Chapter 9: The Transportation Plan

The Transportation Plan is another important component of the General Development Plan, along with the Land Use Plan. These two components are interdependent and should be prepared collaboratively so that transportation services and infrastructure will support and promote the land use and development patterns desired.

The County's transportation planning approach focuses on seven key elements:

- Maintenance of the existing transportation facilities inventory to protect public investment in facilities and to support redevelopment and revitalization of the County's neighborhoods and commercial areas;
- Expansion of the transportation facilities inventory to meet the increasing travel demand;
- Emphasis on improving safety for motorists, pedestrians, and bicyclists;
- Provision of alternative means of mobility through increased transit service;
- Implementation of travel demand management strategies;
- Inclusion of emergency management principles in transportation plans; and
- Expansion of pedestrian and bicycle facilities.

The County's key transportation objective is to create a safe and well-managed transportation network that provides greater choice for the traveler and limits or even reduces congestion on the road system. Various roadway improvements, improved regional and local transit, expanded bicycle and pedestrian networks, and improved connections between the different modes will help to lessen reliance on the single-occupancy vehicle and reduce vehicle emissions. Additionally, land use and housing policies supporting mixed-use development, higher densities around transit hubs, and retention of neighborhood retail and services will further promote transit use and help reduce new trips.

Proposals in this Plan that will help accomplish the above include the following:

- A greater County leadership role in the pursuit of regional transportation funding, planning, and improvement strategies, with strong advocacy for sufficient funding to implement local transit and roadway and highway projects.
- Continued monitoring and management of roadway congestion in the County through level of service standards, signal timing, access management, and other means.
- Local roadway and regional highway interchange improvements to increase safety, improve flow and reduce congestion.
- Improved and expanded local bus service, and more accessibility to commuter bus service.
- More accessibility to commuter rail service.
- Continued support of transportation demand management programs and techniques to encourage less driving.
- Continued implementation of the Bicycle and Pedestrian Master Plan to provide an expanded bikeway and sidewalk network and greater overall support for biking and walking.

- Reaffirmation of Goals and Policies of the *1997 General Development Plan* where those Goals and Policies do not conflict with proposed Plan recommendations or in those instances where the 1997 Goals and Policies have not yet been implemented.

The following sections of this chapter present information on the various modes of transportation available in the County today: the highway network, transit service, rideshare and van pool services, airports, and the pedestrian and bicycle network. These are then followed by recommendations for a transportation functional master plan, priority highway improvement corridors, transportation demand management strategies, and other related policies and actions.

Land Use and Transportation Interaction

There is a relationship between land use patterns and the use of transportation facilities. Anne Arundel County is a suburban jurisdiction with identified town centers, extended commercial districts along its major arterial highways such as MD 2 and MD 3, and low density residential uses in other areas.

As a suburban jurisdiction located between the two major urban centers of Washington, D.C. and Baltimore, the transportation investments (both highways and transit) have been made to support travel between those areas through the County. Highway facilities which carry travel within the County experience significant travel demand in part because of existing development patterns and densities. The relatively low residential densities over much of the County make it difficult to support mass transit opportunities and tend to result in longer vehicle trips.

Successfully achieving development patterns that result in fewer vehicle trips and increase public transit viability requires the convergence of land use and transportation facility design as well as a diversity of uses. Combined, these interact to generate shorter-distance person trips which can reduce longer distance automobile travel for work, social/recreational, and other purposes. Facility and land use design must include opportunities for safe pedestrian and bicyclist travel, as incorporated into the design of the roadway as well as the design of the land use.

The Highway Network

The County's highway network consists of approximately 4,850 lane miles of roads and is the predominant mode of travel used by residents and employees in the County. This section describes the roadway Functional Classification system, roadway design considerations, and roadway levels of service under existing and future conditions.

Functional Classification

Transportation planning for highway facilities must consider the relationship between the function of the roadway, the land use pattern served by that facility, and the design of that facility to make it compatible with both the adjacent land use and the type and volume of travel generated by that land use.

The GDP Background Report on Transportation (May 2008) presents a detailed discussion of the functional classification system of highways and roads in the County. Functional classification is the process by which streets and highways are grouped into classes, or systems, according to the character of traffic service that they are intended to provide. Typically, travelers will use a combination of various classes of roadways over the course of their trips.Each type of road has a specific purpose or function. Some provide land access to serve each end of the trip. Others provide travel mobility at varying levels, which is needed en route.

There is a basic relationship between functionally classified highway systems in serving traffic mobility and land access. Anne Arundel County identifies five levels of functional classification:

Freeways are high speed, multi-lane facilities with a high degree of access control. These facilities provide for efficient and uninterrupted travel over long distances serving interstate and commuter needs. They should provide a high level of traffic service for travelers making longer distance trips at high speeds. Freeways provide no direct access to abutting properties.

Principal Arterials serve the needs of through traffic for moderately long trips. They serve the major activity centers in the County and major portions of the trips entering or leaving urban areas. Principal Arterials are the primary travel route for commercial, commuter and recreational travel in rural areas. They also provide secondary linkages between large urban centers and suburban population / employment centers. Access may be controlled through medians or by the limitation of curb cuts through the orientation of access for new developments. Typically, they intersect minor arterials, collector or major activity locations.

Minor Arterials connect higher functional class facilities, activity centers, regions of the area, and major county roads. Traffic is composed predominantly of trips across and within regions of the city. They provide service to traffic at a somewhat lower level of travel mobility than principal arterials with minimal control of access to abutting commercial, industrial and residential properties. Direct access to individual properties and neighborhoods is discouraged.

Collectors provide traffic circulation within neighborhoods, commercial and industrial areas. These roads collect traffic from local streets in neighborhoods and channel it into

the arterial system. Connections between arterials should be indirect or should not be allowed in order to discourage use by traffic from outside the neighborhood.

Local roads are designed specifically to have high accessibility to abutting land and access to the higher classification facilities. They offer the lowest level of mobility and service. Through traffic is deliberately discouraged when possible.

The County's Functional Classification Map of roadways is shown in Figure 9-1. As new roadways are added to the Map, they are classified based on the criteria presented above.

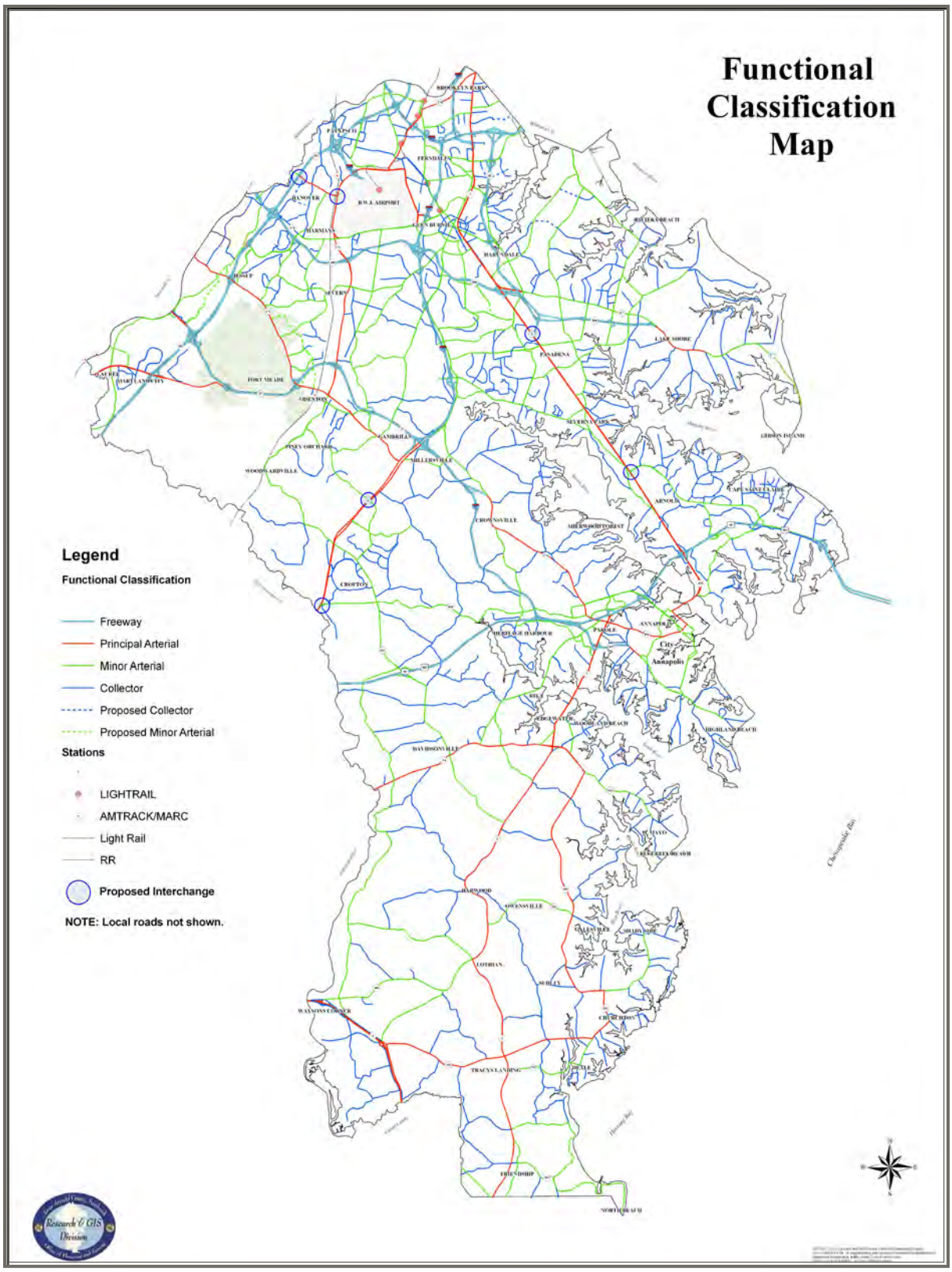
Design of Roadways

Roadways should be designed, or redesigned and constructed, based on their function (access versus mobility), the adjacent land use (right-of-way width and needed appurtenances such as medians, sidewalks, trails, stormwater drainage, design speeds), and volume (sufficient number of travel and turning lanes to meet the anticipated vehicular demand).

Design and redesign of roadways is governed by the County's Design Manual. This manual must be updated to reflect changes in design standards, compatibility with adjacent land use activities, standards for designated evacuation routes, inclusion of pedestrian/bicycle use within the right-of-way and, where appropriate, transit use. In seeing transportation facilities as part of the community rather than a divider of neighborhoods, greater emphasis on context sensitive solutions (or design) should be incorporated into the design and redesign of roadways whether by governments or by the private sector.

The roadway's surrounding environment must be considered in context and physical location during planning and design. The design must consider both the physical constraints as well as the opportunities such as the characteristics of the corridor, the use of the corridor, the destination spots along the way that require safe access for pedestrians to cross, use by bicycles and other non-motorized vehicles or pedestrians traveling along the road, vegetation along the corridor, important viewsheds from the road, the use by bus or light rail transit vehicles, the width of the existing roadway and its fit with its surroundings, presence of historic or especially sensitive environmental features (such as wetlands or endangered species habitats) along the roadway, the road's comparison to other roads in the area, particular features or characteristics of the area that should be preserved (a rural character, a neighborhood atmosphere, or a main street), and the population served by the roadway (elderly, disabled, children etc).

Figure 9–1 Functional Classifications of Roads



Therefore, this Plan makes the following roadway design recommendations:
Actions:

- Update and revise the County's Design Manual and appropriate sections of the Subdivision Regulations to incorporate context sensitive design requirements to promote design and redesign of the County's roadways to be more compatible with the surrounding land uses and the GDP Land Use Plan.
- Establish street design criteria to the extent permitted by State law to support alternative transportation modes to better meet user needs and minimize conflicts between competing modes.

Level of Service

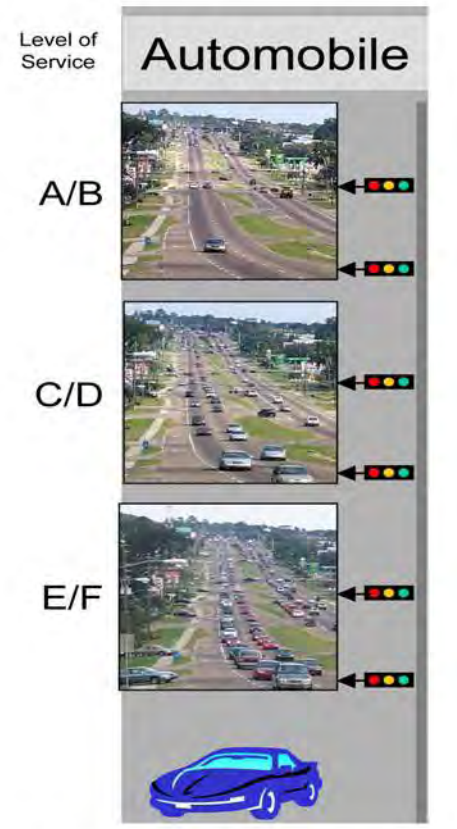
Level of service (LOS) is a grading and evaluation system for the amount of congestion on a roadway, using the letter LOS A to represent the least amount of congestion and LOS F to refer to the greatest amount. The appropriate degree of congestion (that is, the level of service) to be used in planning and designing highway improvements is determined by considering a variety of factors. These factors include the desires of the motorists, adjacent land use type and development intensity, environmental factors, and aesthetic and historic values.

To determine future (anticipated) level of service, the County's travel demand model generates vehicle trips on an average daily basis. There is a relationship between daily travel and peak hour travel demand where daily travel demand generated by the model is compared to the maximum service flow of the roadway based on the road's operating characteristics (numbers of lanes, width of lanes, and number of signals per mile). When that relationship exceeds 80% (generated traffic is 80% of daily service flow), vehicles using the roadway segment could be operating at a lower than acceptable level of service in the peak hour.

Peak-Hour Level of Service

Once an appropriate design speed has been selected, the other basic defining elements of the highway (i.e., the number of lanes and the basic configuration of junctions with other highway facilities) can be determined through application of the concept of acceptable peak hour level of service. For a comprehensive treatment of this topic, refer to the *Highway Capacity Manual*. The graphic shown below offers a visual understanding of the concept.

As mentioned above, a variety of factors are weighed in determining the policy level of congestion for planning and design. The factors must be weighed against the financial resources available to satisfy the motorists' desires. Where possible, the County and the Maryland State Highway Administration (SHA) recommend LOS D as a standard for operation during the peak demand hours. However, this standard is not always achievable, especially in an urban or town center setting.



Source: Florida DOT Quality of Service Handbook, 2002

Maps depicting the relationship of the maximum daily service flow with the observed (for 2005) and the forecast (for 2035) traffic are shown in Figures 9-2 and 9-3, respectively. The County's travel demand model provides daily traffic as its output. That output is the estimated amount of vehicles using a specific segment of a road in a 24-hour period. However, roadways receive most of their use in a smaller segment of time typically referred to as morning or afternoon peaks. It is not uncommon for eight to twelve percent of all daily traffic to use a roadway and its intersections within a one hour time frame. Therefore a relationship between daily and peak demand can exist where the daily flow is less than the total amount of traffic the roadway can absorb in 24 hours, but the peak demand is greater than the roadway can accommodate in a specific hour. The closer that daily volume comes to the amount of traffic the roadway can absorb in 24 hours, the longer the period of time is that motorists using the roadway will have to deal with poor operating conditions worse than LOS D, which is the typical standard for any particular hour. However, in more urbanized and developed areas, LOS D standards are perhaps not attainable, or necessarily desirable. Therefore a better approach may be to establish LOS standards based on the type of land use in the area.

This Plan makes the following recommendation related to roadway level of service:

Action:

- Establish LOS standards based on planned land uses and densities so that the LOS standard may be lower in town centers and urbanized areas where transit and other mobility options are available and higher in rural and less developed areas based on land use recommendations.

Highway Improvement Projects

The output of the travel demand model indicates that several major highway facilities in the County will require upgrades to improve existing levels of service and to meet anticipated travel demand by 2035. These projects are in various stages of planning, design, or construction as indicated in Table 9-1.

Table 9–1 Highway Improvement Projects

Highway Improvement Projects				
LOCATION		**2005 Marked Lanes**	**2035 Proposed Lanes**	**STATUS / COMMENTS**
FROM	**TO**			
I-195 from AA/Baltimore County Line to Terminus				
AA/Baltimore County Line	BW Parkway	4		Initiate Feasibility Study
BW Parkway	MD 170	5		Initiate Feasibility Study
MD 170 East	Terminus	4		Initiate Feasibility Study
I-695 from AA/Baltimore County Line to AA/Baltimore County Line				
AA/ Baltimore County Line	AA County/ City of Balitmore Line	6	8	NEPA/LRP. I-695 to I-195 under construction.
I-895 from MD 2 to AA/Baltimore County Line				
MD 2	AA County/ City of Balitmore Line	4		HNI/LRP
I-97 from MD 695 to US 50				
MD 32	US 50/301	4	6	HNI/LRP. Managed lanes.
MD 176	MD 178	6	8	HNI
MD 695	MD 176	6	8	HNI
MD 100 from Howard County Line to Mountain Road				
Howard County Line	MD 10	4	6	HNI
MD 10	I-97	4	6	LRP
I-97	Mountain Road	4	4	Initiate Feasibility Study
MD 170 (Telegraph Road) from MD 175 to MD 176				
MD 176	MD 100	4	6	HNI
MD 100	MD 32	2	4	HNI
MD 32	MD 175	2	4	HNI
MD 173 (Fort Smallwood Road) from MD 607 to Wagner Station Road				
Wagner Station Road	Edwin Raynor Boulevard	4	4	Initiate Feasibility Study
Edwin Raynor Boulevard	MD 607 (Hog Neck Road)	2	4	Initiate Feasibility Study
MD 174 (Reece Road) from MD 175 to MD 170				
MD 175	MD 170	2	4	LRP
MD 175 (Annapolis Road/Jessup Road) from Howard County Line to MD 170				
MD 170	MD 32	4	5	NEPA
MD 32	MD 295	2	6	NEPA
BW Parkway	Howard County Line	2	4	Initiate Feasibility Study
MD 177 (Mountain Road) from MD 2 to MD 100				
MD 607	MD 100	2		Initiate Feasibility Study
MD 648	MD 607 (Hog Neck Road)	2		Initiate Feasibility Study
MD 648 (B&A Boulevard)	MD 648 (Solley Road)	4		Initiate Feasibility Study
MD 10	MD 648	4		Initiate Feasibility Study
MD 2	MD 10	4		Initiate Feasibility Study
MD 198 (Laurel Fort Meade Road) from Howard County Line to MD 32				
MD 32	MD 295	4		NEPA
MD 295	Prince George's C/L	6		Initiate Feasibility Study
MD 2 from MD 214 to MD 10				
MD 10	College Parkway	4	6	HNI/LRP
College Parkway	US 50	4	6	HNI
US 50	MD 665	6	6	HNI/LRP
MD 665	MD 214	6	6	Initiate Feasibility Study
MD 214 (Central Avenue) from MD 253 to MD 468				
MD 253	MD 468	2	4	CIP
MD 295 (BW Parkway) from Prince George's County Line to I-695				
Prince George's County Line	MD 175	4	4	National Park Service road
MD 175	Arundel Mills Interchange	4	6	Constructed
Arundel Mills Interchange	MD 100	4	6	Constructed

