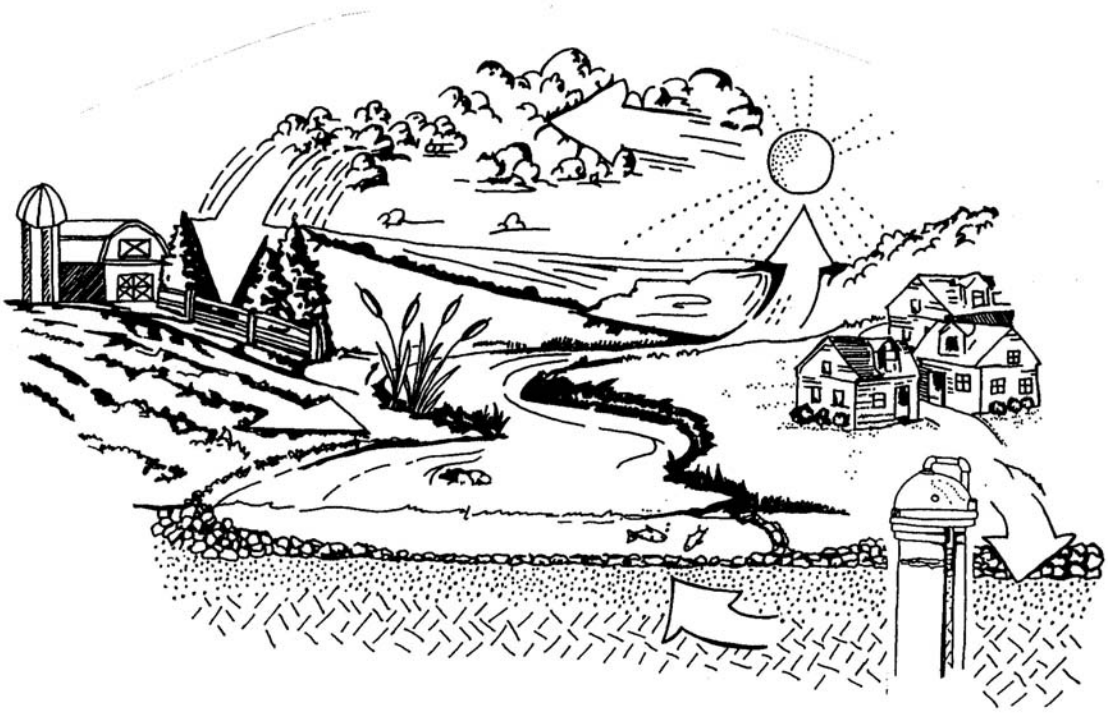
Water Resource Management Manual Carroll County, Maryland



May 2007 Edition

Department of Planning
Bureau of Resource Management
225 North Center Street, Westminster, Maryland 21157

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I. INTRODUCTION AND PURPOSE

The Carroll County Master Plan for growth and community development directs growth in and around the municipalities where public utilities are provided. In an effort to assess the ability of the community water supply systems to support projected demand, a study was conducted to evaluate existing water supply sources, identify new sources, and develop a management plan for each system and the County. During the course of the study, several incidents of point and non-point source groundwater contamination, reduced water yield, and limitations on viable well sites occurred.

The study recommended development of a comprehensive water resource management program that includes delineation of management areas and adoption of measures to protect drinking water supplies from both existing and future ground and surface water degradation sources.

The overall goal of Chapter 218, Water Resource Management, of the Code of Public Local Laws and Ordinances of Carroll County and this Manual is to allow development to proceed in a manner that will minimize adverse impacts on the uses of the resource as a water supply. Programs and ordinances across the Country were researched then modified to address Carroll County conditions. In addition, some of Carroll County's geology and land use are unique and standards were developed to address local needs. This manual addresses the regulatory element to accomplish the goal.

The manual is based on the delineation of Management Areas and the identification of activities that may impact water quality and quantity. The general location of the Management Areas can be found on the "Water Resource Management Area Guidance Map, Carroll County, Maryland". The Management Areas are:

Carbonate Rock
Wellhead Protection
Aquifer Protection
Surface Watershed
Stream Buffer

II. DEFINITIONS

For the purposes of this Manual, the following definitions describe the meaning of the terms used in this Manual:

ACTIVITY - Any use, action, condition, or proposed action which changes the physical characteristic of the land or which presents a potential threat to the water resources of Carroll County, including, but not limited to, construction, demolition, development, reconstruction, conversion, structural alteration, relocation or enlargement of any structure, road, driveway or appurtenance; and any mining, excavation, grading, landfill, or disturbance.

ADVERSE IMPACT - Any adverse effect on waters of the State, including their quality, quantity, surface area, species composition, aesthetics or usefulness for human or natural uses that are or may potentially be harmful or injurious to human health, welfare, safety, or property; to biological productivity, diversity, or stability; or that unreasonably interfere with the enjoyment of life or property, including outdoor recreation.

APPLICANT - Any person, firm, or governmental agency who executes the necessary forms to procure official approval of a project or a permit.

APPROVAL - The authorization of the County to perform activities as defined in Chapter 218.

APPROVED METHODS - Procedures for design, evaluation, or construction of a project that has been determined acceptable by the County to meet the requirements of Chapter 218.

AQUIFER - A porous water bearing geologic formation generally restricted to materials capable of yielding an economically significant or otherwise appreciable supply of water.

BERM - A ledge, shoulder, or raised rim that may appear along the perimeter of a basin generally used to deflect the overland flow of the water.

BUFFER – A regulated area left undisturbed adjacent to a specific natural feature or resource.

BUILDING ENVELOPE - The area of disturbance for site development which includes, but not limited to buildings, parking areas, stormwater management, erosion and sediment control structures.

CARBONATE ROCK - Bedrock that is chemically composed, primarily of calcium and/or magnesium carbonate minerals and, due to this, is subject to dissolution creating a condition of characteristically prolific aquifers susceptible to contamination and subsidence.

CAVERN - A subterranean cavity or cave produced by dissolution of limestone or dolomite.

CLEARING – The removal of trees and brush from the land but shall not include the ordinary mowing of grass.

CLOSED DEPRESSION - The remnants of a sinkhole that has been partially filled with soil by erosion and settlement and are generally identifiable on the surface as shallow, dish-shaped depressions. Closed depressions occur in areas underlain with carbonate rock.

COMMISSIONERS - The duly elected Board of County Commissioners of Carroll County, Maryland.

