding of the problems of building capacity. Toward this end commonly identified rural community capacity needs will be reviewed and factors which influence the development of locally responsive technical assistance capacity building strategies will be discussed to provide background information to facilitate analysis of capacity and capacity building programs and to guide the design and implementation of future capacity building strategies and programs.

Capacity Needs and Capacity Building Factors Capacity building is a management problem, which suggests the need to develop improved strategies to transfer technical assistance in response to capacity needs, thereby, facilitating local community problem solving. Technical assistance is defined as the provision of programs, activities or services which transfer information, skills or products to strengthen the capacity of recipients to respond to local problem solving needs (Wright, 1982). Gamm and Fisher (1980) state that technical assistance in the spirit of community capacity development seeks to insure that the community has the necessary resources, human and material, to guide and sustain it in effectively adapting to changing environmental conditions or in

pursuing new courses of action; while allowing for some degree of community autonomy in problem definition, action, and resolution. Technical assistance may be transferred in a variety of forms, as outlined in a U.S. Office of Management and Budget bulletin, which describes technical assistance provided to local governments as: "funds, manpower or contracts, training, seminars, workshops, conferences, technology transfer, research utilization, personnel exchange, information services and dissemination, and other similar activities" (Macaluso, 1975:698). However, transfer of technical assistance and development of local level capacity can be influenced or constrained by several factors.

Several authors (Warren, 1978; Brown, 1980; B.W. Honadle, 1983; Reid, 1986) have identified factors which variably influence rural community problem solving capacity: isolation, scarcity of fiscal resources, lack of expertise and personnel, high management turnover rates, limited access to information and training, parochial perspective, resistance to innovation, and lack of ancillary services. Local capacity building management is critically dependent upon contextual factors. Mead (1986) states that capacity building activities in local organizations, governments or communities will display varying forms due to: 1) role perspectives (the differing

perceptions of capacity building objectives and adequate standards in relation to capacity building needs), 2) scale (determination of appropriate levels of capacity building activity in response to capacity building needs), 3) available resources (differing levels of available resources will determine responses to capacity building needs), 4) form (variations in organizational structure and methods utilized to meet capacity building needs), and 5) function (type and degree of services or operations provided in response to capacity building needs). Mead (1986) emphasizes that these factors occur in a socio-political milieu and are not strictly technical deliberations. Thus, capacity building processes must be cognizant of the variable parameters of the factors influencing capacity building initiatives in any given local context.

An increasingly prevalent feature of management capacity building, is that the increasing complexity of the issues affecting communities and the actions to cope with them have tended to transcend the boundaries of individual communities and organizations, requiring development of collaborative problem solving relationships to effectively respond to complex environmental change (Trist, 1980; Kyler, 1984). Bradshaw and Blakely (1979) have determined that rural community capacity building is dependent on the development of effective linkages with technical assistance

organizations in order to access needed problem solving resources. Solving these complex issues requires a capacity to appreciate the structure of both the substantive problems and the institutional relationships required to respond to them. Varying patterns of social, economic, and environmental development values create differing pressures and perspectives for improving management capacity. As a result, capacity building approaches should be tailored to local problems and to desired outcomes.

Existing research has identified several capacity building needs as perceived by local rural community management personnel. B.W.Honadle (1981b) claims that obtaining the commitment of senior management or local government officials to management improvements is essential for successful capacity building. B.W.Honadle (1981b) further identifies factors which can influence local acceptance of management capacity building initiatives: expenses associated with change, perceived threats to existing positions and operations, risk of failure, and a reluctance to pursue external assistance. Blakely and Zone (1976) found that small non-metropolitan municipal centers (population under 5,000) were severely constrained in their ability to develop problem solving capacity, due to a lack of appropriate administrative structures to engage in the development of sophisticated

plans, limited capability to participate in grant programs, and a lack of resources to implement and support programs even if planned and funded. Sullivan and Lacy (1982) identified the need for planning assistance and increased access to information for more effective decision making among rural community managers. Similarly, Reid (1986) found needs for improved training and information, more effective utilization of personnel, stabilizing personnel turnover, and improved organizational abilities to solve problems facing rural communities. Farmer et al (1978) in a major survey of rural Virginia communities identified main capacity building needs in the areas of: 1) fiscal resources, 2) staffing, 3) planning, 4) citizen participation, and 5) intergovernmental coordination. More specifically, in a related study, Hickey (1982) found an expressed need for technical assistance in planning and engineering capital projects, especially those related to sewage and water management activities.

Farmer et al. (1978) and Hickey (1982) have suggested that small rural communities require a certain level of organizational sophistication in order to take advantage of the technical assistance networks of public and private agencies; thus greater levels of capacity result in increased local autonomy and lessened dependence on external assistance. Clearly, responding appropriately to

rural needs for advice and information to cope with local problems is an important objective of capacity building. Failure to consider a community's capacity to effectively manage and sustain local programs is often neglected in the transfer of technical assistance, resulting in ad hoc approaches to capacity building which often fail to develop permanent local management mechanisms (Brown, 1980). Brown (1980) suggests a main cause of this problem is that management systems, programs, and procedures are usually developed by consultants on a project basis, often with little attention given to the long range problems of implementation and maintenance. Capacity building assistance must be made available and translated to local personnel in a manner which is understandable and relevant within the local context (Brown, 1980). A more systematized response from technical assistance resource networks is required which is capable of responding adaptively to varying local problems, and avoids a strict reliance on transfer of standardized solutions (Lassey, Horn, and Lovrich, 1981). Beyer and Trice (1983) have noted that technical assistance resource personnel who have not developed a competence or expertise with the resources or procedures they transfer can constrain the capacity building process by failing to provide crucial technical support to clients at the implementation and maintenance stages of

a project. Therefore it must be emphasized that useful technical assistance be professionally competent, readily available, responsive to specific problems, and free of conflicts of interest (Farmer, et al., 1978).

Cigler (1986) in a study of senior government responses to local community energy management needs, found that technical assistance programs that transfer skills and resources required to develop, implement, and evaluate new management programs must be responsive to user needs and be incorporated into the existing overall management structure of the community if they are to be successful. Warren and Warren (1986) found that federal assistance for energy and financial management practices at the local community level effectively utilized a process of transferring and sharing proven management practices and techniques among a network of technical assistance partners, thereby overcoming the problem of local community capacity gaps. This process had the advantages of: 1) appropriately responding to local program priorities, 2) employing appropriate levels of assistance, 3) operating through existing agencies and organizations, and 4) contributing to the development of a knowledge network.

In a variation of the resource sharing theme, Sokolow (1982) suggests that contracting or cooperating with other public or private agencies is a viable alternative to

meeting local needs under conditions of inadequate local capacity. Mason (1979) documents a university extension program which provides easily accessible problem solving assistance to small municipalities through information and training programs developed in response to expressed community needs, which are then delivered on a local or regional basis; thereby linking the vast resources of a university to practical needs at the local community level. Blakely and Zone (1976) suggest that community capacity deficiencies can be addressed through systematized resource sharing, such as municipal information organizations, university cooperative extension, technical assistance programs, or circuit riding teams.

Howitt and Kobayashi (1986) note that the effectiveness of capacity building technical assistance is dependent upon the interorganizational relationship between the aid provider and the recipient; and is critically influenced by the degree of reciprocal understanding of the interests and perceptions each brings to the relationship and how these factors can affect the capacity building process. Understanding how organizations and communities will respond to specific issues is essential to effective capacity building. Organizations, depending on their interests, mandates and capabilities will vary in: 1) ability to enter technical assistance relationships, 2) ability to respond

to local problem solving needs, 3) ability to provide individualized versus prepackaged assistance, and 4) the duration and intensity of the assistance relationship (Howitt and Kobayashi, 1986). To counter these problems, Howitt and Kobayashi (1986) emphasize the need to: 1) establish a reciprocal understanding of needs and response capabilities which affect the assistance relationship, 2) develop a strategy of assistance which will accommodate needs and resources, and 3) institutionalize organizational change resulting from the capacity building relationship.

Capacity building should be conceptualized as a relationship in which both aid provider and recipient are constrained by varying interests and capabilities. The goal of capacity building is to develop a reciprocal capability to secure the acceptance, implementation, and institutionalization of the proposed change. The challenge of capacity building is to overcome constraints which limit the amount of information which communities are capable of absorbing and devise strategies to provide appropriate information which is applicable to the capacity building management process and to construct institutions which can best utilize existing information (Benveniste, 1977). Jacobs and Weimer (1986) view capacity building as organizational change and innovation in response to local deficiencies in knowledge, funds, or technical expertise.

Therefore, capacity building strategies should mitigate factors inhibiting local development. Toward this end, Jacobs and Weimer (1986) categorize three generic capacity building strategies: 1) targeted financial subsidies; strategies of short term funding which contribute to longer-term increases in capacity (e.g. skills seeding, functional unit building, tool introduction, evaluation requirements), 2) information; strategies to increase the local executives' knowledge of capacity building innovations (e.g. exemplary projects, strengthening information networks, performance standards), and 3) technical assistance; strategies to share expertise with local agencies (e.g. direct training, personnel exchange, joint projects).

A variety of structural or developmental impediments can constrain rural community capacity building processes. As such, the diversity of circumstances at the local community and technical assistance resource level requires caution in determining appropriate capacity building strategies. Capacity building requires some degree of internal capacity on the part of the local community, however, the conditions affecting rural community life realistically limit the degree of expected internal capacity. Thus, the acquisition of appropriate technical assistance resources is a crucial element of capacity building and the corresponding mechanisms for transferring

these resources are extremely important. Understanding factors conducive to capacity building improves the chances of developing, implementing, and institutionalizing successful programs.

SUMMARY

Capacity is defined as an increase in the adequacy and effectiveness of local community organization to manage problems. Capacity building is concerned with improving local problem solving management to generate appropriate and sustainable change. Successful capacity building is dependent upon an understanding of what is to be built and what strategies can be utilized to build it. In an attempt to further research and progress regarding these issues, Beth Walter Honadle has developed a capacity building framework which identifies components of capable management practice, and serves to facilitate analysis or guide development of individual organizational capabilities. Key components of capacity are defined as an ability to: anticipate and influence change, make informed decisions about policy, develop programs to implement policies, attract and absorb resources, manage resources, and evaluate performance to guide future actions. Successful capacity building strategies have generally focussed on tailoring solutions to the local environmental context,

sharing program costs, reducing risk and gaining local support, and integrating solutions within the existing management structure of the community.

Capacity building requires the concerted efforts of local communities and technical assistance resource systems to develop collaborative problem solving linkages to address specific local needs. In an era of increasingly complex problems and scarce resources, rural communities will increasingly be required to rely upon their internal capacity to develop and implement management improvements, with senior government agencies and private consultants functioning in the role of information providers to facilitate the capacity building process.

CHAPTER THREE

METHODOLOGY

THE CASE STUDY METHOD

A case study approach was utilized in this investigation to complement and operationalize the empirical and theoretical background underlying the capacity building concept. This study is concerned with an analysis of the capacity building processes inherent in local community water conservation management improvement in Alberta. Specifically, this study seeks to assess the current water conservation management capacity of the local community; identify water conservation capacity needs; define capacity gaps; and recommend ameliorative mechanisms which would facilitate future water conservation management capacity building activities.

Case studies represent comprehensive descriptions and explanations of the many components of a specific social context and provide insights that will have generalized applicability beyond the single case under study (Babbie, 1973; Kennedy, 1979). Case study methodologies have proven

effective in examining decision making and knowledge utilization processes and ultimately to recommend and design appropriate policy mechanisms (Yin, 1981). Therefore, this method will lead to new insights into local community water conservation management capacity building which could be used to develop similar projects and to improve the overall capacity building process.

Yin (1984) advocates the case study method as an appropriate empirical research tool under the following conditions: the investigator has little control over events; when a contemporary phenomenon is investigated within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are utilized. Investigation of the complex water conservation management capacity building processes in Hanna, Alberta represents such conditions and is therefore an appropriate context for the case study research approach. Yin (1984) further suggests that case study methods are appropriate in unique or exemplary circumstances. Water conservation initiatives in Hanna represent a unique approach to water management problems in Alberta and is the first attempt in the Province to develop a comprehensive conservation program. Case study methodologies are appropriate in situations where existing theoretical propositions are to be tested

(Yin, 1984). Use of Beth Walter Honadle's capacity building framework as an analytical tool is therefore acceptable within the parameters of the case study method.

Stake (1979) summarizes the case study approach as the study of a bounded system, emphasizing its complex, dynamic nature, but confined to those aspects which are relevant to the research problem at the time. The essence of a case study, therefore is that it seeks to clarify the patterns of a decision, explain why it was taken, how it was implemented, and with what result (Yin, 1984).

CASE STUDY DESIGN

Stake (1979) delineates four components which comprise case study design:

1) a bounded system (the case under study);
2) study issues (what will be examined within the scope of the study);
3) foreshadowing questions (research guiding questions);
4) patterns of meaning (criteria which link data to issues; thereby facilitating analysis of data and interpretation of findings in relation to predicted patterns or theoretical propositions).

1) Bounded System. This case study will examine the water conservation management capacity building process in Hanna, Alberta from the perspective of the local community and the institutional technical assistance resource systems.

2) Issues. This study will focus on the capacity of the local community to develop a comprehensive water conservation management program and assess the effectiveness of available technical assistance resources in building local community water conservation capacity. Specific issues of focus are: assessing the current state of community water conservation management capacity, identifying water conservation capacity needs, assessing existing local and institutional technical assistance resources, identifying capacity gaps, and recommending ameliorative strategies to bridge capacity building gaps in order to facilitate future water conservation management activities.

3) Questions. This study is guided by consideration of the following questions:

1) What is the current state of water conservation management in the community?

2) What are the water conservation management capacity needs of the community?

3) What assistance is available to meet these needs? What sources provide assistance? Is the assistance useful?

4) What are the water conservation management capacity gaps?

5) What mechanisms could bridge these gaps?

4) Patterns. Pattern matching is a common analytical technique in case study research. This study attempts to compare empirical data from the Hanna case study with the theoretical components of the B.W. Honadle capacity building framework; thereby providing criteria to assess the current water conservation capabilities of the community, identify capacity needs, determine capacity gaps, and recommend ameliorative mechanisms to bridge the gaps. The capacity building framework is useful for analyzing and organizing the components of capable management and interpreting the patterns of capacity needs, gaps, and bridging mechanisms which emerge from the case study data.

INSTRUMENTATION

This study was designed to determine the current water conservation management capacity of the community, identify capacity needs, assess available capacity building

resources, outline capacity gaps from the perspective of both community members and technical assistance resource system personnel, and recommend appropriate mechanisms to bridge gaps and meet local water conservation management capacity needs.

Interviewing of community and technical assistance personnel was designed to include all persons involved in the community water conservation management capacity building process. The interview schedule (Appendix B) was constructed to obtain direct input from community and technical assistance personnel regarding the current water conservation management capabilities of the community and capacity needs and resource capabilities in order to isolate capacity gaps. The roles of the local community, provincial government departments, agencies, and personnel, and consulting firms were also examined in an effort to further define the nature of the water conservation management capacity gaps.