Table 9–1 Highway Improvement Projects

Highway Improvement Projects				
LOCATION		2005 Marked Lanes	2035 Proposed Lanes	STATUS / COMMENTS
FROM	TO			
MD 100	I-195	4	6	NEPA
I-195	I-695	4	6	LRP/ Under construction.
MD 3 (Robert Crain Highway) from MD 175 to MD 450				
MD 175	MD 450	6	6	NEPA / Interchanges.
MD 32 from Howard County Line to MD 175				
Howard County Line	MD 295	4	8	LRP
MD 295	MD 175	4	6	Initiate Feasibility Study
MD 4 from Calvert County Line to PG County Line				
Calvert County Line	MD 259	4	4	Access Controls
MD 259	MD 408	4	6	HNI
MD 408	PG County Line	4	6	HNI
MD 424 (Davidsonville Road) from MD 3 to Rutland Road				
Rutland Road	MD 450	2	2	Initiate Feasibility Study
MD 450	MD 3	2	4	HNI / Feasibility
MD 607 (Hog Neck Road) from MD 173 to MD 177				
MD 173	MD 177	2	4	HNI / Feasibility
MD 177	MD 100	2	4	CIP / Construction
MD 665 (Aris T. Allen Blvd.) from US 50 to Forest Drive				
US 50	Forest Drive	4	4	CIP / Construction
MD 713 (Ridge Road) from MD 175 to MD 100				
MD 175	MD 100	2	4	LRP
US 50 from Bay Bridge to MD 3				
MD 3	I-97	6	8	Managed Lanes
I-97	MD 665	6	8	HNI/LRP/ Feasibility
MD 665	MD 179	6	8	HNI/LRP/ Feasibility
MD 179	Bay Bridge	6	8	Requested Study
Benfield Boulevard from Veterans Highway to Benfield Road				
Veterans Highway	Benfield Road	2	4	Feasibility
Benfield Boulevard from Veterans Highway to Robinson Road				
Veterans Highway	Robinson Road	4	4	Feasibility
Forest Drive from MD 665 to Hill Top Lane				
MD 665	Hill Top Lane	4	6	CIP
Hanover Road from MD 295 to MD 170				
Howard County Line	MD 295	2	4	NEPA / Interchange
MD 295	MD 170	2	4	NEPA
Magothy Bridge Road from MD 2 to MD 177				
MD 177	MD 100	2	4	CIP / Construction
MD 100	Edwin Raynor Boulevard	2	3	Feasibility
Edwin Raynor Boulevard	MD 648	2	3	Initiate Feasibility Study
MD 648	MD 2	2	3	Initiate Feasibility Study
Robinson Road from Benfield Road to MD 2				
Benfield Road	MD 2	2		Feasibility

Figure 9–2 2005 Transportation Level of Service

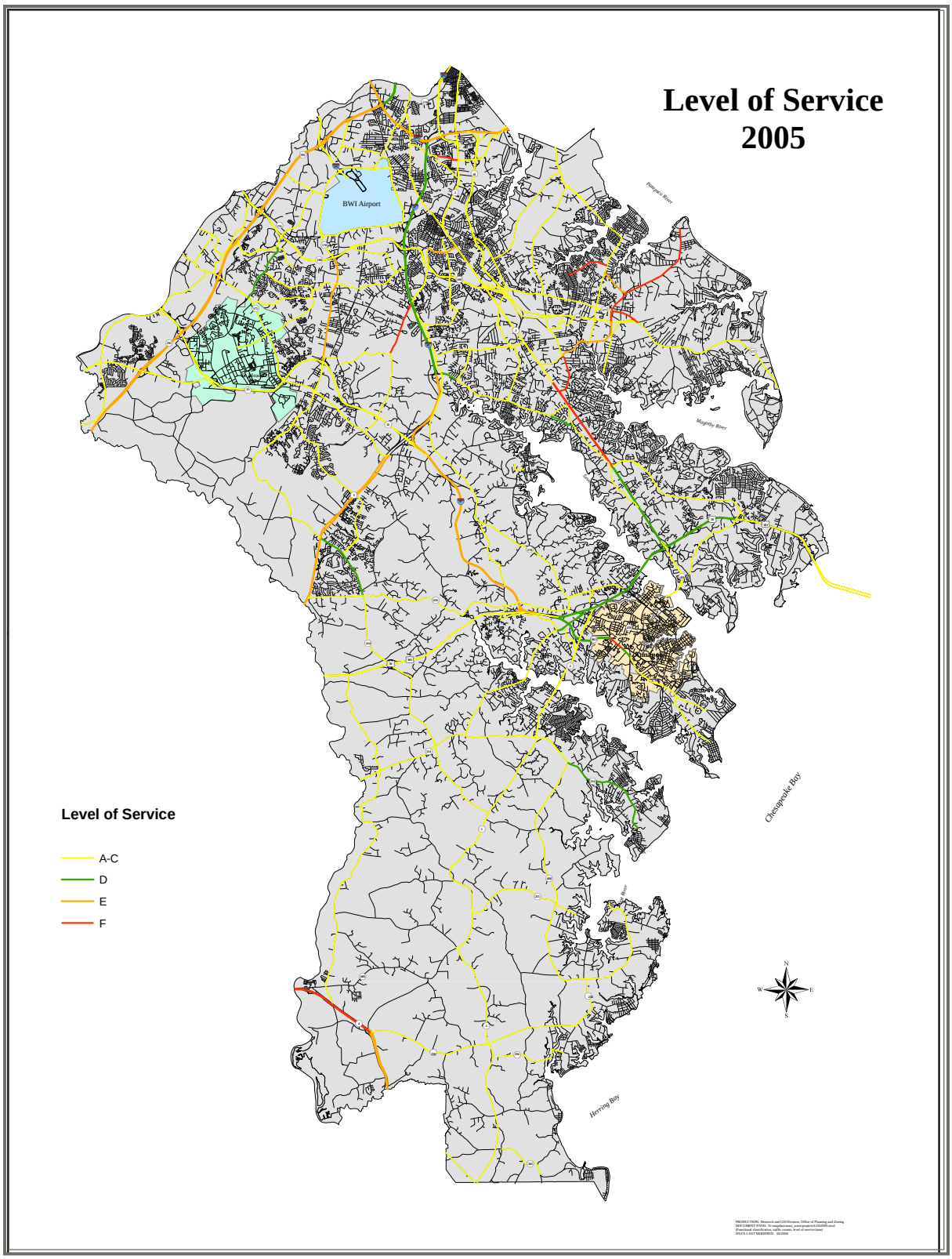
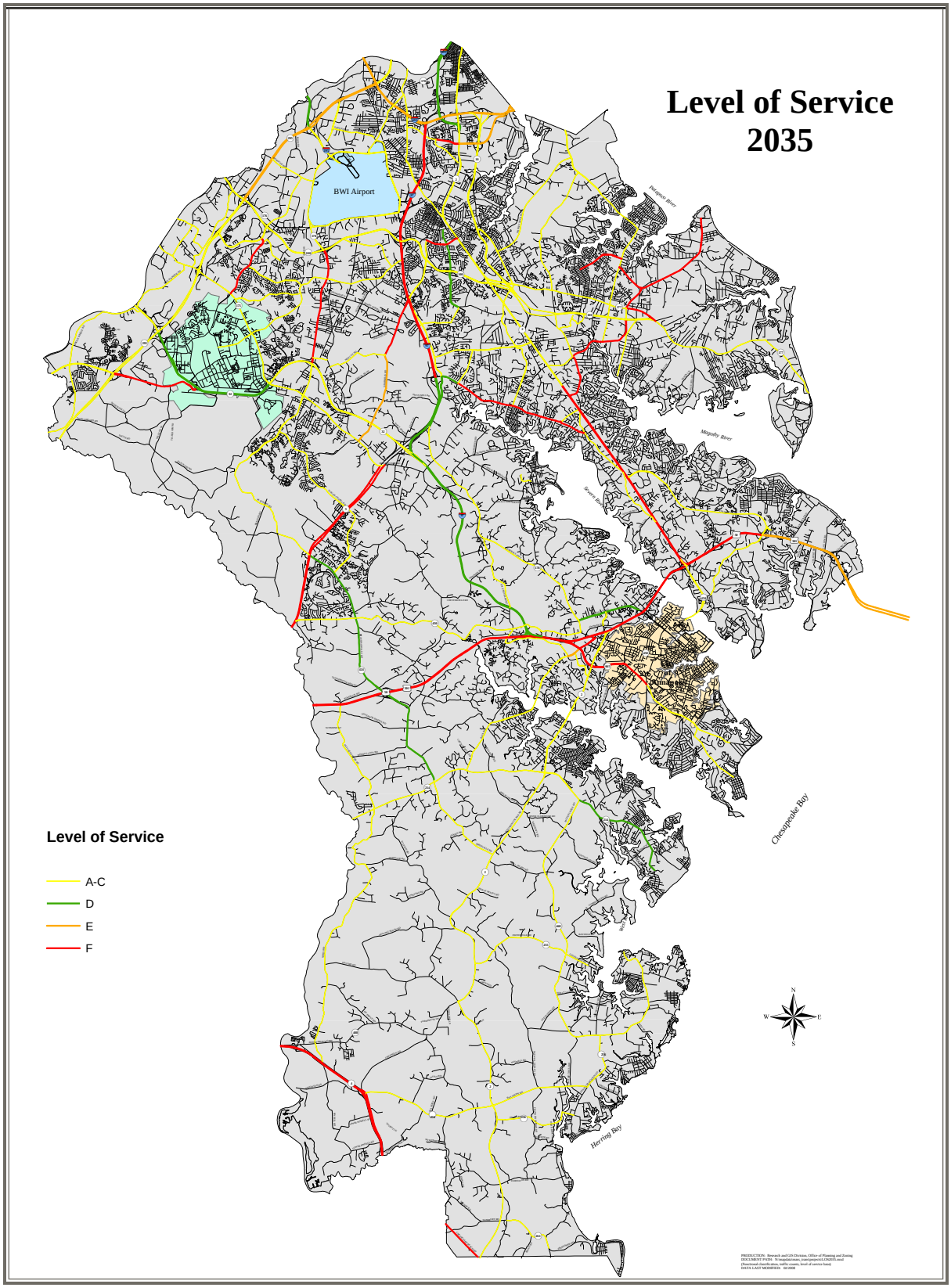


Figure 9–3 2035 Transportation Level of Service Forecasts



In general, projects on major highway facilities are identified through analysis and programmed for construction through three stages in State methods:

- Consolidated Transportation Program (CTP) which is the State of Maryland's capital budget document identifying all funds to be expended (Federal, State, local and other) on State-owned facilities. The document has a six-year horizon.
- The Long Range Plan (LRP) which identifies projects arrayed over a longer span of time, and although funds are not presently identified for all phases of project development (planning, design, right-of-way acquisition and construction) there is a reasonable assumption that these activities will occur over the 30-year span.
- The Highway Needs Inventory (HNI) which is limited to highway facilities for which there is an assumed need to plan, design and construct improvements over a longer span of time beyond known funding

Projects are typically noted in the Highway Needs Inventory, moved into the Long Range Plan as funding becomes reasonable to assume, and finally identified in the Consolidated Transportation Program when funding becomes available. Once a project has been funded, an environmental impact study is typically required during the preliminary design stages in accordance with the National Environmental Policy Act (NEPA).

In addition to the State process, the County has funded State facilities either in total or in part using impact fees, general obligation bonds, taxing districts and other forms of revenue generation. Those projects appear in the County's Capital Improvement Program (CIP).

Transit Service

Transit in the County is provided by both fixed guideway (rail) and by bus transit. Bus transit is provided both in terms of State operated commuter and fixed route transit by the Maryland Transit Administration (MTA) and locally operated transit systems provided by the City of Annapolis Transit (AT) and by the Corridor Transportation Corporation (CTC). Both AT and CTC receive operating subsidies from the County to offset the cost of providing routes within County areas. The County is preparing a Transit Development Plan (TDP) which is required by MTA for transit funding purposes. The TDP will identify areas underserved in the County and recommend priorities to deliver transit service.

The long term intent is to combine management of the fixed route County-operated services with the demand-response and specialized transit operated by the Department of Aging and Disabilities. This action will improve the coordination of services and reduce duplication of effort.

Equally important in providing transit services are the landside support elements of transit. Among those are transit-oriented development opportunity areas, intermodal centers, sidewalks, lighting, bus passenger shelters, and park and ride lots.

Figure 9-4 presents a Transit Investment Corridor (TIC) Map showing recommended transit facilities and/or corridors for transit investment, intermodal center locations, and fixed route bus service. The TIC Map recommends that major highway corridors be designed or redesigned to be transit compatible to offer higher quality transit service connecting major activity centers in the County and connecting the County to regional activity centers outside the County, such as using Solomons Island Road-Governor Ritchie Highway (MD 2) from Edgewater to I-695 as a means of connecting to Baltimore and John Hanson Highway (US 50-US 301) from Parole to Bowie and the HOV lanes as a means of connecting to the Washington Metropolitan Area, as examples.

Fixed Guideway Transit

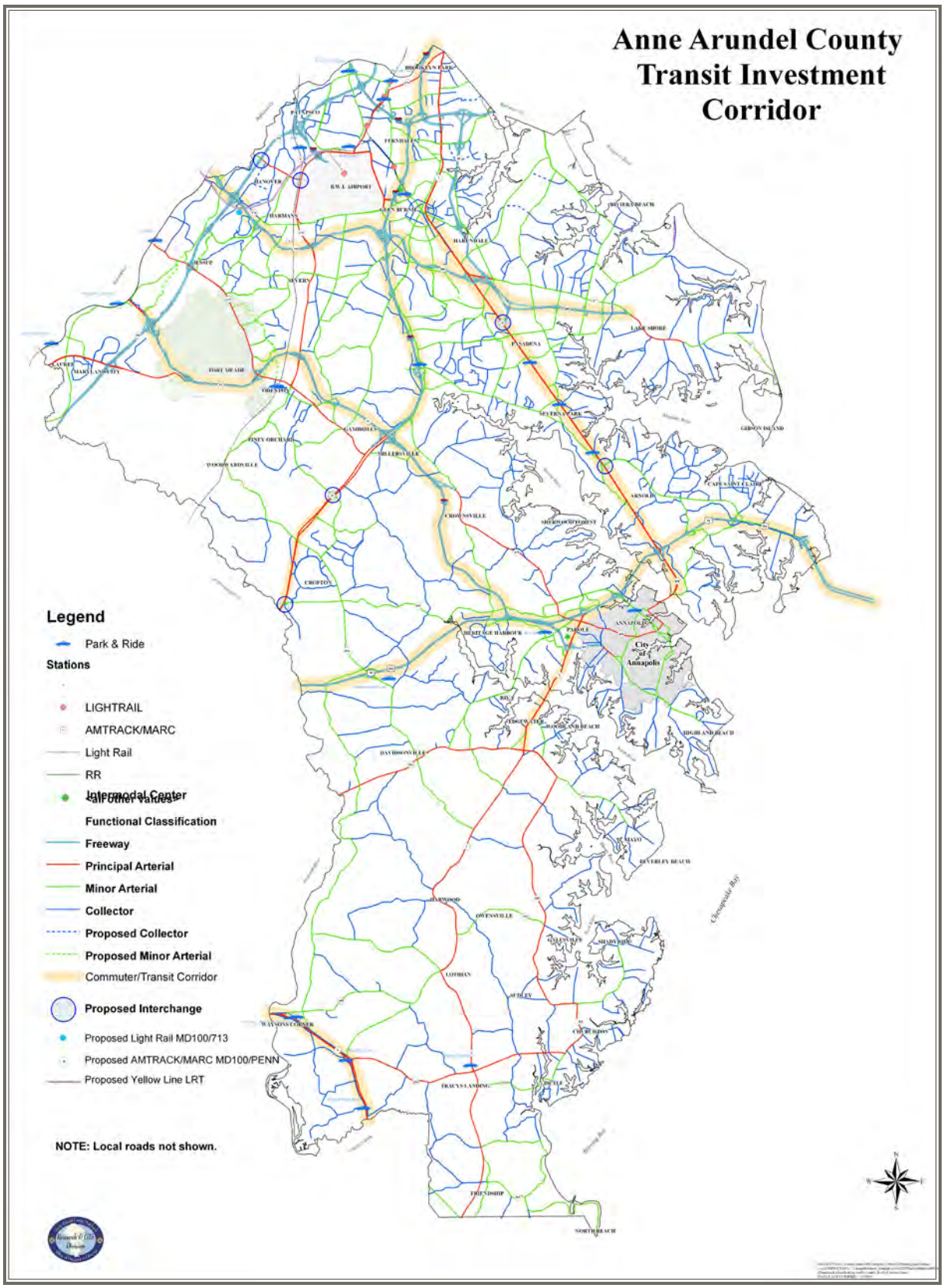
Light Rail Transit Anne Arundel County is served by seven Light Rail stations. Located at Nursery Road, North Linthicum, Linthicum, the BWI Business District, the BWI Thurgood Marshall Airport, Ferndale and Cromwell Station/Glen Burnie, these stations offer daily connections both to and from the City of Baltimore and beyond. As part of a regional process, the County participated in the Baltimore Regional Rail Plan. That plan included a proposed extension of the Yellow Line from the BWI Business Park to the Dorsey Road MARC station on the Camden Line and ultimately connecting Columbia in Howard County.

The GDP Transportation Plan includes this alignment and recommends its implementation between the BWI Business Park Light Rail Station and the Dorsey MARC station.

Maryland Rail Commuter System In addition, Anne Arundel County has easy access to five MARC Commuter Rail Stations as well. BWI and Odenton are located on the Penn line. Dorsey, Savage and Jessup are situated on the Camden or CSX Line. Combined, these stations accommodate approximately 3,700 riders per day via the Penn and Camden Lines. The Odenton Station, on average, accounts for more than 50% (2,100) of that ridership, followed by BWI with 1,300 daily riders. The predominant travel pattern for commuters utilizing MARC trains continues to be from Anne Arundel County southward toward the Washington metro area.

Combining the growth in employment opportunities in the Washington Metro Area with the increasing financial and environmental costs of operating an automobile for work trips and the congestion on roadways leading into the Washington Metropolitan Area, this Plan recommends improving accessibility to MARC stations by adding a Penn Line station and additional road access, parking, pedestrian / bicycle facilities, and bus transit connections.

Figure 9–4 Transit Investment Corridors



Bus Transit

Anne Arundel County is served by various operators and different styles of bus transit service. Among these are traditional fixed route service to Baltimore, commuter bus services connecting to Washington, D.C. and the WMATA Metrorail System, and community based smaller fixed route services provided by Annapolis Transit and by Corridor Transportation Corporation's Connect-A-Ride (CAR) service offering neighborhoods access to transit via smaller buses.

The County's vision is to tailor transit services to the areas they serve and to augment the services provided by MTA with circular routes connecting neighborhoods with desired employment, transit, and activity centers. The vision in South County is to offer demand-response style services to provide mobility to those persons residing in areas where traditional transit would be cost prohibitive.

Maryland Transit Administration Presently, MTA operates three commuter weekday only bus routes (921, 922 and 950) between Anne Arundel County and the Washington metro area. Originating on Kent Island and in Annapolis, these three routes alone currently accommodate nearly 2,400 passengers per day, the majority of which board at the Harry S. Truman Park & Ride. The MTA 14 bus route offers service extending from the Patapsco Light Rail Station to the City of Annapolis, concentrating mainly on the MD 2 corridor. Likewise, the MTA 17 bus route serves as a connection between the BWI Business District and the Arundel Mills Complex. Both the 14 and 17 routes offer service seven days a week.