COMMUNITY WATER SUPPLY SYSTEM - Any community water supply as defined in the Code of Maryland Regulations 26.04.01.01.

CONTAMINATION - The introduction into water of any substance that may transfer infectious agents or other foreign substances (organic, inorganic, radiological, or biological), in concentrations that may constitute a health hazard or impair the usefulness of the water.

CULTIVATING - Physical methods of soil treatment employed within established farming, ranching or agriculture lands, which aid and improve crop growth, quality, or yield.

DEVELOPER - An individual, partnership, firm, corporation (or agent there of), that undertakes or participates in the activities covered by Chapter 103, Development and Subdivision of Land, of the Code.

DISTURBANCE - The clearing, grading, excavating, filling, paving, demolition, or building upon a parcel of land or otherwise modifying the existing topography.

DRAINAGE - All methods used to change existing hydrologic conditions, including but not limited to lowering of groundwater or surface water levels through pumping, piping, ditching or other means of altering water flow patterns.

DRAINAGE AREA - That area contributing run-off to a single point measured in a horizontal plane, that is enclosed by a ridge line.
ENGINEER - Professional engineer registered in the State of Maryland.

EPA - The United States Environmental Protection Agency.

EXCAVATION - To dig or remove soil, rocks or other material resulting in a temporary or permanent change in all or part of the elevation of a site.

FAULT - A surface or zone of rock fracture along which there has been noticeable movement.

FILL - Any materials placed in an area that alters the elevation of the site either temporarily or permanently.

FISSURE - An extensive crack, break, or fracture in the rock along which there is a distinct separation.

FOREST - Those areas that meet the definition of a forest as set forth in the Chapter 115, Forest Conservation, of the Code.

FRACTURE TRACE - The natural linear topographic depression, line of depressions, anomalous soil tone or vegetation pattern less than one mile in length that reveals faults, joints, or fissures in the bedrock that are primarily only visual on aerial photography. These linear features are usually characterized by increased hydraulic conductivity and generally indicative of preferred pathways for groundwater movement both vertically and laterally.

GRADING - Any disturbance of the earth, including but not limited to clearing, stripping, stockpiling, excavating, scarifying, filling, or any combination thereof.

IMPERVIOUS SURFACE - An impermeable construction covering the natural land surface, including but not limited to roads, parking areas, buildings, swimming pools, rooftops, and sidewalks.

INFILTRATION - The passage or movement of water into the soil surface.

INTERMITTENT STREAM - A stream or reach of stream that flows continuously during periods of at least one month and is contained within a defined channel or bed. A defined channel or bed is indicated by hydraulically sorted sediment, or the removal of vegetative litter, or loosely rooted vegetation by the action of moving water. Roadside ditches and ditches that convey surface runoff from storm events are not included in this definition.

KARST - A type of topography formed by the dissolution of limestone, dolomite, or marble; characterized by sinkholes, underground drainage, and caverns.

LAGOONS - Any shallow artificial pond or excavation used for the storage of waste materials.

MDE - The Maryland Department of the Environment.

NUTRIENTS - Any element or compound essential as a raw material for organism growth and development including nitrogen and phosphorus.

OUTCROP - **A**ny exposure of bedrock or stratum projecting through the overlying cover of soil and rock fragments.

PERMEABILITY - The capacity of a material for transmitting water. It is a measure of the relative ease of fluid flow under unequal pressures.

PERSON – Includes the federal government the state, any county, municipal corporation, or other political subdivision of the state, or any of their units, or an individual, receiver, trustee, guardian, executor, administrator, fiduciary, or representative of any kind, or any partnership, firm, association, public or private corporation, or any other entity.

PESTICIDE - Any chemical compound which kills or checks the growth of pests present in the environment including but not limited to worms, fungi, rodents, insects, and plants.

PINNACLE - A tall, slender spire of carbonate bedrock. Pinnacles are formed from the chemical dissolution of carbonate rocks along planes of discontinuity in the rock mass. Pinnacles are divided into surface and subsurface features that protrude above ground level and those formations that exist below the surface of the ground, respectively.

POLLUTANT - Any contamination, or alteration of the physical, chemical, or biological properties of groundwater or surface water, including any change in temperature, taste, color, turbidity, or odor of the waters or the discharge or deposit of any organic matter, harmful organism, or liquid, gaseous, solid, radioactive or other substance into groundwater or surface water that will render the character of water harmful or detrimental to: public health, safety, or welfare; domestic, commercial, industrial, agricultural, recreation, or other legitimate beneficial uses; livestock, wild animals, or birds; or fish or other aquatic life.

POTENTIAL WELL SITE - Well sites that have been identified from geologic, topographic, and photogeologic fracture trace analyses and are in relative proximity to existing public supply systems. These sites are considered optimum locations for groundwater exploration for community water supply wells and are identified on the Carroll County Master Plan for Water and Sewerage.

PROJECT – The proposed and projected phases of development or activity on a parcel of land, including, but not limited to, activities conducted in a non-tidal wetland, a wetland buffer, or expanded buffer.

RECHARGE - The addition of water to the zone of saturation, together with the associated groundwater within the saturated zone.

REGULATED SUBSTANCE - Substances that:

A. Produces toxic, lethal, or other injurious effects or causes sub-lethal harmful alterations to plant, animal or aquatic life; or
B. May be injurious to human beings.

RESTORE - Actions performed to return lost ecological benefits.

SEDIMENT - Soils transported or deposited by the action of wind, water, ice, gravity, or artificial means.

SINKHOLE - A funnel-shaped depression with subsurface drainage caused by dissolution of parent rock material (carbonated), subsurface soil erosion, and collapse or subsidence of the roof of subterranean caverns.

SPRING - A discharge of groundwater at the surface forming a pool or that provides intermittent or perennial surface flow, and is usually characterized by saturated or organic soils.

STORAGE TANK - A stationary or movable device and all associated piping designed to contain an accumulation of regulated substances. Storage tanks are constructed of non-earthen material and provide structural support such as concrete, steel, fiberglass, and plastic.

STORMWATER MANAGEMENT:

1. For quantitative control, a system of vegetative and structural measures that control increased volumes and rates of surface runoff caused by man-made changes to the land.
2. For qualitative control, a system of vegetative, structural, and other measures that reduce or eliminate pollutants that might otherwise be carried by surface runoff.