This case study utilized an interview schedule, a flexible question guiding outline, which is responsive to the varying roles and perceptions of the study participants vis-a-vis the capacity building issues (Lofland, 1971; Yin, 1984). The Honadle (1981a, b, 1986) capacity building framework provided the basic outline for development of the interview schedule. The capacity building framework is

intended to facilitate the analysis of components of capable management within the community and to determine whether appropriate resources are available to identify needs, set policies, develop programs, acquire and manage resources, and evaluate impacts (Honadle, 1981a). The interview schedule was tested for face validity in relation to the Honadle framework through review by a group of educational psychology graduate students, representing a homogeneous group with knowledge of research design procedures (Babbie, 1973; Selltiz, Wrightsman, and Cook, 1976). Face validity is concerned with the evaluation of a group of items (i.e. questions) by knowledgeable judges in relation to their relevance to a given underlying theoretical dimension (i.e. capacity building framework) (Nunnally, 1967). Issues of construct validity and reliability, as they apply to case study research, have been addressed by providing the interview schedule (Appendix B) and making the assumptions and procedures utilized in this study explicitly; thereby allowing opportunity for replication (Yin, 1984). As a further measure of validity and reliability, information contained in the case study has been periodicaly reviewed with the town managers and regional planners through follow-up interviews and telephone communications to validate the descriptions and analysis of water conservation activities between 1982 to 1986.

Measures of current community water conservation management capacity were operationalized through a descriptive case study of the capacity building process with reference to the components of the capacity building framework. In addition, key evaluative questions (Appendix B) were directed to the town managers and regional planners regarding what water conservation management activities the community is currently conducting, whether these activities were meeting their objectives, and if the current activities were appropriate in relation to the level of community capacity.

Questions (Appendix B) to obtain perceptions of capacity needs, areas which require attention in order to facilitate water conservation program development, implementation, and management, were directed to the town managers and regional planners.

Available local and technical assistance resource capabilities were operationalized by a series of questions (Appendix B) asked of the town managers and regional planners concerning the extent to which the local and institutional technical assistance resources were able to meet community capacity needs. Provincial planning and engineering personnel (Alberta Environment, Alberta Energy, Alberta Utilities, Alberta Agriculture and Alberta Municipal Affairs) were interviewed to obtain perceptions

of the roles and resources they contribute in meeting community water conservation management capacity needs. This method provides analytical information plus descriptive and comparative information based upon the perceptions of local community personnel and provincial government resource personnel (Farmer et al., 1978; Davie, et al., 1979). Capacity gaps were operationalized through analysis of the relationship between community capacity needs and the local and institutional resource capabilities. If community water conservation management needs could not be met with local or institutional resource assistance this represented a capacity gap (Farmer, et al., 1978).

DATA COLLECTION AND ANALYSIS

Data were obtained from three main sources: 1) local community administrative documents (proposals, reports) 2) existing studies of the region and community, and 3) personal interviews and communications.

Interviews were conducted in two phases. In phase one, informal exploratory interviews were held with six key community leaders (eg. town manager, newspaper editor, mayor and town council, executive director of the regional planning commission). Through these interviews background documents were obtained, key local personnel involved in

the water conservation initiatives were identified, and a general background to the water conservation project obtained.

In phase two, extensive interviews were held with four key personnel involved in the local water conservation management project (i.e. town managers and regional planners) to determine local water conservation management capacity needs, available capacity resources, capacity gaps, and suggested causes and ameliorative mechanisms. Ten key resource personnel with provincial government departments and agencies (i.e. Alberta Environment, Alberta Utilities, Alberta Municipal Affairs, Alberta Energy, and the Palliser Regional Planning Commission) and the town's consulting engineer were interviewed to obtain information regarding their roles in local water conservation management capacity building and the technical assistance resources they offer in support of local resource management initiatives.

As a means of and case study organization, the B.W. Honadle capacity building framework was utilized as a descriptive framework (Yin, 1984). The case study has been organized to reflect the components of the capacity building framework as they relate to the local community water conservation management context. Data were compared for congruence using pattern matching logic, which

compares the empirical case study data with predicted patterns or theoretical propositions underlying the study (Stake, 1978; Yin, 1984). For the purposes of this study the capacity building framework represented a theoretical or expected pattern of management capacity building (Honadle, 1981a, 1986) with which to comparatively describe local community water conservation management capacity.

Capacity needs were identified and categorized from interview data with the town managers and regional planners. Also, these officials were asked to specifically list and describe community water conservation capacity needs. Congruent capacity needs were determined by comparing the categorized interview data and the listed needs.

Available capacity building resources were assessed by asking provincial government planning and engineering resource personnel to identify and describe resources they contribute to community water conservation capacity.

Capacity needs and available resources were categorized and compared for congruence, if capacity needs were met by available resources, this represented a capacity gap (Farmer, et al., 1978).

Based upon identified capacity gaps, ameliorative capacity building strategies are recommended which will facilitate future water conservation management activities in Alberta communities.

CHAPTER FOUR

COMMUNITY WATER CONSERVATION MANAGEMENT CAPACITY BUILDING: A CASE STUDY OF HANNA, ALBERTA

Chapter four presents a descriptive case study of water conservation management initiatives implemented in Hanna, Alberta, between 1982 to 1986.. The chapter begins by providing background information to the Hanna water conservation management initiative. Second, the current water conservation management capacity of the community will be described in terms of the components of B.W.Honadle's capacity building framework which delineates the capabilities of the community to anticipate and influence change, make informed decisions about policy, develop programs to implement policies, attract and absorb resources, manage resources, and evaluate performance to guide future actions. Finally, this chapter will assess available local and institutional capacity building resources through identification of community water conservation management capacity needs and gaps, and recommend ameliorative mechanisms or strategies which will bridge capacity gaps and respond to local needs; thereby facilitating future local water conservation management program capacity building activities in Alberta.

BACKGROUND TO THE HANNA WATER CONSERVATION INITIATIVES

The Town of Hanna, centrally located in East-Central Alberta, 215 km northeast of Calgary (see Figure 1), has waged a continual struggle in adapting to the variable, restricting water resources of this region. Lack of an assured water supply has been consistently identified as a constraint to the future social and economic development of the community (Woods Gordon, 1981; McDonald, 1982; Fenwick, 1984; Little, 1984; Palliser Regional Planning Commission, 1982a, 1986).

The East-Central Alberta region is a 22 million hectare area bounded on the south and west by the Red Deer River, on the north by the Battle River, and on the east by the Saskatchewan border (see Figure 1). It is characterized by a low population base, a declining rural population and slow population growth in a few municipal service centers, a dependence on primary industry (ranching and mixed farming, some oil, gas and coal development), a limited agricultural and governmental service industry, and is dominated by a semi-arid continental climatic regime which is susceptible to frequent, serious drought, which occurs on average 10 out of 40 years (Alberta Environment, 1981). The range of annual precipitation can be extreme. For example, the region received 190 mm in 1919 and 630 mm in 1940 (Fenwick, 1984). As a result of the region's hummocky

topography and dry climate, surface and groundwater resources are limited. The Red Deer River is the only major permanent water course in this region. The region is characterized by imperfect drainage systems resulting in large internally drained areas demarcated by numerous sloughs, lakes, and intermittent creeks, which generally only flow with springmelt and heavy storm runoff. Unreliable yields and variable quality of groundwater resources limit their support of future municipal, industrial, and agricultural growth and development in the region (Alberta Environment, 1981; Palliser Regional Planning Commission, 1982a).

The region's current population is 36,000 and is expected to grow at just over one per cent per year through 1996 (Palliser Regional Planning Commission, 1986). Growth in the region's larger communities is a result of their increasing roles as regional service centers and a combination of the decline of small hamlets as service providers and rural depopulation due to the consolidation of farming operations (Palliser Regional Planning Commission, 1986). Future urban growth in this region will be constrained by the limited economic return from the marginal lands of the region, distance from markets, superior social and economic opportunities in the province's larger cities, and finally, limited supplies of water for municipal and industrial use and development (Fenwick, 1984).

In response to these conditions of slow population growth and variable water supply, the Town of Hanna developed and implemented several water conservation management program initiatives aimed at utilizing the community's existing water supply more efficiently, in an effort to adapt to changing, yet restricting environmental conditions within the community and in East-Central Alberta in general.

CURRENT COMMUNITY WATER CONSERVATION MANAGEMENT CAPACITY

In this section, the current water conservation of the community will be analyzed in reference to the components of B.W. Honadle's (1981a,b, 1986) capacity building framework which delineates the capabilities of the community to anticipate and influence change, make informed decisions about policies, attract and absorb resources, manage resources, and evaluate performance to guide future actions.

Anticipate and Influence Change. Capacity is represented by the ability to anticipate issues affecting the community and to understand and influence those issues to ensure that local needs and interests are adequately represented within a constantly shifting environment. The impetus for the water conservation management initiatives in Hanna, Alberta can be traced back to early 1982, at

which time concern over the town's dwindling water supply had become a critical, high profile issue. Regional surveys conducted to identify key development issues and concerns for development of a regional plan indicated that only 52 per cent of the region's residents were satisfied with their public water supply; whereas in Hanna, 70 per cent of the residents were dissatisfied with the town's water supply (Palliser Regional Planning Commission, 1982a).

Since 1974, Hanna has experienced below average annual precipitation, resulting in severe drawdown upon the town's surface reservoir water supply (Little, personal communication, August 15, 1984). Severe drought occurred in this region from 1982 to 1984, further exacerbating an already serious problem (Environment Canada, 1986). The town's water supply was dependent upon annual surface runoff collection stored in three reservoirs; the Canadian National Railway reservoir (capacity 1,066,962 m^3) which had become contaminated from surface runoff collection and was prohibitively expensive to clean up and protect; the Helmer Dam reservoir (capacity 838,767 m^3); and adjoining Fox Lake (capacity 6,167,410 m^3) which has been completely dry on two occasions due to drought since 1960. By April of 1983, Hanna's three reservoirs, with a storage capacity of 8,017,633 m^3, had been reduced to 709,252 m^3 or 8.8 per cent of total usable water supply (Little, personal communication, August 15, 1984).

Further exacerbating the water supply problem has been modest population growth. Since 1971 (pop. 2,500) the town's population has increased to 3,000 in 1986, placing increasing demand pressure on already constrained water resources. Hanna's role as an administrative and agricultural service center plus an influx of personnel associated with the construction and operation of the nearby Sheerness Thermal Power Station has been responsible for the population increase in recent years (Fenwick, personal communication, August 15, 1984). Continued population growth is expected, and the population is projected to reach 4,000 by 1996 (Palliser Regional Planning Commission, 1982b).

This critical water shortage and the lack of an assured water supply are perceived to be a main constraint to accommodating growth and development in Hanna, and in this region generally. A survey of area residents found that 55 per cent perceive water supply limitations as a negative factor in accommodating growth and development (Palliser Regional Planning Commission, 1982a). Between 1981 and 1984, in response to increasing growth and development pressure upon the local water supply, the community undertook expansion and upgrading of its water treatment and sewage treatment facilities through the Alberta Municipal Water Supply And Sewage Treatment Grant Program (see Alberta Municipal Affairs, 1986). These projects

placed Hanna at the upper limit of this grant program; therefore the community was no longer eligible for funding of future water management projects under this program. As a result the town decided to evaluate water conservation options as a means of extending the present water supply and of delaying future expenditures on water supply and treatment facilities.

Based upon a predesign study for the town's water supply and treatment project which evaluated a water conservation option (Underwood McLelland, 1981), residential water use has been estimated to account for 80 per cent of total water consumption in Hanna (Town of Hanna, 1982c). Residential water use was estimated to be 338 litres per day per capita (23 million litres annually) and is expected to increase to 428 litres per day per capita (27 million litres annually) by 2000 (Town of Hanna, 1982c). A 20 to 30 per cent reduction in water demand was estimated to lower daily per capita water use to 248 litres and 225 litres respectively (Town of Hanna, 1982c). It was estimated that the existing water supply could be extended to accommodate an additional 700 people, with a 20 per cent reduction in water demand, and an additional 1000 people with a 30 per cent reduction in demand (Town of Hanna, 1982c).

Faced with the prospect of critical water supply constraints and increasing population and water demand, the Town of Hanna decided to influence these issues through development of water conservation management policies to guide program development.

Make Informed Decisions About Policy. A key component of capacity is the ability to formulate appropriate policy based on the best available knowledge, reflecting community needs and values in response to the environmental constraints influencing community decision making. In response to conditions of limited water supply, the Town of Hanna with technical assistance from the Palliser Regional Planning Commission, established the following water use objectives to guide the community's water management activities: 1) to provide sufficient water quality and quantity to support a population of 4,000 by the year 2001; 2) to have an assured water supply to attract industry, and 3) to conserve water as a valuable resource (Town of Hanna, 1982a).

Building upon the water conservation objective, preliminary research was undertaken, with the assistance of the Palliser Regional Planning Commission, to develop appropriate water conservation policies for the community. Policy research indicated that: 1) a 20 to 30 per cent reduction in domestic water consumption has been shown to be cost effective, technologically feasible, and socially

acceptable in other communities; 2) with a 20 to 30 per cent reduction in water demand the community could accommodate the expected population growth to 2001 with the existing water supply, and 3) the community would benefit from lower operation and maintenance costs of the water and sewage facilities and a reduciton in effluent loads to local streams (Town of Hanna, 1982c).

Based upon preliminary policy research and water management objectives, the following water conservation policy elements were adopted: 1) conduct a water conservation device pilot project, 2) develop a public information and education program, 3) develop regulatory means to conserve water, and 4) seek senior government support in conserving water. (Town of Hanna, 1982b). A policy of conservational pricing (increased water rates) was adopted in 1983 as a further incentive to conserve water (Little, personal communication, August 15, 1984). These policies, which are reflective of the most common components in existing water conservation management programs in Canada and the United States (e.g. Ashton, Howard-Ferriera, and Bond, 1979; American Water Works Association, 1981)and also complement Provincial water management principles (Alberta Environment, 1983), guided water conservation program development in the community.

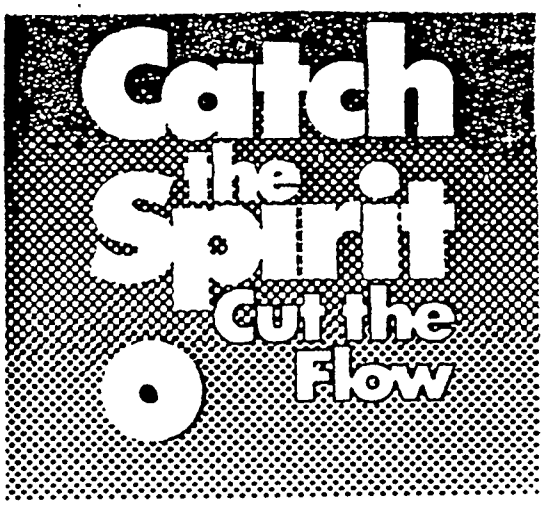
Develop Programs to Implement Policies. Capacity is exhibited in the development of programs which reflect policy guidelines and are responsive to changing environmental conditions in the community. The community implemented a comprehensive water conservation management program aimed at reducing municipal consumption. Hanna's water conservation program consisted of the following components: 1) water conservation device pilot project, 2) public information and education activities and materials, 3) water rate pricing structures, 4) regulatory mechanisms, and 5) solicit senior government support for water conservation.