Corridor Transportation Corporation (CTC) Connect-A-Ride CTC provides transit service to Laurel, Jessup, Maryland City, Arundel Mills, Odenton, Glen Burnie, Pioneer City, and Seven Oaks in the western portion of the county, as well as Edgewater, South River Colony, Shadyside and Deale to the south. CTC operations costs are covered through a combination of Federal, State and County grants, plus revenue generated from passenger ticket sales. Routes operated by CTC under its Connect-A-Ride services link the County with Prince George's, Montgomery and Howard Counties. Since capital assets of transit (such as garages and vehicles) are not owned by the County, the cost of operating these routes is increasing in direct correlation with the depreciation costs of assets owned by CTC's operator. Those cost increases do not reflect the increased cost of fuel, insurance or labor costs, which account for nearly 80% of the hourly cost to provide transit service.

Annapolis Transit Annapolis Transit (AT) services the greater Annapolis area (including Arnold and Edgewater) as well as the BWI Thurgood Marshall International Airport. The system consists of three (3) shuttle routes and one fixed route system comprised of eleven (11) individual routes. Ridership equates to over 1.3 million passengers annually. AT funding comes from a combination of Federal, State and local sources, as well as an operating subsidy grant provided by the County. Census statistics and definitions used by the U.S. Department of Transportation have recently changed, resulting in the City

of Annapolis losing a significant percentage of operating subsidy funds previously made available because of its status as a small, urbanized area. The loss of this funding will most likely impact the extent of service AT is able to provide in the future.

Since the County remains a mostly suburban area with established residential and commercial activity centers, bus transit will remain the major opportunity to improve mobility choices for residents and workers because of its cost to initiate and operate ,and its flexibility.

Bus transit provides a major opportunity to improve mobility choices for residents and workers.

This Plan recommends implementing the recommendations for bus transit found in the Transit Development Plan and providing the landside infrastructure (such as sidewalks, street lighting, bicycle racks, park and ride lots, and pedestrian safety improvements) which are necessary to promote transit use. The Transit Development Plan Map is shown in Figure 9-5.

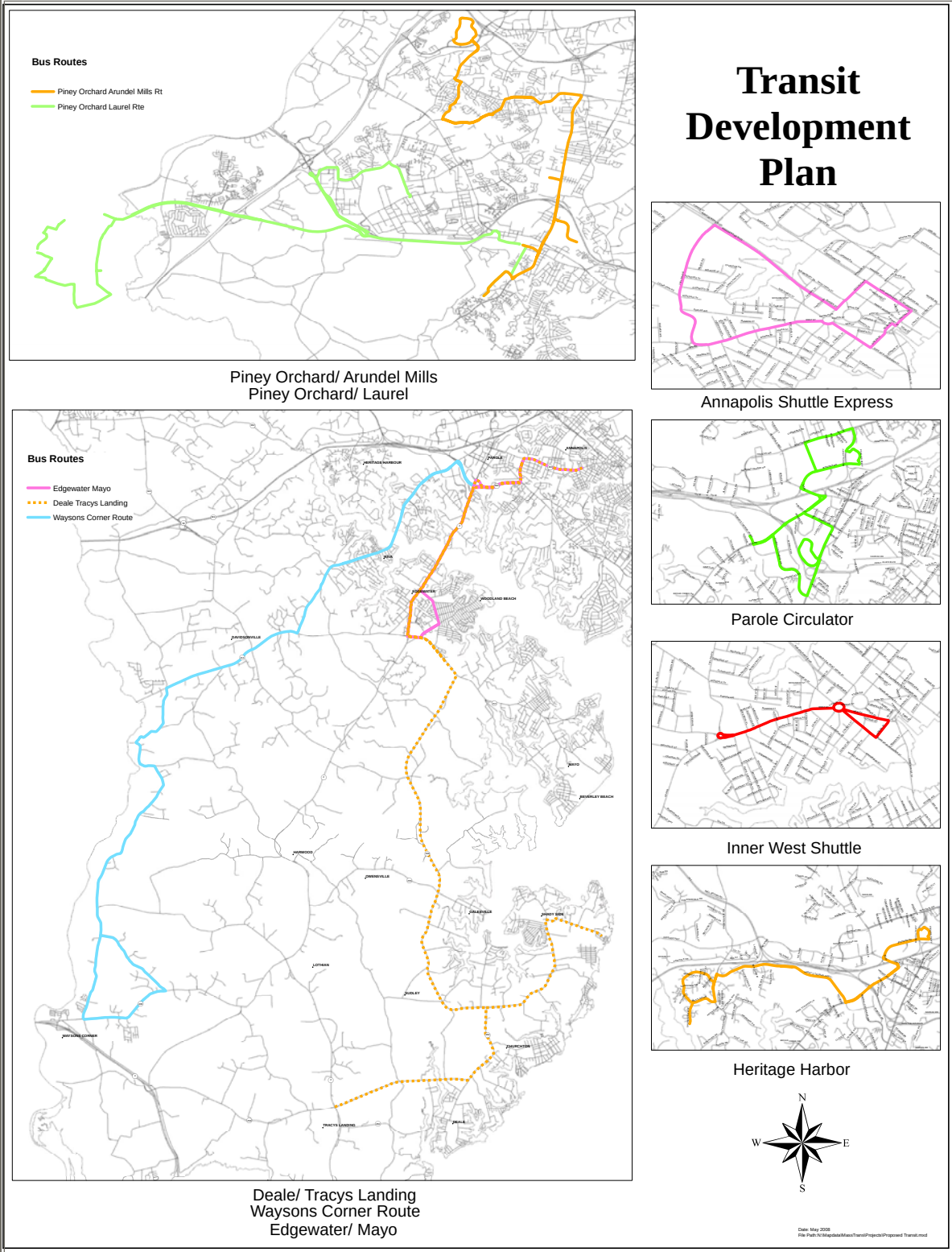
This Plan recommends consolidating transit activities under a single agency to promote coordination of services and reduce confusion among existing and potential users of the mode. It is also recommended that the County obtain the capital assets necessary to operate fixed route and demand-response bus transit. These assets would consist of bus vehicles, radio equipment, computer aided dispatch equipment, automatic vehicle location devices, and a maintenance facility combined with Howard Transit so that the County can eliminate hourly depreciation expenses currently being paid to its contractors. Eliminating these hourly costs will increase the dollars available to provide transit service as recommended by the Transit Development Plan.

The Plan also recommends facilitating development in the vicinity of existing and planned transit nodes through improved access; focusing growth in areas served by existing or planned transit including rail stations and intermodal locations; encouraging improved access, increasing parking availability, and feeder bus service between rail stations and employment areas; and promoting development and revitalization areas that are in scale with the transit provided.

In addition, the Plan recommends the completion of a MARC station feasibility study in the vicinity of MD 100 along the Penn Line to promote the location of a new station where additional access to the line would be possible through park and ride, connecting bus transit, trails, and transit oriented land use activities.

In summary, this Plan makes the following recommendations related to transit service:

Figure 9–5 Transit Development Plan



Actions:

- Combine management of fixed route County-operated services with the fixed route, demand-response and specialized transit operated by the Department of Aging and Disabilities.
- Extend the Baltimore Light Rail Yellow Line from the BWI Business Park Station to the Dorsey MARC Station.
- Improve accessibility to MARC stations by adding a Penn Line station, road access, parking, pedestrian/bicycle facilities, and bus transit connections.
- Implement the recommendations for bus transit found in the Transit Development Plan and provide the landside infrastructure (sidewalks, street lighting, bicycle racks, park and ride lots, and pedestrian safety improvements) necessary to promote transit use.
- Consolidate transit activities under a single agency to promote coordination of services and reduce confusion among existing and potential users.
- Obtain the capital assets necessary to operate fixed route and demand-response bus transit. Sources could be impact fees, utility fees, and bonds.
- Evaluate possible revisions to the impact fee regulations to allow the fees to be used for transit-related projects.
- Facilitate development in the vicinity of existing and planned transit nodes through improved access; focusing growth in areas served by existing or planned transit; encouraging improved access, increasing parking availability, and providing feeder bus service between rail stations and employment areas; and promoting development and revitalization areas that are in scale with the transit provided.
- Identify and, to the extent feasible by law, protect the alignment of the Yellow Line of the Baltimore Central Light Rail Line from BWI Airport to the Dorsey MARC Station.
- Complete a MARC station feasibility study in the vicinity of MD 100 along the Penn Line to promote the location of a new station where additional access to the line would be possible.

Rideshare Car and Van Pooling

With more than 500,000 citizens and over 12,800 employers, Anne Arundel County has one of the state's largest work forces. Subsequently, the County is constantly experiencing an increase in travel demand, leading to congestion of both the highway and transit network if the demand is not effectively managed. An estimated 112,000 county residents commuting outside of the County for work, combined with 144,000 in-county commuters and an influx of 82,000 commuters from neighboring jurisdictions put a constant strain on county infrastructure. To relieve this strain, the County uses two private concerns

to both administer and promote rideshare, car and van pool opportunities within the County.

The Annapolis Regional Transportation Management Association (ARTMA)

In cooperation with both the Maryland Transit Administration (MTA) and the County, ARTMA manages a comprehensive ridesharing program for residents of Anne Arundel County. The mission is to promote transportation options and transit expansion throughout the County while increasing mobility, reducing traffic congestion, and improving air quality as well. The service areas include Annapolis, Parole, Severna Park, Crofton, Crownsville and the entire South County area.

Baltimore/Washington International Business Partnership (BWIP)

Similar to ARTMA, BWIP promotes ridesharing, carpooling and point-to-point van service via Congestion Mitigation/ Air Quality (CMAQ) funding both in and around BWI-Thurgood Marshall International Airport, as well as the Odenton and Glen Burnie Town Centers.

In order to meet the demands for commuter transportation programs and services brought on by increasing residential and commercial development, this Plan recommends the following actions:

Actions:

- Continue to promote rideshare, carpooling, and van pooling strategies to support transit use and offer options beyond the use of single occupant automobiles for mobility.
- Increase employer and resident awareness of rideshare programs, strategies, and opportunities.
- Require use of TDM strategies to reduce vehicle trips generated by new development as a condition of mitigation.

Airports

There are two publicly –owned airports located in the County providing regional, national, and international air service.

BWI Thurgood Marshall International Airport

Accommodating over 21 million passengers annually, this is the largest airport in the State. Owned by the State of Maryland and operated by the Maryland Aviation Administration (MAA) the airport is located in Linthicum, approximately 10 miles south of

Baltimore and 30 miles north of Washington D.C. Close proximity to the Baltimore/ Washington Parkway, Fort Meade and NSA have helped make the airport one of the biggest economic engines in Maryland, serving the federal government, technical, and hospitality and tourism industries.

Tipton Airport

Transferred to the County in 1999 as the result of an earlier BRAC recommendation, Tipton Airport is located south of Fort Meade and operated by the Tipton Airport Authority, a facility management entity that is appointed by the County Executive. Over one hundred aircraft are based at the facility that handles approximately 150 aircraft arrival/ departures daily. Current parameters include the utilization of a 3,000-foot runway with approved permits to extend the length of that runway to 4,000 feet and increase the amount of hangar space to accommodate larger turboprop aircraft.

The following recommendations are made in relation to air service:

Actions:

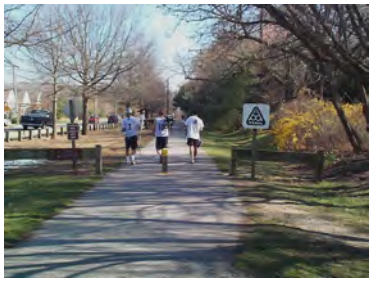
- Accessibility to airports provided by surface transportation facilities should be maintained, and as necessary, improved to protect the competitiveness of these facilities that support the County's economic development. Accessibility improvements should include transit and pedestrian/bicycle facilities as well as highway capacity increases.
- Land uses near the airports should be monitored to prevent the compromise of the operations of these necessary facilities.

Pedestrian and Bicycle Network

In 2003, the County Council adopted the *Anne Arundel County Pedestrian and Bicycle Master Plan*. Meant to encourage the integration of bicycle and pedestrian facilities into the roadway design and development review process, the ultimate goal of the Plan is to provide a safe, alternate means of mobility which offers economic, environmental, recreation/health and quality of life benefits. The Plan also promotes bicycle safety through education of both adults and children and creates an organized structure to implement bicycle and pedestrian programs and projects. The Plan strives for cohesion with other planning tools such as the *Greenways Master Plan*, the adopted Small Area Plans, the City of Annapolis Take-A-Step Map, the Maryland Statewide Greenway Atlas, and the *Maryland Statewide Bicycle and Pedestrian Plan*.

The Plan identifies corridors for pedestrian/bicycle facility location and areas where pedestrian activity should be supported through the construction of appropriate amenities such as sidewalks, street lighting, pedestrian ramps, and crosswalks. The Transportation Facilities Planning program funds design studies for pedestrian and bicycle facilities.

The County currently affords residents approximately 30 miles of existing multi-use trails including the Baltimore & Washington Trail, BWI Trail Park, Chesapeake Beach Rail Trail, South Shore Trail, Poplar Trail, Kinder Park Trail, Quiet Waters Park and Annapolis Colonial Maritime Trail. The West County WB&A Trail is adding segments as well. As a whole, opportunities for on-road bicycling are inadequate, due to a lack of striped bicycle lanes, designated bicycle routes, funding, rights-of-way and logical connections between desired origins and destinations. Topography and drainage infrastructure, high speed traffic flow and scenic/historic road designations all limit opportunities. More than one third of all travel in the County is less than two miles in length. Improving the bicycle and pedestrian network, making it safe to use and offering connections between local activity centers such as schools, shopping centers, and other public facilities can serve to reduce automobile use, promote personal mobility and offer a healthier choice to the County's residents.



A map illustrating the County's adopted Pedestrian/Bicycle Master Plan is provided in Figure 9-6. This map also displays the County's trail network.

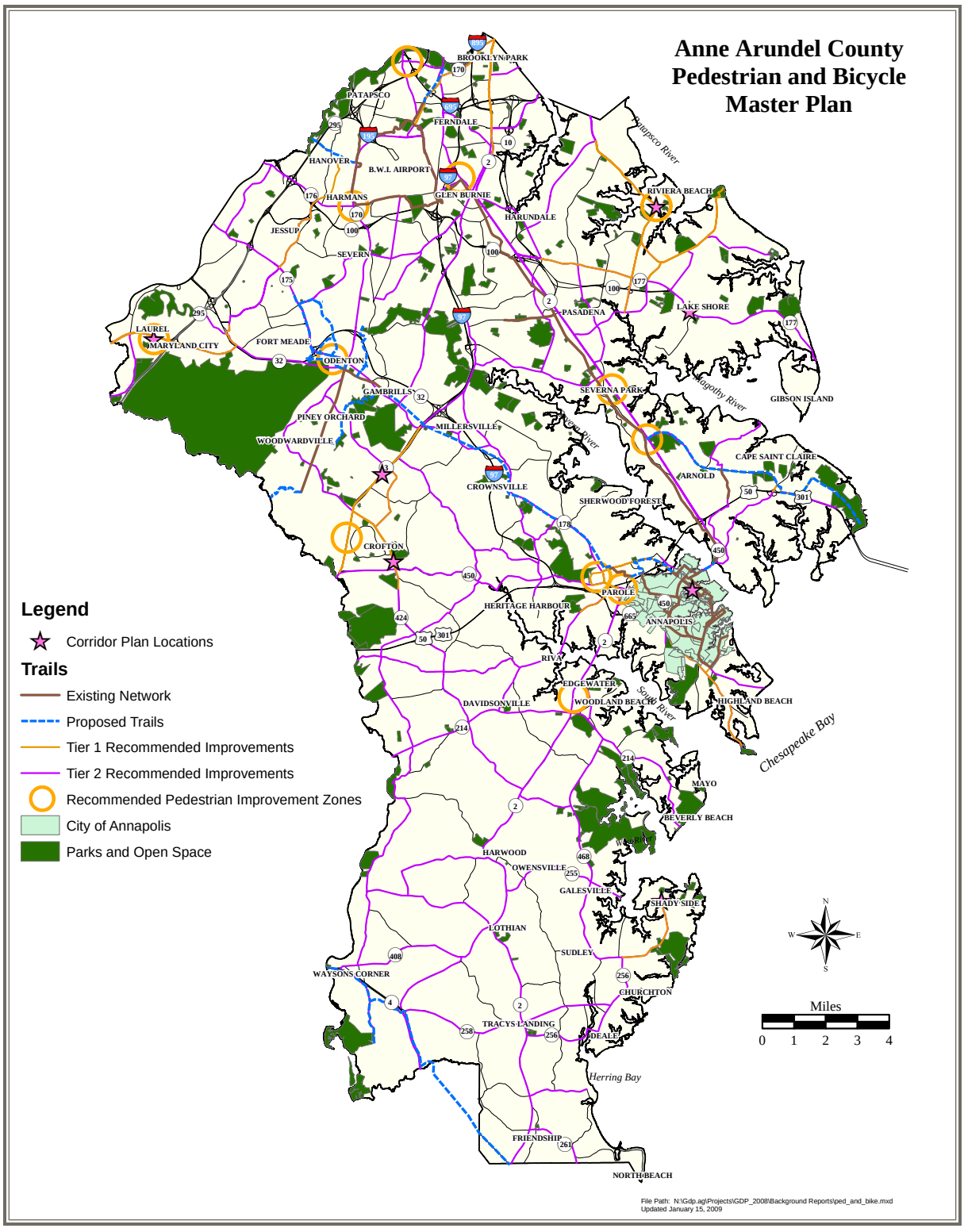
Mobile Source Air Quality

A result of the interaction among transportation (specifically fossil fuel burning vehicles), land use activities and the climate is an overall impact on the quality of the County's ambient air. Mobile source emissions (automobiles, trucks, buses, etc) amount to an ever smaller, but still significant component of oxides of nitrogen, volatile organic compounds, and particulate matter which combine to generate low-level ozone.

Anne Arundel County is a participating member of the Baltimore Regional Transportation Board (BRTB) which consists of the cities of Annapolis and Baltimore as well as Anne Arundel, Baltimore, Carroll, Harford and Howard Counties. Anne Arundel County, as a jurisdiction within the Baltimore region is considered an air quality nonattainment area. The BRTB has a Federal requirement under the Clean Air Act Amendments of 1990 and the Transportation Reauthorization legislation to ensure that federal air quality standards are maintained for federally funded transportation projects in the Baltimore region. Therefore, the federally funded transportation projects, which are identified in the Baltimore Region's Long Range Plan must meet the Federal air quality standards and demonstrate that these projects do not promote a further degradation of the Region's ambient air quality.

Anne Arundel County includes many projects that improve air quality in the Long Range Plan. Since most of the transportation projects that must be constructed in the County over the next 30 years require federal funding up to 80% of the cost, air quality conformity is very important as projects will not be funded from Federal sources without a declaration of conformity. Beyond specific federal requirements, a more aggressive pursuit of strategies is recommended to reduce emissions from mobile sources.

