CHAPTER FIVE : MANAGING GROUNDWATER RESOURCES IN SUSSEX COUNTY

In this chapter lies the foundation for the groundwater management process that this manual embodies. The first four chapters have endeavored to provide background information and present a rough quantification of groundwater resources in Sussex County as well as define the need for groundwater management and protection. This chapter will group the "critical" aquifers into three management categories according to their sensitivity to development. These are delineated on the Groundwater Management Area Map at the end of the document. Finally, an example will be illustrated for applying and implementing the groundwater management concepts to a hypothetical municipality.

Classification System

For the purposes of this manual, the greatest weight or consideration for groundwater management and protection has been given to the most productive and potentially productive aquifers which are also, due to their nature, highly susceptible to contamination. This approach has been taken in light of the degree/extent of consequences that mismanagement of these systems would have on the overall water supply capabilities in the County over the long term. This does not mean that other formations not listed in Levels I through III (eg. Martinsburg shale or Pre-cambrian crystallines) are exempt from the need to be managed from the point of view of groundwater supply or contamination. On the contrary, these formations, although mainly low yielding, are often the sole available source of water supply in many areas of the County and are easily subject to contamination through mismanagement. Although the impact would be soemewhat localized, this does not preclude these areas from concern nor does it de-emphasize their importance to those individuals that depend upon them. (Please refer to the Carrying Capacity Manual prepared by this agency).

Each of the aquifer types described and delineated in Chapter Four have distinctive characteristics which provide the basis for categorization. The most obvious distinction that can be made is between stratified drift and rock aquifers. At the on-set it can be assumed that all Kittatinny Limestone for example should have the highest level of protection, as it is extremely difficult to pinpoint exact locations of members with high water holding capacity or to decipher the complex patterns of water movement within the rock. Therefore, the real differentiation in categories will occur among the stratified drift formations and between limestone and other consolidated rock aquifers.

The classification of the stratified drift aquifers is based on the degree to which they are susceptible to groundwater contamination and their capability to yield large amounts of water. (See Table VII). The major aquifers and associated minor aquifers are grouped in Level 1, and assigned the highest degree of stringency, as is the Kittatinny Limestone and its recharge areas. Because the isolated minor aquifers are not hydraulically connected to aquifers of thicker sands and gravels, the measures needed to protect them are not as stringent as those for Level I areas. Therefore, isolated minors comprise the areas classified as Level II. Level III

areas are those suspected of possibly containing confined stratified drift deposits of high yield. Because these areas are confined under a layer of impermeable material they are relatively shielded from contamination, and thus are assigned to Level III groundwater management areas*.

As a general note, recharge areas for stratified drift aquifers can be assumed to be located directly above them, as they are porous formations. Recharge areas for carbonate aquifers, however, may not lie directly over them, but may very likely be some distance away and connected through hydraulic gradients. For this reason, it is possible that not all carbonate aquifer recharge areas appear on the Groundwater Management Map and therefore the need for site specific analysis remains.

The following section will discuss land use and its application to critical groundwater areas. It will then match various land uses to the three groundwater management areas (GMA's) described above.

*NOTE: Under heavy development of a prime, semi confined aquifer, recharge can be induced on a greater scale through pumping. Protection by the confining layer is then reduced under pumping conditions.

TABLE VII

CLASSIFICATION OF GROUNDWATER MANAGEMENT AREAS

LEVEL I (highest stringency)

Members of Kittatinny Formation and related critical recharge areas

Major and Minor Unconfined Stratified Drift deposits of very high and high risk of contamination and related critical recharge areas

Critical recharge areas of possible confined aquifers of high yield

LEVEL II (second degree of stringency)

Isolated minor aquifers of moderate risk of contamination and related recharge areas

LEVEL III (Lowest degree of stringency)

Possible confined aquifers of high yield

LAND USE COMPATIBILITY WITH

GROUNDWATER MANAGEMENT AREAS

Determinations of land use in municipalities has traditionally been based on property values, available road networks and circulation patterns, and established residential settlement behavior. Until recently environmental attributes have had little influence other than through matters of an aesthetic nature and the notion of letting the characteristics of the land dictate the use to which it is put. An environmental attribute which warrants most careful consideration in Sussex County, but which is usually the least visible, is the presence of large quantities of high quality groundwater. The subsequent discussion will center on land uses as they relate to areas critical to the management of groundwater quality and quantity. The discussion will begin by explaining the objective of maintaining the preconstruction water budget. It will then outline some land uses which are incompatible in "critical areas", due to possible degradation of groundwater systems. A general description of land uses which would be most and least suitable on these areas follows. Residential, commercial, industrial, agricultural, and recreational land use categories will be broken down into their components and discussed based on groundwater management criteria. Finally, the appropriatness of various land uses will be discussed as they apply to the three levels of groundwater management delineated for critical areas in Sussex County.

Maintenance of the Pre-construction Water Budget:

The prime objective of managing the use of critical areas is to maintain the quality and quantity of the water in the aquifers. Some land uses require more attention to maintaining the recharge levels than others. For example, critical areas which are used for passive recreation will be marginally affected, while careful attention to the treatment and flow of stormwater runoff will be necessary where residential, commercial, and industrial development is considered. It is possible to direct the runoff created by impervious surfaces back into the ground via recharge basins, porous pavements, and roof collection systems (see BMP Fact Sheets). These recharge methods should be incorporated into the subdivision/site plan requirements for development lying within groundwater management areas. A regulatory device which ensures the proper installation and operation of these structural recharge aids is the property maintenance code. Although property maintenance codes are commonly used to prevent the deterioration of the housing stock of a municipality, the concept might be adaptable to the maintenance of the groundwater supply as well.

Incompatible Activities (In Critical Areas):

Certain activities are totally incongruous with land which hosts large quantities of high quality groundwater or those areas which serve to replenish these sources. Groundwater which is held in stratified drift deposits of sand and gravel is particularly vulnerable to activities which occur at ground level. These injurious activities can be categorized as follows:

A. Introduction of hazardous substances into surface soil horizons

B. Extensive disturbance or removal of surface soil horizons

C. Installation of storage tanks, large underground pipelines, or similar structures deep in surface or subsurface soil horizons

D. The manufacture or use in manufacturing and subsequent disposal of any substance which cannot be rendered harmless to groundwater through natural processes (e.g. bio-degradation)

A) In areas critical to groundwater management, the components of the surface soil horizons will ultimately affect the amount and composition of the gravitational water which moves toward the water-table. It is of paramount importance, therefore, to prevent any substance that has a potential for degrading the existing quality of the underlying groundwater from entering the soil environment.

B) Unfortunately, stratified drift deposits of sand and gravel as well as limestone deposits are valued not only for their water holding capabilities, but as commodities to be extracted, packaged in different forms, and sold on the open market. The cause for concern lies in the critical role that the surface soil overburden plays in screening out most harmfull substances before they can gravitate toward the saturated areas. When this overburden is removed to gain access to the sand, gravel, or limestone, there is nothing to stop waterborne pollutants from flowing directly into areas of groundwater below. A determination of how much, if any, surface mining can be tolerated in areas of stratified drift and Kittatinny limestone without degrading groundwater quality is needed based on a widely applicable criteria.

C) As one must exercise caution in removing the protective soil overburden in order to extract marketable materials, it is also a threat to groundwater to bury structures beneath the overburden especially in areas which are conducive to high water storage and/or recharge. As an example, underground storage tanks used for storing substances such as oil or gasoline are often constructed of tar-coated steel and are prone to corrosion. Fiberglass tanks, introduced in the early 1960's do not corrode, but may crack under cold temperatures or excessive surface loads.[25] The

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25. *The New Jersey Pinelands Comprehensive Management Plan, State of New Jersey Pinelands Commission, Adopted November 21, 1980, pg. 16.*

potential danger presented by the leakage of hazardous substances directly into porous materials or limestone solution cavities is obvious and the possibility of that event occurring should be prevented.