1. Water Conservation Device Pilot Projects. During July and August of 1982, the community implemented a limited water conservation device pilot project with the goal of achieving a 20 to 30 per cent water reduction in the retrofitted buildings. A variety of water conservation devices (toilet dams, shower flow restrictors, and faucet aerators) were installed in eight homes and two offices. Project results indicated that the devices contributed to an average water consumption reduction of 18 m^3 or 31 per cent per building; thereby realizing the project's goal (Ashton, 1982). Based upon a 30 per cent reduction in water use it was estimated that a town-wide distribution of water conservation devices, at a cost of $18,000 could result in:

1) average reductions of $10,800 annually in chemical and power costs to operate the town's water supply and treatment facilities, 2) the residents of Hanna could save an average of $60,000 annually or $60.00 per household in water bills, 3) an additional population of 800 could be accommodated with the existing water supply, and 4) stabilization of the water supply, through reduced consumption, could provide an interim water supply to attract industrial development (Ashton, 1982). These projections fail to address the fact that if the town's costs decline by $10,800 but its revenues decline by $60,000, the town is left with a $49,200 revenue shortfall, hardly a water conservation benefit.

In November of 1983, a town-wide pilot project was conducted to distribute shower flow restrictor devices to the 1006 households in Hanna. Water flow restrictors, provided by Alberta Energy, Energy Conservation Branch, were distributed with the November 1983 water bill and reminder messages encouraging and illustrating how to install the device were enclosed with the December 1983 water bill. The water bill inserts utilized in this program are displayed in Figure 4. It was assumed the shower devices could reduce water use 20 to 60 per cent, with annual household savings in water and energy totalling $40.00 (Ashton and Little, 1984). A survey of residents

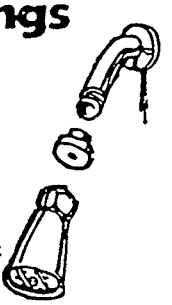
FIGURE 4. WATER CONSERVATION PILOT PROJECT WATER BILL INSERTS.



Catch the water
Count the savings

Installation

- Unscrew shower head
- Insert flow restrictor with raised side toward inlet. **Important:** Will whistle if reversed.
- Shower yourself with savings

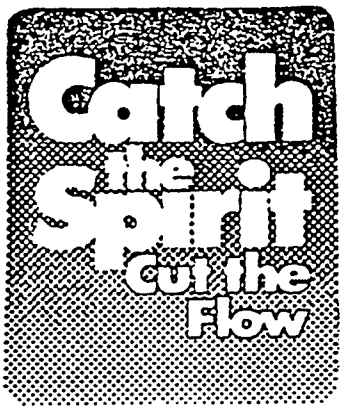


More spirited ideas

- Turn down hot water tank thermostat
- Insulate tank

For more energy saving tips, write:

Alberta ENERGY AND NATURAL RESOURCES
Energy Conservation Branch
[illegible] 10th Street
Edmonton, Alberta T5J 4L8



SHOWER DEVICE SAVES WATER & ENERGY

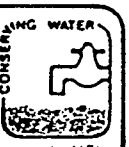
20 - 60% water use reduction

Annual water bill $27.50

Annual gas bill $12.50

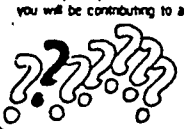
Total Savings each year..... $40.00

CONSERVING WATER



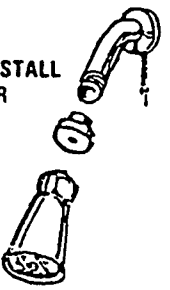
HANNA, ALTA.
854-4433

Not only do you save money by installing the shower flow restrictor, you will be contributing to a solution for Hanna's water shortage problem



Your comments would be appreciated about this water saving shower device when paying your utility bill

REMINDER HOW TO INSTALL YOUR FLOW RESTRICTOR



1. Unscrew shower head
2. Insert flow restrictor with raised side toward inlet
3. If restrictor makes slight whistling noise please reverse

A gracious thank-you is extended to the Energy Conservation Branch of Energy and Natural Resources in Edmonton, for supplying the shower flow restrictors.

Thanks also to the staff of the Palliser Regional Planning Commission for organizing this pilot project

Sam Bookie

MAYOR OF HANNA

indicated that 27 households (29 per cent) installed the devices and 67 households (71 per cent) did not install the devices (with 29 households or 43 per cent of these households citing a lack of interest for not installing the device) (Ashton and Little, 1984). The poor installation rate (29 per cent) is consistent with results of other projects utilizing mass mailing distribution techniques (e.g. California Department of Water Resources, 1978; American Water Works Association, 1981). It is apparent that this project achieved only modest success and that increased educational efforts and direct installation methods are required to implement conservation devices among at least 43 per cent of the residents.

2. Public Information and Education. The community has undertaken several water conservation public information and education initiatives. The local newspaper, the Hanna Herald, is concerned about water resource management and actively supports water conservation, when possible, through articles and editorials (Gorman, personal communication, August 16, 1986). Businesses in town have been encouraged to stock water conservation devices (Ashton, 1982). The town itself has made efforts to reduce water use by installing conserving devices in its buildings and by reducing outdoor watering schedules (Little, personal communication, August 15, 1984). A series of water bill

FIGURE 5. WATER CONSERVATION PUBLIC INFORMATION AND EDUCATION WATER BILL INSERTS.

CONSERVING WATER

HANNA, ALTA.
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WHY CONSERVE:

- Water saved is money saved.
- Reducing hot water use lowers energy bills.
- Clean drinking water is a limited resource which needs to be wisely used and managed.

WATER USE FACTS:

- Toilets use about 40% of a family's indoor water consumption or about 400 litres (88 gallons) per day.
- Showering for 6 minutes requires the same amount of water as filling a bathtub. About 30% of a household's water flows down the bathtub drain.
- Leaving the water running while brushing your teeth uses 10 x more water than using the water only to wet and rinse the toothbrush.

1 Palliser Regional Planning Commission

AROUND THE YARD:

- Watering lawns and gardens at night minimizes evaporation and avoids overtaxing the town's system. Letting the grass grow higher in dry weather prevents burning the lawn as well as saving water.
- Lawns only require short waterings to stay green; long waterings may actually remove important nutrients out of the soil, causing the lawn to fade.
- Innovative landscaping practices, such as planting rock gardens, can reduce excessive lawn space thus reducing water needs. A plastic sheet, to retain soil moisture and discourage weeds, covered with gravel and decorated with large rocks, shrubs, trees, and drought resistant ground plants will break up large unused lawn space and add to the appearance of the home.

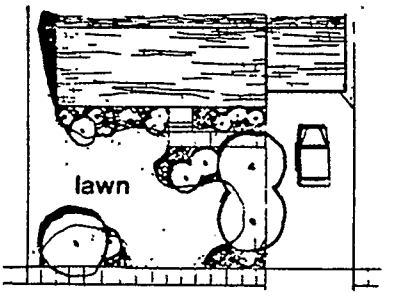

FIGURE 5. continued.

landscaping tips

DROUGHT RESISTANT

TREES
Russian Olive
Green Ash

SHRUBS
Siberian Peashrub
Buffaloberry
Russian Olive
Caragana
Siberian Elm

MODERATELY DROUGHT RESISTANT

TREES
Scotch Pine
Mugho Pine
Scopulorum Junipers
Western Chokecherry

SHRUBS
Serviceberry
Redtwig and Yellowtwig
Dogwood
Peking Cotoneaster
Pfitzer and Savin Junipers
Bush Cinquefoil
Sand Cherry
Sumacs
Currants
Austrian Copper Rose
Lilacs
Elderberry

- These plants are available at nurseries, or through seed catalogues.

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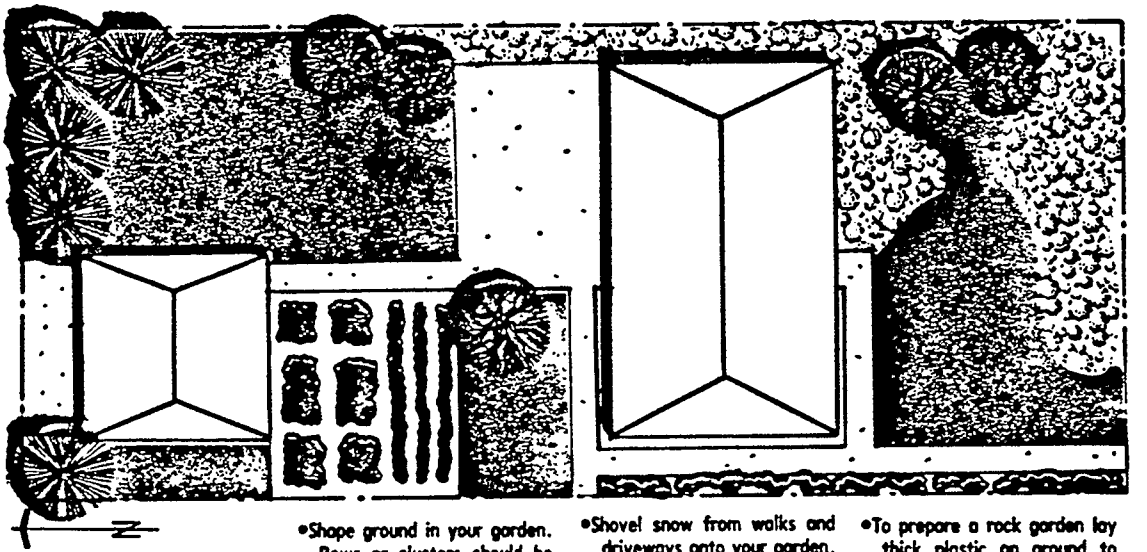
FIGURE 5. continued.

- Water lawns for two hours every 7 to 10 days.
- Over watering removes essential soil nutrients.
- Water trees, plants, and flowers once a week to avoid shallow roots which make vegetation susceptible to disease and damage.
- Water in morning at night or on cloudy days to prevent evaporation.
- Keep lawns green with high nitrogen fertilizer.

- Direct water from eavestrough to trees and bushes or catch water in barrels for later use.

- The south side of your lot is the hottest and dryest.
- Try to use rock gardens and drought resistant ground cover instead of a large grass area.



- If possible plant pine trees on the north side and/or west sides of your lot.
- This not only reduces wind in your yard, but slows evaporation and will trap snow in winter to protect nearby vegetation.

- Shape ground in your garden. Rows or clusters should be planted in shallow trench and watered only in the trench with a hose.

- Shovel snow from walks and driveways onto your garden, plants and tree bases to provide valuable spring moisture and frost protection.

- To prepare a rock garden lay thick plastic on ground to retain moisture and discourage weeds. Cover with gravel and decorate with large rocks, shrubs, trees and drought resistant ground cover to break up large unused lawn space.

FIGURE 5. continued.

rain, an alternative water source

CONSERVING WATER
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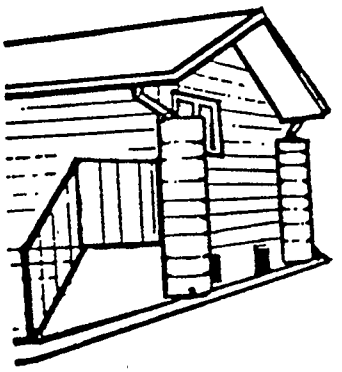
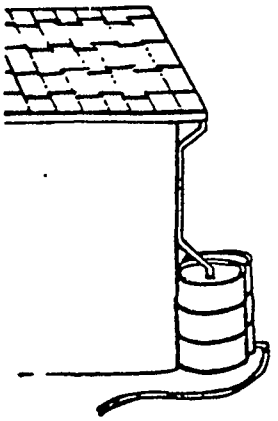


- Rainwater, collected and used on-site can reduce the demand on existing community water supplies by providing either an alternative or a supplement to out door water needs.
- In a survey taken by Don Laux it was found approximately 8 out of 10 homes in the older section of Hanna have water catching containers under the downspouts, compared with 1 in 10 in the newer sections.
- Water barrels do not have to be unattractive. Some solutions to that problem are:
  - -placing barrels next to the house, and finishing with the same building materials (see diagram).
  - -locating barrels in a hidden spot in your backyard
  - -planting shrubs around the containers
  - -building a box or shelter around the barrels



- Locate the rain barrel(s) under the downspouts at the eavestroughs on your house and/or garage.
- A ½ inch rainfall could yield the average bungalow (1200 ft.² roof area) about 1.5 cubic meters, which can be used later to water trees, shrubs, flower beds, and gardens.
- To prevent overflow, two barrels can be placed side by side with a hole connecting the two. If the first barrel fills, the water will flow into the adjoining one. (Don't allow overflow if placed adjacent to house foundation.
- Water can either be scooped out with a small pail, or a hose attachment can be built into the bottom of the barrel.
- Keep eavestroughs clear to prevent clogging.
- Keep barrels covered if possible to prevent evaporation, and keep out bugs and leaves.

PALLISER REGIONAL PLANNING COMMISSION

inserts were also developed cooperatively between the town and the Palliser Regional Planning Commission. The water bill inserts, displayed in Figure 5, focus upon reasons to conserve water and water use facts, water conservation landscaping practices, and use of rainwater as an alternative water source.

3. Water Rate Structures. Based upon the findings of the 1982 pilot study (Ashton, 1982), the town concluded that its existing water rates offered little incentive to conserve water. Therefore, in 1983, a 20 per cent water rate increase was instituted through an increasing block rate structure of $18.00 bimonthly up to 25 m^3, an additional $.85 per cubic metre up to 45 m^3, and $2.00 per cubic metre above 45 m^3 (Little, personal communication, August 15, 1984). Water rates were increased again in 1986 to $32.00 bimonthly up to 25 m^3, an additional $.85 per cubic meter from 25 m^3 - 55 m^3, and $2.00 per cubic metre over 55 m^3, plus a 10 per cent sewage rate surcharge was applied per cubic metre of water used (Binnendyk, personal communication, June 18, 1986). Water meters have existed in the community for several years as a means of promoting water conservation and administering the town's water rates (Little, personal communication, August 15, 1984). However, new computerized models may have to be

installed to overcome tampering problems (Binnendyk, personal communication, June 18, 1986).

4. Regulatory Mechanisms. A variety of regulatory means of conserving water (i.e. restrictions, incentives, by-laws, and policies) were instituted by the community. In 1984, in response to drought conditions, the town implemented a ban on outside watering between the hours of 8 a.m. and 7 p.m. (Little, personal communication, August 15, 1984). Although no longer in effect, the community had instituted a by-law which provided a $1.00 rebate per $1,000 value of a building permit, if water conservation devices were installed (Binnendyk, personal communication, June 18, 1986). Furthermore, water conservation policies have been instituted in the Town of Hanna General Municipal Plan (Palliser Regional Planning Commission, 1983) and the Palliser Regional Plan (Palliser Regional Planning Commission, 1984). Through these statutory mechanisms, Hanna is committed to development of a town-wide water conservation program which integrates water resource management and land use planning, to guide future growth and development in Hanna.