Figure 9–6 County Pedestrian and Bicycle Master Plan



This Plan recommends the initiation of an "awareness" program to make the employers, residents and County employees aware of Transportation Demand Management (TDM) services. Transit and ridesharing informational literature can be made available to potential, active and retired County employees as part of information they are currently receiving from the County such as paychecks. Active employees could receive information about air quality (Code Red and Code Orange Days as "popups") on their computers as well. The information could be made available to the general public at County buildings including libraries, the County's website and information that is already sent out by the county such as water bills. Public broadcasting such as the County Council meetings could also be utilized to disseminate information as appropriate.

Specific cost effective programs for County employees should be considered and implemented where they are appropriate. These could include providing priority parking spaces for carpoolers and subsidizing transit passes. Departments could implement flexible work schedules, where appropriate, similar to those that are being implemented by the private sector and County and State governments. Telecommuting (providing the option to work one or more days a week from a location other than a person's primary office) could also be implemented.

This Plan also recommends a review of the County's existing practices regarding generation of emissions. Among these practices are County equipment purchasing procedures. Priority should be given to purchasing vehicles that are fuel efficient and produce lower rates of emissions of hydrocarbons, oxides of nitrogen and particulate matter (soot). This would include all trucks, buses, utility vehicles, and generators, or any other equipment that uses fossil fuel to produce energy. It would also include information to employees about fuel conservation which also leads to reduction in emissions. These could include fueling vehicles early in the morning and not mowing grass on Code Red or Orange days.

Since mobile source emissions are related to land use patterns, this Plan also recommends reviewing existing land use codes and regulations, providing incentives for development of in-fill lots, promotion of areas designated for Transit Oriented Development, establishment of maximum number of parking spaces in areas served by transit, and implementation of transit service and pedestrian connection improvements to help mitigate development-generated vehicle trips, where feasible.

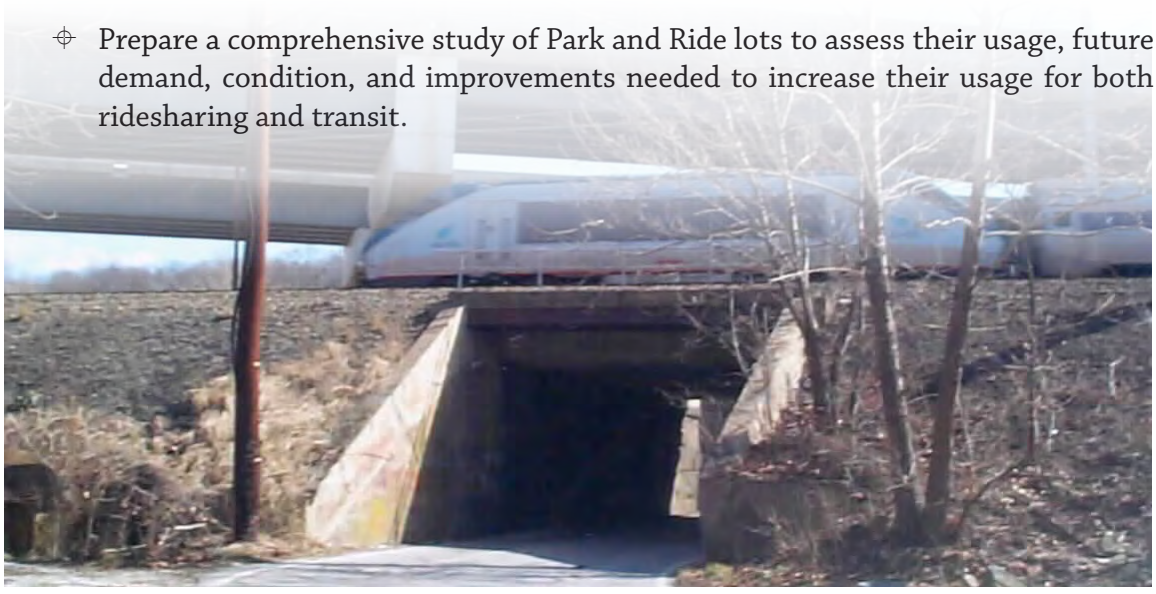
The County should also identify larger private sector employers (over 100 full time employees) and work with them to implement TDM programs through ARTMA and BWI Business Partnership. They should include transit information for their employees, guidance to find ride sharing information and incentives that the company could provide to encourage the use of transit (subsidized bus passes or preferential parking near the building for carpoolers).

Finally, the Plan also recommends the preparation of a comprehensive study of the Park and Ride lots. The study would identify current usage and future demand to determine lots that need to be expanded as well as the condition of the lot to determine improvements that are necessary to increase their usage for both ridesharing and transit. These could include such things as sidewalks, bike racks, benches, lighting and shelters. Information could also be obtained as to the potential location of new facilities.

In summary, the Plan makes the following recommendations related to mobile source air quality:

Actions:

- Initiate an "awareness" program to make the employers, residents and County employees aware of Transportation Demand Management (TDM) services.
- Consider and implement specific cost effective programs for County employees where they are appropriate, such as priority parking spaces for carpoolers, subsidizing transit passes, flexible work schedules, and telecommuting.
- Review the County's existing practices regarding generation of emissions and adopt strategies to reduce emissions. These should include purchasing vehicles that are fuel efficient and produce lower rates of emissions, and providing information to employees about fuel conservation.
- Review existing land use codes and regulations and provide incentives for development that reduces the number of vehicle trips, where feasible.
- Identify larger private sector employers (over 100 full time employees) and work with them to implement TDM programs through ARTMA and BWI Business Partnership.
- Prepare a comprehensive study of Park and Ride lots to assess their usage, future demand, condition, and improvements needed to increase their usage for both ridesharing and transit.



Plan Recommendations

Jobs, mobility, and economic prosperity are the kind of benefits that we typically attribute to a good transportation system. While considerable attention has been focused on environmental impacts that may result from transportation, little has been said about the multitude of environmental and societal benefits that do result from transportation. These benefits include a system that is designed to be compatible with its adjacent land uses and activities; a system which offers mobility options (automobile, rideshare and van pool, bus and rail transit, biking and walking); and a system that promotes both economic and physical vitality. Planning, monitoring and improving that system promotes this outcome. However, the opposite course of action where travel demand exceeds available capacity and there are little or no other options beyond an overburdened highway network can jeopardize these benefits.

The Transportation Plan proposes recommendations that can be implemented to balance mobility with accessibility, safety, environmental impact and cost to construct and operate trails, roads, and transit.

Transportation Functional Master Plan

The embodiment of the recommendations found in this Plan will be evaluated in greater detail through the preparation of a Transportation Functional Master Plan (TFMP). Among the issues to be addressed in greater detail in the TFMP are the following:

- Relationship to land use in the County: The County's and the Region's land use patterns and activities generate both the desire for mobility and the need for accessibility leading to conflict and the requirement to establish a hierarchy. The impact of this process on transportation facilities and land use patterns must be evaluated in a comprehensive fashion.
- Relationship to land use and activity centers in the Region: The Baltimore and Washington regions have multiple activity centers (residential, commercial, governmental, transportation, etc). They generate travel through, into and out of the County. Total travel demand within the County must account for these locations and must consider their impact on the overall County surface transportation network.
- Revised forecasts County wide: Changes in land use both within and in the vicinity of the County will result in changes in travel demand and must be considered when making recommendations about functional classification of facilities as well as numbers of highway lanes or type of transit.
- Enhanced forecasts per corridor: This same effort must be included in evaluation of travel demand within corridors of the County. Physical changes in each of these

corridors can result in changes in travel demand along parallel or perpendicular corridors and should be not studied separately.

- Priority Highway Improvement Corridors Program (PHIC): The TFMP will initiate studies by highway corridor preparing detailed recommendations using the known tool box of potential improvements ranging from additional travel lanes, access control and/or management, system signalization, transit, pedestrian/bicycle connections, and potentially zoning and land use design overlays.
- Transit Investment Corridors (TIC): Provision of improved or initial transit needs to be part of any overall transportation plan. Adjacent land uses both in terms of density and activities, right-of-way availability, connectivity to other transit facilities, and land side supporting infrastructure must all be considered and evaluated in a larger Countywide context and in far greater detail than would be possible in a policy-level plan.
- Coordination and Promotion of Improved Transit Services: As noted earlier in this Plan, transit services in the County are provided by State, County, municipal and private sector sources. Better coordination of these services, coupled with improvements along the Transit Investment Corridors, will be necessary to implement improved services throughout the County and provide better connections to regional activity enters in both the Washington and Baltimore areas.
- Changes to Facility Design (sidewalks, on-road biking, multipurpose trails): While a policy plan can offer recommendations about the need to change facility design to meet current needs, that plan cannot examine the impact of these changes comprehensively and in a fashion needed to alter current Design Manual standards. Changes to facility design for roadways including a documented need for sidewalks, on-road bicycle space, and multipurpose trails are necessary to meet assumed land uses, activities and densities as recommended in the Plan.
- Changes in timing of dedication / reservation: Combined public costs associated with right-of-way acquisition for all transportation facilities (highways, fixed guideway transit, dedicated bus transit lanes, sidewalks, multipurpose trails, etc) continue to mount as the County's current policy of reservation requirements are only extended to projects with identified construction funding. By linking travel demand, facility type, number of lanes and added appurtenances to the Design Manual, the TFMP will help to identify longer term right-of-way needs and make informed recommendations about land requirements.
- Context Sensitive Design: Construction and reconstruction of transportation facilities must occur to support adjacent land use activities. Town Centers and revitalization areas should not be divided by suburban style roadways, but should be drawn together by facilities that support those land uses. Roadways must be designed to accommodate all parties using that right-of-way including motorists, bicyclists, pedestrians, and transit riders, regardless of their age and skill.
- Motorist, Bicyclist, and Pedestrian Safety: Currently the County ranks between third and fifth among Maryland's counties for various categories of fatalities and severe accidents caused by various actions. While this is fairly consistent with total annual vehicle miles traveled, it is far too high based on the County's population.

Comprehensive evaluation of crash locations, and examination of the motorist and pedestrian policies which could lead to reductions in crashes and incidents will be included in the TFMP.

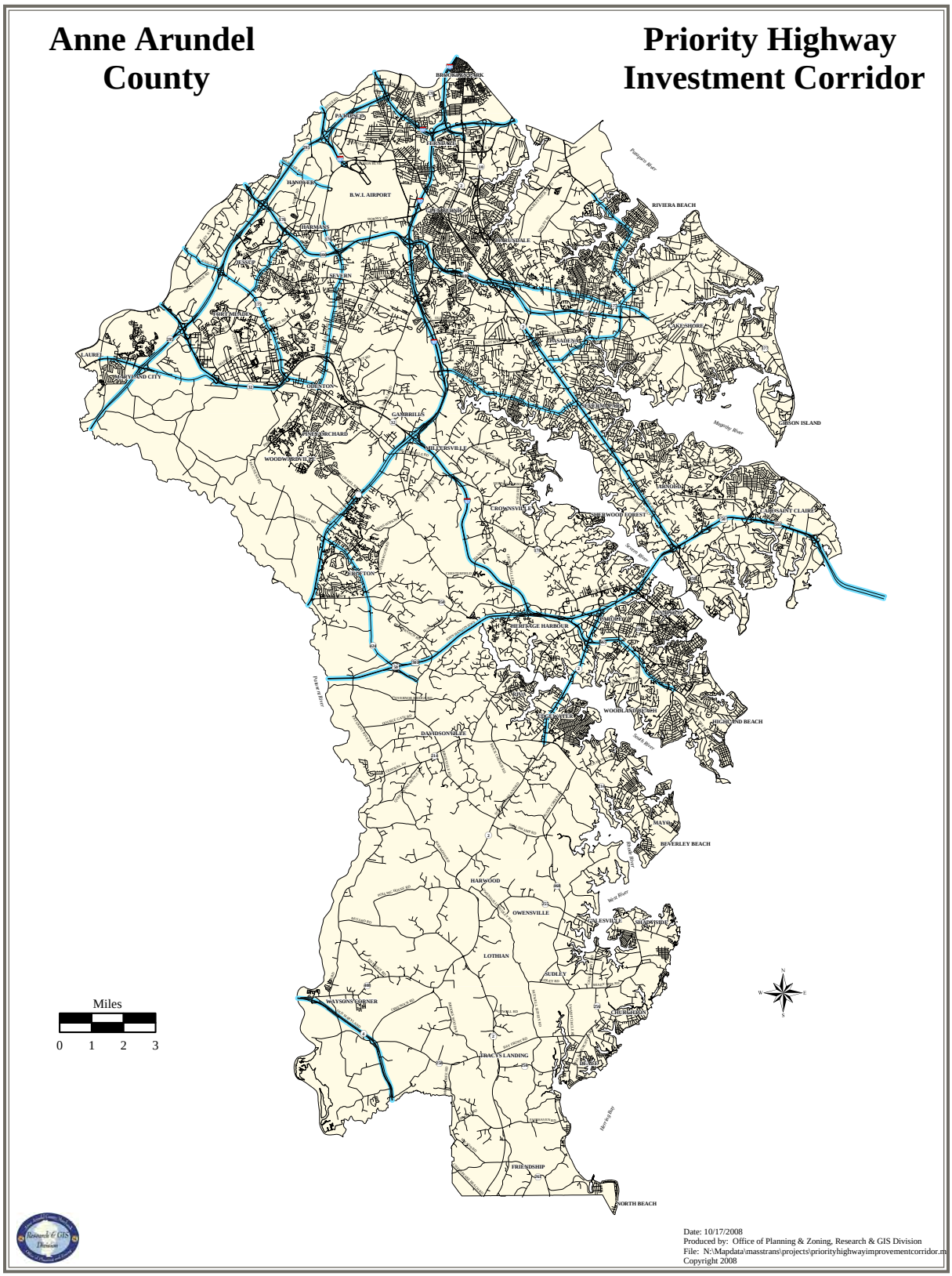
- Parking structures and Park & Ride Facilities: Car pooling and transit usage are identified at the policy level as strategies to reduce congestion, conserve fossil fuels, and promote a cleaner environment. The extent of land used to support parking needs to be evaluated on a Countywide basis. As the County's Transit Oriented Development Program advances and areas of the County experience economic revitalization, provision of parking must be evaluated as well. Areas where parking facilities are necessary to promote these goals must be identified and preserved in a rational fashion based on informed recommendations.
- Input to Capital Improvement Program: The GDP Background Report on Transportation demonstrated a need to improve facilities to meet future travel demand. The PHIC and TIC elements of the TFMP will provide detailed recommendations for improvements to both State and County facilities. The TFMP will provide an informed process to identify projects to be included in the County's Capital Improvement Program as well as the MDOT Construction Priority Letter.
- Sources of Funding: Cost to plan, design, acquire right-of-way and construct projects will require a fundamental change in how projects are presently funded. Among the obvious sources to consider are impact fees, fees in lieu of construction, special funding districts, developer exactions, increment financing and other innovative sources of capital financing.
- Intergovernmental Coordination: The County relies on State funding, as virtually all of the major transportation facilities in the County are maintained by the State of Maryland. It must coordinate with the City of Annapolis with regard to transit service in the Parole, Arnold and Edgewater areas, as well as interjurisdictional issues with ownership of the highway network. Further, the County must also work with adjacent counties and with Federal agencies to achieve common goals. The TFMP will identify methods to improve intergovernmental coordination both within the County and with adjacent jurisdictions.

Priority Highway Improvement Corridors

The Background Report on Transportation provided tables and graphics identifying forecast future travel demand along the major facilities that comprise the County's highway network. On average, the network can accommodate much of the anticipated growth in travel demand. However, there are several segments where travel demand will exceed the hourly capacity of the facilities. In those cases, congestion (lack of mobility) is expected to occur. Where the demand far exceeds the hourly capacity, the duration of this congestion will be much longer.

This Plan recommends the creation of Priority Highway Improvement Corridors (PHIC), as identified in Figure 9-7. The concept of PHIC is to apply the entire tool box of demand management, access management, transit, pedestrian safety, and geometric improvement strategies to accommodate the anticipated travel demand.

Figure 9–7 Priority Highway Investment Corridors



It is doubtful that a single set of strategies can be applied across the entire table of PHIC, so it is recommended that the Transportation Functional Master Plan (TFMP) address each of these corridors in a specific fashion.

In addition to preparing corridor specific recommendations in the TFMP, this Plan recommends configuring or re-configuring street patterns to improve traffic flow and turning movements in balance with safety considerations and to widen roadways only when necessary to accommodate travel demand where no other option is available.

Transportation Demand Management Strategies

Congested streets and roadways result when too many people use the same routes at the same time, particularly during peak commuter hours or special events. The term "demand" refers to the amount of street or road use during a given time period. Transportation Demand Management (TDM) programs focus on changing or reducing travel demand, particularly at peak commute hours, instead of increasing roadway supply. Thus, TDM makes more efficient use of the current roadway system. With the right incentives (or disincentives) travelers can be influenced to use transportation systems in a way that contributes less to congestion. In fact, Federal Highway Administration research around the country indicates that well-designed TDM programs can reduce vehicle trips by as much as 30 or 40%. Travelers base their travel choices on a number of important motivators including the desire to save time and money, to reduce stress or to improve convenience. At least some of these motivations must be addressed to encourage a change in habits. Some of the most promising TDM programs emphasize coordination with local employers on measures such as car or van pooling programs, bus pass subsidies, alternative work schedules, telecommuting options and parking management. Studies also indicate that congestion pricing is an especially effective approach, which should gain favor as congestion worsens and new variations on the concept are developed. The GDP identifies some strategies below.

Transportation Demand Management (TDM) programs focus on changing or reducing travel demand, particularly at peak commute hours, instead of increasing roadway supply.

Public Information about Transportation Encourage development and distribution of transit information through printed materials, kiosks, web sites, radio and television broadcasts, and other means. Provide transit information on the County's website, at County offices open to the public and through other dissemination means. Include transit access information on County meeting notices and in notices for County-permitted events, and encourage merchants to provide transit information in their advertisements and in their places of business.

Transit Information Dissemination Encourage development and distribution of transit information through printed materials, kiosks, web sites, radio and television broadcasts, and other means. Provide transit information on the County's website, at

County offices open to the public and through other dissemination means. Include transit access information on County meeting notices and in notices for County-permitted events, and encourage merchants to provide transit information in their advertisements and in their places of business.

Utilizing Transportation Technology Use the most effective technologies in managing the County's roadways and congestion. For example, support timed connections at transit hubs and promote the use of transportation information systems.

Identify Transit Needs Work with transit providers to identify underserved neighborhoods and population groups and advocate for expanded service in those areas and populations.

County and Regional Support for Transportation Demand Management (TDM) Programs Identify cost-effective Anne Arundel County TDM programs for County employees. Serve as a resource to employers wishing to implement TDM by providing information through printed materials, workshops and other means. Encourage smaller employers to "pool" resources to create effective TDM programs. Support regional efforts to work with employers to provide TDM programs.

County Survey of Transit Needs In County-sponsored surveys of residents, seek transit satisfaction levels when appropriate and feasible.

Intelligent Transportation Systems (ITS) Intelligent Transportation Systems are part of the national strategy for improving the operational safety, efficiency, and security of our nation's highways. Since the early 1990s, ITS has been the umbrella under which significant efforts have been conducted in research, development, testing, deployment, and integration of advanced technologies to improve the measures of effectiveness of our national highway network. Deployment of these technologies requires coordination with both State and municipal transportation agencies, both in terms of highway and transit operations. These measures include level of congestion, the number of accidents and fatalities, delay, throughput, access to transportation, and fuel efficiency. A transportation future that includes ITS will involve a significant improvement in these measures while remaining environmentally friendly and assuring the safety and security of the traveling public. The GDP recommends consideration of ITS application wherever possible to reduce congestion and improve information and system operation.