STREAM - A part of a watercourse, either naturally occurring or artificially created, that contains intermittent or perennial base flow of groundwater origin, but not including a ditch that conveys surface runoff exclusively from storm events

STREAM BASEFLOW - That portion of the stream flow that originates as groundwater.

STRIPPING - Any activity that removes the vegetative surface cover including tree removal, clearing, grubbing and storage or removal of topsoil.

SUBDIVISION - A division of a parcel of land into two or more lots or parcels for the purpose, whether immediate or future, or transfer of ownership, sale, lease, or development, including those divisions referred t as off-conveyances.

UNDERGROUND STORAGE - The containment of liquid in a tank that is buried below ground such that visual inspection of the entire tank is not possible.

WASTE - Industrial waste and all other liquid, gaseous, solid, or other substances that may pollute any waters of the State.

WATER BODY - Any bounded aggregate of water.

WATERCOURSE - Any natural or improved stream, river, creek, ditch, channel, canal, conduit, culvert, drain, gully, swale or wash in which waters flow either continuously or intermittently.

WATERSHED - The total area draining into a stream, lake, river, river system or body of water at a defined point.

WATER TABLE - The surface of a body of unconfined groundwater, below the unsaturated zone, where the pressure is equal to that of the atmosphere.

Well Site/Wellhead Buffer – The area, defined as a minimum 200' X 200' centered on a well site or wellhead which shall remain undisturbed during the development process except for water supply development. This area may be conveyed to the County or a municipality.

WELLHEAD - The physical structure, facility, or device at the land surface from or through which groundwater flows or is pumped from subsurface water-bearing formations.

WELLHEAD PROTECTION AREA - The area recharging existing public supply wells as described in III.A

WETLAND - An area that meets the conditions for a wetland according to the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands".

III. WATER RESOURCE MANAGEMENT AREAS

The following Water Resource Management Areas have been delineated and will serve as the regions upon which the standards of this Manual will be applied.

A. Wellhead Protection Area

The Wellhead Protection Area includes wellhead and springhead regions which contribute groundwater to an identified water supply source. These areas are based on capture zones as estimated from available field testing data, hydrologic flow equations, and groundwater availability estimates, in combination with hydrogeological characterization. In some cases the areas were limited to a theoretical maximum zone from which a source could reasonably be assumed to draw. The shape of the area was modified approximately within the context of the hydrogeologic framework.

B. Aquifer Protection Area

The Aquifer Protection Area encompasses regions within and adjacent to Community Planning Areas which constitute potential groundwater resource which may be reasonably available for development to a municipal water system. These areas may become, at least in part, a wellhead protection area when new sources are drilled, tested, and developed.

C. Carbonate Rock Area

Carbonate Rock aquifers in Carroll County are the most unique and sensitive aquifer areas in the region. These areas are underlain by prolific aquifer materials that produce high-volume groundwater supplies; however, they are extremely susceptible to contamination and are potentially structurally unstable. This is due to the soluble nature of the carbonate materials which can dissolve and lead to the formation of relatively large voids and openings in the subsurface. Groundwater migration through subsurface open-channel conduits and downward soil migration leading to a sinkhole formation are characteristic.

The Carbonate Rock Area encompasses all areas which are currently known or suspected to be underlain by carbonate rocks. This includes the Wakefield Marble and Silver Run Limestone geologic units, as well as unnamed calcareous zones within schist and phyllite areas.

D. Surface Watershed Area

The Surface Watershed Area encompasses the watersheds of all existing and proposed surface water reservoirs and stream intakes in Carroll County. It also includes that portion of the watersheds of the Baltimore City reservoirs in Carroll County. The delineation is based on topography and gravity drainage to the reservoirs and stream intakes.

The Surface Water Management Zone is a sub-area of the Surface Watershed Area and establishes a zone of extended vulnerability surrounding the reservoirs and tributary streams. This zone is based on slope and soil characteristics within each watershed and is measured from the normal pool edge of a reservoir and from the bank of a tributary stream. The width of the Surface Water Management Zone shall be:

Watershed	Reservoir Pool(feet)	Tributary Stream (feet)
Piney Run Reservoir	700	300
Gillis Falls Reservoir	700	300
Liberty Reservoir	700	300
Cranberry Reservoir	700	300
Big Pipe Creek/Union Mills	1000	600
Loch Raven Reservoir	N/A	600
Pretty Boy Reservoir	N/A	600

E. Stream Buffer

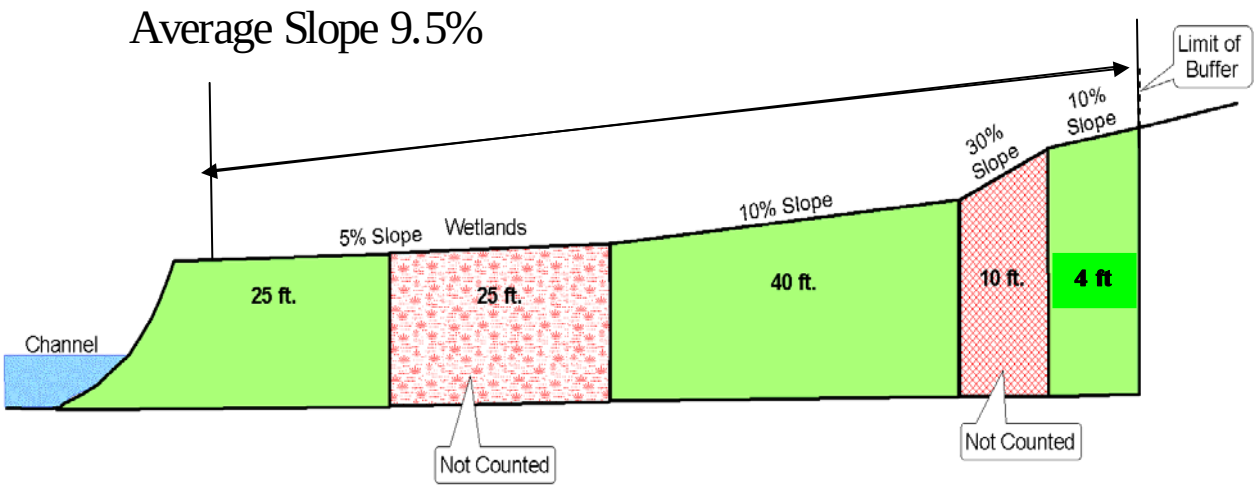
The Stream Buffer is an undisturbed zone extending from the banks of a stream. Stream buffers will be applied County wide, regardless of whether they are located within another Water Resource Management Area (e.g. Surface Watershed Area.)