5. Solicit Senior Government Support For Water Conservation. As a means of realizing its water conservation objectives and policies Hanna actively sought financial and technical assistance resources from the Province

through a series of proposals to establish a comprehensive water conservation pilot project which could eventually be used in other Alberta communities.

In 1982 the Town of Hanna submitted a proposal to Alberta Environment outlining the water conservation objectives, potential benefits, program outline, and cost-sharing budget for a one year pilot project (Town of Hanna, 1982c). Alberta Environment responded by expressing interest in the project and offering limited technical assistance, although this was never forthcoming (Little, personal communication, August 15, 1984).

In 1985 an updated proposal was submitted to Alberta Environment (Town of Hanna, 1985). It was proposed that the municipal government, provincial government and a consulting team, form a committee to develop and evaluate a pilot project in the community and then implement the program in a second community to verify results. Based on this research a water conservation information and resource package would be developed and distributed to other municipalities through workshops. In response, Alberta Environment indicated that although it found merit in the proposal, it was unable to provide funding at that time (Binnendyk, personal communication, October 22, 1986).

In 1986, the community again approached Alberta Environment regarding a municipal water conservation program.

Alberta Environment, Water Resources Planning Division, provided background information for developing water conservation programs and indicated that funding could be available on a shared-cost basis (75 per cent Province and 25 per cent Hanna) under the Alberta Water Management And Erosion Control Program (see Alberta Municipal Affairs, 1986) (Binnendyk, personal communication, October 22, 1986). In response, Hanna submitted a preliminary water conservation engineering report as part of a study to reduce water supply costs in the community by the town's consulting engineer. The report listed water conservation measures appropriate to small towns, profiled water use in the community, and outlined implications of water conservation for the community (Binnendyk, personal communication, October 22, 1986). Alberta Environment notified the town that the report contained insufficient water use figures and cost data and that the department's current budget restricted consideration of the project at present time (Binnendyk, personal communication, January 14, 1987).

Attract and Absorb Resources. A key component of capacity is the community's ability to develop resource linkage mechanisms to attract and absorb appropriate, available resources which the community is capable of utilizing in developing and implementing its programs. Development and implementation of the water conservation

initiatives in Hanna was dependent upon the ability of the community to obtain and utilize the support of local community officials and a variety of local and institutional technical assistance resources.

Although the Hanna Town Council supported the local water conservation activities, it was the initiative and commitment of three key local personnel, which provided the catalyst to initiate and maintain support and interest in a comprehensive municipal water conservation program. The town managers, Vance Little (1982-1985) and Richard Binnendyk (since 1986) and William Ashton, a planner with the Palliser Regional Planning Commission (1982-1985) who brought to Hanna an extensive background in water conservation planning, were instrumental in the development and implementation of water conservation components from 1982 to 1986.

A variety of local and institutional technical assistance resources were utilized to develop and implement local water conservation initiatives. The Palliser Regional Planning Commission and Alberta Environment assisted the community in locating and obtaining water conservation program planning information. The community relied heavily on these agencies to assist in interpreting these materials, which generally assumed a more sophisticated knowledge of planning and engineering procedures than is present in a small rural community (Binnendyk, personal communication, June 18, 1986).

Manage Resources. Capable management involves the community's ability to convert resources into effective program solutions to local problems and to implement those programs utilizing existing organizational structures or through development of appropriate operations. Coordination and maintenance of resource acquisition linkages were an integral function of capable community management throughout the development and implementation of the water conservation program. The community managed program implementation through the use of established administrative and regulatory procedures and personnel. The town's administrative staff were able to absorb the increased clerical and operational tasks associated with adjusting water rate schedules and disseminating water conservation information and pilot project devices (Ashton, personal communication, October 14, 1986). Existing statutory mechanisms were utilized to establish a policy of water conservation in the General Municipal Plan (Palliser Regional Planning Commission, 1983) and the town's By-law Officer was responsible for enforcing the community's water restrictions and by-law regulations.

In general, Hanna's existing administrative structure was of sufficient size and sophistication to adequately absorb the management responsibilities associated with the

development and implementation of the local water conservation program initiatives factors which Farmer, et al. (1978) associate with local community capacity.

Evaluate Activities to Guide Future Actions. A community's ability to critically assess its ongoing activities in order to understand and improve on them in the future is an integral component of capacity. Capacity building evaluation functions to: 1) monitor what the community is currently doing; are the policies and programs employed meeting given objectives, 2) evaluate how well it appears to be doing it; are the programs effective and efficient, and 3) assess whether the current level of activity is appropriate over time; was the amount of activity appropriate and could resources have been utilized more effectively.

1. What are the current water conservation management activities in the community? Having developed and implemented water conservation activities a community needs to determine if the policies and programs utilized are doing what is needed to achieve given objectives. Hanna's policies and programs advocating retrofit devices, public information and education, water rate structures, and regulatory mechanisms are reflective of commonly accepted water conservation practices (Ashton, Howard-Ferriera and Bond, 1979; American Water Works Association, 1981;

New England River Basins Commission, 1981; California Department of Water Resources, 1984; Seattle Water Department, 1986).

Between 1982 to 1986 there were several changes in the current status of water conservation management in the community. There have been no follow-up activities after the initial pilot project activities of 1982 and 1983. Formal public information and education activities are no longer practiced. The community continues to utilize water rate structures in an effort to reduce water consump- tion. Water conservation remains as a policy issue in the Town of Hanna General Municipal Plan (Palliser Regional Planning Commission, 1983) and the Palliser Regional Plan (Palliser Regional Planning Commission, 1984). The water conservation building permit incentive By-law has been discontinued, although water restrictions may still be employed, as the need arises (Binnendyk, personal communication, October 22, 1986). The community is currently at an impasse in pursuing senior government support of water conservation. After submitting three unsuccessful pilot project proposals to Alberta Environment, the community is seriously questioning whether further pursuit of this issue is worthwhile (Binnendyk, personal communication, January 14, 1987).

Two main factors have contributed to the general decline in water conservation activity in Hanna. First, the departure of Vance Little (Town Manager 1982-1985) and William Ashton (Planner, Palliser Regional Planning Commission, 1982-1985), removed from the community the local expertise and experience necessary to develop a comprehensive water conservation management program. Although displaying initiative and interest in pursuing a water conservation pilot project for the community, the new town manager lacks the knowledge and skills vis-a-vis water conservation held by Little and Ashton. Second, the Town of Hanna obtained its first assured water supply in 1986. In 1984 the community had concluded a shared-cost agreement with the federal government's Prairie Farm Rehabilitation Administration and Alberta Utilities for a $3 million, 24 km, 30 cm pipeline from the Red Deer River via the Sheerness Thermal Power Station, which became operational in 1986. As a result, water supply constraints and water conservation were supplanted by other community problems as a priority.

It is apparent that although the town implemented state-of-the-art water conservation principles and components, current activities are generally limited in achieving given objectives.

2. How well is the community managing water conservation? Evaluation of community capacity building is also concerned with how effective and efficient activities are and how they could be improved. Each of the water conservation program initiatives will be discussed in terms of these issues.

The limited pilot project which tested a variety of water conserving devices proved very effective with an average water use reduction of 31 per cent. Similar reductions are cited by Meyer, et al. (1978), Ashton (1981) and Loudon (1984). The town wide shower flow reduction device pilot project was somewhat less successful. Devices were installed in only 29 per cent of the homes and no attempt was made to document water savings. The project failed to install devices in 43 per cent of the households; while in the remaining 28 per cent of the homes the devices were redundant, they already had similar devices or did not have showers (Ashton and Little, 1984). The poor installation rate (29 per cent) is consistent with results of other water conservation programs utilizing mass mailing distribution techniques (California Department of Water Resources, 1978; American Water Works Association, 1981). A combination of increased information and education efforts and use of direct installation methods (American

Water Works Association, 1981) would increase the installation rate of future programs. However, the additional time and expense required may be prohibitive within the administrative capacity of a small community.

Due to the fact that a comprehensive water conservation retrofit project has not been implemented and therefore, a 20 to 30 per cent water reduction not realized; the water and financial savings and the increased capacity to accommodate population growth projected on the basis of preliminary policy research (Town of Hanna, 1982c) could not be compared to actual results. If the community is to benefit fully from water conservation management, a comprehensive retrofit program must be implemented.

Although a necessary component of water conservation programs, public information and education activities are extremely difficult to evaluate (Lattie, 1977). The American Water Works Association (1981) estimates that information and education may result in a 5 per cent to 10 per cent reduction in per capita water use. The public information and education materials developed by the Town of Hanna and the Palliser Regional Planning Commission (see Figure 5) were successfully disseminated to the community. The information messages reflected Holland's (1979) principles for water conservation information: provide rewards, implement in phases, provide credible information

and provide practical "how to" information. The water bill inserts provided water conservation information and education appropriate to the Hanna context by promoting the benefits of conserving water, outlining methods of drought resistant landscaping, and suggesting optimal use of rainfall. A lack of background information, training and time constrained the development of more extensive programs in the community. The California Department of Water Resources (1984a,d) provides material to assist in program development and the American Water Works Association distributes a series of water bill inserts and other informational material at a reasonable cost which small communities could easily utilize. There was no attempt to implement an in-school program in Hanna, due mainly to a lack of available materials (Ashton, personal communication, June 17,1986). There are currently no water conservation materials available specifically for use in Alberta schools (Martin, personal communication, August 14, 1986). However, Alberta Environment is preparing water literacy curriculum materials for distribution in September 1988.

The California Department of Water Resources (1984b,d, 1986a) has developed manuals to assist teachers and water utilities in the development of water conservation education materials. Similarly the American Water Works Association distributes educational materials for use by

schools or communities, at a nominal cost. Again, time, staff, skill and budget limitations can constrain acquisition, development and dissemination of these materials.

The community's water rate schedule is based upon an increasing block rate structure, wherein the charge for each unit of water used increases as the customer's use exceeds certain levels for each billing period, plus an excess use surcharge; both methods are advocated to reduce municipal water consumption levels (American Water Works Association, 1981; California Department of Water Resources, 1984; Loudon, 1984). Although formal evaluation of the price structures was never attempted, water use was reduced by a modest 3785 m^3 following a water price increase in 1986 (Binnendyk, personal communication, January 14, 1987). Water rate increases and universal metering are an effective and efficient water demand management strategy (Alberta Environment, 1983; Grima, 1984; Loudon, 1984; Millerd, 1984). Water rates are generally based on: 1) average cost pricing, the average unit cost of production, 2) marginal cost pricing, the cost of providing additional water in the system, or 3) a combination of these methods (Milliken and Taylor, 1981; Fortin, 1985). Water rates in Hanna are based upon consideration of cost of production but are finally determined by an estimate of what price the community would be willing to

accept; due to the fact that water rates are a volatile political issue in the community (Binnendyk, personal communication, January 14, 1987). The town also obtains water rate information from other nearby communities and uses this knowledge in setting and adjusting water rates. The political constraints affecting water rates in the community, in conjunction with escalating water supply costs have contributed to an annual loss of $150,000 (1986) in water operations (Binnendyk, personal communication, January 14, 1987). The existing water rate structures only recover 75 per cent of water supply costs, with the remaining 25 per cent being recovered by increased taxes of $50.00 per capita; a more politicaly acceptable method of cost recovery than full cost water rates (Binnendyk, personal communication, January 14, 1987). In short, Hanna is circumventing water conservation by subsidizing water use.

Implementation of more effective and efficient conservational pricing structures would be assisted by: 1) increased training of local officials and dissemination of water rate scheduling information (Grima, 1984; Fortin, 1985), and 2) increased public education regarding water use reductions, water supply costs and rate structures (Robinson, Fitzgibbon and Benninger, 1984).

Regulatory mechanisms function to legitimize water conservation programs and provide a statutory basis for

their enforcement. Water conservation policies instituted in the General Municipal Plan (Palliser Regional Planning Commission, 1983) and the Palliser Regional Plan (Palliser Regional Planning Commission, 1984) continue to maintain water conservation as a viable development policy issue guiding community decision making. The building permit conservation rebate program proved to be ineffective and has been discontinued. Given the limited values of annual building permits in Hanna, the size of the resulting incentive ($1.00 rebate per $1,000 value of building permit) did not create sufficient interest to continue administering the program (Binnendyk, personal communication, October 22, 1986). For example building permits for 1984 totalled $2,179,000 which would have resulted in total rebates of only $2,179. Although water conservation rebate incentives have been advocated in Waterloo, Ontario (Robinson and Benninger, 1983) and are assumed to be effective in Denver, Colorado (Denver Water Department, 1986) experience in Hanna suggests that such measures are not effective in small communities, unless substantial rebates cannot be offered. Water use restrictions were considered to be effective when utilized (Little, personal communication, August 15, 1984). The American Water Works Association (1981) advocates the use of water restrictions as an effective water conservation strategy during periods of short term water supply shortages.

Overall water conservation effectiveness could be improved in Hanna if the retrofit programs were operated on a mandatory rather than a voluntary basis. Lee (1981b) states that mandatory programs are more effective and efficient than voluntary programs.

Past efforts to solicit senior government support for the development of local water conservation management capacity have not been successful. Until the community succeeds in enlisting senior government support it will be extremely difficult to develop a comprehensive sustainable program. Currently, the community is severely constrained by a lack of fiscal and technical assistance resources. In order to overcome these capacity building constraints the community must continue to lobby for government support; to continually place the issue upon the provincial water management agenda.

3. Is the current level of community water conservation management activity appropriate? Finally, community capacity building evaluation functions to determine if current activities are responsive to changing conditions in the community, if resources were used optimally, and if activities are sustainable.

The water conservation initiatives in Hanna were developed in response to community water conditions and are reflective of the principles and objectives of currently

accepted water conservation management practice. The study of water conservation in Hanna reveals a story of mixed success. Given the community's limited capacity to develop and implement programs, it was able to initiate a comprehensive water conservation program. However, financial and technical assistance constraints have limited the ability of the community to benefit fully from the potential of these strategies and to sustain them.

Although the community has an assured water supply, via pipeline, for the first time in its history; rising water supply and treatment operation costs are becoming a major fiscal problem. As a result there has been a shift in the town's orientation toward water conservation. Initially envisioned as a strategy to extend the town's inadequate water supply, water conservation is currently viewed more as a component in a water management cost control strategy. Aside from an annual $150,000 water operations deficit the town loses 20 per cent of its pumped water supply through distribution system leakage (Binnendyk, personal communication, October 22, 1986). Water system leakage has been identified as a major source of revenue loss for water utilities (Hennigar, 1984), with Canadian municipalities experiencing an average 18 per cent water loss through system leakage (Environment Canada, 1986). Cost-effective technology to detect and control leakage is currently

available (California Department of Water Resources 1984c, 1986b; Kroushl, 1984; Hennigar, 1984) and therefore, should be made available to and utilized by small communities as a component in water conservation activities.