Other Goals, Policies, and Actions

The following goals, policies, and actions are Countywide and integrate transportation with the other elements in this Plan such as land use and environmental stewardship.

Goal: Provide a safe, efficient and affordable multimodal transportation system in Anne Arundel County.

Policy 1: Promote and encourage a transportation system that adequately and safely serves the public, minimizes negative environmental impacts, and supports the county's land use goals.

Actions:

- Prepare and adopt a Transportation Functional Master Plan (TFMP) that addresses roadway, bicycle, pedestrian, and public transportation modes, and that includes a financial plan to implement proposed improvements over the next ten years. The TFMP should include the following components: relationship to land use and activity centers in the county and the region, linkages between transportation modes, a priority highways investment corridors program, transit investment corridors, transit services, facility design, timing of highway dedication/reservation, context sensitive design, transit and highway corridor overlays, motorist and pedestrian safety, parking structures and park and ride facilities, capital improvement program, funding sources, consolidation of transit operations, connections to public facilities, emergency management, and intergovernmental coordination.
- Identify the purpose and need to conduct a highway corridor study of US 50 / 301 between Prince Georges County and Queen Anne's County in cooperation with State, Federal and local transportation agencies.

Policy 2: Explore extension of transit along major transportation corridors.

Actions:

- Study feasibility of transit, including bus transit and rail transit, along corridors as identified in the GDP and TFMP.
- Identify locations for intermodal centers.
- Conduct feasibility study for the extension of light rail to other areas of the County.
- Study the feasibility of adding stations on the commuter rail line.
- Revise the Impact Fee Program to allow a portion of transportation impact fees to be dedicated for expansion or improvements to public transit.

Policy 3: Promote carpooling, vanpooling, transit programs, and improvements to park-and-ride lots.

Action:

- Conduct periodic public workshops, neighborhood meetings, staff reports, and other means to disseminate information about available programs.

Policy 4: Provide public information and education on local transportation conditions, safety behavior, issues, and improvement options.

Actions:

- Work with transit providers to identify underserved neighborhoods and population groups and evaluate them for the potential inclusion in the transit system.
- Conduct a traffic and transportation workshop annually to update the public on conditions and proposed improvements.

Policy 5: Improve the efficiency of personal travel by providing more options to reduce current dependency on automobile use.

Action:

- Encourage high occupancy vehicle (HOV) lanes, carpooling, flexible work schedules, telecommuting, subsidized transit passes, and stricter parking controls as means to reduce traffic congestion.

Policy 6: Improve transportation and utility infrastructure in the vicinity of BWI and Tipton airports.

Action:

- Improve vehicular and transit access to BWI and Tipton airports.

Policy 7: Improve coordination of transportation services in the County

Action:

- Consolidate transportation activities (highway, bridge, transit, sidewalks, demand management) into one department providing a single agency to deliver transportation services in the County.

The following goals, policies and actions will serve to encourage the integration of bicycle/pedestrian facilities into the roadway design and development review process.

Goal: Create and maintain a pedestrian and bicycle-friendly community with a convenient and efficient multi-modal system.

Policy 1: Continue implementation of the Bicycle and Pedestrian Master Plan to provide an expanded bikeway and sidewalk network and greater overall support for biking and walking.

Actions:

- Develop a program for prioritizing the maintenance of existing pedestrian facilities based on pedestrian use and connectivity as well as maintenance need, and secure funding sources for its implementation.
- Monitor progress in implementing the pedestrian-related goals and objectives of the *Bicycle and Pedestrian Master Plan* on an annual basis.

Policy 2: Ensure an interconnected community that provides multi-modal access to all neighborhoods.

Actions:

- Establish and/or maintain sidewalks, trails, context-sensitive street design, and community-oriented transit services.
- All new streets should connect, wherever possible, to existing streets as well as future potential developments.
- Provide safe corridors for pedestrians and bicycles throughout communities.
- Include transit shelters in neighborhoods and business developments along designated routes.
- Identify publicly owned properties in the vicinity of transit stations that could be used for joint public / private development.

The following goal, policy, and actions encourages flexibility in design to promote compatibility with the character of the area but does not recommend any design that sacrifices pedestrian, bicyclist, or motorist safety.

Goal: Design and improve the road network to further land use, community preservation, environmental (both the natural and built environment) protection, public safety, and neighborhood compatibility goals.

Policy 1: Monitor and manage Anne Arundel County's transportation system to reduce existing traffic congestion.

Actions:

- Support efforts to configure or re-configure street patterns to improve traffic flow and turning movements in balance with safety considerations and impacts on the environment.
- Establish street design criteria to both support and eliminate conflicts between alternative transportation modes. Update road design standards for all road functional classifications.
- Seek funding for circulation and safety improvements needed and to maintain or improve traffic level of service.
- Incorporate integration of emergency evacuation route planning when designing or redesigning and constructing transportation facilities.

Chapter 10: The Water Resources Plan

Introduction

The State of Maryland has long considered protection and preservation of the Chesapeake Bay and its tributaries to be a high priority. Stewardship of the Chesapeake Bay is one of the seven core visions of the Maryland Economic Growth, Resource Protection and Planning Act of 1992 that served as a guide to current local comprehensive planning throughout the State.

In 2006, the State General Assembly adopted a new planning legislation that requires a Water Resources Element (WRE) to be incorporated into local governments' comprehensive plans by 2009. The principal purpose of the WRE is to address the relationship between planned growth and its impacts on area water resources. Specifically, the WRE must address: 1) the adequacy of the County's water supply to meet current and future needs; 2) the adequacy of the County's wastewater treatment capacity, septic supply, and stormwater management capacity to meet current and future needs; and 3) the impact that meeting these needs will have on area water resources. The flow chart in Figure 10-1 illustrates the steps required to complete the WRE analysis.

This Water Resources Plan describes the current planning framework for watershed protection and provides a summary of the County's water supply and wastewater treatment capacities, septic systems, and stormwater management capacity. The Plan also summarizes the analysis that was conducted to show the impact of nutrient loads on the watersheds for existing conditions, conditions based on the current land use plan and conditions based on the proposed land use plan. In addition, the Water Resources Plan outlines a mitigation plan that is consistent with the watershed protection goals and strategies outlined in Chapter 5 on Environmental Stewardship.

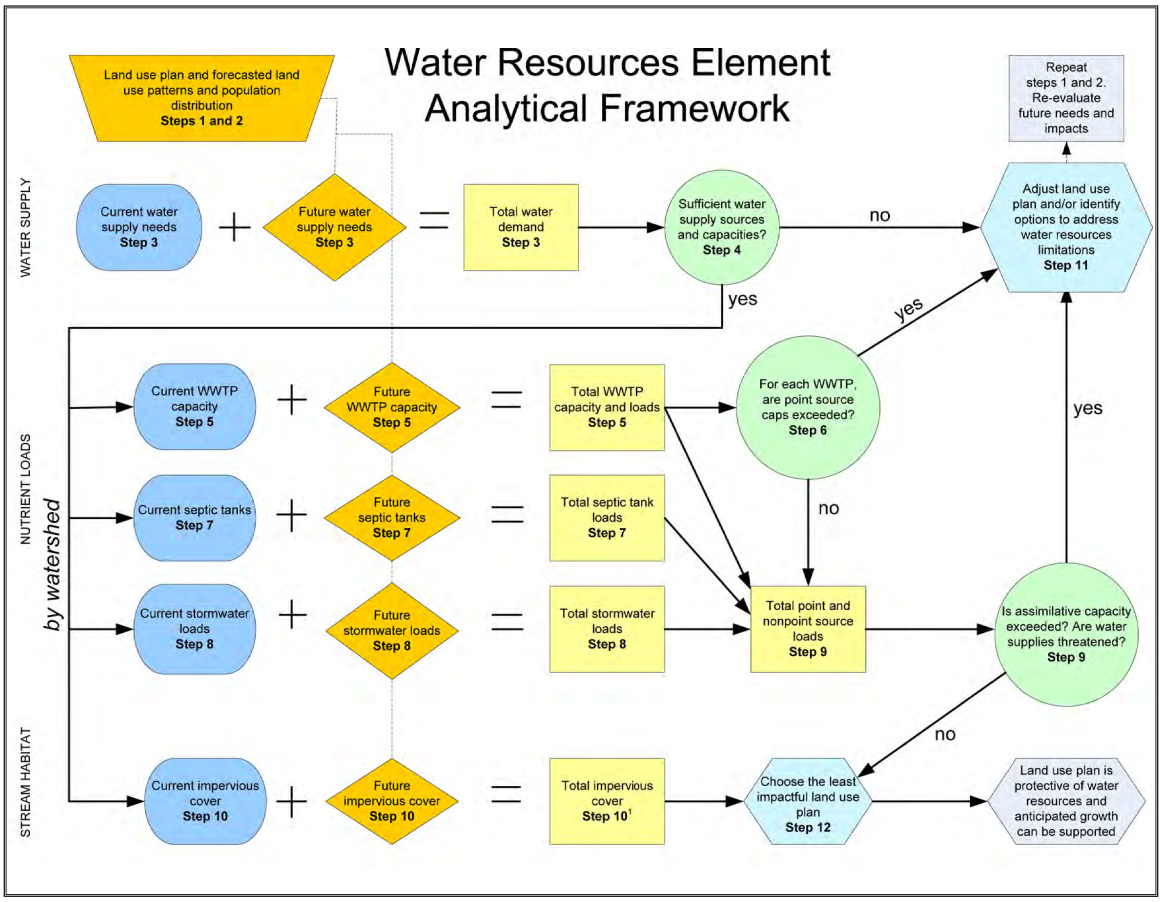
While this Plan accomplishes the milestone goal of quantifying the stormwater, septic, and wastewater treatment facility impacts and establishing the assimilative capacity criteria of all watersheds to receive pollutants from the various sources, the Water Resources Plan will continue to be developed and implemented over the coming years until it can be demonstrated that the pollutant loading associated with ultimate build out conditions meets the regulatory water quality standards.

Planning Framework for Watershed Protection

Over the last twenty years, the County has made strides in watershed protection through various plans, programs, and regulations that are in place to comprehensively approach the solution to water quality impairments. These include: the General Development Plan, the Water and Sewer Master Plan, Stormwater regulations, Subdivision regulations, Watershed Management Plans, Erosion and Sediment Control Program, Enhanced Nutrient Removal at Water Reclamation Facilities, Agricultural and Woodland Preservation Programs, Greenways Master Plan, Chesapeake Bay Critical Area Program, Wetland and Floodplain Management regulations, In-Stream & Biological Monitoring Program, Wellhead Protection Program, Wastewater Industrial / Commercial Pretreatment Program,

the Capital Improvement Program, Onsite Sewage Disposal Systems study and implementation plan, and participation on Maryland's Tributary Strategy Teams.

Figure 10–1 Water Resource Element Analytical Framework



General Development Plan

The *1997 General Development Plan* recognized the threat to water quality from overflow of pumping stations, failing septic systems, untreated thermal runoff from roads and other impervious surfaces, and other contaminates into creeks and rivers. Several key goals and recommendations were adopted to lessen the threat of pollution and improve water quality conditions. The County's *2009 General Development Plan* carries these goals forward and formulates sound policies for watershed protection. Additional strategies for enhanced protection or restoration, as well as incentives to promote conservation are also provided.

Water and Sewer Master Plan

The Anne Arundel County *Water and Sewer Master Plan* includes goals, objectives, policies, and procedures as well as background information, descriptions of facilities and service areas, population and flow projections, strategies for facility optimization, and policies

to address problem areas in both water supply and sewerage systems. The most recent update to the Water and Sewer Master Plan was completed in 2007 and reflects the land use policies of the *1997 General Development Plan*, the 16 Small Area Plans, the Town Center Plans and related planning policies that focus on protection of water resources.

Stormwater Regulations

Regulations requiring stormwater management implementation are linked with land development and other land disturbing activities. The County's stormwater management requirements are within the County Code and are implemented through the County's *Stormwater Practices and Procedures Manual*, which is a comprehensive tool that provides specific design requirements; procedures and documentation requirements for stormwater management plan submission, and requirements for stormwater management facility maintenance and inspection. The manual currently encourages environmentally sensitive design (ESD) and infiltration of runoff rather than collection and conveyance to a downstream pond or stream. The County Code and the *Stormwater Practices and Procedures Manual* will be updated accordingly to meet the new requirements of the State's 2007 Stormwater Management Act, which now requires that ESD be implemented through the use of non-structural best management practices and other better site design techniques.

Septic System Strategic Plan

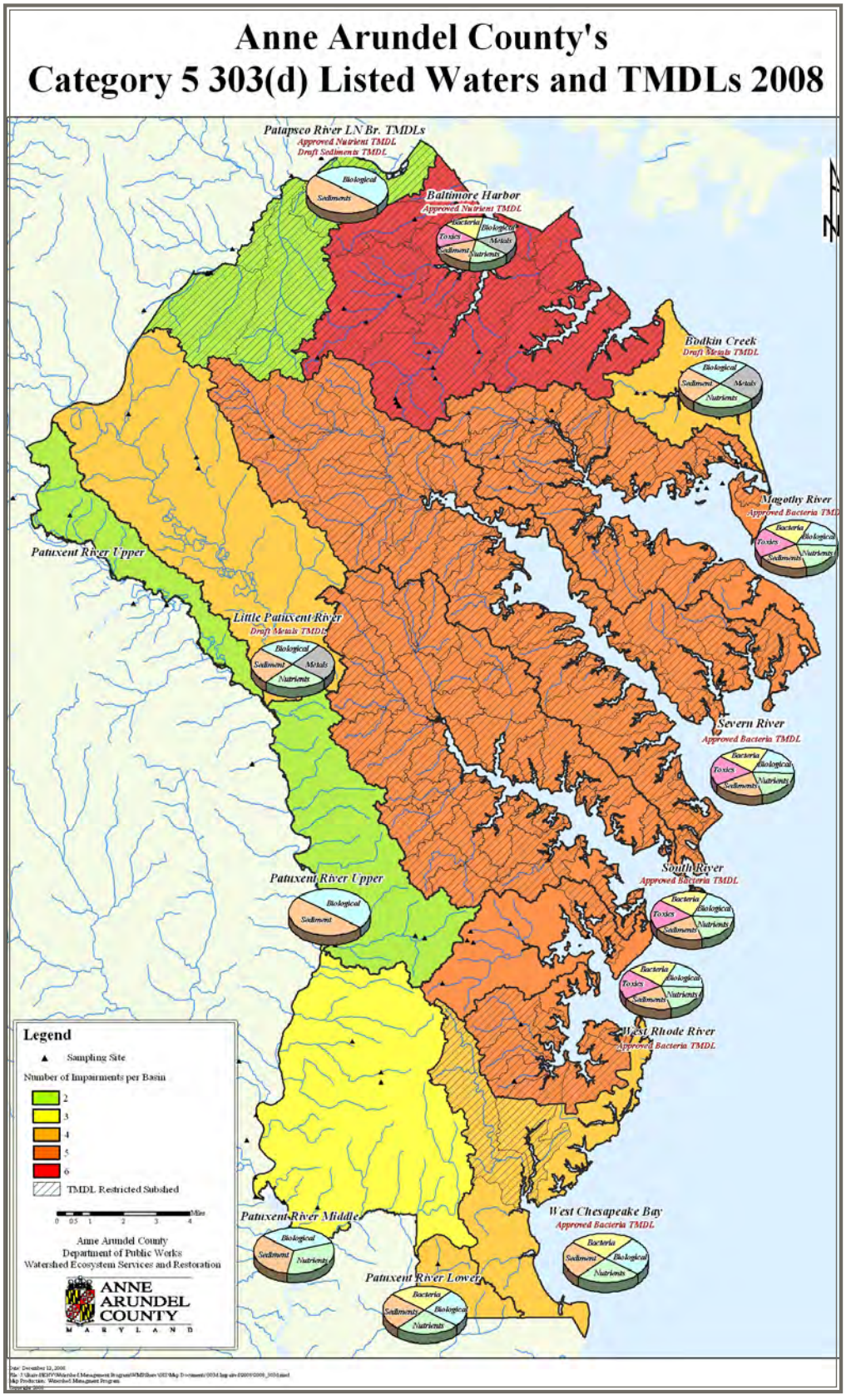
An On-Site Sewage Disposal System Evaluation Study and Strategic Plan was completed in early 2008 that provided a Countywide evaluation of the service options available for properties with onsite sewage disposal systems (OSDS, or septic systems). It focused on the most cost-effective approach to reducing nitrogen loads from septic systems. In addition, management areas were defined and evaluated to determine the effectiveness of four treatment approaches: sewer system extensions, cluster wastewater treatment facilities, upgrade individual OSDS to an enhanced OSDS, and no near-term action, which consists of low-density, low-nitrogen delivery onsite systems. More details about this study are found in Chapter 10 and the Background Report on Water Resources.

Total Maximum Daily Loads

Each of Anne Arundel County's twelve watersheds is listed for two or more water quality impairments (Figure 10-2). The State of Maryland has been involved in an on-going process of developing and promulgating specific Total Maximum Daily Loads (TMDL's), which are the maximum amount of a pollutant that a waterbody can absorb and still meet water quality standards. The TMDL's represent mandatory standards for site-specific water quality goals.

The State has issued a nutrient TMDL for the Baltimore Harbor (Patapsco Tidal and Patapsco Nontidal watersheds) and bacteria TMDLs for the Magothy, Severn, South, West

Figure 10–2 Category 5 303 (d) Listed Waters and TMDLs



and West Chesapeake Bay (Herring Bay) Watersheds. Anne Arundel County was allocated 159,318 lbs/year of total Nitrogen and 17,244 lbs/year of total Phosphorous from urban stormwater sources within the Patapsco Tidal and Non Tidal watersheds. These levels are exceeded by the current and future land use projected pollutant loading levels by more than 70%. In addition, the State has issued notice of development of a sediment TMDL for the Patapsco Non Tidal watershed. The Water Resource Element planning framework requires the County to develop implementation plans to mitigate for impacts created by implementation of the Land Use Plan. The County's Watershed Management Plans, discussed below, will provide the background information and technical support needed to prepare these implementation plans.

State Antidegradation Policy and Tier II Waters

Maryland's water quality standards consist of three components that, together, set goals to protect the State's water quality. The components are:

1) Designated Uses for each water body (e.g., recreational use, potable water supply);

2) Criteria that set minimum conditions to support the designated use (e.g., dissolved oxygen concentration not less than 5 mg/l at any time); and

3) Antidegradation Policy that recognizes three tiers of water quality and establishes a way to maintain high quality waters such that they are not allowed to degrade to meet only the minimum criteria for their designated use.

The regulatory intent of Maryland's Antidegradation Policy is to protect the existing designated uses, and the water quality necessary to support those uses, by providing a means for assessing activities that may lower the quality of the State's high quality waters. For purposes of implementing this policy, waters of the State are categorized into one of three tiers based on their assessed water quality and biological conditions. Tier I waters are those that meet the minimum criteria to support their designated uses. Tier II "high quality" waters are those water bodies where existing conditions are better than the minimum required for their designated use. Tier III Outstanding National Resource Waters (ONRWs) are those water bodies of exceptional quality, where the most stringent protection is both necessary and appropriate to protect and maintain the resource.