D) Industries which produce harmful substances which do not break down biologically or otherwise (e.g. organics, such as tetrachlorethylene) or which uses such substances to manufacture or refine a product, should be prevented from locating in critical groundwater management areas. The rationale for excluding these substances from areas where contact with groundwater is possible is the porous nature of the surface and subsurface soil horizons which have minimal adsorption capabilities. The contaminants if introduced into the ground, would therefore travel at a rapid rate and even very small quantities, released accidentally or through carelessness, could cause immediate and lasting degradation of groundwater quality. These substances are dangerous at very low concentrations.

Best Utilization of Critical Areas:

The ideal condition for the future of the most critical areas would be their preservation in an undeveloped state. However, in an urbanizing state with limited land area available for growth, the economic pressures on undeveloped land exert a force on local landowners and governments which is usually too great to resist for long. Therefore, realistic compromises to total preservation or total development are needed. Some ideas for the use of critical areas follow in order of decreasing desirability:

A. Parks, fish and game preserves

B. Agriculture and silviculture

C. Low-density Residential

D. Commercial

E. Light Industrial

A. Parks and preserves are the ideal use which could be applied to critical areas. Preserves and other passive recreation areas are the most ideal, as they involve no real disturbance of natural vegetative cover and the components of the hydrologic cycle remain essentially unaltered. Parks, ball fields and most forms of outdoor recreation have small percentages of impervious surfaces relative to other land use types and little requirement for subsurface disposal of waste.

There are several ways in which this use of critical areas can be encouraged in Sussex County. Areas proximate to state and federal park lands might be aquired and incorporated into the system. In addition, the county park system, which should include lands well distributed throughout the county and close to population centers, can always be expanded to include many

acres of critical groundwater areas. Although the aquisition of land for parks in a county with so much open space may not seem prudent at present, it will prove a good investment when future demands on land force property values to soar and the recreational needs of a swelling population become more pronounced. Many municipalities have their own park systems and could adopt the same strategy for incorporating critical areas as was suggested for the county. It is conceivable that municipal boards of education might include critical areas as candidates for aquisition as part of their efforts to provide for the recreational needs of primary and secondary school children.

B) The use of critical areas for agricultural or silvicultural operations, although involving various degrees of surface soil disturbance, does minimize the amount of impervious surface needed on the land. The greatest concern from a groundwater management perspective is that proper BMP's be applied to prevent contamination from these activities (see BMP section).

C) Residential uses may be accommodated in critical areas depending on type, density, and methods of wastewater treatment. The various types of residential development involve different percentages of impervious surfaces. Therefore, certain residential development is more suitable for location in critical areas than others, just as some less critical areas are more able to support housing configurations with higher associated impervious surface ratios. Along with the percentage of impervious surface coverage, the insulation of the groundwater from residential wastewater is the crucial consideration. Strict guidelines should be laid down detailing domestic wastewater systems and periodic inspections to insure proper operation should be required if possible.

D) Certain commercial uses may be harmless in critical areas if not concentrated into a confined area. Some commercial types (convienence stores, liquor stores, small restaurants, etc.) may easily be integrated into residential developments and largely or wholly be supported by their inhabitants. Similar concerns for impervious surface cover and on-site wastewater disposal/ treatment pertain to commercial development as for residential development, and in cases where the two land uses are mixed (e.g. Planned Unit Developments (P.U.D.'s)), a reduction in the amount of paved surface area and number of waste water systems needed may be achieved through staggered use.

E) Most industry, as a rule, should be discouraged in critical areas. There are certain types of light industry which may be accommodated in critical areas, depending on the materials which they handle/produce, the amount of impervious surface cover and the degree to which the runoff from impervious cover (e.g. roof, and parking lots) is directed into the soil to recharge. Office/ research complexes, depending on the chemicals used in the

research, can be an acceptable use of critical areas. They often feature areas of landscaped or natural open space and may actually enhance the appearance of some critical areas while still maintaining most or all of the recharge.

Land Use Description:

Among the general forms of land use; agricultural, residential, commercial, industrial, and recreational, there are many varieties. General characteristics of these varieties and their groundwater relationships will now be outlined.

Agricultural:

The typical types of agriculture found in Sussex County can be summarized in the following manner:

A. Family Truck Farms

B. Inactive Farms or farms that are leased

C. Large Dairy/Crop Operation

D. Tree Farms (including nurseries)

E. Livestock Operations (Cow-horse-pig-sheep)

F. Poultry Farms

A) Family truck farms can be described as large vegetable gardens which yield enough vegetables to allow the family to sell the surplus in order to support itself. These operations usually range from between 10 and 50 acres in size and typically do not use high technology methods or machinery. Because of the small scale nature of these farms, the effective management of stormwater can be achieved with relative ease. Standard cultivation practices such as conservation cropping and tillage systems would be the BMP's most applicable to operations of this size. (See BMP section)

B) Gentlemen Farmers are usually individuals who own large farms but whose full time occupation is something other than farming. Sometimes managers are hired to operate and oversee the farm, or certain parcels are leased but most often the farms are not worked at all and serve mainly as country retreats. Because the land is left idle and undisturbed, natural water cycle patterns are unaltered and thus there is minimal danger to groundwater.

C) The predominant type of farming which occurs in Sussex County is a combination of dairy and crop farming which involves large amounts of land and fairly sophisticated technology. It is in operations of this magnitude that the full range of BMP's for agriculture should be applied to minimize the impact of pollution from stormwater runoff.

D) Tree farming and harvesting is a significant agricultural activity in Sussex County. Such silvicultural operations should not present a threat to groundwater if common sense BMP's are incorporated into standard operating procedures.

E) Livestock operations can be found in Sussex County, though not nearly of the scale typical of the vast midwest feedlots which generate unmanageable amounts of animal waste. To the degree that beef and other livestock is raised locally, practices such as controlling animal location through fencing (to keep them away from waterways), proper waste reclamation and storage, and the interception of stormwater runoff from areas where animals are yarded, can minimize contaminants from animal wastewater entering groundwater.

F) Though little poultry farming is done in Sussex County relative to other types of farming, similar practices can be used for them as were recommended for large livestock operations.

Residential:

Residential land use consists of many types and arrangements of shelter. The variations range from the large estate on acres of land to the high-rise apartment building. The housing varieties that have the most potential for groundwater management in Sussex County are:

A. Single Family Attached/detached

B. Lot line house

C. Duplex

D. Townhouse

E. Multiplex

F. Garden Apartment

G. Manufactured Housing

A) The single family home has been the traditional American living unit since the end of World War II, when the Farmers Home Administration offered low interest mortgages in order to satiate the housing demand created by returning veterans. Single family homes are usually sited on lots of a quarter acre or more and are normally centered on the lot with large front and rear yards and narrow side yards. Single family homes can occur in any of the arrangements A through F, but in its common location in standard

subdivisions its impervious surface ratio is .16.[26] It is also common practice in standard subdivisions to clear the entire lot prior to construction, producing an open space ratio of .00.

Single family housing may also be attached in several ways to reduce impervious surfaces and heating costs, as well as lot size. The most significant advantage of these attached single family varieties is the percentage of the site that can be left as undisturbed open space.

B) The lot-line house is a variation of the detached single family unit theme. They are detached units which are sited flush against one of the side lot lines. This novel concept not only makes side yards usable, but because of its orientation away from the street, all but eliminates the need for a front yard, which is rarely used anyway. The end result is a net reduction in the amount of land required, thus permitting an open space ratio of .55. Lot-line designs occur in arrangements C through F.