All Stream Buffers shall be a minimum of 50 feet wide from each stream bank. The existing conditions of the site shall determine the ultimate Stream Buffer width. Land features such as wetlands and slopes greater than 25% do not count toward the calculation of the Stream Buffer width.

The average stream valley slope shall be calculated to determine the Stream Buffer width for each area along stream; it shall be measured at regular intervals along the stream through the site. The average stream valley slope shall be measured from the edge of the stream bank to a point 100 feet from the edge of the stream bank (measured perpendicular to the stream). The Stream Buffer is calculated by adding two feet to the minimum Stream Buffer width (50') for each one percent of the adjacent stream valley slope.

Applying a Variable-Width Stream Buffer

This example illustrates how to apply the variable -width stream buffer. In this example, the average slope of the stream valley is 9.5 percent, which corresponds to a buffer width for one side of the stream of 69 feet (50 feet minimum + 19 feet). Since environmentally sensitive areas such as wetlands and steep slopes are *not* counted toward the required buffer width, the actual buffer width is 104 feet (69 + 25 feet wetland width + 10 feet steep slope width).



IV. MANAGEMENT STANDARDS AND DESIGN CRITERIA

A. Regulated Substance Storage and Use

1. Standards for regulated substances shall not be applicable to substances used exclusively for private residential purposes, such as routine lawn and garden pesticides and fertilizers or household cleaning products which are used consistent with the manufacturer's recommendations and instructions.

2. In any Water Resource Management Area any person proposing any activity that involves the storage, use, sale, or maintenance of a regulated substance(s) shall demonstrate to the County that proper safeguards have been proposed to prevent the discharge of the regulated substances(s) to the water resource. Such safeguards shall ensure the chemical, physical, and biological, or radiological integrity of the water resource will not be detrimentally altered by the proposed activity.

   Those items which may be used to demonstrate adequate safe-guards include, but are not limited to, the following:
   - Location, type, quantity, and methods of storage, use, and disposal of regulated substances.
   - Copies of Federal, State, or Local permits required.
   - A Spill Prevention Control and Counter Measure (SPCC) plan if required.
   - A Pollution Prevention Plan if the activity requires an industrial stormwater NPDES Permit.
   - Process flow diagrams or life cycle management details for the regulated substance.
   - A plan showing material storage, handling, and transfer points.
   - Structural methods incorporated into the facility design to ensure the containment of regulated substances from the environment.

3. The County may require a Regulated Substance Management Plan. The Plan shall include, but not be limited to, the following:
   - Management and structural measures to safeguard the regulated substance(s) from the environment.
   - Measures and procedures to prevent and respond to releases of regulated substances.
   - Reporting procedures if spills or releases occur.
   - Annual updates concerning changes to the location, type, quality, and methods of handling of any regulated substances.

4. The County may require the installation of monitoring equipment and establish sampling/reporting requirements where it deems necessary.

5. All general purpose floor drains located in facilities utilizing regulated substances shall be connected to a public sanitary sewer system (pretreatment may be required), on-site holding tank or treatment system, or a system authorized through a state

groundwater discharge permit or surface water discharge permit.

6. All requirements for secondary containment shall ensure the design and construction of the facilities are capable of capturing the regulated substance on-site.

7. The design and materials of the secondary containment structure(s) shall be subject to approval by the County.

8. The following requirements shall apply to the storage and handling of regulated substances in each Water Resource Management Area (Table 1).

Table 1. List of requirements for storage and handling of regulated substances for each Water Resource management Area.

Surface Watershed Area		
Storage Type	**Region**	**Requirements**
Above ground Storage	Stream Water Management Zone	Option 1: Secondary containment Option 2: Lined and roofed if diked
	Surface Watershed Area	Option 1: Secondary containment Option 2: 150% containment and lined if diked
Under ground Storage	Surface Water Managementt Zone	Secondary containment
	Surface Watershed Area	State requirements
Wellhead Protection Area/Aquifer Protection Area		
Storage Type	**Region**	**Requirements**
Above ground Storage	Wellhead/Wellsite Buffer	Not Allowed
	Wellhead/Aquifer Protection Area	Option 1: Secondary containment Option 2: 150% containment and lined if diked
Under ground Storage	Up to 500 foot radius from Wellhead/Wellsite	Not Allowed
	500 + foot radius from Wellhead/Wellsite	Secondary Containment
Carbonate Rock Area		
Storage Type	**Region**	**Requirements**
Above ground Storage	Carbonate Rock Area	Option 1: Secondary containment Option 2: 150% containment and lined if diked
Under ground Storage	Carbonate Rock Area	Secondary Containment
Stream Buffer		
Storage Type	**Region**	**Requirements**
Above ground Storage	Stream Buffer	Not Allowed
Under ground Storage	Stream Buffer	Not Allowed

9. The placement of any underground tank for the storage of regulated substances at or below the seasonal high water table is prohibited within Carbonated Rock, Surfacewater Management Zone, Wellhead or Aquifer Protection Areas. Underground storage must have leak protection and secondary containment and must be at least 4 feet above the seasonal high groundwater level.

10. Exclusive of those regulated substances necessary for water supply treatment or as permitted under state regulations, no regulated substance shall be stored, mixed, transferred, or applied within 100 feet of a community water supply well.

11. Within Carbonate Rock Areas, no lagoon or pond may be constructed with the intention of storing any quantity of regulated substance unless permitted under applicable State law. If permitted under applicable State law, such structure shall be lined and monitored.

B. Community Water Supply Development

The County has identified optimum potential wellsites adjacent to the Municipalities. Those wellsites have been delineated on the Carroll County Master Plan for Water and Sewerage. Numerous other wellsites have been identified by studies performed by the Municipalities. In addition wellsites have been drilled, tested, and designated for future use by the County or Municipalities.

In order to ensure the viability of those as yet drilled wellsites as well as those which have been confirmed by drilling and testing, the following requirements shall apply to land development where such wellsite(s) or well(s) are located:

1. Potential well sites which are designated by the County or a Municipality or identified during the development process and located in any proposed subdivision or site development shall be reserved by leaving a minimum of 200-foot by 200-foot buffer area with the well site in the center. The County may require drilling and testing to be completed by the applicant prior to approval of a preliminary plan. Access to the well site must be reserved.

2. Existing community supply wells located on parcels to be developed shall be protected by reserving a minimum of 200 foot X 200 foot buffer centered on the wellhead.