Anne Arundel County contains three Tier II stream segments. Two are located on Lyons Creek in the southern portion of the County, along the Calvert County line. A third stream segment was designated as Tier II in 2009 and is located on the Patuxent River west of Crofton, along the Prince George's County line. These stream segments are designated High Quality Tier II waters due to exceptional aquatic biological community conditions (fish and aquatic benthic macroinvertebrates) in the stream.

New or proposed amendments to water and sewer plans, and new discharge permits or proposed changes to existing permits trigger an antidegradation review to assure consistency with antidegradation requirements. Specifically, COMAR 26.08.02.04-1B states that "An applicant for proposed amendments to County plans or discharge permits for discharge to Tier II waters that will result in a new, or an increased, annual discharge of pollutants and a potential impact to water quality, shall evaluate alternatives to eliminate or reduce discharges or impacts. If impacts are unavoidable, an applicant shall prepare and document a social and economic justification. The Department shall determine, through a public process, whether these discharges can be justified." It should be noted that a Tier II Antidegradation Review does not apply to individual discharges of treated sanitary wastewater of less than 5000 gallons per day, if all of the existing and current designated uses continue to be met.

Ultimately, the existing Tier II instream designated water uses, and the level of water quality necessary to protect those uses, must be maintained and protected. MDE may deny any proposed discharge or plan amendment if the existing uses will not be maintained and protected.

The Lyons Creek and Patuxent River Tier II stream segments abut County lands that are designated as either Rural Area or as Natural Features. The GDP and Land Use Plan do not contain any proposals that would result in increased pollutant loads or water quality impacts to these stream segments.

Watershed Management Plans

As recommended in the *1997 General Development Plan*, the County is in the process of preparing Comprehensive Watershed Management Plans for each of the 12 watersheds (Figure 5) that will provide technical support for the development, implementation, management, and refinement of the programs listed above. They also provide a holistic and systematic watershed perspective to land use planning and development review activities. These Plans, which are developed on a community watershed scale, include the characterization of watershed baseline conditions and resources, while identifying existing and potential concerns, along with short- and long-term opportunities for improvement of water quality issues. Analysis of the baseline conditions and resources identified in the Plan provides for an informed basis for prioritizing watershed restoration and preservation initiatives. Through the characterization and analysis of a watershed area, the plans provide recommendations necessary to facilitate daily land use and infrastructure decisions to protect watershed resources. The watershed management plans integrate and link existing watershed management business processes with watershed models and geographic information systems to provide

interactive information on how changes in land use, zoning, subdivision regulations, best management practices, and other watershed conditions affect water quality and living resource habitat. To date, the County has completed watershed management plans for the Severn River, South River, and Upper Patuxent River watersheds. A fourth watershed management plan is in progress for the Magothy River watershed and is expected to be completed in 2009. The Patapsco Non-Tidal watershed management plan is expected to be completed in 2010, and management plans for the remaining seven watersheds will be scheduled over the next few years.

With the preparation of the Severn River Watershed Management Plan, a Watershed Management Tool for the County was developed that helps assess the data, prioritize where to focus restoration and preservation investment, and with selection of the most appropriate alternative solutions or best management practices. This information also allows assessment of current land use plans and policies relative to watershed impacts. The assessment of these existing policies can be modeled to predict future watershed water quality conditions more favorable to meeting defined water quality standards.

By simulating storm water run-off water quality, soil erosion from the land surface, flooding and changes in flow regime, groundwater and surface water interactions (watershed water budget), and stream habitat quality, environmental impacts of land use changes can be analyzed using the watershed modeling tool. In addition, the tool allows simulation of point and non-point source pollutant loads; fate and transport of pollutants on land and in the waterbody; and the role of time and spatial scale.

The watershed modeling results can be used to examine "future conditions" of the watershed in categories such as pollutant loading; flooding of road crossings; stream erosion potential; and hydrology of streams and groundwater. The watershed models can also be used to evaluate the pollutant loading levels associated with scenario policy considerations such as cluster zoning or septic system retrofit alternatives. Future conditions can be modeled for these policy considerations and the conditions compared to traditional community development.

Stream and Subwatershed Assessment and Ranking

The County has begun the task of a Countywide prioritization of its subwatersheds and stream reaches to determine which are most in need of restoration or protection.

Prioritization of the stream reaches and subwatersheds are based on a set of physical, chemical, and biological indicators that are assigned a weight and then combined for an overall rating for prioritization. To date, stream reach and subwatershed preservation

assessments have been completed for the Severn, South, and Upper Patuxent watersheds. The remaining watersheds are on schedule to be completed with the watershed management plans. The two charts in Figures 10-3 and 10-4 below illustrate the indicators and their assigned weighting factors that were used in this analysis. In addition, figures 10-5 and 10-6 illustrate the priority ranking of the subwatersheds for purposes of restoration and preservation, respectively.

Figure 10–3 Indicators Used in Ranking Subwatersheds for Restoration

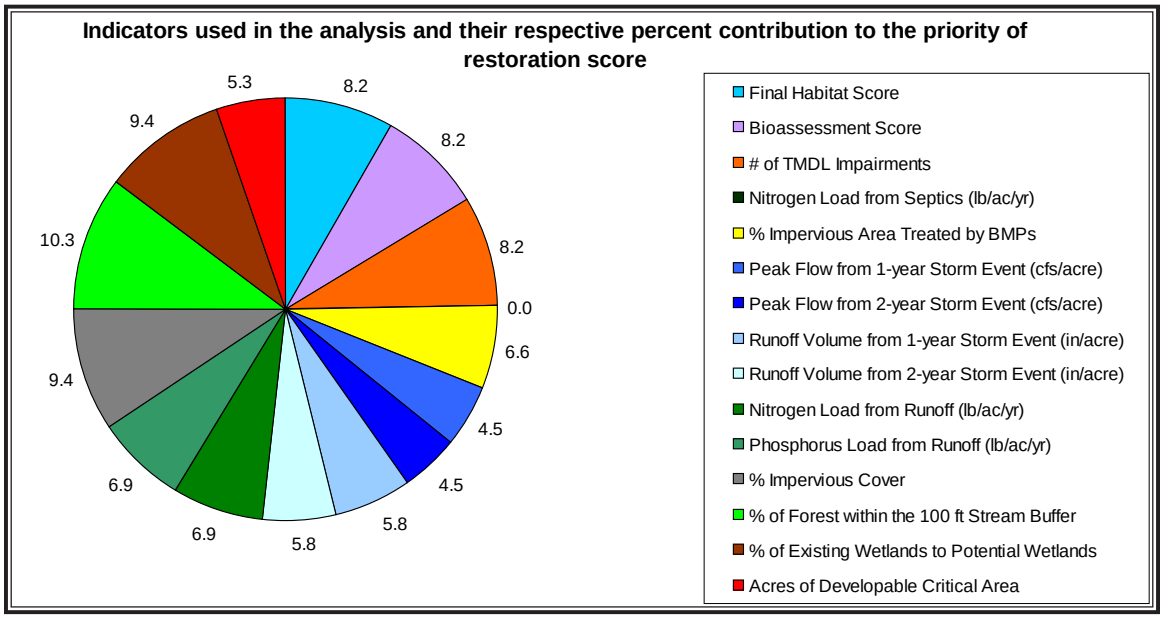


Figure 10–4 Indicators Used in Ranking Subwatersheds for Preservation

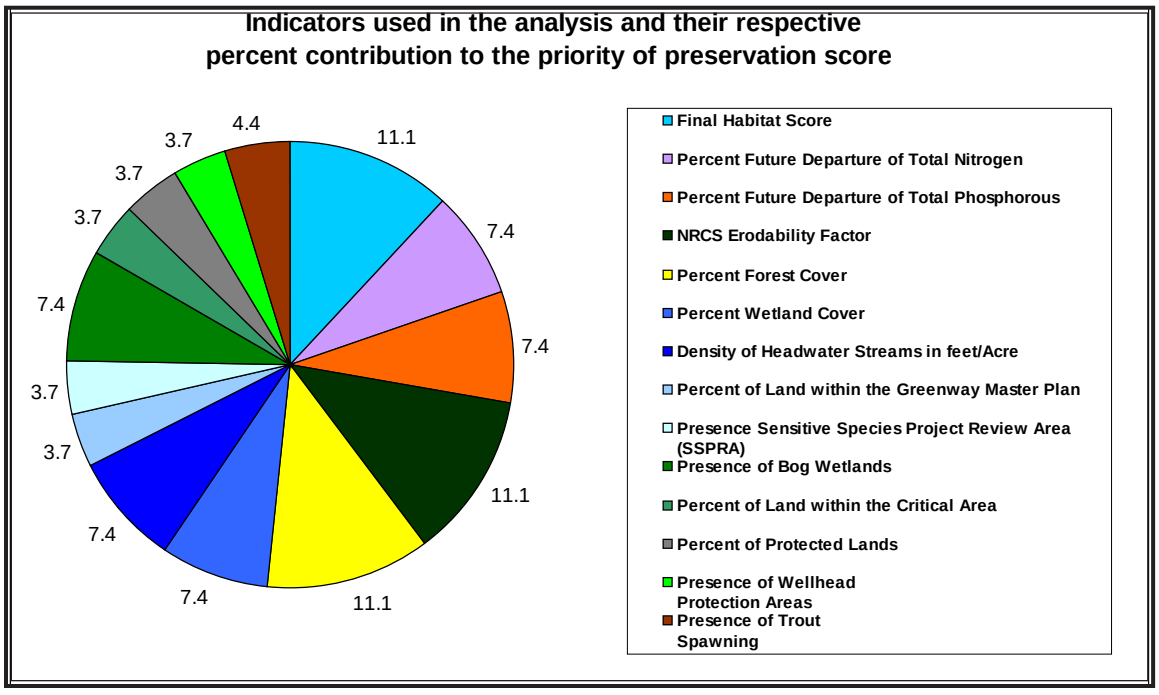


Figure 10–5 Condition of Subwatersheds for Restoration

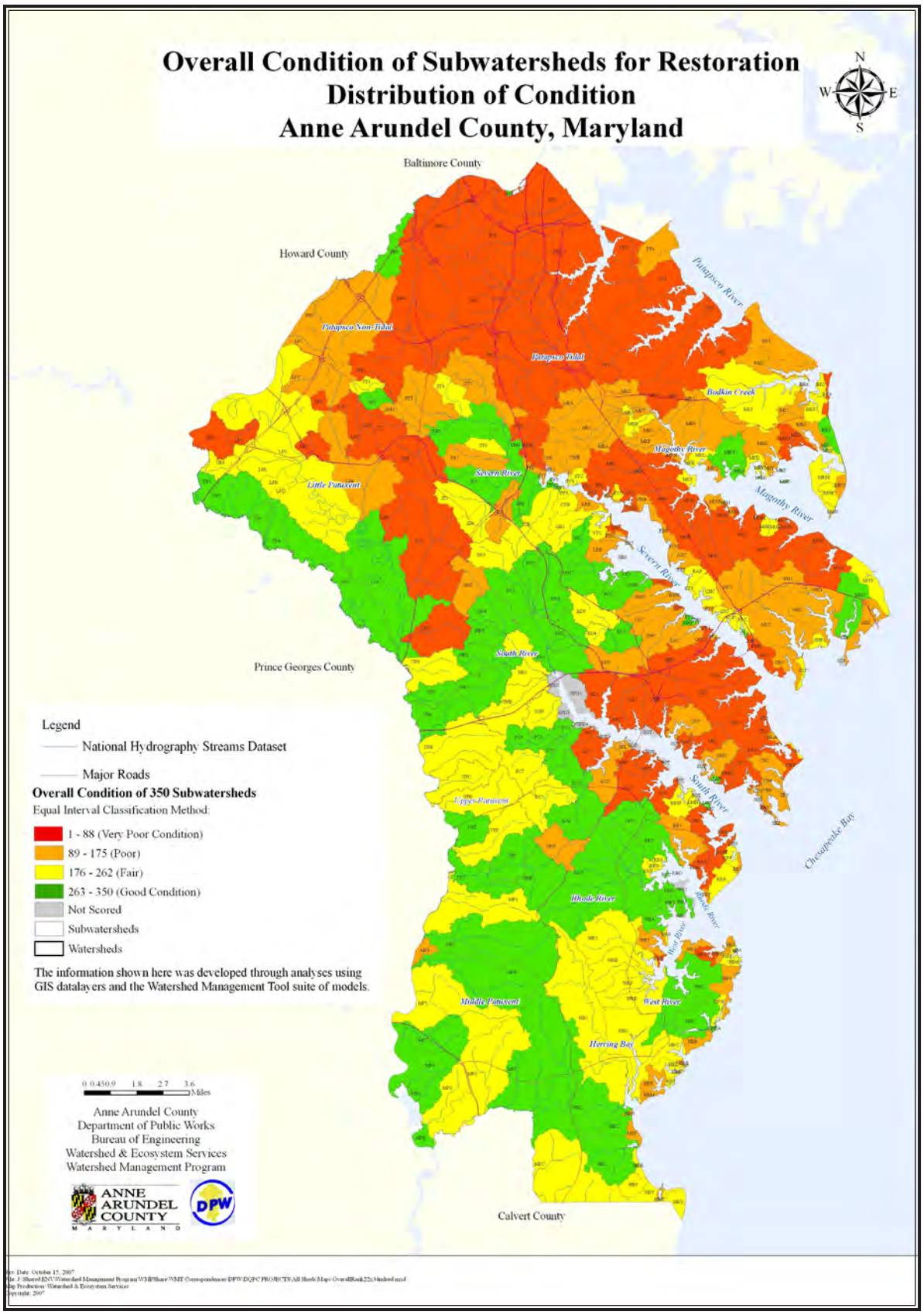
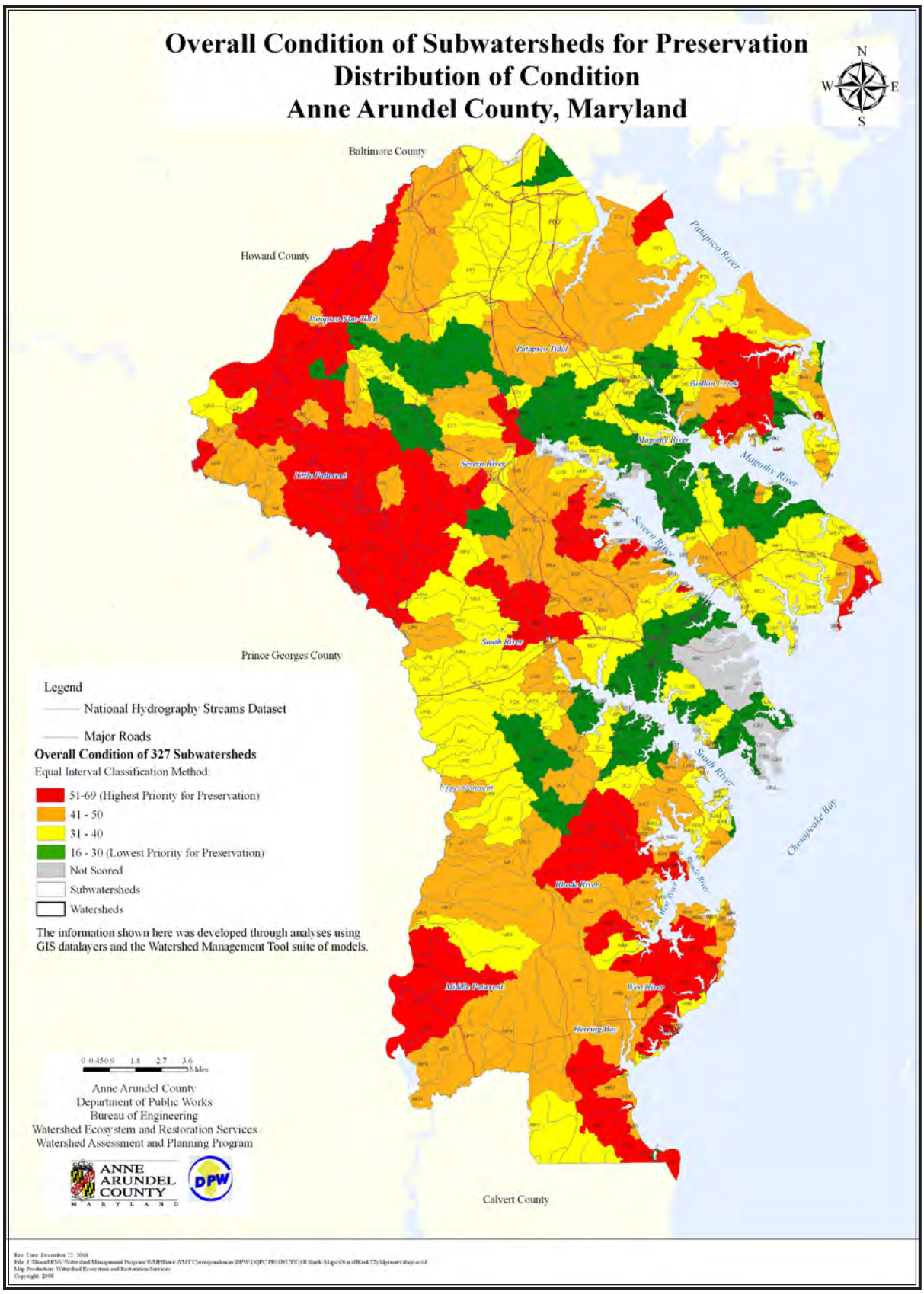


Figure 10–6 Condition of Subwatersheds for Preservation



Targeted Nutrient Reduction Implementation Plans

The County utilized the data repository and modeling components within the Watershed Management Tool to evaluate the current, future, and restoration/preservation land use plan scenarios. The degree of impact that proposed development will have on watershed conditions such as pollutant loads and stream flows were modeled and evaluation criteria were set to allow restoration and preservation scenarios to be compared economically on the basis of cost/benefit ratio. This analysis can be used to help guide expenditure decisions out of the County's limited environmental Capital Improvement Program (CIP) fund.

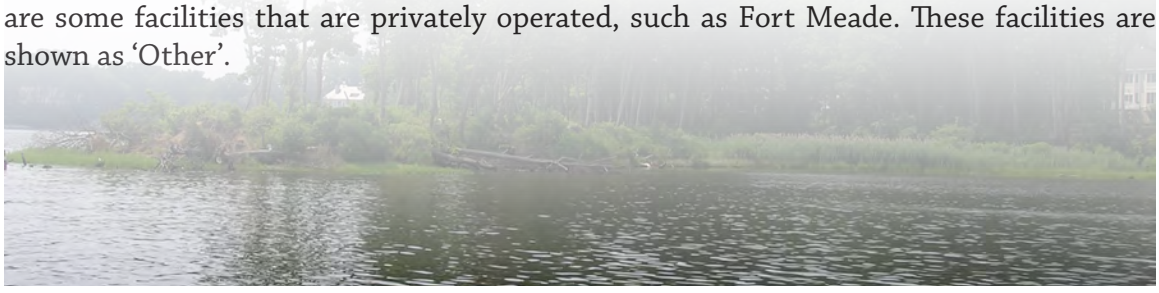
This targeted nutrient reduction strategy has been included in the overall watershed management program. Evaluations have been conducted for the Severn River, South River, Upper Patuxent River, and the Patapsco Non Tidal and Tidal Watersheds. Efforts are underway to develop implementation plans for the remaining watersheds within the County in accordance with the Comprehensive Watershed Study Master Planning schedule.