C) The traditional duplex is a large two story structure which is divided into two living units either horizontally or vertically. The two units are served by separate entrances, but share the same service area. The "twin" house is a modern adaptation of a duplex where the two units have evolved into distinct entities unto themselves even though they share a common wall. When situated on a site with separate lots the duplex house or twin house configuration covers about 13% of the site with impervious surfaces, but allows for 72% of undisturbed open space. This housing type occurs primarily in arrangements C through F, although duplexes can often be found in older towns where they are separated by narrow drives or alleyways.

D) The Townhouse is a modern version of the "row" house, common to the fringe communities of large cities. Although the overall effect of the two forms is similar, distinctions between them are rather significant. Row houses were built as single units albeit so close together as to appear connected. Because of rigid front and rear yard set-back requirements, they were forced into long straight rows (thus its name). Conversely, townhouses share common side walls and are therefore built as one structure. The set-back requirements are flexible, allowing the units to be off-set in varied configurations. This minor innovation has a very

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26. The source for all figures for impervious surface and open space ratios were taken from Performance Zoning, by Lane Kendig et.al., published by the APA Press. Impervious surface ratios were derived using a sample site and dividing the various square footages of impervious surfaces for each housing type by the entire area of the site.

significant effect in breaking up the monotony of long straight rows while simultaneously creating small semi-enclosed spaces which allow for the increased personalization of the exteriors. The increased density facilitated by this housing form allows for an impervious surface ratio of .08, and thus an open space ratio of .85. Townhouses occur in arrangements D through F.

E) The multiplex can be described as a cross between the duplex and the townhouse. It can be designed as either a single family attached unit or a multifamily unit. There are several configurations available with the multiplex unit. They can be arranged in a row, attached back to back with each unit the corner of a square, or with some units on the first floor and some on the second. Access may be either individual or by shared outside entrance. Units may be either owned or rented. The multiplex has an impervious surface ratio of .11 and leaves nearly 82% of the site in common open space. They are most often used as components in P.R.D.'s and P.U.D.'s.

F) The garden apartment is a multifamily unit. Access is from the outside and is shared by two or more units. This unit type may be either rented or owned (condominium). The typical garden apartment structure is two stories high and can be arranged in a variety of configurations. Although this type of housing is very often found homogeneously in multifamily zones, (usually as close to neighboring townships as possible) it is becoming more frequently used as a member of heterogeneous housing developments. Because of the attractiveness of a well designed development with mixed housing types, the poor image that garden apartments have had in the eyes of local officials and residents has improved markedly.

G) An alternative for shelter which has a sales rate that has increased as fast as the interest rates on home mortgages is the manufactured home. A manufactured home refers to any residential structure that is constructed either entirely or modularly in a factory and assembled at the site. The most familiar form of manufactured housing is, of course, the mobile home, although modular homes are gaining popularity as well. Mobile homes, because of the trailer park stigma attached to them, have been treated by local ordinances as second class housing at best and more often not as houses at all but as vehicles. The mobile home industry, largely due to strict federal construction code specifications, has made great strides to constantly improve its product. The result is a wide range of sizes and styles targeted toward the lower and lower-middle income segment of the housing market; a segment which represents the majority of Americans. The limitation of the manufactured home has not been its availability, however, but finding a place to put it. The mobile home has been relegated to mobile home parks by local ordinances, which base their reasoning on the notion that it is temporary or transitory housing. It is highly unusual, however, that the modern mobile home be moved during its entire life span other than from the factory to its first site.

Other complications stemming mainly from disagreement over the mobile home's identity as something between vehicle and permanent home, make it difficult to evaluate it on the same basis as the standard site-built housing types previously discussed.

The housing varieties discussed above may be arranged in numerous fashions including:

A. Isolated parcels

B. Standard subdivisions

C. Cluster subdivisions

D. Planned Developments

E. Planned Residential Developments

F. Planned Unit Developments

A) Housing still occurs on isolated parcels in rural areas where the pressures of migration and development have yet to manifest themselves in the form of large subdivisions. The common unit type to be found on isolated parcels is the conventional single family house, (although the manufactured single family unit does appear, especially in poorer rural areas).

B) The standard subdivision is still status quo in current residential development, although alternatives to and improvements on this "rubber stamp" kind of housing arrangement have been gaining acceptance in recent years. A subdivision is characterized by a completely cleared site, although often done incrementally lot by lot as homes are being constructed. Generally, 100% of the site is subdivided into lots and there is no common open space. Lot sizes vary depending on the size and nature of the units being sited on them. Conventional single family units are most prevalent in standard subdivision arrangements, although other types such as manufactured housing have begun to be designed as subdivisions rather than parks.

C) The cluster subdivision concept is based on the premise that a site can be more efficiently developed and utilized if the same number of units are located closer together on smaller lots and the remainder of the site left as common open space. The resulting cost of site development is lower because less of the site requires clearing. The cost of providing roads and utilities is also lower because of the concentration of the units.

D) Planned Developments (PD's) take the concept of clustering one step further by incorporating a number of clustered areas into a comprehensive design for a large site. The clustered areas, which take on the character of small neighborhoods, are connected by

corridors of common open space, often containing a network of bike and walk ways. Planned developments usually involve only one housing type, typically single family or town house, and often will feature a community center or recreational area.

E) The Planned Residential Development (PRD) is a further elaboration of the P.D. in that it integrates two or more housing types into one cohesive design for one large site. The same features characteristic of the P.D. are components of the P.R.D. In addition, however, the P.R.D. may have provisions for an elementary school to accommodate expected school age children from the development. It is common practice for the developer to donate land for the school to the municipality where the P.R.D. is located.

F) The P.U.D. is a PRD with the added dimension of mixed land use. In other words, some neighborhood commercial uses, such as convienence stores, bank branch offices, and pharmacies, as well as some professional office use, such as doctors, dentists, and real estate offices are integrated with the residential neighborhoods. Sometimes the commercial uses are separated within the P.U.D. and placed either in a central part of the site or at the entrance along a major collector road. Occasionally the stores will be included right in the individual neighborhoods, on the ground floors with apartments above them. A local example of a P.U.D. is Panther Valley, which is located on Route 517 in Hackettstown.

Land Use and Water Quality

Residential

When making determinations of which housing types and arrangements to apply to critical areas the object is to come up with a layout where roads and other impervious surfaces do not interfere with natural drainage on the site but compliment it as much as possible. The most sensitive groundwater areas on the site should be identified and incorporated into the undisturbed open space systems as well as any flowing or standing surface water on the site.

Another consideration in choosing housing types and arrangements is the way wastewater will be handled. For single family detached homes on individual lots, the cummulative effect of their septic systems must not surpass the ability of the soil and groundwater to assimilate the wastewater.[27] For clustered arrangements of various housing units on small lots a wastewater treatment system that serves groups of units would be most practical. In Sussex County such a group

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27. *For a more detailed discussion of this concept see the discussion of the dilution model developed in Environmentally Based Growth Management - The Carrying Capacity Approach in Sussex County; a manual developed by the Sussex County 208 Water Quality Management/ Planning Department.*

oriented system would most likely be a cluster type septic system. In order to guarantee the maintenance of groundwater quality in critical areas, these cluster systems would have to be capable of at least a primary treatment process before their release of wastewater into the soil environment at such a magnified volume. Such systems should have adequate storage capacity to enable the timed discharge of wastewater so that the assimilative capacity of the soil and groundwater system is not exceeded.