3. When it is determined by the County or the Municipality that potential well site(s) must be verified by drilling and testing, acceptability of the well for use by the County or Municipality shall be based on the criteria specified in Approved Method V.A or other requirements adopted by the County or Municipality. Drilling and testing shall be conducted by the applicant prior to approval of a preliminary subdivision plan.

4. Successful test wells, as identified and accepted by the County or the municipality, shall be preserved via fee simple with a permanent minimum 200 foot X 200 foot parcel centered on the wellhead. Access and utility rights-of-way shall be reserved and dedicated via fee simple to the appropriate public agency for future water supply use.

5. Unsuccessful test wells shall either be converted to observation well status as approved by the Maryland Department of the Environment (MDE) with monitoring rights dedicated to the appropriate public agency, or other use as approved by the Carroll County Health Department, or properly abandoned according to COMAR 26.04.04. as determined by the County or municipality.
6. New septic systems shall not be installed within 200 linear feet of a community water supply well.

C. Watershed Protection

Watershed protection is essential to protecting water quality within all management areas, especially the Surface Watershed Areas. A significant portion of Carroll County drains to three reservoirs operated by the City of Baltimore (Liberty, Loch Raven, Pretty Boy). In addition, the County has three planned reservoirs, one of which has been constructed but is not currently used as a water supply (Piney Run, Gillis Falls, Union Mills). Protecting the water quality on the land that drains to a water supply source can reduce both the cost of water treatment and the risk of water quality impairment. The following standards shall apply to any development proposed within the Surface Watershed Areas:

1. Stream base-flow shall be maintained within surface watershed areas through the use of infiltration practices and open space preservation.
   a. Stream base-flow shall be preserved by distributing infiltration throughout the development.
   b. The impact from impervious surfaces to any stream shall be evaluated by the developer's engineer and reviewed by the County.
   c. The impacts from impervious surfaces as determined by the above evaluation shall not reduce the site recharge by more than 10% of the predevelopment recharge of the site.
2. Commercial and industrial development within Surface Watershed Areas shall adhere to the following:
   a. The storage, use, and transfer of regulated substances shall be performed under roof so that exposure to rainfall is eliminated and the contamination of stormwater runoff prevented.
   b. Pollutants shall be removed from runoff as close to the source of exposure as possible.
   c. Stormwater flows should be designed to be dispersed rather than concentrated. Stormwater flows should be directed to areas containing permeable soils, hydrologic soil groups A or B, where site design allows.
   d. A minimum of 90% of the annual, total runoff volume from all impervious surfaces shall be recharged into the ground on site .
   e. Stormwater management shall be achieved through the use of a series of connected practices (i.e., a treatment train approach). Water quality management and recharge shall be distributed throughout the site.
   f. Landscape islands and other vegetated areas shall be utilized within the building envelope for stormwater management.
   g. Where feasible, 10-year quantity and channel protection volumes as well as any required water quality and recharge volumes (not satisfied by e. and f.) shall be provided in a perimeter modified recharge/sand filter facility with disturbed outflows. Before other measures can be used in place of the perimeter and sand filter, County agreement must be obtained.
   h. Between any parking area or structure and the perimeter facility, the

following minimum grass filter strip shall be installed:

Filter Strip Requirements	
Slope of Strip (%)	Minimum Length
1	25 Feet
2	25 Feet
3	29 Feet
4	33 Feet
5	37 Feet
6	41 Feet
7	45 Feet
8	49 Feet
9	53 Feet
10	57 Feet
11	61 Feet
12	65 Feet
13	69 Feet
14	73 Feet
15	77 Feet

3. The following requirements apply to stream buffers throughout the County:

a. Provide a table on a plan sheet showing the Stream Buffer calculation. Select representative transects along the stream throughout the property to calculate the Stream Buffer width. Show and label these transects on the plan.

b. To insure that stream buffers are adequately protected from construction activities, the following practices shall be implemented before any construction begins and shall be maintained throughout the entire construction phase of the project:

(1) Soil disturbance shall not occur within the stream buffer, except as approved by the County.

(2) Stream buffers shall be shown on all plan sheets including, but not limited to, the site plan, the stormwater management plan, the grading plan, and the erosion and sediment control plan beginning with the Concept Plan stage of development.

(3) Stream buffers shall be identified on the construction site and protected through the installation of highly visible, well-anchored fencing prior to any land clearing or grading. Suitable fencing measures include blaze-orange, plastic, mesh fencing; two or

three-strand wire fence with highly visible flags; or snow fencing with highly visible flags on anchor posts. If a forest conservation area, as required by Chapter 115, Forest Conservation, of the Code, completely includes the stream buffer area, then no additional fencing is required. Protective fencing shall be installed and inspected by the County prior to the issuance of any grading permit.

(4) After construction has been completed and the site is stabilized, all stream buffer protective fencing shall be removed from the site for proper disposal; however, signs shall remain in place after construction has been completed.

c. Storm drain pipe outfalls

(1) Discharges from storm drain pipe outfalls shall be designed to avoid release onto any slopes greater than or equal to 15% within the stream buffer. In cases where discharges are unable to avoid such slopes, outfalls within the stream buffer may be allowed at the County's sole discretion. At no time may an outfall be closer than 50 feet to the stream channel.

(2) Storm drainage up to and including the 10-year design storm shall not produce discharge velocities exceeding 2 feet per second prior to entering the buffer.

d. Stream Buffer Crossings

(1) Development designs shall minimize the number and extent of stream buffer crossings.

(2) The County shall approve all stream buffer crossings.

(3) Where a buffer crossing is proposed, the crossing shall:

(a) Minimize disturbance to the stream's floodplain,

(b) Avoid disturbance to adjacent wetlands,

(c) Minimize disturbance of steep slopes and forested areas,

(d) Be located on straight, not meandering, sections of the stream channel, and

(e) Be as perpendicular to the stream channel as possible.

(4) Free-span bridges are preferred to the use of culvert pipes.

(5) Where culvert pipes are used, a multi-cell culvert design shall be used unless a single cell culvert can pass the 100-year storm event while maintaining the stream channel's geometry with regard to width, depth, and velocity.

(6) Multi-cell culvert designs shall consist of at least one cell located on the floodplain and one low-flow cell located within the stream and sized to maintain the stream's normal and natural flow width, depth, and velocity through the entire length of the crossing.