Based upon observations of current capacity in Hanna, the following water conservation activities would continue initiatives already established and would correct shortcomings of current community water conservation management:

1. Retrofit component which focuses upon toilet and shower use, the main indoor household water use activities (Brown and Caldwell, 1984; Environment Canada, 1986), and provides low cost, easily installed devices.

2. Water rate structures and universal metering components which apply marginal cost pricing (user-pay principle) based on the premise that increasing prices result in decreasing water use (American Water Works Association, 1981; Loudon, 1984; Fortin, 1985).

3. Leak detection and control component which would address a major source of water loss in a cost-effective manner. (Denver Water Department, 1986; California Department of Water Resources, 1984d; 1986b).

4. Education and information components which promote the benefits of water conservation and outline the true cost of water supply operations (California Department of Water Resources, 1984a).

5. Regulatory components through which a mandatory conservation program could be institutionalized (Lee, 1981b).

Sustainable implementation of these measures will require that local community water conservation management capacity building needs be addressed by identifying and bridging existing gaps in the technical assistance resource system through the development of strategic mechanisms which will ameliorate the capacity gaps.

WATER CONSERVATION MANAGEMENT CAPACITY BUILDING NEEDS AND GAPS: AN ANALYSIS

The previous section presented a descriptive case study of current water conservation management capacity in Hanna, Alberta. It was observed that the community lacked sufficient capacity to implement a sustainable comprehensive water conservation management program in the absence of appropriate external technical assistance. Currently available technical assistance resources are not adequately responding to local community water conservation management capacity needs.

This section focuses on analyzing relationships between community capacity needs and technical assistance resource capabilities. Local community personnel identified water conservation capacity needs and evaluated currently available technical assistance resource capabilities to respond to those needs. Technical assistance resource system members outlined the roles and resources they contribute to the water conservation management capacity building process. A capacity need is an area which requires attention in order to facilitate program development, implementation, and management. When local community and technical assistance resources are not adequate to meet community needs, a capacity gap exists. Analysis of community capacity needs provided a framework for identifying and

evaluating technical assistance resource capabilities. When needs exceed capabilities, resulting gaps will be identified and discussed.

The major community water conservation management capacity needs identified were: 1) financial assistance, 2) planning assistance, 3) information and technical assistance resources, and 4) coordinated provincial government assistance. The following section summarizes the major causes of each capacity need and the resulting capacity gaps and discusses the interrelationships between capacity needs and technical assistance capabilities.

Financial Assistance. The ability of Hanna, Alberta to financially support sustainable water conservation management activities is constrained by a variety of internal and external conditions. The main causes of financial assistance needs in the community are: 1) a limited local residential and industrial tax base, 2) increasing water supply costs associated with new and expanded water supply and treatment facilities, and 3) provincial municipal water management assistance programs which lack appropriate policy to accommodate municipal water conservation projects.

Due to its small population and limited industrial and business development, the community's fiscal base is limited. Future population growth is projected to be slow

and industrial development will be limited by the region's distance from markets, competition with larger urban centers and a small unskilled labor pool. As a result the community lacks sufficient internal capability to generate adequate fiscal resources to sustain additional program services.

Increasing water supply costs associated with Hanna's cost share of upgraded water supply and treatment facilities, plus an additional apportionment assumed with the Sheerness pipeline project, are severely straining the community's fiscal resources. Compounding this problem is an annual water supply revenue deficit resulting from water rates which are below cost. Current water rates are already extremely unpopular in the community; therefore, the town is reluctant to charge the full economic costs of the water supplied (Binnendyk, personal communication, January 14, 1987). Local residents favor a province-wide water rate equalization scheme as a means of lowering local water costs (Little, personal communication, August 15, 1984).

At present there are no provincial funding programs available specifically for development of municipal water conservation programs. As a result, the only option to pursue municipal water conservation financial assistance is

to apply through existing water management assistance shared cost programs. Existing financial assistance programs, however, are not structured to accommodate municipal water conservation management projects.

The Alberta Municipal Water Supply And Sewage Treatment Grant Program, administered through Alberta Utilities, is mandated to assist municipalities with the capital costs of installing modern and adequate facilities for water supply and sewage treatment (Alberta Municipal Affairs, 1986). Priorities of this program are oriented toward water supply capital projects. At present there are no policy structures for funding specific infrastructure improvements such as water conservation programs, water meters or leak detection and control, unless they were included as a component in an overall water supply system improvement (Shillabeer, September 3, 1986).

Alberta Environment's Alberta Water Management And Erosion Control Program provides cost sharing assistance to local authorities for the enhancement and regional development of the province's water resources and to provide corrective measures where water, in its natural state, creates conditions adverse to the public interest (Alberta Municipal Affairs, 1986). Although this program is concerned with water conservation, it was not intended for application within municipal water management contexts

(Bruce-Cavanaugh, personal communication, September 3, 1986).

The Town of Hanna was the first Alberta community to pursue municipal water conservation funding with either Alberta Utilities or Alberta Environment. However, the current water conservation management policy gap constrains the funding of conservation management strategies by placing them in competition with high priority water supply capital projects.

Current local community and external resources are unable to meet the financial assistance capacity needs. The capability of the community to bridge this gap is limited. Therefore, progress on this issue will require government initiative to ameliorate the water conservation management financial assistance policy gap through provision for municipal water conservation funding.

Summary of causes of capacity needs and gaps - Financial Assistance:

Cause:	Gap:
o Limited residential and industrial tax base	o Inadequate local tax revenue
o New and expanded water supply system facilities	o Water system revenue inadequate; costs exceed revenue
Water priced below cost	
o Lack of policy regarding	o Current water management

municipal water conservation

- Lack of a precedent for funding municipal water conservation
- Uncertainty regarding water conservation funding decisions

grant programs do not accommodate municipal water conservation initiatives specifically

- Lack of a mandate/policy for municipal water conservation funding

Planning Assistance. The major causes of planning assistance capacity needs are: 1) community reliance on external planning expertise, 2) absence of water conservation planning experience among the technical assistance resource network, and 3) limited mandates of provincial departments and agencies to provide logistical support for water conservation planning and management.

The community is unable to support full time planning and engineering staff, due to its small size. As a result, the community relies upon private consultants to fulfill these needs for water management projects. Alberta Environment, Planning Division, and the Palliser Regional Planning Commission provide assistance to the community to interpret and evaluate consultant reports and to integrate this information into the municipal planning process. Although the community exhibits limited evaluative and planning capabilities, it is able to conduct the administrative operations associated with water conservation program management.

Unfortunately, a lack of definitional understanding and experience with the water conservation management concept limit the effectiveness of available consultant and provincial planning assistance. Therefore, it is not surprising to find capacity needs and gaps relating to water conservation management resources, experience, skills, and policy among provincial water management assistance programs. A lack of appropriate resource materials and training opportunities contribute to these gaps.

The problem of overcoming these barriers is exacerbated by current mandates and policies which limit government departments and regional planning commissions to providing advisory and technical planning assistance, but constrain provision of logistical support at the implementation and operational levels.

Current conditions in the community will continue to limit its capability to support professional planning and engineering staff, unless shared on a regional basis in the future. Therefore, bridging the current planning assistance capacity gaps will require that the traditional role of technical planners expand to include an additional function as facilitator of project implementation at the community level.

Summary of the causes of capacity needs and gaps - Planning Assistance:

Cause:	Gap:
o Reliance on external planning assistance Lack of local experience, time and funds Limited ability to support local professional staff	o Lack of locally available expertise Limited evaluative and planning capability
o Absence of water conservation management planning experience among government agencies Lack of local materials	o Lack of available water conservation expertise Lack of usable information
o Limited policies and mandates of goverment departments and agencies Inability to utilize existing water conservation planning resource materials	o Lack of logistical support Limited strategic management ability Absence of specific municipal water conservation policy

Information And Technical Assistance Resources. Main factors influencing capacity needs in this area are: 1)

lack of an adequate information dissemination system, 2) lack of usable information for community level personnel, and 3) limited information and resources applicable to municipal water conservation management program development and implementation.

The local community is limited in its ability to locate and acquire specialized information and technical assistance resources. As a result it relies upon the regional planning commission or the appropriate government department for assistance. Water conservation management information and technical assistance dissemination, however, is limited and poorly coordinated. Information is disseminated either directly from Alberta Environment, or through the Palliser Regional Planning Commission, to the community. Local community officials indicated that the acquired resources were of limited local utility due to a lack of expertise and time to interpret and apply the information within the community (Binnendyk, personal communication, June 18, 1986). Similar constraints limited the effectiveness of the provincial government's water management personnel. Alberta Environment's library contains several major water conservation references which provide background data. However this information is not directly transferrable to local contexts and Alberta Environment's technical assistance personnel currently lack the

familiarity and experience with water conservation to assist local communities with their application and maintenance (Mollard, personal communication, September 4, 1986).

A lack of usable information was cited by local community officials as a constraint to municipal water conservation management capacity building. Resource materials acquired from Alberta Environment (i.e. New England River Basins Commission, 1981) were found to require prior planning or engineering knowledge and experience and adequate water management data, which the community lacked (Binnendyk, personal communication, June 18, 1986). A further constraint was the form in which information is dissemin- ated. Most water conservation information is disseminated in procedural manuals, which the community is unable to utilize effectively due to limitations of local expertise, staff and time (Ashton, personal communication, June 17, 1986). The community prefers and is used to utilizing information in the form of assistance programs which outline program objectives, community eligibility require- ments, project eligibility, financial arrangements, and provide a contact person for further information (Binnendyk, personal communication, June 18, 1986).

Local community personnel expressed a need for information and technical assistance resources aimed at developing a comprehensive municipal water conservation management program. Current provincial water conservation information dissemination activities focus on provision of water conservation information to individual homeowners upon request (e.g. Alberta Agriculture, 1983; Alberta Energy 1986a, b; Alberta Environment, n.d.). Community officials expressed a need for local materials to guide development of a comprehensive municipal water conservation management program (Binnendyk, personal communication, June 18, 1986). Hanna was the first Alberta community to approach Alberta Environment for assistance in developing a water conservation program resulting in a resource system gap as there had not previously been a perceived need to develop local water conservation program planning resources for use at the municipal level (Mollard, personal communication, September 4, 1986).

While currently available materials can provide a general framework for developing a water conservation program, technical assistance resources are needed to assist in the development of specific program components at the local community level.

Summary of the causes of capacity needs and gaps - Information and Technical Assistance Resources:

Cause:	Gap:
o Information dissemination is limited and poorly coordinated Limited ability of community to locate and acquire information and resources Lack of locally relevant resource materials	o Limited awareness of information and resources Limited awareness of program options
o Materials are generally developed for planning and engineering specialists Community lacks expertise and time to utilize resources Information is not disseminated in a usable form	o Lack of user-oriented resource materials Lack of a water conservation assistance program
o Current provincial information activities focus upon individual	o Lack of locally relevant information and technical assistance for development

homeowners of municipal water conservation programs.

- Lack of municipal water conservation policy at provincial level

Coordinated Provincial Government Assistance. The main causes of capacity needs in the area of coordinated provincial government assistance are: 1) lack of explicit municipal water conservation management policy at the provincial level, and 2) lack of coordinated water conservation technical assistance among provincial agencies concerned with municipal and water management issues.

Although water conservation is a component in provincial water management principles (Alberta Environment, 1983) there is currently an absence of policy to implement these principles at the municipal level. Current municipal water manage- ment assistance programs are oriented toward water supply capital or structural projects. As a result, demand management projects have been difficult to accommodate within existing policies and programs. Provincial departments (i.e. Alberta Utilities, Alberta Environment) have expressed an interest in accommodating municipal water conservation proposals. However, they must compete with supply projects for the limited budget and technical planning resources (Shillabeer, personal communication, September 3, 1986; Bruce-Cavanaugh, personal communication, September 3, 1986) and will likely lose.

Uncoordinated technical assistance activities among government departments concerned with municipal water management problems contribute to a lack of local community water conservation management capacity building. Alberta Energy and Alberta Agriculture disseminate water conservation information materials related to energy conservation and household use; however, it is the activities of Alberta Environment and Alberta Utilities which relate most directly to municipal water conservation management program capacity building. Current mandates, water management priorities and budget constraints limit the ability of these agencies to adapt their resources to the needs of the local community. As a result the community has a limited awareness of existing resources and receives limited usable assistance in developing a locally appropriate water conservation program. Local officials also expressed a need for the regional planning commission to extend its current mandate as an advisory and technical land use planning agency, to provide or coordinate operational and program maintenance assistance (Ashton, personal communication, January 20, 1987; Binnendyk, personal comunication, January 14, 1987).

Meeting these needs will require a fundamental shift in provincial water supply management policy and priorities, and the development of appropriate water conservation

management resources, expertise, and assistance mechanisms. The initiative in these areas must come from the provincial government, as a small rural community lacks the internal capability to develop sustainable effective programs.

Summary of the causes of capacity needs and gaps - Coordinated Provincial Government Assistance.

Cause:	Gap:
o Lack of explicit municipal water conservation policy at provincial level	o Limited capability of current provincial water management assistance programs to accommodate water conservation proposals
o Current water management assistance structured for water supply capital projects	
o Water conservation perceived as a municipal management problem rather than a water management problem	
o Differing mandates and responsibilities among provincial agencies' activities related to	o Lack of coordinated technical assistance o Lack of logistical support

municipal water management issues

- Limited time, experience and budgets constrain technical assistance effectiveness

RECOMMENDATIONS: WATER CONSERVATION MANAGEMENT CAPACITY BUILDING STRATEGIES

Analysis of the Hanna, Alberta case study indicates that small rural communities are constrained in their ability to develop and sustain an effective comprehensive water conservation management program.The presence of water conservation expertise, in the person of William Ashton (planner, Palliser Regional Planning Commission, Hanna, Alberta), allowed the community to undertake water conservation management initiatives and contributed, more than anything, to the limited success the community has been able to achieve. Local community water conservation management capacity needs and gaps were identified in the areas of financial, information, planning, and coordinated government assistance. Similar needs have been found to constrain general rural community capacity development (Farmer, et al., 1978; B.W.Honadle, 1983; Reid, 1986). Current local community and technical assistance resource

system capabilities are unable to meet these needs. The resulting gaps must be bridged if progress toward sustainable water conservation capacity building is to be realized.

It has been suggested that capacity building mechanisms should provide technical assistance resources which are locally oriented, utilize existing agencies or organizations, and contribute to development of a knowledge network (Warren and Warren, 1986). In response to generally documented capacity needs related to deficiencies in funds, knowledge, and access to technical expertise capacity builders can utilize three generic capacity building strategies: 1) financial assistance, 2) information resources, and 3) directed technical assistance. Based upon the preceding considerations, the following capacity building strategies are recommended to ameliorate current capacity gaps and facilitate local community water conservation management activities in Alberta.