Commercial

The typical types of commercial uses found in Sussex County can be summarized in the following manner:

A. Central Business District (CBD)

B. Neighborhood Business

C. Strip Commercial

D. Resort Commercial

E. Rural Roadside

A) CBD's in Sussex County are characterized mainly by service establishments which cater to the lunch hour or daytime shopper. Examples of such establishments are restaurants, delicatessens, hardware stores, liquor stores, hair salons, banks, etc.

B) The neighborhood business is typically the family run franchise of a popular convenience store, the small discount grocery store, the laundramat, the pizzaria, or sometimes even a supermarket. These establishments are almost entirely supported by the neighborhood in which they are located.

C) Strip commercial development usually includes fast food chains, supermarkets, branch offices of banks and real estate agencies, and large discount department stores. It occurs along major arteries and its market is targeted at the through traveler. As such, these establishments are geared to the automobile and therefore require large parking areas or drive through accommodations to encourage rapid customer turnover. Routes 206 and 23 in Sussex County are currently experiencing this kind of commercial development which has occured in clusters that are gradually expanding towards each other.

D) Resort commercial establishments are usually novelty shops, exclusive boutiques, lodging, and eating establishments targeted towards seasonal residents and tourists. As a result, many of these establishments are seasonal as well. In some cases such as the Cobblestone Village in Vernon, there is a year round tourist trade attracted to the Vernon Valley Ski Area and the Action Park which supports the shops and restaurants.

E) Rural roadside businesses are still prevelent, especially along the prominent county roads. Most of these road stands sell fruits and vegetables grown on adjacent farms. Some mobile roadside concession stands operate on roads in Sussex County, and in some places antique dealers can be found.

Industrial

Industry is defined as a branch of productive enterprise or large scale business activity[28]. Industrial uses in Sussex County can be summarized as follows:

A. Manufacturing

B. Construction

C. Mining Resource Extraction, Refining

D. Retail Trade

E. Storage/Distribution

F. Services

G. Transportation

A) The manufacturing industry covers an extremely wide range of products and systems. In general, a manufacturing plant takes a number of raw materials and combines, shapes, and refines them into a finished product. These finished products may either enter the marketplace as a commodity or be assembled along with other products into a secondary commodity. The processing and/or packaging of items is considered part of the manufacturing industry as is large scale storage and distribution of marketable commodities.

The types of manufacturing industry found in Sussex County include:

1. Apparel
2. Chemical
3. Fabricated Metal Products
4. Food and Kindred Products
5. Furniture and Fixtures
6. Lumber and Wood Products
7. Machinery
8. Paper Products
9. Rubber and Plastics
10. Stone, Clay, and Glass Products

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28. Webster's New World Dictionary, (New York: World Publishing Corp. 1970), page 719.

B) The construction industry includes not only building construction, but allied construction trades as well. These trades include road construction, general masonry, electrical contracting, excavation, etc.

C) A significant and long established industry in Sussex County is that which involves resource extraction, processing and refining. Examples of this industry include, metal extraction, surface mining, and petroleum refining.

D) The retail trade industry is related to commercial uses in concept in that it involves the sale of finished products both to other industries or to the general public. These products do not fit into the commercial types outlined earlier, however, as they include items such as fuel oil, machinery, contruction materials, farm supplies, etc.

E) An important industry which represents the link between the manufacturing industry and the retail trade industry is the storage and distribution industry. The storage component involves warehousing firms and the distribution component involves trucking firms. There are no large representatives of the former in Sussex County, but several of the later.

F) The service industry emerged as a support industry to the other primary industries. Service industries include advertising, maintenance, entertainment, information processing, waste collection and disposal, etc. All of these services, and many more, are available in Sussex County.

G) The transportation industry is fairly self explanatory, but can be defined as the movement of goods and services. In Sussex County there is no rail service at present, so the transportation industry is limited to trucking and bus lines.

Recreational

Recreational land uses, as described earlier in the section discussing land use compatibility with groundwater management areas, consist generally of active and passive recreation. Sussex County is rich in passive recreational land as the Delaware Water Gap National Recreation Area, Stokes and High Point State Forests, and Wawayanda and Swartswood State Parks occupy vast acreages and other smaller state and federal parks are scattered around the County. Opportunities for active recreation such as organized sports, water sports, and winter sports are limited to school systems, private lakes and lakes in state parks, and commercial resorts. Other than school facilities there is comparatively little county or municipal park land set aside in Sussex County due to the large amount of land in state and federal parks.

Suitability of Land Uses To Sussex County Groundwater Management Areas

As described in an earlier section, critical groundwater areas in Sussex County have been divided into three recommended levels of stringency. The section to follow will suggest a guideline and methodology for the application of the various land uses to these groundwater management areas.

Level I

Groundwater management areas which fall into this category (represented in purple and all hashed areas on the Groundwater Management Map) are the most sensitive to contamination from the various sources mentioned during the course of this text. Therefore other than land uses such as parks and preserves which allow the land to remain in its natural state, the development of these Level I areas should be restricted to the least harmful of any land use and even then should be permitted only when compliance with stipulations geared toward preserving water quality is ensured.

A suggested approach towards achieving this end follows below: All land uses besides those listed below should be prohibited.

1. Agriculture/Silviculture - Cultivation and harvesting on Level I lands should be permitted conditioned on the strict application of all pertinent Best Management Practices. An enforcement strategy to ensure compliance is essential.

2. Office/Research - a development of this type would be limited to operations which do not involve the use or disposal of harmful chemicals involved with or supporting laboratory research. (See pg. 70 (E)). In addition, site plan requirements should specify that the artificial recharge devices used to maintain the pre-construction water budget be shown and detailed in the working drawings.

3. Residential - Because residential development in Sussex County is for the most part married to on-site wastewater treatment, the safest and simplest method of preventing the degradation of groundwater by wastewater is to only permit single family detached dwellings on lots large enough to provide for the necessary dilution and adsorption of harmful elements. (See Sussex County Carrying Capacity Manual). BMP's such as street sweeping, catch basin cleaning, and general stormwater and erosion control should be implemented in these areas as well.

Level II

Groundwater management areas which fall into this category (represented in dark blue on the Groundwater Management Map) could accommodate any of the land uses suggested for Level I plus the following recommended uses:

1. Residential - Cluster subdivisions, P.D.'s, P.R.D.'s, and P.U.D.'s may be permitted conditioned on the establishment of parameters regarding percentages of open space required relative densities of allowable housing types, site plan specifications for stormwater control retention devices, and on-site wastewater treatment. The safe removal of solid waste from the area will also become a factor due to the increased densities.

   If P.U.D.'s are to be a permitted use in Level II areas, guidelines as to the kinds of commercial establishments that could be allowed in the PUD should be promulgated based first on their possible effect on groundwater quality, and then on their relative effects on the local economy. The suggested procedure is as follows:

   A. Calculate housing density based on groundwater management parameters.

   B. Calculate expected population generated by the PUD and breakdown into age groups.

   C. Determine market demand generated by the expected population (Supportive capacity).

   D. Determine the capability of local commerce to service the market demand.

   E. Determine additional commercial types needed to be incorporated into the PUD to satisfy demand.

   F. Of the additional commercial types needed, determine suitability for location in Level II groundwater management area.

   G. Program suitable commercial types into design.

Level III

Groundwater management areas that fall into this category (represented in aquamarine on the Groundwater Management Map) require the least amount of protection but deserve consideration because of the possible confined groundwater pockets of high yield potential that lie within the deeper subsurface strata. For that reason, the recommendation here is that the land uses with their associated conditions that were outlined for Level I and Level II be permitted uses in Level III areas. The following land uses should not be permitted:

1. Industry which uses or generates hazardous or toxic materials

2. Resource Extraction or Processing Industries

3. Landfills

4. Chemical Dumping or Storage Activities

5. Industrial Waste Lagoons

6. Hazardous Waste Disposal Sites

7. Commercial establishments using organic chemicals (e.g. dry cleaners, printing shops or other toxic or hazardous materials)

8. Pipelines and/or tanks which carry and store petroleum products and other chemicals

After applying the previously described GMA concepts into a master plan and translating them onto a zoning map, certain alterations in zoning will probably occur in most municipalities. The next section offers a hypothetical example of this application.