(7) Low-flow cells shall discharge into a plunge pool designed to maintain the normal depth of flow in the low-flow cell.

e. Locate water and sewer lines and other utilities outside of the stream buffer area. Written justification shall be provided to the County for instances where it may not be feasible to avoid stream buffer disturbance. Where permitted, disturbances shall be minimized and restored.

f. Water Resource Protection Easement Requirements

(1) The developer shall provide a Water Resource Protection Easement encompassing the stream buffers area(s). The easement shall be shown on the construction drawings and final record plat, and conveyed to the Board of Commissioners of Carroll County at the time of recordation of the plat.

(2) There are two types of water resource protection easements: forested or non-forested. Label each Water Resource Protection Easement with the appropriate type.

(3) A note shall be placed on the final record plat stating "The area shown hereon as a Water Resource Protection Easement shall be granted to the Carroll County Commissioners by deed intended to be recorded simultaneously herewith." Specify the type of Water Resource Protection Easement present (i.e., forested or non-forested) in the note.

(4) The developer shall provide the acreage and length of stream within the Water Resource Protection Easement.

(5) The developer shall provide permanent signs to identify the Water Resource Protection Easement Area. These signs shall be installed at 100 feet intervals around the perimeter of the

easement. Signs shall be constructed of non-biodegradable materials and affixed to posts of lasting materials (e.g., oak or metal stakes). Posts shall be four feet above ground and two feet below ground.

(6) At the County's discretion, Water Resources Protection Easements less than 5,000 square feet may not be required.

D. Sinkhole Protection and Mitigation

Protection and mitigation measures found in this section are confined specifically to the Carbonate Rock Area. This includes the Wakefield Marble and Silver Run Limestone geologic units, as well as unnamed calcareous zones within schist and phyllite areas. These areas may be prone to subsidence (sinkholes) as well as accelerated groundwater flow. This condition allows for contaminants to flow more freely in the subsurface. Therefore the following requirements afford protection against structural failures due to sinkholes and groundwater quality degradation.

1. A karst investigation conducted by an individual with experience in carbonate rock terrains, in accordance with Approved Method V.B, may be required.
2. No new septic system shall be installed within 100 linear feet, measured from the rim, of an existing or remediated sinkhole.
3. Replacement septic system may only be installed within 100 feet, measured from the rim of an existing or remediated sinkhole, if no other alternative exists.
4. When sinkhole(s) occur within sediment control facilities, not to be converted to stormwater management, repairs shall be within 24 hours (or one business day) of the first observation in accordance with Approved Method V.C.
5. Sinkhole(s) occurring in sediment control facilities to be converted to stormwater management, or within existing or proposed road right-of-way, shall be reported to the County immediately. A repair design shall be coordinated with the County. Sinkhole repair shall be completed immediately after receiving design approval from the County.
6. The County shall be notified within 24 hours or the next business day, as applicable, of the discovery of a sinkhole occurring on a site. Except for those provisions above, all other sinkholes shall be repaired within 30 days of discovery using Approved Method V.C. Until the repair is completed, a temporary berm to divert surface flow away from the sinkhole shall be constructed.
7. Discharge from sediment control facilities or stormwater management structures shall not be routed either directly or within 100 feet of any sinkhole.
8. Design and documentation on any repair shall be certified by a registered professional engineer and submitted to the County.
9. There shall be no disposal of any solid or liquid waste into sinkholes or other karst features.

E. Golf Course Impact Assessment

This section applies to any golf course development within any water resource management area.

1. In addition to any requirements from other chapters of the Code the following should be submitted:

   a. Golf course layout including all planned construction areas, chemical storage, proposed grading with underdrain system and outfalls shown.

   b. Aerial photo scale not to exceed 1"=100' showing proposed layout.

   c. Total acreage of fairways and green/tees.

   d. Total acreage of impervious surfaces.

2. An environmental impact assessment shall be submitted to the County and shall include, but not be limited to, the following:

   a. Wetland Impacts – identify the potential impacts to wetlands including proposed clearing, filling, change in vegetation type and dominance, and change due to increase in drainage from proposed roads and underdrain systems.

   b. Surface Water Impacts

      (1) Where stream buffers are to be crossed, indicate how impacts will be addressed.

      (2) Determine the nutrient loadings to the receiving streams from stormwater runoff and mitigation measures to reduce nutrient loads for entire project area. Site conditions to consider include:

         (a) Vegetation type

         (b) Nutrient Application Rates

         (c) Slope

         (d) Distance to stream

      (3) Identify potential impacts to stream flows from a reduction in baseflow due to groundwater withdrawals for irrigation.

      (4) Identify potential impacts to the stream from outfalls for underdrain systems, stormwater management, drainage systems or water hazards. Impacts should include temperature, pesticides, nutrients from fertilizers, and sediment delivery generation.

c. Groundwater Impacts

(1) Identify soils which may be susceptible to leaching due to:

(a) High water table

(b) Bedrock within 4 feet of the surface

(c) Permeability

(d) Low total organic carbon

(e) Low clay content

(2) Field verify soil types and extent in areas deemed as highly vulnerable to leaching where greens, tees and hazards are proposed.

(3) Impacts which may be associated with groundwater extraction for on-site irrigation shall be identified.

3. The following Mitigation/Design Measures shall be implemented:

a. An Integrated Pest Management plan as may be recommended by University of Maryland Cooperative Extension Service shall be developed for use on the site. The plan shall be submitted to the County. A listing of all herbicides, soil amendments, or pesticides to be used on the site including the following shall be submitted:

(1) Pesticide Classification

(2) Application Rates

(3) Toxicity

(4) Leachability

(5) Environmental Persistence

A design for storage and handling of all such materials shall be provided.

b. Forest cover replacement areas and wetland mitigation areas shall be identified on the plan.

c. A nutrient management plan shall be prepared in accordance with the University of Maryland Cooperative Extension Service guidelines.

d. The following standards shall be used in the development of the Golf Course Design:

(1) Fairway crossings shall:

(a) Minimize the number of stream crossings

(b) Cross perpendicular to any wetland and/or stream

(c) Be maintained as unplayable rough with shrub-scrub or herbaceous vegetation. Shrubs and small trees along the stream banks should be preserved or planted to provide shading and stability.

(d) Be located at the narrowest possible area of wetland and/or stream to minimize disturbance.

(e) Not require any filling or grading in buffers, wetlands or floodplains

(f) Utilize cart paths made of timber or timber pilings and be constructed with minimal disturbance. Paths should not be located on steep or erodable slopes.