1. Develop locally relevant water conservation resource materials which can be used by local community personnel. An appropriate resource package should: 1) document methods of reducing municipal water use, 2) outline procedures to develop and implement water conservation management strategies and programs, 3) provide resource contacts for further information and assistance, and 4)

suggest appropriate applications of water conservation methods in municipal contexts especially related to leak control and conservational pricing structures. The materials and activities of the American Water Works Association and the California Department of Water Resources would provide an excellent model upon which to develop user-oriented water conservation programming resources appropriate for Alberta communities. Appendix A provides background information appropriate to initial research activity regarding this task.

2. Water conservation management should be integrated into the existing Alberta Municipal Water Supply and Sewage Treatment Grant Program. Water conservation strategies can contribute to reduced operational costs and postpone costly system expansion. Water conservation strategies should be integrated on a provincial-municipal cost sharing basis and be a condition of water supply project approval. Such an approach represents the public interest as it conserves valuable natural resources and enhances public spending accountability within the pressures of fiscal retrenchment and rising costs.

3. Develop a municipal water conservation management assistance program. Communities which do not qualify for existing municipal water management assistance programs will require an alternative program. This program must

specifically address water metering and conservational water rates and municipal leak detection and control, issues which current programs do not address, yet result in serious water loss and excess consumption.

4. Provincial water conservation management activities should be coordinated by a single agency. Alberta Environment should function as the lead agency as it is responsible for provincial water management issues. The department should coordinate the development, dissemination, and operation of water conservation management activities in the province; thereby, serving as the main resource referrent. Alberta Environment should work closely with Alberta Energy, Alberta Utilities, Alberta Agriculture, Alberta Municipal Affairs, and regional planning commissions in providing a comprehensive municipal water conservation program which is responsive to the needs of a variety of water users.

5. Water conservation management should be given a higher profile in provincial water management planning, municipal planning, and public communication activities. Increased training and information dissemination activities are required. Personnel associated with water management issues at both provincial and municipal levels should be trained in the application of water conservation strategies. Workshops could be developed by water

conservation consultants and utilized to increase the awareness of water conservation benefits and procedures among provincial and municipal water planners, engineers, consultants, management personnel, and political decision makers. A water conservation curriculum unit should be implemented in schools to create awareness of sound water management and to develop well informed consumers. Water conservation should be promoted through public information and education programs which would create an awareness in the general populace regarding the complexities of municipal water management and promote wise water use.

6. Regional consolidation of community water management systems should be considered in rural regions. A regional approach to water management would reduce costs and increase the quality of viable community water management systems.

SUMMARY

Progress toward local community water conservation management capacity must be accompanied by an increase in assistance to meet community capacity needs in the areas of finance, planning, information resources, and government coordination. The existence of current capacity gaps in the related areas of finance and revenue, information and planning resources and expertise, operational water

conservation policy, and municipal water management coordination and logistical support will continue to constrain development of community water conservation management capacity.

Many of the needs and gaps are caused by factors over which local communities have little or no control. Thus, local water conservation management capacity is increasingly dependent on the availability of external technical assistance resources. Strengthening the technical assistance network to provide appropriate, timely, and adequate resources, through the preceding recommendations, is the key to improving water conservation management capacity building activities.

CHAPTER FIVE

SUMMARY

THE PROBLEM AND STUDY DESIGN

Water resource constraints have historically been an issue of great concern among communities in East-Central Alberta. This region is located in a section of the Canadian Prairies which is forecast to face serious water deficiencies in the future, unless water management programs are implemented which will balance projected demand and supply. In response to these conditions the community of Hanna, Alberta, undertook the development and implementation of comprehensive municipal water conservation management program initiatives.

Rural community water conservation management capacity building is constrained by two complex interrelated problems. First, small rural community problem solving capabilities are generally constrained by an inability to marshall resources effectively to cope with complex problems. As a result of these capacity gaps small communities are dependent, to varying degrees, upon external resource systems for technical assistance. Second, the ability of the resource system to respond effectively

and provide appropriate technical assistance will influence the degree to which local community capacity is facilitated.

Capacity building processes are concerned with improving local problem solving management capabilities to develop policy and practice which generates sustainable and appropriate change. Thus, capacity building is a management problem, which suggests the need to develop appropriate mechanisms to transfer necessary management resources from the technical assistance resource system in response to local community needs. Therefore, the main reasons for studying capacity are to ascertain a community's current ability to achieve given objectives and to determine the effectiveness of available resources and programs in building local community management capacity.

This case study addresses the current capacity of Hanna, Alberta to develop and implement municipal water conservation management program initiatives during 1982-1986, and the effectiveness of available technical assistance resources to contribute to community water conservation management capacity. The study was designed to achieve four main objectives:

1. Determine current community water conservation management capacity.

2. Identify community water conservation management capacity needs. These are are areas which require attention in order to facilitate program development, implementation, and maintenance.

3. Identify water conservation management capacity gaps. A gap occurs when community needs exceed technical assistance resource capabilities.

4. Recommend strategies that could be utilized to ameliorate capacity gaps; thereby, facilitating water conservation management capacity building.

Data used in this study were obtained from interviews with local community personnel directly involved with the water conservation projects. Technical assistance resource system personnel were also interviewed to obtain information regarding their roles in local water conservation management capacity building and the resources they contribute to local water conservation management initiatives.

Beth Walter Honadle's (1981a,b, 1986) capacity building framework was utilized as a descriptive framework to analyze data and organize the case study. Honadle defines components of capacity as the ability to: anticipate change, make informed decisions about policy, develop programs to implement policy, attract and absorb resources, manage resources, and evaluate activities to guide future actions.

Data were analyzed and interpreted to reflect patterns of current community water conservation management capacity in relation to the components of Honadle's capacity building framework, to assess available capacity building resources, and to identify capacity needs and gaps and discuss possible causes. Based upon analysis of capacity needs and gaps ameliorative capacity building strategies were recommended which will facilitate future water conservation management capacity building activities in Alberta communities.

It was assumed that sustainable local community resource management is dependent upon improving local problem solving capabilities to respond adaptively to complex environmental issues and rapid change. Progress toward sustainable ecological adaptation requires local resource management decisions to be based upon the best available knowledge and skills and operate within a framework of environmental and institutional factors which influence local decision making capabilities. Capacity building progress must proceed from a sound base of continually updated knowledge and skills which are coordinated and disseminated in a manner that is responsive to local user needs. In essence, knowledge system processes function to organize information within specific knowledge domains according to a certain objective and specifically

attached to certain tasks within that objective.

Effective use of technical assistance resource knowledge systems for improving capacity building policy and program objectives requires that major gaps between technical assistance resource systems and local capacity needs be identified and bridged in order to sustain local capacity building activities.

FINDINGS AND RECOMMENDATIONS

Current water conservation management capacity in Hanna, Alberta is limited. Although the community was able to develop and implement a limited pilot project which achieved an average 31 per cent water reduction per building, it was unable to sustain a comprehensive town wide program. As a result the community was unable to evaluate whether the projected water and financial savings, based upon preliminary research and the initial pilot project results were realistic. The limited capacity the community has exhibited was the result of the presence of a local water conservation expert and limited technical assistance from the provincial government. The community was able to initiate the major components of a comprehensive water conservation management program; however, local personnel turnover, resulting in the loss of local expertise, and the lack of adequate government support conspired to limit

program success, ultimately resulting in virtually no sustainable water conservation management capacity having been established in the community. Current water management conditions in Hanna reflect the dominant water supply management policy of the Province. Development of a pipeline supply for the community has created a dependence on external water resources while little concern has been demonstrated for utilizing the previously existing resources or even the new resources more efficiently.

The study found that community water conservation management capacity is being constrained by capacity needs in the areas of: 1) financial assistance, 2) planning assistance, 3) information and technical assistance resource availability, and 4) coordinated provincial government assistance. Main capacity gaps exist in the areas of: 1) finance and revenue, 2) information and planning resources and expertise, 3) water conservation policy, and 4) coordinated government water management assistance and logistical support. Capacity gaps were found to be interrelated with capacity needs. The local community found its local revenues insufficient to support water conservation activities and funding from provincial programs and agencies was not forthcoming. Planning assistance was constrained by a lack of community planning ability and limited water conservation planning expertise among

provincial government agency personnel. Capacity needs and gaps associated with information and technical assistance resources were caused by a lack of locally relevant and user-oriented resource materials. Capacity constraints associated with a lack of government water conservation management assistance and logistical support resulted from limited operational water conservation policy and limited mandates of government agencies to provide operational and maintenance support at the community level.

Improving future municipal water conservation management capacity building activities will depend upon reconciliation of identified capacity needs and gaps. To facilitate this process, the following water conservation management strategies are recommended:

1. A locally relevant, user-oriented water conservation management capacity building resource package should be developed and piloted for application in Alberta.

2. Water conservation management requirements should be integrated into existing provincial municipal water supply management assistance programs.

3. Development of a specific municipal water conservation management assistance program.

4. Provincial water conservation management should be coordinated through Alberta Environment as the lead agency.

5. Water conservation management should be given a higher profile and priority in provincial water management planning, municipal planning and public communication and education activities.

6. Regional consolidation of rural community water management systems should be considered to reduce costs and improve service levels and viability.

IMPLICATIONS AND FUTURE RESEARCH NEEDS

Progress toward improving municipal water conservation management capacity building activities in Alberta will require changes within current water management resource assistance processes. The effective and efficient use of problem solving resources for the improvement of water conservation management policy and practice requires that major gaps between institutional resource systems and the local community be bridged in order for knowledge to be brought to bear on specific problems.

Small rural communities are dependent upon linkages to external resource systems to bridge local financial, knowledge, and skill deficiencies. Strengthening these linkages is an integral component of the capacity building process. Capacity building strategies must disseminate information, knowledge, skills, and other technical assistance resources in a form that is usable, locally appropriate, and within a

suitable timeframe for local use, if they are to be effective and efficient.

Such capacity sharing arrangements are essential to local development improvements. Progress toward an idealized knowledge system for water conservation management capacity building will require fundamental shifts in current water management processes at both the provincial and municipal levels.

The provincial government must reorient its water management policy practice to integrate water conservation or demand management options into a comprehensive municipal water management strategy aimed at balancing supply and demand. Furthermore, the province must take the initiative to facilitate water conservation information sharing through the development of appropriate planning and programming technical assistance resources and training of water management personnel to provide advisory and logistical support at the community level in response to community needs.

Improvements in the water conservation management capacity building process will also have ramifications at the local community level. Improving local water management requires that local communities assume the burden of increased responsibilities related to the operations and maintenance of additional water management services

associated with conservation strategies. Water conservation programs must be adapted to local conditions and monitored to be responsive to changes in local water system characteristics. Therefore, responsibility for implementing and maintaining water conservation activities must be institutionalized in the community's existing administrative structure. If internal administrative capacity is unable to accommodate these increased responsibilities, then the use of consultants or regional capacity sharing arrangements with other communities to sustain operations, may be required.

Water conservation management requires that technical assistance resources and appropriate organizational arrangements be coordinated, at both senior government and local community levels, to develop, implement, and maintain conservation initiatives. Toward this end, water conservation management capacity building process improvements will generally require an increased awareness of the benefits of water conservation, improved access to information, and development of local and institutional capabilities to identify, adapt, implement, and sustain locally appropriate water conservation activities.

Arising out of this study are several areas of further research which would contribute to future water conservation capacity building activities in Alberta:

1. Development of comprehensive user-oriented water conservation management resource materials appropriate for use in Alberta municipalities.

2. Development and evaluation of a comprehensive long term municipal pilot project to substantiate potential benefits of water conservation in Alberta.

3. Development of a provincially coordinated water conservation program modelled after the California Department of Water Resources water conservation technical assistance programs.

4. Further research on factors which influence the development, dissemination and utilization of water conservation information at both the institutional and community level.

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APPENDIX A

WATER CONSERVATION MANAGEMENT: AN OVERVIEW

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The water conservation management capacity building problem described in Chapter One is based on information in this Appendix. The purpose of this Appendix is to present an extensive overview of substantive municipal water conservation management program issues found in the field of water resource management in order to provide a more comprehensive understanding of water conservation management capacity building issues than that provided in Chapter One and to provide background information for interpretation of the Hanna water conservation management program case study. The scope of this Appendix is limited to background information outlining: 1) the rationale for conserving water, 2) procedural steps for planning and implementing local water conservation programs, and 3) the range of water conservation management methods which have proven effective in reducing municipal water use and water loss.

RATIONALE FOR WATER CONSERVATION MANAGEMENT

The possibility of water shortages and the emerging

impact of increasing water demands is shifting the emphasis of water demand from issues of supply to aspects of demand. Castle (1983) suggests that water supply shortages will generally be regional in nature, however increasing attention will be focused on conservation and efficiency of use in the future. Several factors have contributed to the growing challenge to balance future water demands against water supplies within the field of water management. The need for comprehensive water management planning, including consideration of water conservation options, is likely to continue for several reasons. First, levels of municipal water demand are increasing. Second, there are environmental constraints in procuring additional water supplies; water supply is governed by carrying capacity. Third, the capital costs of expanding water supply and treatment infrastructure has risen to record levels. Finally, fiscal retrenchment, at both senior government and local municipal levels constrain their ability to meet the costs of providing additional water supplies and treatment facilities.

As competition grows for increasingly scarce funding and limited water resources, a greater emphasis will be placed on cost sharing partnerships among various levels of government resulting in smaller scale water projects oriented to local conditions and objectives (Castle, 1983).

The gap between future demand and supply may be reduced by either: 1) water supply augmentation, 2) water conservation management, or more likely, 3) a combination of both procedures. The need to integrate water conservation into comprehensive water management planning at the national, regional, and local levels, therefore will likely continue.

Comprehensive water conservation management may be operationally defined as the application of water management strategies (e.g. information and education programs, technical devices, metering and pricing measures, regulatory mechanisms, etc.) which improve the efficient use of water resources resulting in any beneficial cost-effective reduction in water use or water loss (American Water Works Association, 1981: Baumann, Boland, and Sims, 1984).

Several municipalities have substantiated benefits of conserving water through significant reductions in water use after instituting comprehensive water conservation management programs. Waterloo, Ontario reduced municipal water demand by 10 per cent (Robinson and Benninger, 1983). Seattle, Washington reduced water use 15 million litres per day from 1980 to 1985 (Seattle Water Department, 1986). Denver, Colorado reduced per capita water consumption by five per cent from 1979 to 1984 and expects a further five per cent reduction through introduction of a more

comprehensive program over the next five years (Denver Water Department, 1986).

Among potential benefits to be derived from water conservation practices are:

- reduced water supply and wastewater treatment operating and maintenance costs.
- decreased capital costs due to postponement of system expansion.
- reduced need for new supplies and extended planning horizons for acquisition of new supplies.
- ability to adapt to a sustainable growth situation through efficient use of a limited resource base.
- conservation and improved utilization of other resources (e.g. treatment chemicals and energy) thus reducing costs and environmental degradation.
- reduced vulnerability to fluctuations in natural water supply by increasing water levels in existing supply systems and reduced drawdown upon reservoirs and groundwater levels.
- optimized capital spending accountability in relation to system expansion, operation, and maintenance, thereby reducing or deferring government assistance for future municipal water infrastructure.