Zoned areas that are unaltered after applying GMA concepts will more than likely also require some re-examination since the inception of groundwater management into municipal master plans and development regulations will set the stage for a more comprehensive growth management strategy and scheme.

New considerations for areas not in GMA's may and should arise with an overall objective of providing balanced fiscal growth within the municipality and properly managing infrastructural aspects.

The following section will present groundwater management guidelines patterned after ongoing programs being conducted by regional agencies in the United States. It will then apply the ordinance to an actual situation in order to walk the user through the process.

SUGGESTED GROUNDWATER MANAGEMENT GUIDELINES

I. Purpose

In order to protect and preserve the quality and quantity of the groundwater resources of a municipality, thereby ensuring the availability of clean, safe, potable water for its present and future residents.

II. Definitions

A. Aquifer - An underground layer of porous rock, sand, etc. containing water, into which wells can be sunk.

B. Attached - A connection of two or more dwelling units, whether it be by an extension of the roof line, by a common garage, or some other means.

C. Critical Recharge Area - Any area of land which permits access of precipitation to an aquifer to a degree which is vital to the natural groundwater budget.

D. Cluster Septic System - An on site, though not necessarily "on-lot" wastewater treatment facility which serves more than one unit

E. Density - The number of dwelling units per acre of land.

F. Development - An arrangement of newly constructed residential dwelling units, and/or commercial structures, and/or industrial or office plants.

G. Groundwater - Water which has collected and is held in soil or rock below the surface and which may be available for withdrawal.

H. Groundwater Budget - The balance of water which is naturally maintained in an aquifer after compensating losses and recharge.

I. Hazardous Substance - Any waste or combination of wastes which alone or in relation with other substances pose a present or potential threat to human health, living organisms or the environment, including but not limited to waste material that is toxic, carcinogenic, corrosive, irritating sensitizing, biologically infectious or flammable, and any waste so designated by the United States Environmental Protection Agency.

III. Establishment of Groundwater Management Areas

The municipality should establish Groundwater Management Areas (GMA's) which should be delineated on the official zoning map of the township. The GMA's will be based on the locations of stratified drift deposits, carbonate rock aquifers and critical recharge areas.

It should also be established that wherever a GMA lies within the same area as a previously established land use zone, the regulations of the GMA shall prevail where they diverge from the existing regulations for that zone. All BMP's for respective uses (see BMP section) should be exercised in all 3 GMA's.

Level I GMA

Recommended Uses (other uses prohibited)

A. Parks, active and passive

B. Agricultural/Silviculture - Conditioned on the strict application of all pertinent Best Management Practices.

C. Office/Research - Limited to operations which do not involve the handling and use or disposal of harmful chemicals involved with or supporting laboratory research as well as the guaranteed maintenance of the pre-construction water budget.

D. Large Lot Residential - Residential dwellings developed at a density consistent with the determinations of the nitrate dilution model;[29] using the figure for drought conditions.

Level II GMA

Recommended Uses (other uses prohibited)

A. Any use recommended for L-I GMA's

B. Cluster Residential Subdivision

1. The determination of the open space ratio for a cluster subdivision in a L-2 GMA shall be made based on the following procedure:

a. Consult Table VI and/or properly performed aquifer pump test for the minimum lot size required for the entire site in order to ensure adequate dilution of wastewater.

b. Determine maximum number of units allowed on site based on minimum lot size

c. Produce cluster design according to municipal standards for open space ratios in a cluster development.

d. If no such standard exists, base open space ratio determination of 50% of the total site area.[30] Base

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29. *See Environmentally Based Growth Management: The Carrying Capacity Approach for Sussex County, a manual prepared by the Sussex County "208", which presents the nitrate dilution model in detail.*

30. *50% open space is significantly higher than is normally required in municipal ordinances, but the sensitivity of the area merits a comfortable safety margin in order to ensure proper dilution.*

location of open space on a site analysis which will reveal environmentally sensitive areas such as wetlands, steep slopes, or streams that should be protected. The remaining 50% of the site may be developed at double the density established in (1).

e. In the procedure outlined above, the minimum lot size is cut in half. Therefore no single lot should contain an individual wastewater treatment system. Wastewater from the clustered area should be directed to a cluster septic system to be located in the common open space sector of the site and designed to minimize its visual and olfactory impact.

2. No lot should support more than one dwelling unit.

C. Planned Developments

1. The determination of open space shall be calculated for each clustered area within the planned development individually with the cumulative amount of open space for the site to be not less than 50% of the total site area.

2. Onsite Wastewater systems will be governed for each clustered area according to the guidelines under Level II: B-1.

D. Planned Residential Development

1. The amount of open space required to be set aside for each cluster of each housing type shall be adequate to dilute the wastewater generated by the units in the cluster. (See Level II: B-1)

E. Planned Unit Development

1. The residential components of a Planned Unit Development, as they pertain to groundwater and wastewater disposal, shall be governed as those in Level II: B-1.

2. Commercial uses shall not generate or utilize substances which are hazardous to groundwater quality. Provisions shall be made for the additional wastewater generated by commercial uses when determining appropriate wastewater treatment and disposal methods.

Level III GMA

Recommended Uses

A. All uses recommended under Level I and Level II GMA's with associated provisions

The following should be Prohibited in Level III GMA's

A. Industries which manufacture, process or handle hazardous substances.

B. Industries which extract or process natural resources such as sand and gravel, fossil fuels, mineral deposits, etc.

C. Landfills

D. Chemical Dumping or Storage Activities

E. Industrial Waste Lagoons

F. Hazardous Waste Disposal Sites

G. Commercial establishments which handle hazardous substances such as dry cleaners, print shops, etc.

H. Pipelines and tanks which carry and store petroleum products and other chemicals below the ground's surface.

IMPLEMENTATION OF THE GROUNDWATER MANAGEMENT GUIDELINES

This section will suggest a methodology for applying the groundwater management guidelines to an existing municipal zoning ordinance. In order to illustrate the process, a fictional municipality will be used which has characteristics based loosely on an actual municipality. This example will be referred to as X Township.

The Process

The suggested procedure for implementing a groundwater management guidelines ordinance is as follows:

1. Acquire base map of existing zoning

2. Using the Groundwater Management Area Map provided with this manual, prepare map of GMA's for the municipality at the same scale as the base map

3. Overlay the GMA map over the base map and produce a composite map to show how GMA's fit into existing zoning

4. Compare and analyze existing zoning regulations and the groundwater management ordinance and decide on one of the following alternatives:

    a. Amend existing zoning standards so that they are at least as stringent as the groundwater management levels.

    b. Add a section to the zoning ordinance which yields precedence to the groundwater management ordinance in the situation where both apply to the same area of the township. Include a corresponding clause in the groundwater management ordinance

    c. Rezone the township to incorporate the groundwater management areas (see Figure 20)

Example: X Township

As diagramed in Figure 13, the implementation of groundwater management strategies involves two concurrent activities; the overlaying of a groundwater management map upon the existing zoning map, and making the existing zoning ordinance compatible with the groundwater management ordinance. The two end products will then be a revised zoning ordinance and a revised zoning map for X Township which will not only determine the pattern of future growth but will provide the teeth for enforcing the protection of its groundwater resources while allowing for a mixture of land uses. X Township features a variety of zones which provide the opportunity for most possible land uses. (See Figure 14) These zones are determined largely by existing land uses, for example the Conservation District (CD)