(2) Greens and tees should be located in areas where the maximum high water or bedrock is greater than four feet below final grade, including underdrain systems.

(3) Nutrient losses to groundwater and surfacewater should be reduced through the use of best management practices.

(4) Site design considerations should emphasize:

(a) Selection of drought and disease resistant grass species for fairways, tees and greens.

(b) Use of biological control of pests instead of chemicals.

(c) Selection of those chemicals which are less toxic, less mobile and have a shorter environmental persistence.

(d) Elimination or reduction of pesticide applications in sensitive or highly vulnerable areas.

9. APPROVED METHODS

Some standards require specific methods of construction or evaluation to be used to meet the requirements. Methods that have been evaluated and approved for use are contained in Section IV Approved Methods. It is the intent of the Manual to encourage innovation to protect water quantity and quality. Therefore, alternative methods will be considered for use if submitted for review with supporting documentation.

A. Community Water Supply Development Criteria

The following standards have been developed to establish the minimum criteria for yield and construction for the County to accept a well as a County operated community supply. All applicable Federal, State and local regulations and permitting requirements must also be satisfied.

All drilling shall be conducted by a qualified well driller holding a Maryland license, in accordance with regulations and well construction standards as promulgated by the Maryland Department of the Environment. All drilling, well construction, and testing shall be supervised by a qualified geologist or hydrogeologist.

Test Drilling

Test drilling shall be geologically logged, to include geologic contacts, formation materials, and water-bearing zone depths and yields. Basic water quality analyses shall be performed in the field to include, as a minimum, electrical conductivity, visual estimation of turbidity, and nitrate-nitrogen. Static water level in test wells shall be measured prior to each drilling day. Successful sites shall be considered those which have a minimum apparent yield at the conclusion of test drilling as follows:

Geologic Unit	Minimum Apparent Yield
Schist/phyllite	30 gallons per minute
Carbonate rock aquifer	70 gallons per minute
Triassic rock aquifer	70 gallons per minute

Production Well Spacing

Unless actual field testing data indicate otherwise, well spacing for permanent production wells shall be greater than the following:

Schist/phyllite aquifer	100 feet
Carbonate rock aquifer	500 feet
Triassic rock aquifer	
• parallel to strike of bedding	1,000 feet
• perpendicular to strike	

of bedding 300 feet

Production Well Construction

All community supply production wells shall be constructed as follows:

- A six-inch, eight-inch or larger diameter hole shall extend to a minimum depth of ten feet below the major water-bearing zone(s).
- Permanent well casing shall extend to a minimum depth of 50 feet when the well is located within 500 feet of a surface water body. Wells located greater than 500 feet from a surface water body shall have a minimum of 30 feet of casing and be a minimum of 5 feet into bedrock. The annular space between the casing and outer hole shall be grouted from the bottom of the casing to the ground surface. Permanent casings shall have a minimum wall thickness and weight in accordance with the following standards:

Diameter (inches)				Weight per foot (pounds)	
Size	External	Internal	Thickness	Plain Ends (Calculated)	Width Threads and Couplings
6	6.625	6.065	0.280	18.97	19.18
8	8.625	7.981	0.322	28.55	29.35
10	10.750	10.020	0.365	40.48	41.85
12	12.750	12.000	0.375	49.56	51.15
14	14.000	13.250	0.375	54.57	57.00
16	16.000	15.250	0.375	62.58	63.30
18	18.000	17.250	0.375	70.59	73.00
20	20.000	19.250	0.375	78.60	81.00
22	22.000	21.000	0.500	114.81	N/A
24	24.000	23.000	0.500	125.49	N/A

- The well shall be thoroughly cleaned and flushed until discharge is clear and free of solids to maximize well efficiency and yield.

Production Well Testing

All production wells shall be tested in accordance with procedures required by MDE. All testing shall be supervised and evaluated by a qualified hydrogeologist/geologist. In addition, the requirements for all community supply production wells shall include the following:

- A step-drawdown test shall be conducted at a pumping rate up to or exceeding the maximum yield capacity of the well. This will enable determinations to be made regarding well efficiency, optimum pumping rates and water levels, correct production pump sizing; and, short-term yield capacity.
- Long-term aquifer yield testing, either by continuous constant-rate or constant-drawdown testing, shall be conducted for a minimum duration as follows:

Aquifer	Testing Period (hours)
Schist/phyllite	96-hour
Carbonate rock	72-hour
Triassic rock aquifer	72-hour

- Water level monitoring data shall be collected in a minimum of two directions from the test well site in locations, which will represent the unique geologic properties of the sites. Monitoring shall include all community supply and observation wells, and selected and accessible representative privately owned wells within a 1,000-foot radius of the test well.
- All water level monitoring shall be conducted using continuous recording devices, supplemented by manual readings every 12 hours.
- Independent water quality testing shall be performed in accordance with the EPA Primary and Secondary Drinking Water Criteria, and include regulated synthetic volatile organic compounds (VOCs) and any additional parameters required by MDE. Water quality sampling shall be conducted near the end of the aquifer testing.

B. Karst Investigation

The purpose of a karst investigation is to identify subsurface voids, cavities, fractures, or other discontinuities, which could pose an environmental concern or a construction hazard to an existing or proposed facility. By definition, karst investigations are required only in areas suspected of containing carbonate rocks. Various methods of investigation are available, the choice of which is dependent upon the extent and depth of the investigation required, as well as cost, available equipment, and the nature of the proposed construction.

Subsurface data may generally be acquired by soil boring and/or drilling, each of which is termed herein as a boring. These field data may then be supplemented by geophysical techniques. The requirements outlined below should not be interpreted as all-inclusive. The design of any subsurface investigation should reflect the size and complexity of the proposed project.

<u>Preliminary Design Data</u>

In order to guide investigation design, and prior to subsurface data acquisition, pertinent site information shall be collected to include the following:

- Bedrock characteristics (type, geologic contacts, faults, geologic structure, rock surface configuration).
- Soil characteristics (type, thickness and mapped unit).
- Photogeologic fracture traces.
- Bedrock outcrop areas.
- Sinkholes and/or other closed depressions.
- Perennial and/or intermittent stream.

Types of Borings

In order to adequately assess the subsurface conditions on a site, both qualitative and quantitative borings may be utilized.