Assessment of Water Supply Capacity

Most of the existing water supply for Anne Arundel County comes from groundwater supplied by the confined Patuxent, Patapsco, Magothy and Aquia aquifers; however, some of the water that serves residents in the North County area is purchased from Baltimore City and comes from surface water sources.

The City of Annapolis owns and operates its own water supply system and uses groundwater from the Magothy and Patapsco aquifers. In addition, Fort Meade has its own private water system that includes six groundwater wells. The Fort Meade system's primary source of water is the surface water from the Little Patuxent River, which provides approximately 80% of the water used. The remaining 20% is provided by groundwater pumped from the six wells.

The Rural service area utilizes individual private wells and receives water primarily from the Aquia aquifer. Figure 10-7 is a map that shows water service within the County. The areas that are depicted as 'Existing', 'Existing – City of Annapolis', 'Capital Facilities', 'Planned' and 'Future' comprise the ultimate area planned to be served by public water. The area of the County shown as 'No Public Service' is to be served by private wells. There are some facilities that are privately operated, such as Fort Meade. These facilities are shown as 'Other'.



Groundwater Supply, Demand, and Capacity

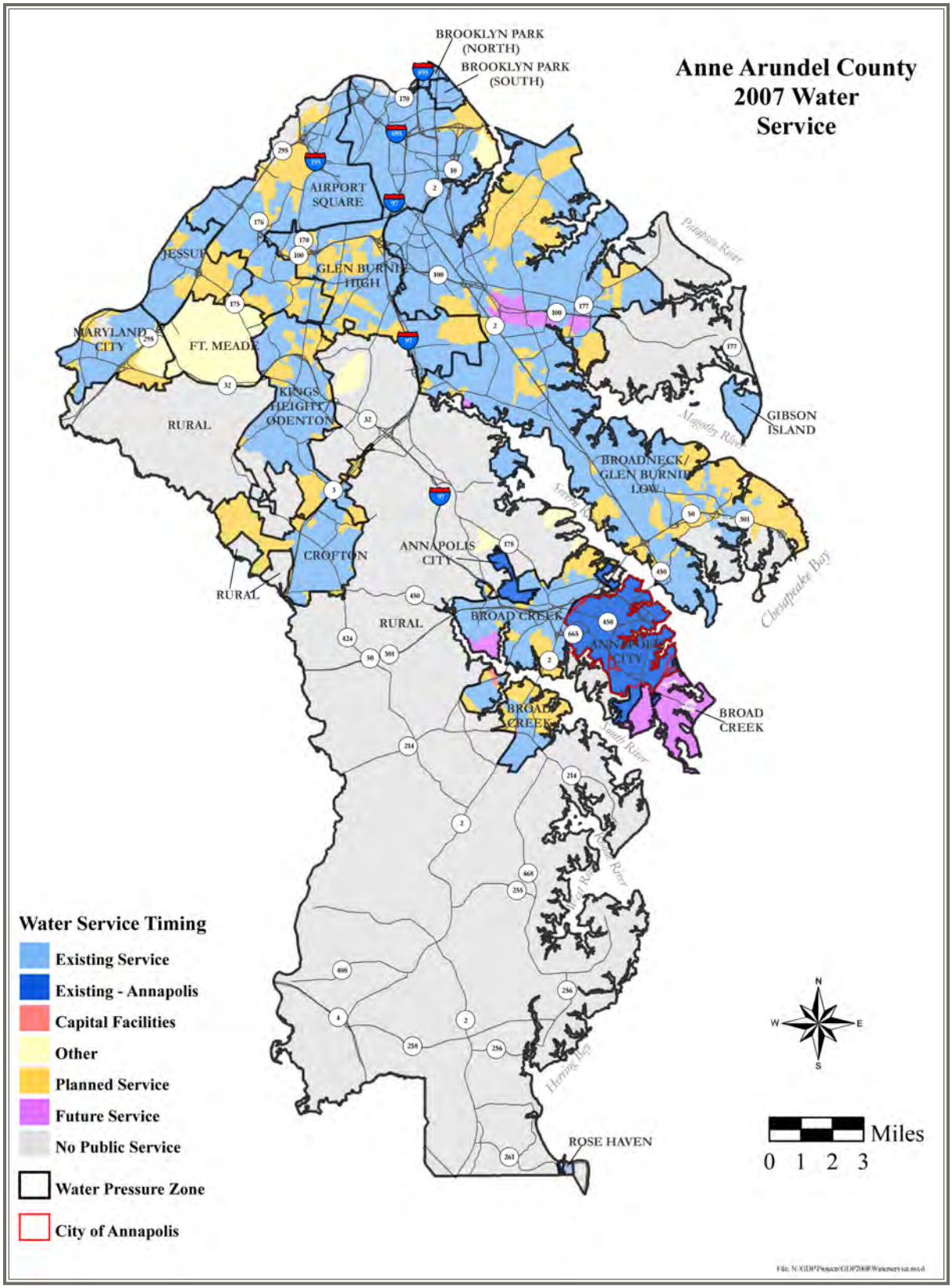
Although the groundwater supply is not as vulnerable to decline due to drought, water levels in all of the confined aquifers supplying the County have been declining for several decades due to population growth and thus increases in use. Continued water level declines could affect the long-term sustainability of ground-water resources, particularly in areas projected for heavy growth. There have been several studies conducted to determine the availability and quality of water supply from the County's aquifers. The most recent include: *Optimization of Groundwater Withdrawals in Anne Arundel County, Maryland, From the Upper Patapsco, Lower Patapsco and Patuxent Aquifers Projected through 2044* and *Future of Water Supply From the Aquia and Magothy Aquifers in Southern Anne Arundel County, Maryland, both conducted by the Maryland Geological Survey (MGS)*.

In 2007, *Optimization of Groundwater Withdrawals in Anne Arundel County, Maryland, From the Upper Patapsco, Lower Patapsco and Patuxent Aquifers Projected though 2044* was prepared by the MGS in cooperation with the County. This report found that in response to pumping, water levels in the County have declined. However, the study found that sufficient groundwater is available to supply the projected demand through the year 2040 at 73 MGD while supplying water to other users in Anne Arundel County and the surrounding counties at permitted levels. An increase in demand could result in water levels falling below the regulatory management levels in some areas, groundwater well operational problems, increased pumping costs and reduced stream baseflow. Meeting projected demand and minimizing impacts will require construction of new wells and well fields, redistributing withdrawals to other wells, and careful well design.

The Future of Water Supply From the Aquia and Magothy Aquifers in Southern Anne Arundel County, Maryland, conducted in 2002 by the MGS concluded that in some areas of southern Anne Arundel County, water levels are approaching or have exceeded the 80% management level due to the combination of increase in localized domestic use and large users in neighboring Calvert County. The model determined that an additional 0.8 MGD withdrawn from the Aquia and Magothy aquifers to serve a projected population of 32,750 in southern Anne Arundel County combined with regional withdrawals from other counties would cause water levels in the Aquia aquifer to decline. The Aquia could supply the projected water demand in most of the area; however, portions of southern Anne Arundel County would exceed the 80% management level. The Magothy aquifer can supply the projected increase in water demand without a significant reduction in available drawdown.

The study also concluded that if withdrawals in the Aquia and Magothy aquifers were held constant in the County and surrounding areas at the 2000 amount, water levels in the Aquia would stabilize in less than a year and in the Magothy, would stabilize in approximately 3 months. Even though there is sufficient available drawdown in a portion of the Aquia, the study stated that an increase in withdrawals will cause water levels to further exceed the management level, and therefore concluded that the Aquia aquifer

Figure 10–7 Water Service Areas



has reached its maximum allowable yield. The maximum allowable yield that the study concluded could be withdrawn from the Magothy aquifer is approximately 7 MGD.

A pilot study conducted as part of an analysis by the Advisory Committee on the Management and Protection of the State's Water Resources also revealed that a small area of southern Anne Arundel County is approaching or has exceeded the 80% management level due to localized domestic use and large users in neighboring Calvert County. Water withdrawals from major pumping centers at Chesapeake Ranch Estates, Solomon's and Lexington Park have resulted in the development of a large cone of depression.

Table 10-1 below shows the current and projected public-supply and domestic, individual well use by aquifer in the County. The data is based on appropriation permits issued by MDE and U. S. Census Bureau population data.

Table 10–1 Current and Projected Water Use in Anne Arundel County, 2000-2030 (MGD)

Aquifer	Public 2000	Domestic* 2000	Public 2020	Domestic* 2020	Public 2030	Domestic* 2030
Piney Point	0	.03	0	.03	0	.04
Aquia	0.18	7.10	0.20	8.02	0.21	8.30
Magothy	2.11	2.19	2.43	2.47	2.47	2.56
Patapsco	21.5	1.61	24.8	1.82	25.2	1.88
Patuxent	5.28		6.1		6.18	
Total for County	29.05	10.93	33.54	12.34	34.01	12.78

Source: The Advisory Committee Report on the Management and Protection of the State's Water Resources, Appendix D, May 2004.

** For Domestic Water Use, the aquifer is the Potomac Group, which includes the Patapsco and Patuxent Aquifers.*

Individual Wells

There are roughly 35,000 wells in the County serving individual homes. The Anne Arundel County Department of Health administers a Sanitary Engineering Program that is responsible for reviewing and approving properties for the installation of private wells in the County. Services provided through this program include issuing construction permits, inspecting private wells, conducting groundwater investigations, and testing private well water. The sources of water to supply these domestic systems are the Patuxent, Patapsco, Magothy, and Aquia aquifers. Some of the wells are susceptible to saltwater intrusion, elevated levels of radium and elevated levels of nitrate. Figure 10-8 shows water quality problem areas for elevated nitrate levels in Gambrills, saltwater intrusion in Annapolis Neck, and the testing region in the northern part of the County for radium. New wells in these areas must meet certain construction requirements to avoid contamination.

Public Water System

The County's public water supply system currently has 17 well fields that contain a total of 53 water supply wells and currently are permitted to produce up to 35.0 MGD

(annual average day) and 48.7 MGD (maximum day). Based on water billing records, the total 2006 annual average day demand was 31.1 MGD. The projected 2043 annual average day demand is 64.6 MGD and the maximum day demand is 123.9 MGD. Table 10-2 provides 2006 data based on billing records and the projected demand for annual average day, maximum day, and maximum day groundwater supply based on existing and future conditions. Thirteen future potential well fields have been identified and would add an additional 33.5 MGD. Wells located in the Rural area have a future maximum day withdrawal of 64.5 MGD. Considering new well construction, expansion of existing wells, demolition of older ones and including wells located in the Rural area, the total future groundwater potential is 126.4 MGD (maximum day).

Table 10–2 Water Demand and Supply By Pressure Zone

Water Pressure Zone	2006 Demand[1] (MGD)	2043 Demand Annual Average Day (MGD)	2043 Demand Maximum Day (MGD)	Maximum Day Groundwater Supply[2] (MGD)
Airport Square[3]	2.88	2.61	4.44	-
Broad Creek	2.56	6.00	15.00	22.7
Broadneck	2.67	6.44	16.10	17.1
Brooklyn Park[4]	0.60	0.89	1.51	-
Crofton	2.05	3.07	6.14	34.2
Gibson Island	0.06	0.17	0.43	0.4
Glen Burnie High	5.05	14.92	25.36	14.4
Glen Burnie Low	10.45	19.32	32.84	18.7
Herald Harbor	0.12	0.32	0.64	1.2
Jessup[5]	1.28	2.49	4.98	-
Kings Heights/Odenton	2.21	5.04	10.08	3.8
Maryland City[6]	1.18	3.20	6.40	-
Rose Haven	0.01	0.10	N/A	0.6
Total (w/out Rural)	31.1	64.6	123.9	112.9
Total (w/ Rural)				126.4

1 Year 2006 reflects actual demand data from water billing records.

2 Based on Existing and Future Conditions

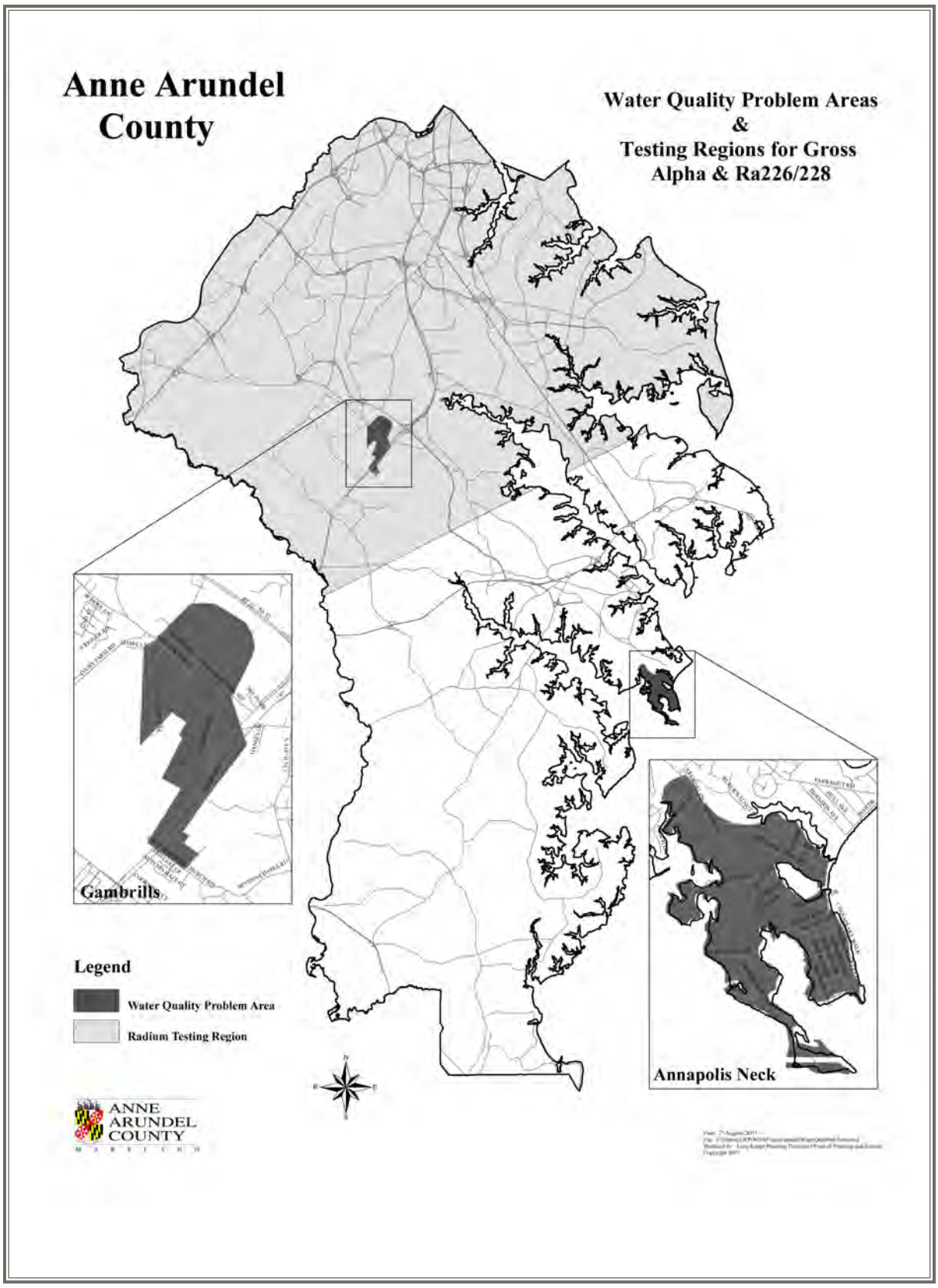
3 There are no water production capabilities. Water servicing this zone is received from the City of Baltimore and / or the Glen Burnie High Pressure Zone.

4 Water servicing this zone is received from the City of Baltimore.

5 There are no water production capabilities within this pressure zone. Water is received via the Montevideo Water Booster Pumping Station. In the future, the expanded Crofton Meadows Water Treatment Plant will also supply this zone.

6 There are no water production capabilities within this pressure zone. The two main supply sources for this pressure zone are the Baltimore City Zone and the Dorsey Road Water Treatment Plant (Glen Burnie High WPZ).In addition to the water supply wells that the County owns and operates, agreements between the County and the City of Baltimore provide the rights to purchase up to 32.5 MGD (maximum day). The County used 10.3 MGD from the Baltimore City supply in 2006 and is projected to use 19.7 MGD (annual average day) by 2043.

Figure 10–8 Water Quality Problem Areas



The *2003 Comprehensive Water Strategic Plan* identified three objectives to have the production facility infrastructure necessary for meeting the expected growth while optimizing the use of potential County groundwater resources. To meet those objectives, expansion of existing facilities and development of new facilities are proposed. The objectives include:

- Centralize facilities when possible,
- Create flexibility whereby water could be transmitted across pressure zones, and
- Reduce reliance on the City of Baltimore.

The County *2003 Comprehensive Water Strategic Plan* developed water demand projections for the planning period 2000 to 2025 and for build-out conditions, estimated to be in 2043. These demand projections were calculated using zoning, flow factors, and water and sewer timing categories.

Other Water Supply Systems

In addition to private wells serving individual homes, there are over 530 community water systems in the County that are operated privately or by a non-County entity. The source of water for these wells is the Patuxent, Patapsco, Magothy and Aquia aquifers. These facilities typically maintain their own water treatment facilities. They are regulated by the Environmental Protection Agency who categorizes the wells into three types:

- Community Water Systems (CWS) – those systems that serve the same people year-round such as mobile home parks, businesses, or smaller communities,
- Non-Transient Non Community Water Systems (NTNC) – those systems that serve the same people but not year-round such as schools, and
- Transient Non-Community Water Systems (TNCWS) – those systems that do not consistently serve the same people such as parks, restaurants and gas stations.

Wellhead Protection

Source Water Assessments have been completed for all of the County's water supply facilities and include identification of potential sources of contamination and the susceptibility of each water supply source to contamination. Potential contamination threats identified include unused or improperly constructed wells. The Water and Sewer Master Plan recommends that these wells be abandoned per State well construction regulations in order to protect the drinking water sources.

The County also contracted to have a broader analysis on wellhead protection initiatives conducted for the Glen Burnie and Annapolis areas. The study, completed in 2003, found some susceptibility to contaminants in the Glen Burnie area. Recommendations include development of a Wellhead Protection Fund and education on best management practices to existing homeowners and businesses located within areas identified as having the highest susceptibility for point source contamination.

The County has also done significant work in collaboration with the State to identify potential contaminant sources and perform a hydro-geological study of the County. This

effort has established the groundwork for the County to pursue a wellhead protection program using the State's model ordinance as a guideline. In addition, the County Health Department currently maintains a Groundwater Protection Plan for private water supplies which documents and summarizes policies and programs regarding onsite sewage disposal systems and the protection of groundwater where public sewer is not available. More detailed information on the topic of wellhead protection is found in the County's Water and Sewer Master Plan.