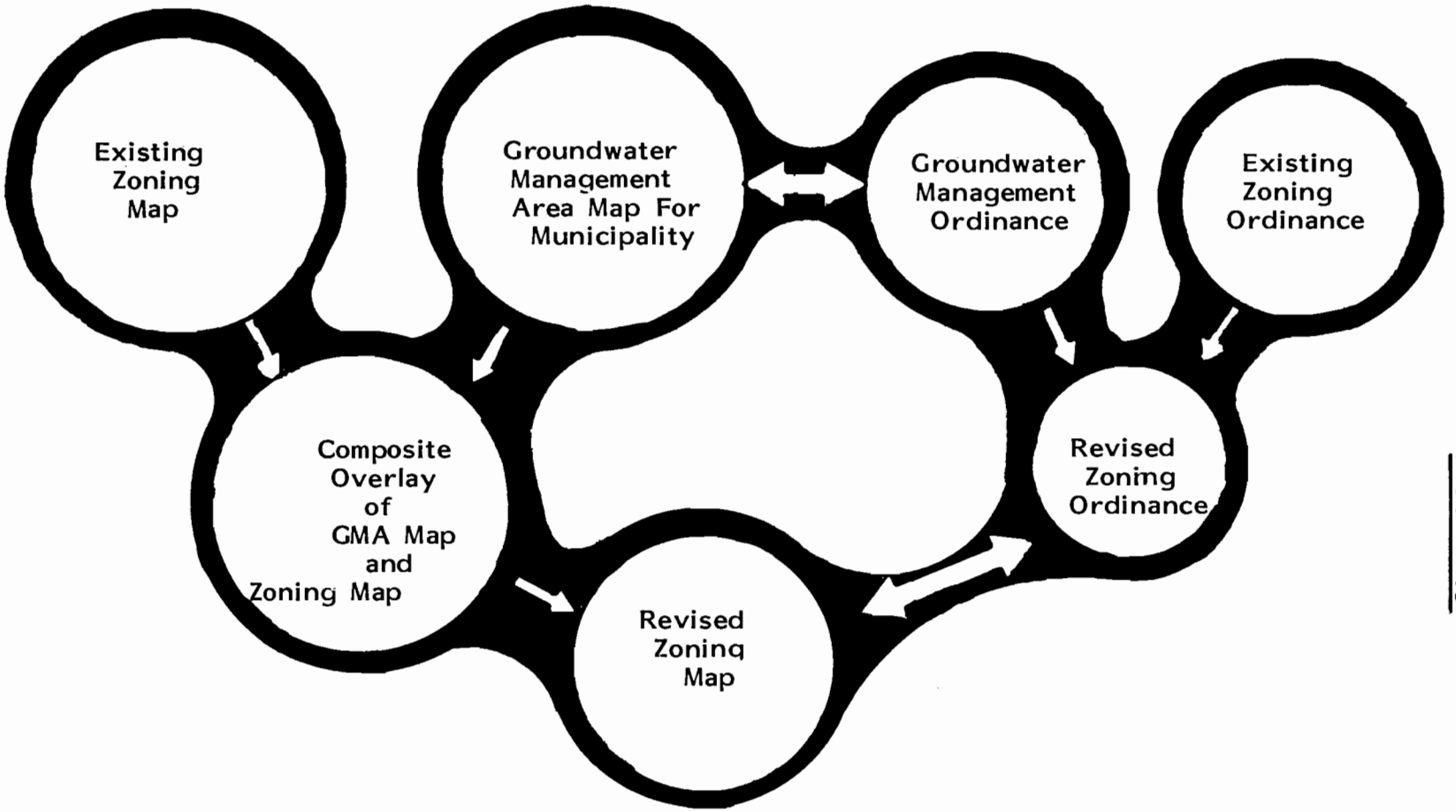
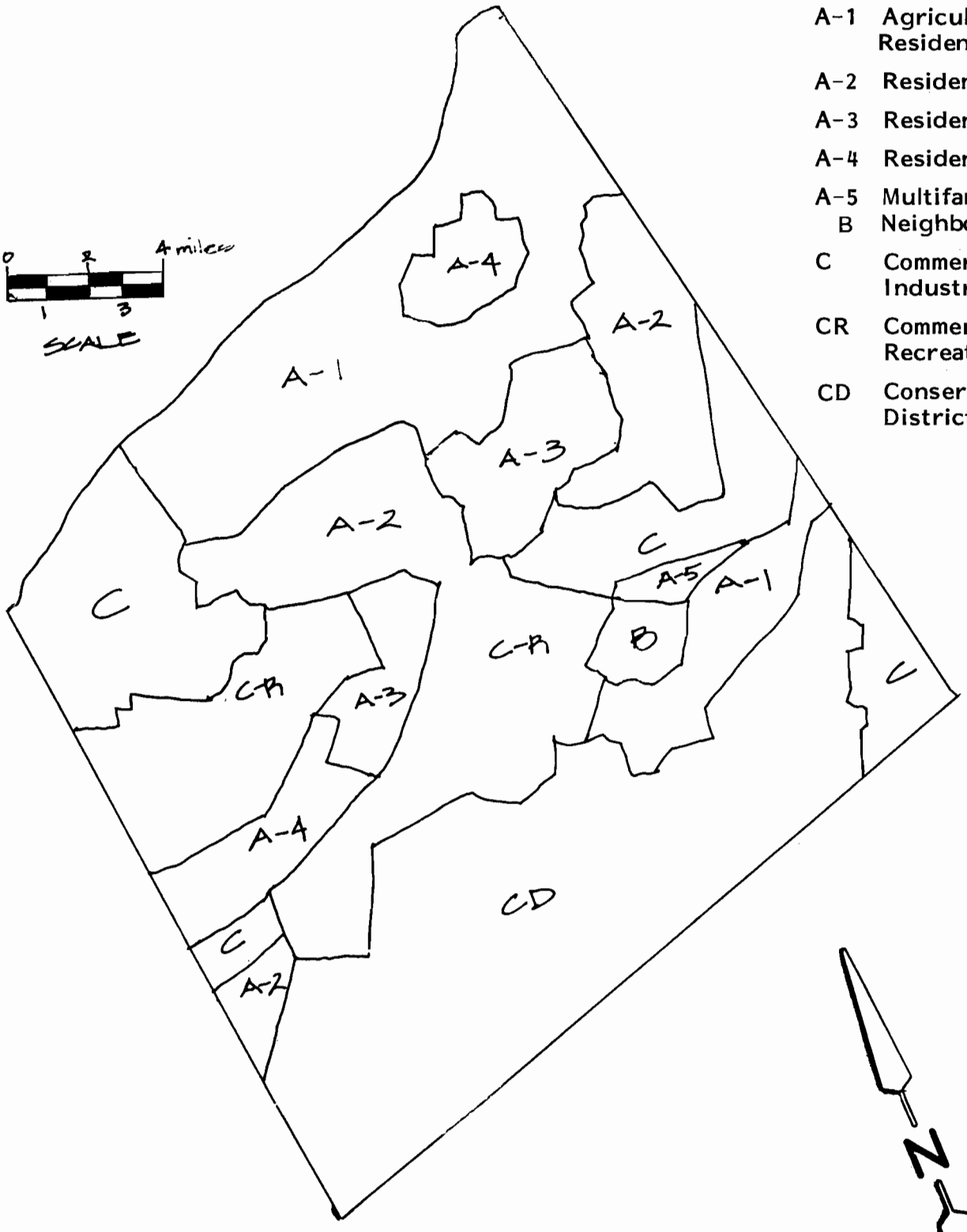


FIGURE 13

IMPLEMENTING GROUNDWATER MANAGEMENT STRATEGIES

FIGURE 14



official zoning map
x township

owes its existence to a state and a federal park, the commercial zones to location and access, etc. Usually these zones are delineated using either property lines or standard setbacks from road rights-of-way.