- Percussion Probes - this type of boring provides a rapid qualitative assessment of subsurface conditions. Information acquired includes depth to bedrock, bedrock type, and possible location of voids. Percussion probes are useful for defining initial areas of concern, confirming geophysical methods results, and providing limits for more intense investigation.
- Standard Penetration Tests (SPT) - this type of boring provides quantitative measures of the competency of the subsurface materials. Information acquired includes depth to bedrock, bedrock type, bearing capacity of subsurface materials, material type and void locations if present. SPT evaluations provide information on the mobility of soils as well as the vertical and horizontal extent of problem areas.

Location of Borings

Borings shall be located in order to provide representative aerial coverage of the proposed facilities. The exact location of borings will be based on the following conditions or features:

- Carbonate rock units mapped by the Maryland Geological Survey, the U. S. Geological Survey, or Carroll County.
- On site geologic or geomorphic indications of the presence of Carbonate Rock.
- Photogeologic fracture traces.
- Bedrock outcrop areas.
- Identified sinkholes and/or closed depressions.
- Layouts for proposed structures (i.e. building, roads, stormwater structures, etc.)
- Areas identified as anomalies from any geophysical studies.

Number of Borings

The minimum number of borings per facility shall be dependent upon the size of the proposed facility, with a minimum of five per facility, or five per acre, whichever is greater.

Depth of Borings

Borings shall be extended to bedrock where possible. Where voids or soft soils are encountered, additional drilling may be required.

Logging of Borings

The following data shall be recorded for material penetrated by the boring:

- Description, logging, and sampling for the entire depth of the boring.
- Identification characteristics including, as a minimum, color, mineral composition, grain size, shape, and sorting, and saturation.
- Any stains, odors, or other indications of environmental degradation.
- A minimum of two soil samples, representative of the material penetrated should be collected.
- Depth to bedrock or refusal and the type of bedrock.
- When conducting a SPT, estimation of soil engineering characteristics, including "N" values or estimated unconfined compressive strength.

Identification of Water Table

Any indications of water saturation shall be carefully logged, to include both perched and groundwater table levels, and descriptions of soils that are mottled or gleyed. Water levels in all borings shall be taken at the time of completion and again after 24 hours. Measures should be taken to assure that the boring remains fully open to total depth for these measurements.

Abandonment of Borings

All borings not utilized for other purposes shall be backfilled within 48 hours of completion, in accordance with COMAR 26.04.04.11.

Geophysical Investigation

A geophysical survey may be conducted over the entire area of the facility and extending outward to 200 feet beyond the boundaries of the proposed facility where possible. This survey may be performed to provide a qualitative evaluation of the area to be utilized. The survey results may be used to identify "suspect areas" which will be further evaluated using borings. The use of this technique may reduce the total number of borings for a site by better defining "suspect areas". These data shall then be correlated with boring data in the site area.

Evaluation

Cross sections shall be provided so as to be representative of the site's subsurface. They extend through a central portion of the proposed facility, using the actual or projected boring data and the geophysical data. In addition , a geophysical contour map shall be constructed. Finally, a bedrock contour map shall be developed to include all of the geophysical and boring data. A sketch map or formal construction plan indicating the location and dimensions of the proposed facility and line of cross section(s) shall be included for reference, or as a base map for presentation of subsurface data.

The evaluation should provide interpretations from a qualified individual whose experience is in carbonate rock terrains.

C. Sinkhole Remediation

Proper sinkhole remediation involves a three-step process:

- Investigation.
- Stabilization.
- Final grading.

Various methods of sinkhole remediation are available, the choice of which is contingent upon the scope of the perceived problem and the nature of subsequent land use. Factors such as cost and available equipment and materials must also be considered.

Investigation

The investigation phase should determine the areal extent and depth of the sinkhole. The investigation should also determine the depth and location of bedrock pinnacles upon which sinkhole stabilization may be founded. The investigation may consist of visual inspection, excavation, or installation of soil borings, and may be conducted in combination with geophysical studies.

- Visual Inspection - This is generally useful for smaller sinkholes (less than 10 feet in diameter), where the bedrock "throat" of a sinkhole is entirely visible from ground surface.
- Excavation - Backhoe excavation is commonly useful for small to moderately sized sinkholes (less than 20 feet in diameter), where the throat of a sinkhole is not visible from ground surface. A track hoe, "clamshell," or other type of equipment may be useful where soil depths exceed approximately 15 feet. Unconsolidated material (soil and fill) is removed from the sinkhole until bedrock pinnacles and/or the throat of the sinkhole is visible.
- Soil Borings - Auger, core, airtrack, or other boring equipment is utilized where large sinkholes and/or extensive sinkhole development is anticipated, and critical foundation structures are planned (bridge abutments, major roadways, and structures with loadings concentrated over small areas). This investigation involves a closely spaced boring program to determine the location and depth of bedrock pinnacles and cavities and sinkhole throats.
- Geophysical Studies - Geophysical measurements may be used in conjunction with intrusive methods to further delineate the sinkhole dimensions. Studies include but are not limited to the use of electromagnetic terrain conductivity (EMC), seismic refraction, or resistivity.

Stabilization

Stabilization of sinkholes may involve reverse-grade backfilling, grouting, or subsurface engineered structures.

- Reverse-graded Backfilling - This method is generally useful on small to moderately sized sinkholes. The throat of the sinkhole is excavated, then filled with clean, interlocking, rock material. The stone diameter of the initial fill layer should be approximately one-half the diameter of the throat or cutter width. Above the initial fill layer is placed progressively smaller

diameter clean rock fill up to or near the ground surface. Compaction of each rock grade is essential. Generally a minimum of three gradation sizes of fill are necessary for stabilization.

- Grouting - This method is generally useful for moderate to large sinkholes. Borings are placed in the ground adjacent to the sinkhole and a concrete mix (grout) is injected, either under pressure or gravity, into the subsurface.
- Engineered Subsurface Structures - This method is generally used on larger sinkholes or where concentrated load-bearing structures are anticipated. The technique involves creating a bridge between bedrock pinnacles to form a stable base, above which appropriate construction may be completed.

Final Grading

In order to provide permanent stabilization and prevent groundwater contamination, final grading of the sinkhole location must be completed to avoid infiltration of water from the ground surface. Where structures such as roads, buildings, parking lots, or other impervious surfaces are planned, grading and construction over stabilized sinkholes may proceed as is appropriate. Where open space is planned at stabilized sinkhole locations, the final grading should include the placement of low permeability topsoil or clay and a vegetative cover, with a positive grade maintained away from the sinkhole location to avoid ponding or infiltration.