PLANNING AND IMPLEMENTING A LOCAL WATER CONSERVATION MANAGEMENT PROGRAM

Successful water conservation management can be planned and implemented through several well established management components and strategies which tailor policies and programs to local needs, capabilities and conditions. Water conservation management programs can assist in extending inadequate water supplies, compensate for water treatment and distribution system deficiencies, and alleviate demands of rapid population growth. This seciton will provide a brief descriptive outline of the substantive procedural steps involved in the development and implementation of local community water conservation management programs. The type and extent of policies and programs are determined by local water supply and demand conditions, the acceptability, effectiveness and financial feasibility of the strategies chosen, and the availability of technical assistance resources (Minton, Williams and Murdock, 1979; Lord, Chase and Winterfield, 1983). This discussion of design steps will be limited to the major procedural elements identified in the following water conservation management planning handbooks: 1) Before The Well Runs Dry: A Handbook For Designing A Local Water Conservation Plan (New England River Basins Commission, 1981) and

2) Water Conservation Management (American Water Works Association, 1981). Readers are referred to these documents for a more detailed description of procedures. The following steps provide a general outline of the requisite procedures in developing, implementing, and evaluating a community water conservation management program.

STEP 1. DEFINING PROGRAM NEEDS AND GOALS. The first step in designing efficient water conservation programs is to define local needs and establish appropriately responsive goals. The information obtained provides the data required to determine the most appropriate demand management measures in relation to local community conditions. The following steps assist in this effort.

1) Determine System/User Characteristics. The water demands of each user (i.e. residential or commercial) and the available water supply capacity should be assessed.

2) Identify Supply and Demand Problems. The nature and extent of supply - demand problems should be determined in relation to: the extent of the problem (i.e. system wide, seasonal, short or long term), the cause of the problem (i.e. leakage, inadequate supply, excessive use), and the demand reduction required to balance supply with demand.

3) Evaluate Existing Conservation Activities. Any existing water conservation efforts should be inventoried and evaluated to determine effectiveness and to estimate future water use reductions which could be expected with further conservation measures.

4) Public Participation. The need for water conservation must be understood and supported by local officials and community members. Community personnel and appropriate government agencies should be apprised of developments throughout the planning and implementation process through continuing participation opportunities and educational initiatives.

5) Establish Program Goals. Goals should be based upon locally determined needs and reflect the interests of all affected groups.

STEP 2. PROGRAM PLANNING. Effective water conservation programs require a documented plan stating policies, facts, figures, expected results, and recommendations for program implementation. The program should be a component of the overall water management strategy and subject to periodic revisions in response to current conditions. Suggested steps in program planning follow.

1) Prepare A Work Plan And Schedule. A work plan should outline budget requirements, allocate responsibilities and provide a time frame for completion of project elements.

2) Identify And Project Supply And Demand Conditions. Selection and evaluation of water conservation practices must be based upon reliable estimates of current and projected water demands, for each water use category, in comparison to current and projected water supply yields (e.g. typical residential water demand in relation to reservoir capacity).

3) Assess Legislative And Institutional Factors. Water conservation management occurs in a legal and administrative milieu which requires due consideration of existing government programs and requirements, statutes related to water management activities, and local ordinances which may assist or constrain development of local programs.

4) Identify And Evaluate Alternative Water Conservation Practices. Water conservation methods based on evaluation of cost-effectiveness, water use reduction capability, and financial feasibility should be outlined and combined in a program appropriate to the local conditions.

5) Summarize Final Plan. A draft plan should be developed and reviewed by all concerned participants. The final approved plan should clearly state how the recommended program will resolve existing and anticipated problems.

STEP 3. PROGRAM IMPLEMENTATION AND EVALUATION. Water conservation program management requires development of an efficient organizational structure capable of conducting required tasks related to instituting, operating, evaluating and revising program elements. Such a process reflects the following steps.

1) Develop Implementation Framework. Effective water conservation implementation requires a detailed framework outlining goals, schedules, tasks, staff requirements, and budget components appropriate to the community's administrative structure.

2) Resource Acquisition And Staff Training. Technical, financial, and human resource requirements for program operation should be identified and acquired. Staff training to understand program goals and operations is essential to success.

3) Implement Water Conservation Program. Program tasks should be scheduled to coordinate staffing, budget requirements, and resources within the parameters of the program goals.

4) Evaluate And Revise Program. The program must be monitored for effectiveness of specific conservation measures, public acceptance, and achievement of stated goals. Based upon these evaluations the program may be modified to achieve optimum effectiveness.

WATER CONSERVATION MANAGEMENT COMPONENTS

Water conservation practices are predicated upon a variety of approaches to changing individual and organizational behavior in relation to the perception and use of water resources. Heberlein (1974) has advanced three approaches to modifying human behavioral responses to demands upon water resources: technological fix, cognitive fix, and structural fix. First, application of technology can alter the physical water system to facilitate efficient use (e.g. shower flow restrictor). Second, the cognitive approach involves information and education programs to modify beliefs, values, attitudes, and motivation (e.g. brochure on how to save water in the home). Third, the structural fix is designed to modify the physical structure or social setting in which action occurs through instituting operational procedures or regulations.

Aspects of each of these basic strategies are apparent in the operation of water conservation management policy components consisting of some combination of the following elements: 1) information and education programs, 2) technological components, 3) pricing structures and metering, and 4) policy and regulatory mechanisms. The water conservation methods described in this chapter are applicable to a variety of municipal residential, commercial, and governmental users. However, this section will focus on

residential water use which accounts for 63 per cent of total municipal water use (Environment Canada, 1986). The appropriateness and desirability of any given method must be determined by individual communities after examining local conditions. Each component will now be described in terms of its contribution to water demand management.

1. INFORMATION AND EDUCATION COMPONENTS. Many consumers have no knowledge of their water source, supply capacity or availability, and necessary treatment and distribution costs. A community seeking to reduce excessive and wasteful use of water should establish a campaign to inform and educate consumers about their water environment and how they can engage in more efficient cost-effective water use. The importance of information and education components are underscored by Flack (1980) who suggests they are as important to conservation program success as the conservation practices themselves. Although information and education programs usually work in conjunction with other water conservation components, the impact of information and education programs alone, have been estimated to account for a five per cent to 10 per cent reduction in per capita water use (American Water Works Association, 1981).. Such a program should incorporate several elements, emphasizing the need to eliminate or reduce excessive water

use, and provide information and technical assistance regarding the cost, installation, maintenance, and potential savings to be realized from water conservation strategies (Milliken and Taylor, 1981).

The goal of information and education programs is to develop a public water conservation ethic which emphasizes that reduced water use is essential and results in economic and environmental benefits; thereby, representing the best interests of the individual and the community. The methods utilized to communicate program messages to the public are crucial. Lattie (1977) contends that a program will only be as effective as its communication strategy. Holland (1979) suggests that programs be based upon social marketing strategies which seek to convince the target audience that conservation behavior is preferable to excessive and wasteful consumption of water. Holland (1979:67) has outlined some guiding principles for the development and implementation of water conservation information and education programs: 2) both intrinsic (i.e. social conscience appeals) and extrinsic (i.e. rewards and sanctions) motivational approaches should be integrated to encourage short-term conservation behavior and ensure long-term commitment to this objective, 2) program must be implemented in phases (allows feedback and appropriate revisions to maintain public interest and cooperation),

3) conservation messages must be credible, relevant and equitable (relate to current identifiable conditions and accentuate positive aspects of conservation for all user groups), 4) provision of clear, practical "how to" information is essential to realize developed responses to conserve (actualize motivation), and 5) solicit ideas from the public as to how to conserve (encourage public participation and commitment).

Once a program has been devised and the various public audiences targeted, many forms of media may be utilized to deliver the information. Fazio and Gilbert (1986) have developed an excellent introduction to the purposes and methods of public relations and communication to guide natural resource managers in the development and implementation of programs. The California Department of Water Resources (1984a, b) has developed "how-to-do-it" manuals to guide the development of public information programs for water conservation. Programs are communicated through: 1) the mass media; specialized newspaper articles, radio, and television, and 2) direct communication; workshops, speaker bureaus, demonstrations, brochures and pamphlets, water bill stuffers or computer printout messages, posters, stickers and buttons, newsletters, etc. Public information programs can educate consumers regarding specific habits or procedures which commonly waste water, such as lawn

watering, use of water saving devices, unnecessary personal water use, and location and repair of household fixture leaks.

Long-term conservation goals should also incorporate in-school education programs. Bock (1984) has outlined the American Water Works Association educational program (grades 1-9) which is applicable to Canadian schools. The program is designed to educate students about the development and maintenance of water resources, water quality, water distribution systems, and conservation in order to develop informed consumers who appreciate the complexities of water management and will utilize water resources wisely. Alberta Environment, Communications Branch, is currently developing a pilot water quality curriculum unit for Alberta schools, however this unit will not address water conservation issues (Martin: personal communication, August 14, 1986). The California Department of Water Resources (1984 b, d, 1986a) has developed manuals to assist teachers and water utilities in the development of water conservation education materials, which would be especially useful in areas without existing curriculum materials.

2. TECHNOLOGICAL COMPONENTS. A variety of water conservation devices and techniques are available for residential, commercial, and municipal application

resulting in considerable water, energy, and financial savings. Several sources (Milne, 1976; North Marin County Water District, 1977; Cameron and Armstrong, 1980; Milliken and Taylor, 1981; New England River Basins Commission, 1981; American Water Works Association, 1980, 1981; Brown and Caldwell, 1984; California Department of Water Resources, 1978, 1984c, d; Olsen and Highstreet, 1987) provide detailed descriptions and analyses of an extensive variety of effective water conservation measures utilized in a number of residential, commercial, industrial, governmental/municipal, and utility settings. Brown and Caldwell (1984) and Maddaus (1987) indicate that retrofit techniques are the most cost-effective water conservation alternative for existing buildings. However, installation of new water efficient fixtures is cost-effective during new building construction or when considering fixture replacement (American Water Works Association, 1981). A full review of these technical components is beyond the scope of this study, which is limited to discussion of retrofit components (installation of water saving devices in existing single and multi-family unit structures), alternative landscaping practices, and leak detection and control. These methods offer the most cost-effective contributions to water savings among the existing water conservation alternatives (American Water Works Association, 1981).

Residential Retrofit Techniques. Residential water use accounts for 63 per cent of total municipal water use in Canada (Environment Canada, 1986). A typical household (family of four) consumes 750 litres of water each day (Alberta Energy, 1986b). Total household use consists of the following demand categories: toilet (45 per cent), showering and personal use (28 per cent), laundry and dishes (23 per cent), drinking and cooking (4 per cent) (Environment Canada, 1986). Since toilets (45 per cent) and showering and personal use (28 per cent) account for almost 75 per cent of annual household indoor water use, these are primary areas for targeted reduction. A recently completed United States Department of Housing and Urban Development demonstration project documented savings in homes which installed a variety of water conserving devices (low-flush toilets, low-flow showerheads, water pressure adjustment, and water meter installation). This study found that water conserving homes use 64 litres per day per capita less water than non-conserving homes (Brown and Caldwell, 1984).

Residential retrofitting forms the cornerstone of the majority of comprehensive municipal water conservation programs identified in the literature and case studies. Once established, the retrofit program should be incrementally built upon and expanded to include other

feasible conservation approaches applicable to the local community. The main targets of retrofit programs are toilet and shower water use, which constitute the largest percentage of total residential water use; thereby offering the greatest potential for water use reduction and financial savings through ongoing water conservation programs (Siegrist, 1983; Barclay, 1984). Retrofit programs generally consist of providing and promoting toilet tank water saving devices (i.e. leak repair, tank displacement devices), shower and faucet flow control devices (i.e. flow restrictors, aerators, low-flow showerheads), and adjunct components (i.e. leak detection dye tablets, information/instructions). The California Department of Water Resources (1981) has produced a manual which provides a complete description of how to conduct a residential retrofit program.

Successful programs have provided devices which have proven water saving capability, are cost-effective, provide comparable service, are functionally similar to conventional products, are compatible with utility systems, are easily obtained and distributed, and can be easily installed and maintained. Devices are commonly distributed by either mass mailing, depot pick-up, door-to-door delivery, or direct installation. The rate of installation usually depends on the distribution method used and the perceived

need by the public to install water conservation devices. A pilot water conservation program conducted in several California communities determined the installation rate of shower flow restrictor devices via distribution method to be: mass mailing (23 per cent); depot pickup (36 per cent), and door-to-door delivery (25 per cent) (California Department of Water Resources, 1978). The American Water Works Association (1981) notes that direct installation would result in increased installation rates, however the time and expense involved may be prohibitive. A summary of the most common retrofit components is presented in Figure A1 to provide an indication of the approximate costs and water and financial savings which can accrue through application of a range of water conservation technologies, as determined by a compilation of data from the sources noted. It should also be noted that Figure A1 represents an approximate guide to expected water and financial savings based upon wide ranging studies. Data contained in Figure A1 should be utilized as a preliminary step in the development of a local program of research and pilot testing to determine appropriate retrofit components which are responsive to local needs and environmental conditions.

Landscape Water Conservation. A major concern of water use in communities located in dry climatic regimes is landscape irrigation demands (i.e. lawn, tree, shrub, and

garden watering). Outdoor residential water use can account for about 40 per cent of all residential use (Ferguson, 1987). Application of water conservation techniques can result in substantial savings from reduced water use, lower fertilizer and pesticide costs, and reduced maintenance time and costs (American Water Works Association, 1981). Ferguson (1987) suggests water conserving irrigation and landscape methods can reduce water use 25 per cent to 70 per cent depending on strategies utilized. Main water conservation landscape technologies consist of trickle drip irrigation and automated sprinkler systems (American Water Works Association, 1981), water use regulations, water use information/education, and water use indexes (McFarlane, 1984), and alternative landscaping (American Water Works Association, 1981).

Alternative landscaping attempts to replace or limit groundcover which is highly water consumptive (i.e. turf) with low water using groundcover (i.e. native vegetation, low water requirement vegetation, rocks, bark chips, patios/decks). Thayer (1982) has shown that people do not inherently prefer large areas of turf to alternative water conserving landscaping in backyards of residences. However, research also indicates that adoption of alternative landscape generaly occurs only in areas which have constrained water supplies (American Water Works Association,

1981). Successful water conservation through application of low water use horticultural practices (Xeriscape) involves seven principles: 1) appropriate planning and design, 2) limited turf areas, 3) soils improvement, 4) use of mulches, 5) selection of low water demand plants, 6) efficient irrigation practices, and 7) appropriate maintenance (Denver Water Department, 1986). The California Department of Water Resources (1984d, 1987) and Ferguson (1987) offer valuable guidance in developing appropriate cost-effective landscape water conservation components.