A. Superimposition of Groundwater Management Areas:

The groundwater management areas for X Township are shown in Figure 15. As opposed to the way in which zones were delineated on the zoning map, the groundwater management areas are based on geologic maps of Kittatinny Limestone (Carbonate) and stratified drift deposits. Therefore the boundary lines are amorphous and even overlap in places. Thus, as shown in Figure 16, the superimposition of Figures 14 and 15 immediately presents the problem of reconciliation.

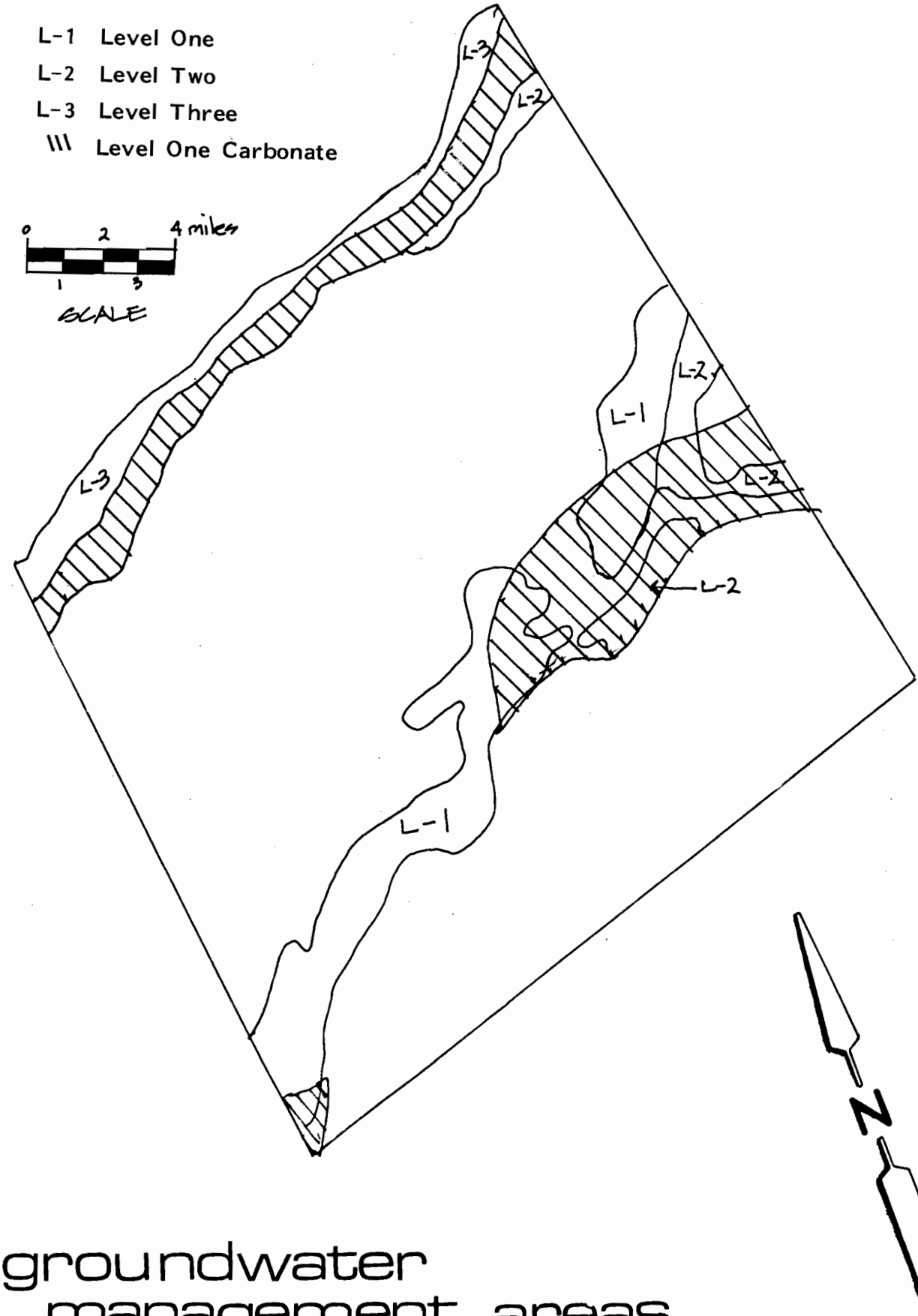
B. Reconciling the Zoning and GMA Maps:

When approaching the problem of getting the zoning and GMA maps to make sense, it must be remembered that there is existing land use that will be a given and that the regulations of the Groundwater Management Ordinance will only be applicable to future uses of the land within the groundwater management areas. As a footnote, it may be possible to have some influence over existing land use in a newly designated GMA by packaging the groundwater ordinance with a property maintenance code that enforces the use of proper BMP's for both present and future uses. In X Township the groundwater management areas were simply grafted directly onto the zoning map and the existing zone lines were adjusted around them (see Figure 17).

The only real problems in applying the method to X Township came with the absorption of most of the B zone and all of the newly created A-5 zone into one of the L-1 zones. Because of the flexibility of the groundwater management guidelines, however, any of the uses permitted in zones either reduced or eliminated may also occur in L-2 or L-3 GMA's under the conditions specified.

Another concern of Township X officials is that their major ratable, a year-round recreation resort complex, would be effected by the rezoning of most of the Commercial Recreation (C-R) zone to a L-1 zone. This concern could be mitigated simply by adjusting the groundwater ordinance to be more specific in regards to commercial recreation in the L-1 zone. For example, the groundwater management guidelines under Section 4-A, permits active and passive parks, but does not specify commercial or non-commercial. Two obvious solutions would be; 1) specifically permit commercial recreation uses as defined in the township's zoning ordinance in the L-1 zone; 2) re-establish delineation of C-R zone where overlapped with L-1 zone; returning jurisdiction to the Township's zoning ordinance (see dotted lines in Figure 14). Conditions set on any new development in areas of overlap of both zones would follow regulations of both the zoning ordinance and L-1 GMA.