Water Conservation Leak Detection. Leak detection is generally a water conservation method utilized by municipalities or utilities to identify and minimize water loss in the residential supply systems. Household leak detection has been briefly discussed in the retrofit section. Water losses, whether due to leakage, theft, or system malfunction represent substantial monetary losses as the community has already paid to obtain, treat, and pressurize this water. For Canada as a whole, some 18 per cent of municipal water supply is lost; any figure over five per cent is generally attributed to water leakage (Environment Canada, 1986). Associated Engineering Services (1980) estimates that the most significant waste of water in small to medium size Southern Alberta communities appears to be water main leakage and that reduction of this leakage would

be a major area of potential savings in water supply costs. The Prairie Provinces Water Demand Study found that in some municipalities 40 per cent of total water pumpage was unaccounted for, and mostly attributed to water leakage (Tate, 1984). In California, a study discovered that 75 per cent of urban water supply leakage could be located and repaired using existing technology (California Department of Water Resources, 1984c).

Several sources (Kroushl, 1984; Hennigar, 1984; California Department of Water Resources, 1984d, 1986b) offer guidance in the development and operation of leak identification and control programs. All programs rely on the use of various sonic listening devices. Communities, depending on the resources they have available, may be able to operate a program internally; otherwise they are reliant upon senior government technical assistance or private consulting services. Although costs will vary according to circumstances, leak detection and repair programs have proven to be cost-effective components in community water conservation activities. For instance, the Denver Water Department (1986) reports that for 1983 leak detection cost $67,000 and saved $93,000, due to reduced repair and property damage costs.

3. PRICING AND METERING COMPONENTS. Water Conservation Pricing Mechanisms. Water pricing policies have two purposes (Milliken and Taylor, 1981): 1) to recover operating costs, and 2) to maintain equity among consumers. Approaches to water pricing generally consist of: 1) average cost pricing (based on the average unit cost of production), 2) marginal cost pricing (based on the unit cost of providing additional water in the system), or 3) a combination of pricing structures.

The American Water Works Association's Water Rates Manual M1 (1983), bases water pricing on average cost pricing and cost recovery, a means to recover expenditures by means of revenue. However, this practice does not necessarily encourage water conservation. Grima (1984) contends that average cost pricing tends to undervalue water and discourage conservation due to increasing economies of scale as the area served increases. Tate, Reynolds, and Dossett (1984) have noted that Canadian water rates have traditionally been based on recovery of construction, operating and administration costs resulting in overbuilt supply systems, suboptimal water use practices, waste of public funds, and undervalued water. In a study of rates of return on capital investments, Mercer and Morgan (1986), found that water rate revenues tend to be below capital costs. Mann and Lefrancois (1983)

similarly note that water rates consistently undervalue water and have called for an increase in price to adequately fund system maintenance and capital improvements. Gray (1983) and Mitchell (1984) contend that undervalued goods tend to be overused and suggest that water should have an intrinsic value.

Increasingly, marginal cost pricing is advocated as a cost-efficient conservational structure to redress some of the imbalances created by average cost pricing. Marginal cost pricing advocates the user-pay principle which charges users the full economic costs of the goods or services they consume (Fortin, 1985). Such an approach promotes equity among users, cost-efficient service, and water use reductions; valued goals in water conservation programs. Several studies have demonstrated that water demand is responsive to pricing policies and therefore pricing represents an effective and efficient water management strategy (Grima, 1984; Loudon, 1984; Millerd, 1984;). Gysi (1980) refers to marginal cost pricing as conservational pricing, a practice which charges increasing block rates for excess water use above a set standard. Hanke (1985) maintains that an equitable economically efficient water conservation pricing policy can only be justified when its incremental benefits exceed its incremental costs. Therefore, Hanke (1985) suggests the establishment of a

pricing policy which sets an annual uniform marginal cost rate schedule which reflects a balance between demand and existing supply capacity and affects all consumer classes equally. Millerd (1984) indicates that marginal costs make beneficiaries pay for what they consume and distinguishes among consumers on the basis of differences in service costs resulting in equitable allocation of the resource. Mann (1987) suggests average cost pricing (to recover costs) and marginal cost pricing (to control demand) be integrated in the rate setting process. Mann (1987) advocates the use of average cost to determine specific rate levels for consumer classes or services based on conventional revenue requirements, and the use of marginal cost to construct rate schedules for individual classes or services based on incremental demand costs.

Among the rate structures utilized by communities to encourage water conservation are the following (California Department of Water Resources, 1984d; American Water Works Association, 1981):

1) Uniform Rates. The uniform rate assigns the same unit cost to all water usage, affording some incentive for individual users to conserve.

2) Seasonal Rates. Seasonal rates increase the unit price of water during the peak seasonal use period.

3) Increasing Block Rates. Under this rate structure,

the charge for each unit of water used increases as the customer's use exceeds certain levels for each billing period.

Although the American Water Works Association (1983), California Department of Water Resources (1984c, d), and certain Canadian provinces distribute rate setting guidelines or manuals (Fortin, 1985) several problems constrain the implementation of water conservation oriented rates. Many rate structures are determined solely by cost recovery considerations (Fortin, 1985). Improved rate setting will require educating water managers about the benefits of conservational pricing and provision of feasible rate setting tools which can be easily understood, utilized, and accepted in communities (Grima, 1984; Fortin, 1985).

Sewer Rate Surcharges/Excess Use Charges. The cost of wastewater treatment also affects water usage and must therefore be considered in an analysis of water conservation pricing. McGarry and Brusnighan (1979) state that increased water and sewer rates contributed significantly to reduced residential consumption. Loudon (1984) reports that a combination of metering, increased water rates, and a new sewer rate surcharge, based on cost-averaging resulted in an equitably distributed 33 per cent average reduction in water demand and increased consumer awareness in Durham County, Ontario. Olding (1981) advocates the

inclusion of effluent surcharges in conservation pricing mechanisms as a component in comprehensive water management policy in the Province of Alberta. Griffith (1984) discusses implementation of an excess use charge, incurred by users exceeding a base rate, which has resulted in reducing maximum daily water demand by 12.5 per cent in Fairfax County, Virginia.

Water Conservation Metering. Successful implementation of water pricing structures is dependent on universal metering and concomitant administrative capability. Meters provide the required data for developing, administering and evaluating pricing mechanisms. The effect of water metering on reducing water demand is positive, but the range of reductions achieved varies. Hanus (1974) concluded that non-metered Alberta communities used on average 60 per cent more water than metered communities. Gysi and Lamb (1977) noted that residents in Calgary, Alberta (non-metered) use twice as much water as residents in Edmonton, Alberta (metered). Within the City of Calgary, Thompson (1983) documents a 46 per cent reduction in water use in metered households in comparison to non-metered homes. One study of the effect of metering on residential water use in Boulder, Colorado, determined that internal domestic use decreased 33 per cent and domestic lawn irrigation decreased 55 per cent after metering (Hanke, 1970). In an extensive three

year flow monitoring study in Denver, Colorado metered households were shown to use about 20 per cent less water annually than unmetered households (Brown and Caldwell, 1984). Associated Engineering Services (1980) found water metering to be generally cost-effective for small to medium size Southern Alberta communities based upon the reduced water supply and sewage treatment costs of metered communities compared to non-metered communities in this region.

4. REGULATION COMPONENTS Regulatory mechanisms are required in order to legitimize water conservation programs and provide a legal basis for their enforcement. Mandatory water conservation regulations have proven to be more effective in reducing water consumption than voluntary policies and were perceived as more effective by policy makers (Lee, 1981b). Water use regulations have proven to be an effective water conservation measure. Ashton, Howard-Ferreira, and Bond (1979) cite examples in Washington, D.C. and Westminster, Colorado where ordinances have reduced water use 60 per cent and 20 per cent respectively. Although a variety of regulatory components exist, the most common water conservation ordinances consist of singular or combinatory applications of: 1) water use restrictions, 2) building code and plumbing fixture standards, 3) land use management practices, and 4) policies and incentives.

Water Use Restrictions. Water use restrictions generally consist of local by-laws and ordinances prohibiting water waste or public requests to limit water use. Such procedures are often utilized during water supply crises and usually consist of mandatory, temporary, or voluntary constraints on excessive outdoor water use (e.g. lawn irrigation).

Building Codes/Plumbing Fixture Standards. A common water conservation practice is the requirement or encouragement to install low water use fixtures in new buildings or during retrofit programs. The State of California (California Department of Water Resources, 1984c) has enacted several water conservation laws requiring beneficial water use and installation of water saving plumbing fixtues. Debo and Rogers (1984) in a national survey identified 21 U.S. States as regulating water use in some manner. Water conservation requirements have been instituted in the United States National Standard Plumbing Code (Sawyer, 1984). Seattle, Washington has mandated installation of low-flow showerheads and 13 litre per flush toilets in all new construction (Seattle Water Department, 1986). Goleta County Water District, Californmia, requires the following fixtures in all new construction: insulated hot water pipes, 6 litre per flush toilets, 0.13 litre per second showerheads, 0.13 litre per second residential

faucets, and 50 litre per cycle dishwashers (Goleta County Water Distict, 1985). In new buildings, a 40 to 60 per cent water saving is technically possible with modest-cost plumbing and building code amendments (Ashton, 1981). The Canadian Standards Association (CSA) has certified a water conserving water closet (13.25 litre per flush) but similar standards for other plumbing fixtures, notably showerheads, do not yet exist (Robinson and Anderson, 1985).

Land Use Management. Water conserving land use management seeks to more efficiently utilize existing water supplies through balanced municipal development. The challenge is to develop alternative land use policies and programs compatible with limited water supplies. A common approach to this problem is to restrict the service area through mechanisms such as building codes and zoning ordinances (Wiley, 1983). While this serves to extend the water supply, it also limits development and restricts addition of new users. Balancing these concerns requires an integration of water supply planning and land use planning in determining the optimal utilization of regional water and land resources. Water conservation options can contribute significantly to extending water supplies and planning horizons facilitating formulation of policies and plans which reflect appropriate municipal development levels in relation to available water supplies (Meyer, et al., 1978;

Ashton, 1981; Ashton and Langfeld, 1982; Ashton and Bayer, 1983, 1985). For example, Ashton (1981) estimates that with a 20 to 30 per cent reduction in residential water use in 13 urban centres in and around Calgary, up to 317,600 people or 55 per cent of the projected growth to the year 2006 could be accommodated.

Policies and Incentives. Policy initiatives and incentives are commonly utilized to manage, finance, and regulate water use activities. Water conservation policies generally correspond to: 1) direct financial rebates, 2) promotion of information and education activities to create awareness of and encourage consumers to recoup water expenses through adoption of conservation practices, or 3) conditional requirements for financial and technical assistance. Direct cash rebates have been advocated for connection fees based on meeting specified water conservation criteria (Robinson and Benninger, 1983). Assuming that saving money is one of the best incentives to conserve water, promotion of water conservation behavior, practices, and devices have proven to be an effective water use reduction policy measure (Denver Water Department, 1986). Sawyer (1984) has documented several examples of United States federal and state water supply and wastewater treatment facility funding and technical assistance programs which are conditional upon integration of cost-effective water conservation measures in the project proposal.

SUMMARY

Several changes are occurring in the water conservation field. The spectre of regional water shortages, increasing water demands, and rising costs of providing adequate supplies are placing burgeoning pressure on water resources. As a result, water conservation management capacity building is receiving increasing attention as a component in comprehensive water resource management policy. Water conservation management research has documented the need to consider water conservation; the expected water savings, benefits and cost-effectiveness of various water conservation measures have been better substantiated; and guidelines are emerging for the development and implementation of water conservation programs. A significant water conservation management information resource base is accumulating. Water conservation management programs generally consist of some combination of education and information components, technical components, pricing and metering components, and regulatory components; with the majority of programs being based upon residential retrofit programs aimed at reducing household water demand.

Water conservation management is emerging from a research and development phase into an information dissemination and utilization phase. Improved water

conservation management capacity building will require increased awareness of water conservation options, improved access to information, and development of local and institutional capabilities to identify, adapt and implement conservation strategies appropriate to local contexts.

APPENDIX B

INTERVIEW SCHEDULE

APPENDIX B

INTERVIEW SCHEDULE

1. PROBLEM ANTICIPATION/INFLUENCE CHANGE

1.1 How and why was water conservation determined to be a feasible solution to the water shortage problem?

- source of ideas?
- workshops"
- what factors influenced the decision (environment; economy; development)?

1.2 What objectives did the water conservation program hope to achieve?

1.3 What types of assistance were needed to identify problem parameters and alternative solutions?

1.4 What sources of assistance were used to identify the problem and potential solutions?

- government agencies
- regional planning commission
- university extension services
- consultants

1.5 What mechanisms were utilized to obtain assistance?

- personal contacts
- meetings/workshops
- existing programs
- manuals

1.6 What were the constraints/barriers to this process?

1.7 How could this phase of the project be improved?

2. DEVELOP POLICY

2.1 Was there a perceived need for water conservation management policy?

2.2 What policy elements were established?

2.3 What were policy decisions based upon?

2.4 What assistance was required in policy development?

2.5 What were the sources of assistance?

2.6 What mechanisms provided access to policy assistance?

- exemplary programs
- external technical assistance

2.7 What were the main constraints/barriers to policy development?

2.8 How could the policy development process be improved?

3. DEVELOP PROGRAMS TO IMPLEMENT POLICY

3.1 What elements constituted the water conservation program?
A) education
B) pricing/metering
C) technical
D) regulative
E) other

3.2 Did the program adequately reflect policy? Explain.

3.3 What types of assistance were needed in developing the water conservation program?

- technical
- financial
- program information
- legal
- other

3.4 What were the sources of assistance?

- individuals
- government agencies
- resource materials

3.5 Was the assistance provided useful?

3.6 What mechanisms were used to obtain assistance?

- personal communication
- workshops
- reports/studies

3.7 What barriers constrained program development?

3.8 How could the program development process be improved?

4. ATTRACT AND ABSORB RESOURCES

4.1 What were the major resource needs relating to this project?

4.2 What were the major resource systems that provided assistance?

4.3 Did resources exist relative to needs?

4.4 Were there appropriate linkages to access the resource systems? Describe.

4.5 Was the community able to communicate its resource needs effectively to the resource systems? Could resource systems understand community needs?

4.6 Were the resource systems receptive to providing assistance? Was long-term assistance available?

4.7 Were the resources usable? Was the community able to absorb or utilize them?

4.8 Were any changes in the community system necessary to absorb the resources?

- personnel
- new positions
- organizational changes
- structural changes
- administrative changes

4.9 What were the main barriers to obtaining and using resources?

4.10 How could the process of obtaining and using resources be improved?

5. MANAGE RESOURCES (PROGRAM OPERATION)

5.1 What were the management operation needs related to this project?

- personnel; finance; time; information?

5.2 What assistance was available to meet these needs?

5.3 What were the barriers to developing management operations?

5.4 How could program management be improved?

6. EVALUATION OF CURRENT ACTIVITIES TO GUIDE FUTURE DECISIONS

6.1 How was the project evaluated?
- criteria?
- was assistance required? source?

6.2 How well did the project meet it's objectives?

6.3 What is the current level of program activity? Describe.

6.4 What has been learned from this project that could be applied to guide future water conservation management activity?