FIGURE 15



groundwater management areas x township

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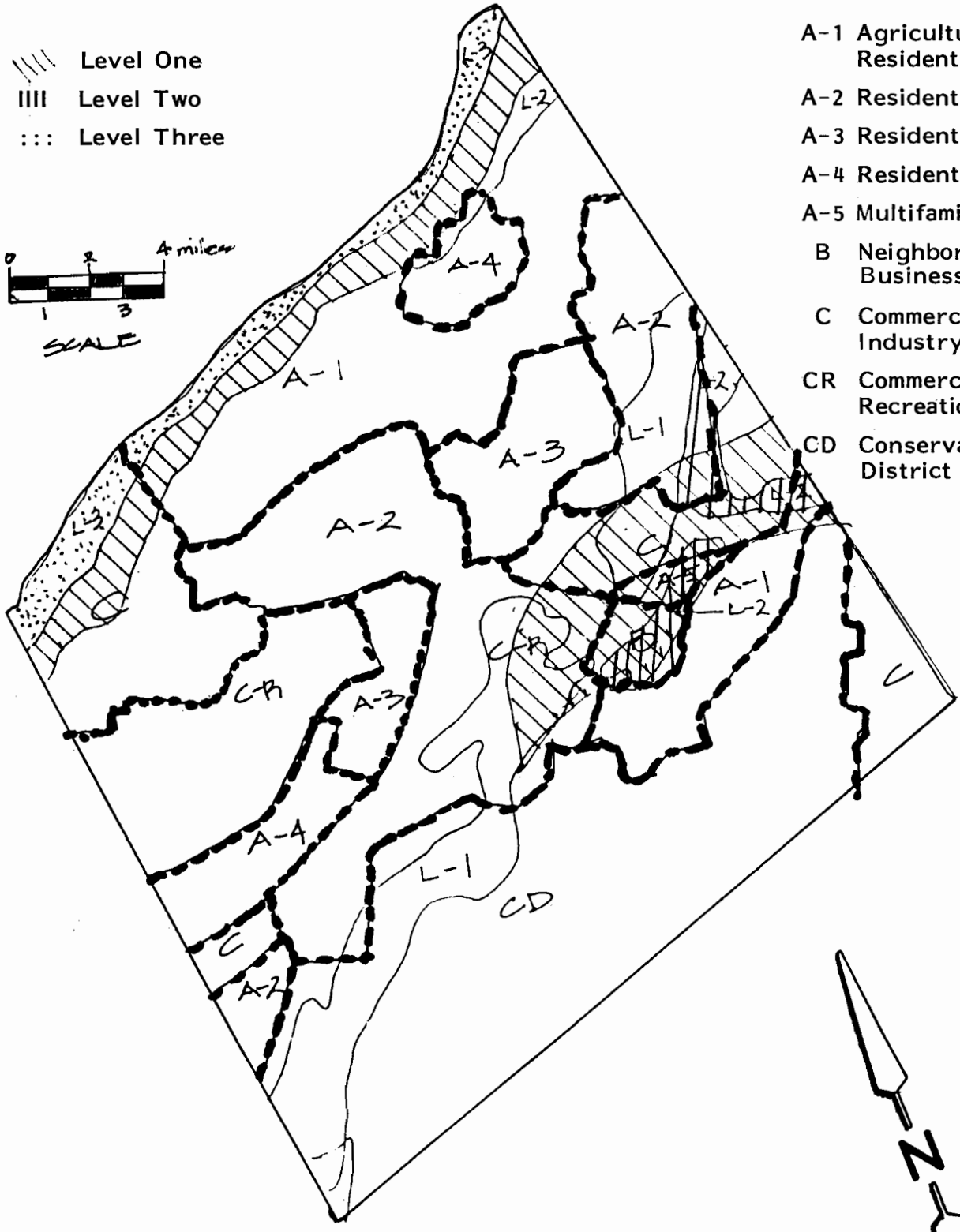
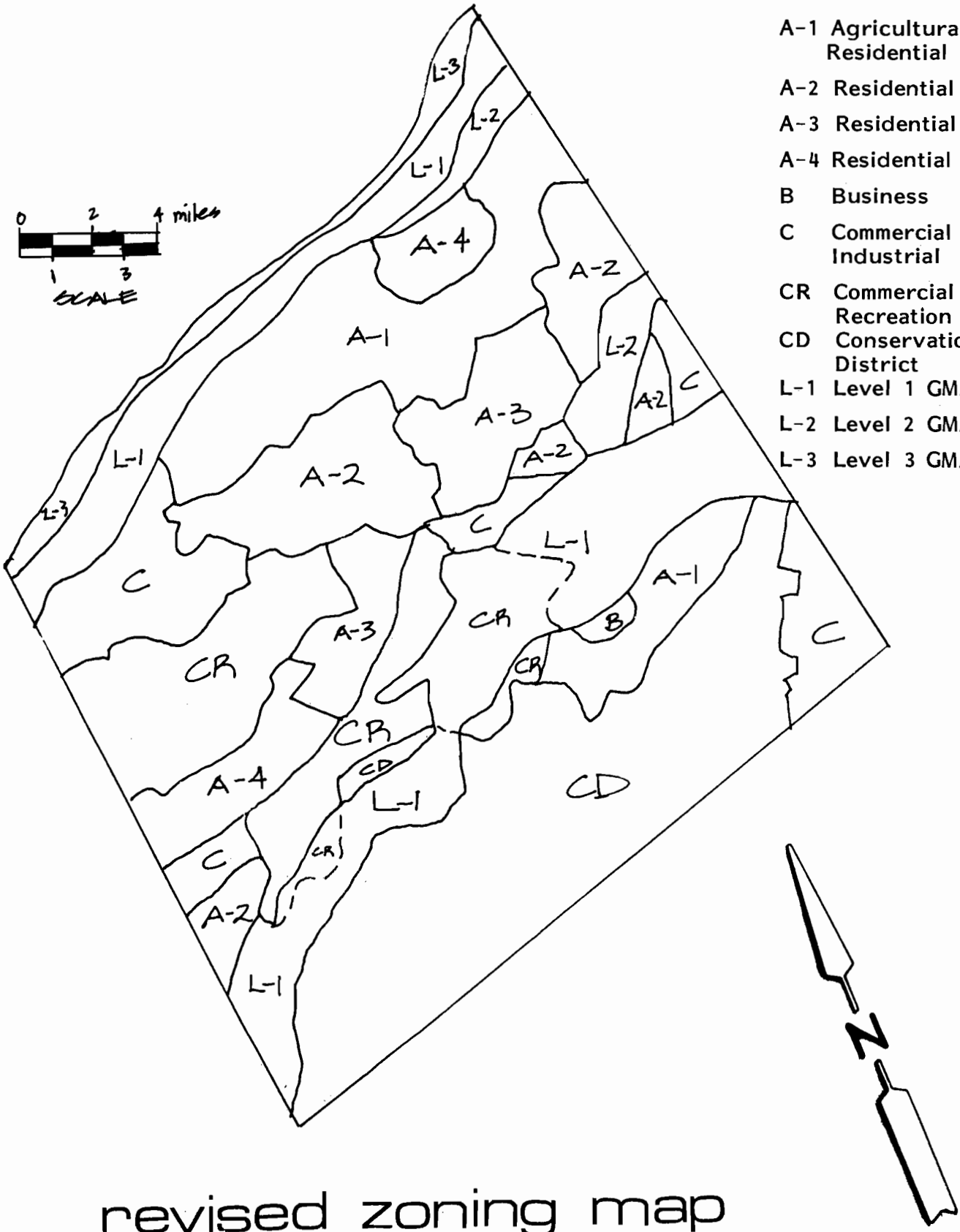
FIGURE 16



composite map g.m.a. & zoning

3 OF 4

FIGURE 17



revised zoning map
x township

Of the two options, the second would be preferable, as the first would then permit commercial recreation in other L-1 zones in the Township, a result which could prove contrary to its long range land use planning objectives.

Role of Enforcement

As was mentioned before, the groundwater management process could not be considered complete without some provision for enforcement. Most municipalities employ a full or part-time code enforcement officer who is responsible for insuring that zoning regulations are complied with. In addition, it was suggested previously that some version of a property maintenance code be included as part of the municipal code enforcement strategy. Such a code would help maximize the use of Best Management Practices on a site-by-site basis.

As a final note, as is mentioned in the Industrial Zoning BMP fact sheet, the granting of variances in groundwater management areas could have the same effect of gradually eroding the effectiveness of the ordinance in maintaining groundwater quality. However, the determination of the appropriateness of any given variance, as always, ultimately rests with the good judgement of local planning and zoning boards.

Hopefully this chapter has clearly presented a process for incorporating groundwater management into local planning and zoning. Managing the use of land and protecting vital resources such as groundwater are difficult and complex tasks which have been divorced within the local planning process for far too long. Sussex County municipalities have an opportunity to blaze a new trail by uniting these two related tasks within a comprehensive land management strategy which addresses the municipal obligation to provide for a balanced mixture of land uses that enriches the quality of the community environment while guaranteeing the availability of good quality water. It is the sincere desire of the Sussex County '208' program that this manual be of assistance in the pursuit of that end.