Wastewater Demand and Capacity

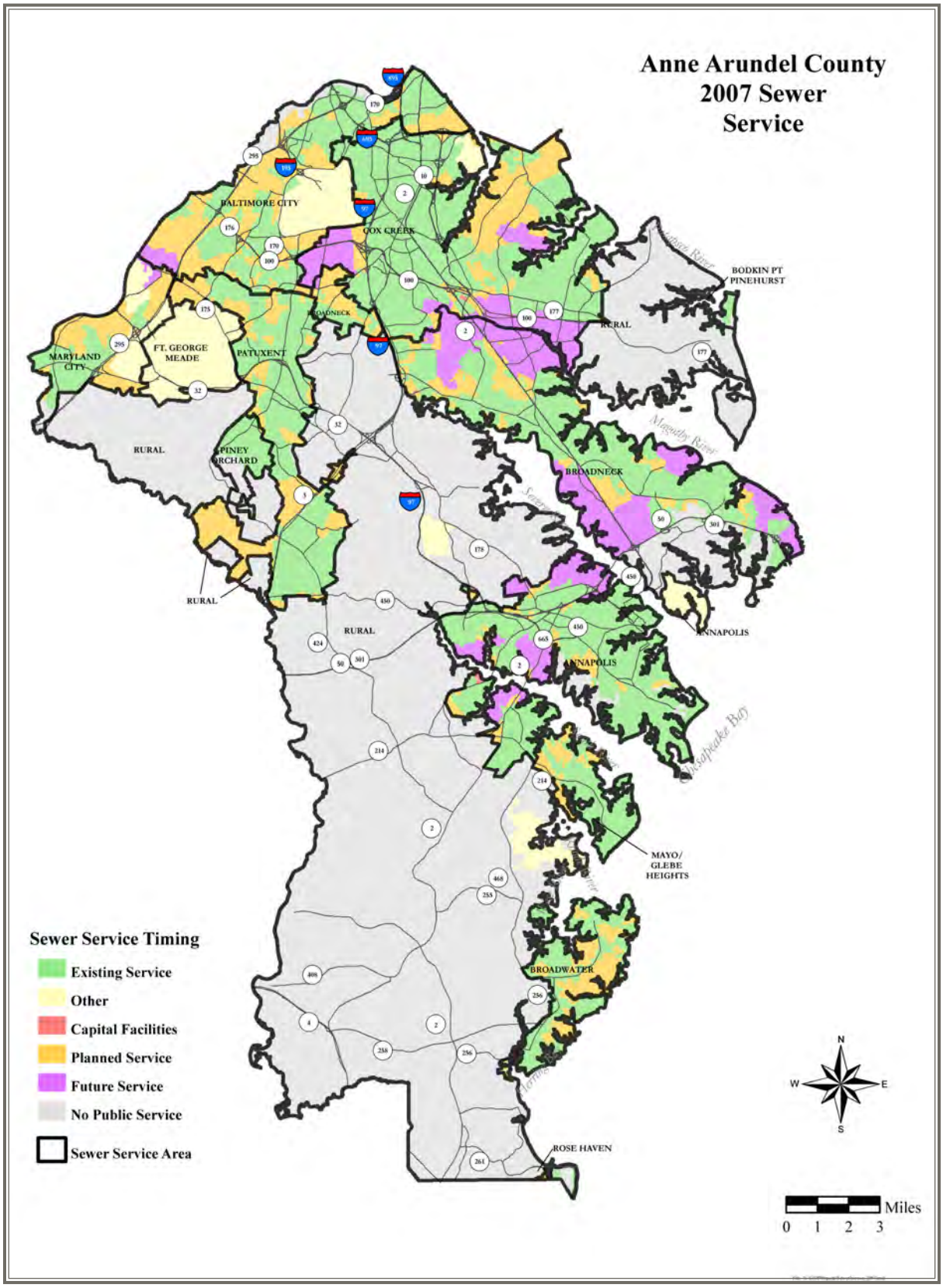
Eleven separate and distinct sewer service areas have been established for the purpose of providing sewerage facilities to serve Anne Arundel County. Figure 10-9 is a map that shows sewer service within the County. The areas that are depicted as 'Existing', 'Capital Facilities', 'Planned' and 'Future' comprise the ultimate area to be served by public sewer. There are some facilities that are privately operated, such as B.W.I. Airport, the US Naval Academy and Fort Meade. These facilities are shown as 'Other'. The remaining land is shown as 'No Public Service'. It is designated as Rural, is not planned for service by public sewer facilities and is or will be served by septic systems.

Public Sewer

According to the 2007 WSMP, the area currently served by public sewer is approximately 27% of the County and the ultimate area to be served is 44%. Of the eleven sewer service areas, eight are served by facilities owned and operated by the County. Two of the service areas have conveyance systems that are operated and maintained by the County but the treatment facilities are located in neighboring jurisdictions. Intra-jurisdictional agreements permit the transport of wastewater from the Baltimore City Sewer Service Area to the Patapsco Sewage Treatment Plant in Baltimore City and from the Rose Haven / Holland Point Sewer Service Area to the Chesapeake Beach Wastewater Treatment Plant in Calvert County. Piney Orchard Sewer Service Area is a privately owned and operated treatment facility; however, the collection system is owned and maintained by the County. There are over 111,000 public sewer connections and approximately 34.1 MGD (2005 total flow) are treated. The projected total flow at build-out is 74.16 MGD assuming full development of all property in the sewer service area at current zoning.

Between 2003 and 2007, the County conducted and completed a *Comprehensive Sewer Strategic Plan* (CSSP) for the Annapolis, Baltimore City, Broadneck, Broadwater, Cox Creek, Maryland City and Patuxent Sewer Service Areas. The CSSP was a 2-phase approach for planning the future modifications and expansion of the existing wastewater collection and treatment system. In Phase I of the study, the County's wastewater treatment plants were evaluated on a number of criteria including the State's anticipated effluent total nitrogen discharge goals and other future discharge permit requirements. Phase 2 evaluated ways to expand or modify the existing wastewater conveyance system to route flow toward treatment plants with the most available capacity to accommodate future growth in a cost effective manner. The major recommendations and findings of this study were incorporated into the 2007 *WSMP*.

Figure 10–9 2007 Sewer Service



Septic Systems

There are approximately 40,700[1] individual septic systems in the County (Figure 10-10). A little more than half of these systems are located in the area designated for No Public Service on the County's sewer service maps. The remaining systems are located in the area ultimately to be served by public sewer (Existing, Planned, and Future categories).

The County contracted with CH2Mhill to conduct a Countywide evaluation of the service options available for properties with onsite sewage disposal systems (OSDS, or septic systems). The *On-Site Sewage Disposal System Evaluation Study and Strategic Plan* (OSDS Study) was completed in early 2008 and focused on the most cost-effective retrofit plan to reduce nitrogen loads from septic systems. The study included four tasks.

Task 1 involved identifying, categorizing and prioritizing OSDS Countywide. Eight evaluation criteria were used. These include distance to on-site wastewater management problem areas, surface water, Critical Areas, bogs, and wellhead protection areas, as well as depth to groundwater, soil percolation rates, and slope. Ultimately only three criteria (distance to surface water and Critical Area, and slope) were used to prioritize the OSDS. As a result of this task, a GIS database was created of the OSDS locations and indication of whether the property is developed, undeveloped, and adjacent to wastewater service. The OSDS were ranked in terms of the severity of environmental and public health impacts and then were categorized relative to potential alternatives for mitigation.

A preliminary cost analysis of alternatives was conducted as part of Tasks 2 and 3. Detailed schematic designs were completed for ten pilot areas. Costs for these ten areas along with 14 other wastewater petition projects were estimated to develop cost factors to be applied for the three recommended treatment technologies. These alternatives included extension to public sewer, construction of a cluster system, and upgrade to an OSDS with enhanced nitrogen removal. The cost estimates were used to determine cost effectiveness of the treatment technologies. Relationships between cost effectiveness and the density of septic systems and to a lesser extent with distance to sewer and treatment technology were shown.

Task 4 of the study was the preparation of an Implementation Plan and a Final Report. A management area was defined as a service area that would have the same treatment approach recommended for each OSDS within the area (Figure 10-11). Each management area was evaluated to determine the effectiveness of four treatment approaches and divided into the following:

- Sewer System extensions with treatment at existing centralized wastewater reclamation facilities upgraded for enhanced nutrient removal,
- Cluster wastewater treatment facilities,

1 *Onsite Sewage Disposal Systems Evaluation Study, 2007, CH2MHILL, John E. Harms, Jr. & Associates, Inc., Stearns and Wheeler, LLC.*

Figure 10–10 Septic System Density Areas

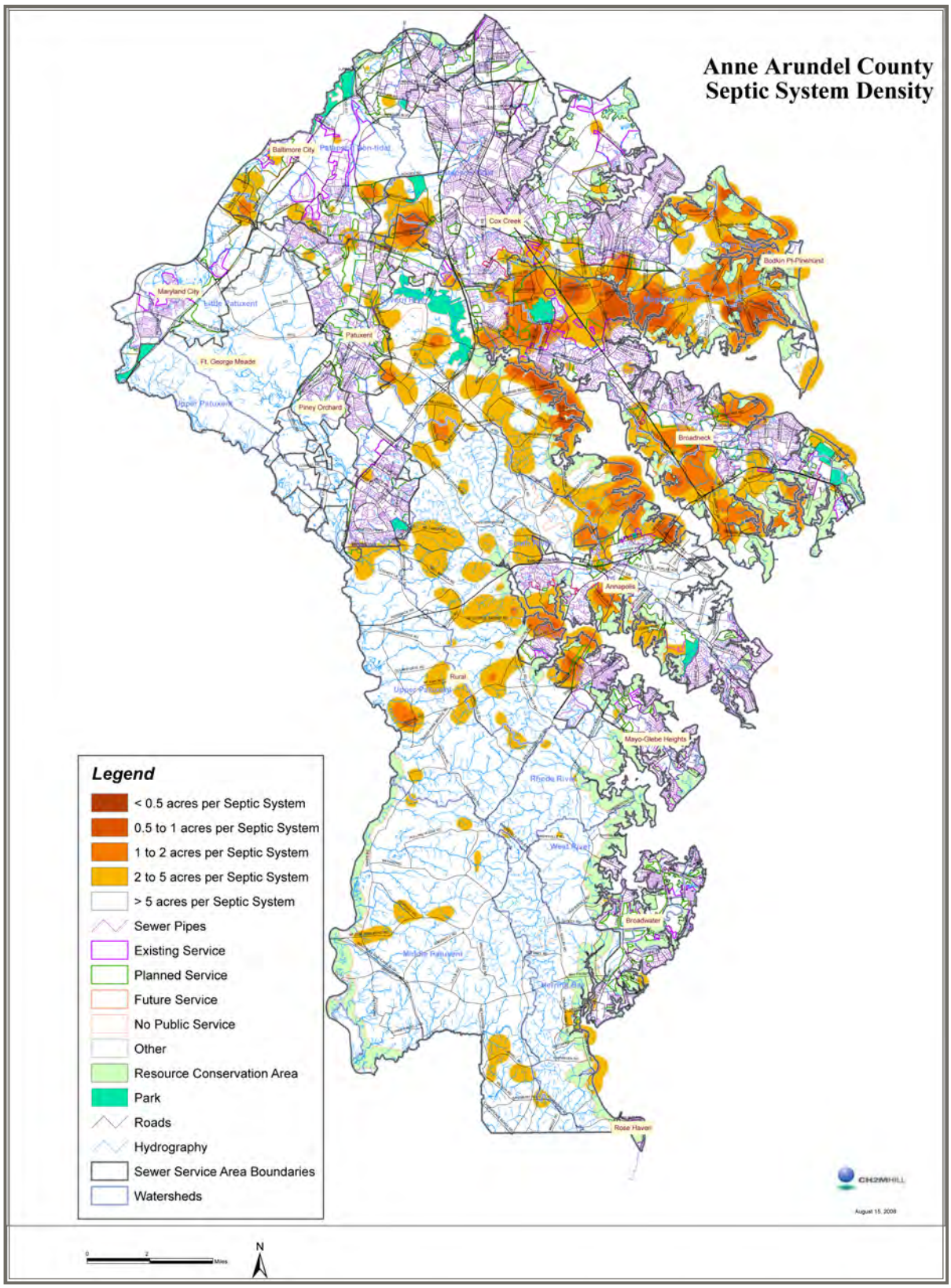
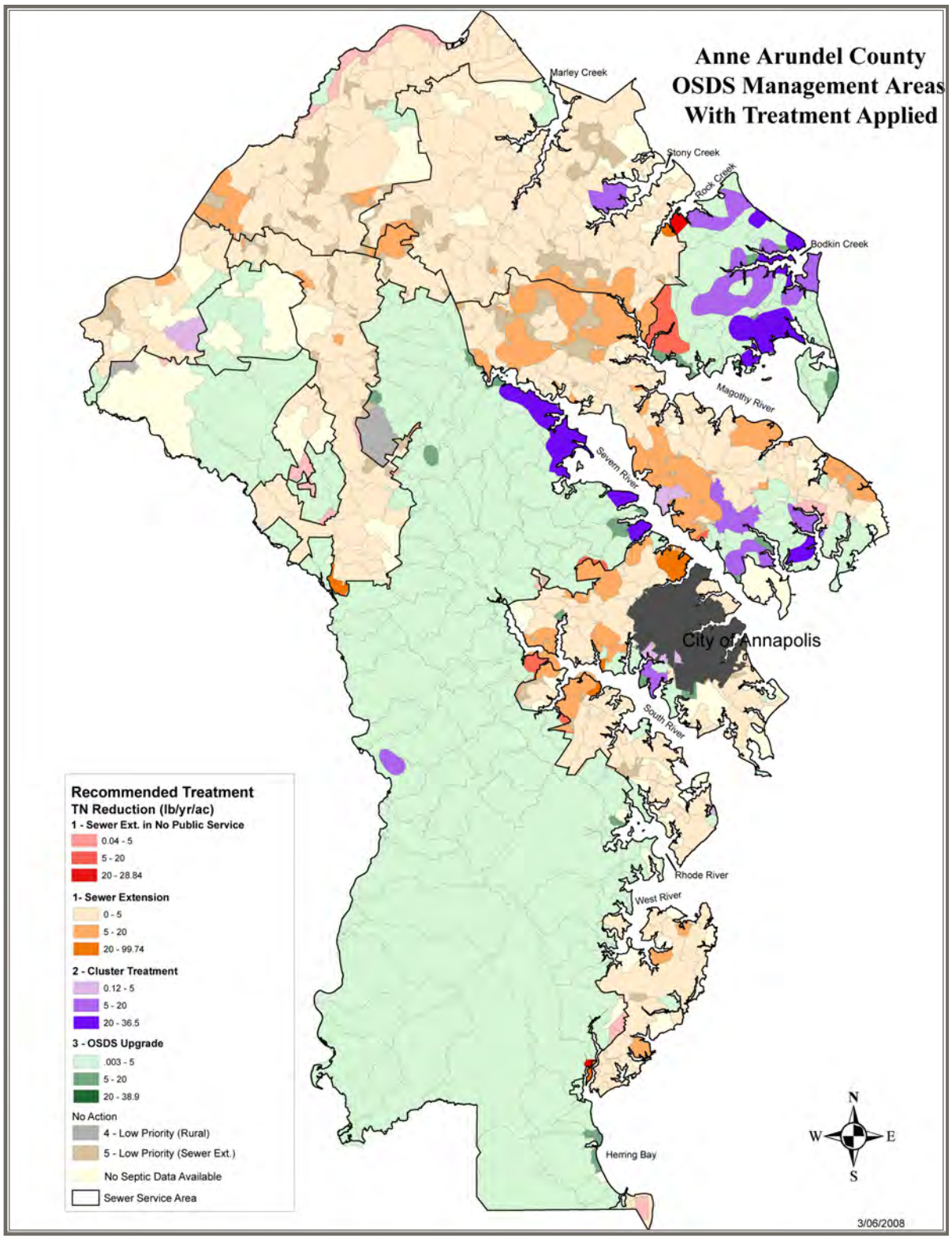


Figure 10–11 Onsite Sewage Disposal System Management Areas



- Upgrade each individual OSDS to an OSDS with enhanced nitrogen removal, and
- No near-term action, which consists of low-density, low-nitrogen delivery onsite systems.

Cost factors developed in Tasks 2 and 3 were applied to the recommended treatment approach for each management area. The management areas were then ranked based on the aggregate cost effectiveness of all OSDS within each area (pounds of nitrogen reduction per OSDS). In addition, several policy issues were identified for consideration in the selection of future treatment approaches and implementation policies for the County's onsite systems. These included permitting issues, Chesapeake Bay Restoration Fund eligibility, and compatibility with County comprehensive plans.

Current and Projected Pollutant Loads

Water Reclamation Facility Loads

The current total design capacity of the County's wastewater treatment plants with BNR upgrades is 46.64 MGD. The maximum total capacity based on the nutrient caps with the ENR upgrades is 62.2 MGD.

Tables 10-3 and 10-4 provide nitrogen and phosphorus pollutant loads for each of the water reclamation facilities based on existing conditions, build-out conditions based on the 2004 Land Use Plan and build-out conditions based on the 2009 Land Use Plan. The projected build-out wastewater flows assume full development of all property in the sewer service area at current zoning, consistent with the Land Use Plan.

In the Broadneck, Broadwater, Patuxent, Baltimore City, Cox Creek and Bodkin Point sewer service areas, build-out flows exceed the WRF's permitted capacity under the 2004 or the 2009 Land Use Plan. Additionally, in the Maryland City Sewer Service Area, build-out flows will exceed the WRF's permitted capacity. The County anticipates that during the planned expansions of these facilities, TMDL requirements will result in more stringent NPDES Permit limits thereby requiring costly facility upgrades. These upgrades will decrease available acreage at each WRF plant site. In order to support planned growth and accommodation of the TDML regulations, the County is investigating alternatives at those WRF sites with restricted acreage to redirect existing and future flows to service areas where facility sites can best support future upgrades and meet loading requirements. In the event that feasible alternatives cannot be identified or the advancement of treatment technologies lags, the TMDL regulations could restrict future land use and could conflict with Smart Growth initiatives.

Table 10–3 Wastewater Treatment Plant Loads Nitrogen (TN)

Nitrogen

	2005 Total Flow (MGD)			Current Design Capacity			Build Out Based on 2004 Land Use Plan			Future Design Capacity (with ENR)			Build Out Based on 2009 Land Use Plan		
Facility/SSA	(MGD)	Current TN (mg/L)	TN (lbs/Year)	(MGD)	Current TN (mg/L)	TN (lbs/Year)	(MGD)	TN with ENR (mg/L)	TN (lbs/Year)	(MGD)	TN with ENR (mg/L)	TN (lbs/Year)	(MGD)	TN with ENR (mg/L)	TN (lbs/Year)
Broadneck	5.32	3.0	48,600	6.00	3.0	54,800	13.86	3.0	126,600	8.00	3.0	73,058	13.86	3.0	126,600
Annapolis	8.84	4.7	126,500	13.00	4.7	186,000	17.24	3.0	157,400	17.30	3.0	158,293	17.24	3.0	157,400
Annapolis City & USNA	4.85						8.20						8.20		
County Portion	3.99						9.04						9.04		
Mayo - Glebe Heights	0.59	8.5	15,300	0.64	8.5	16,600	1.10	3.0	10,000	0.85	3.0	7,762	1.10	3.0	10,000
Broadwater	1.23	5.6	21,000	2.00	5.6	34,100	2.83	3.0	25,800	2.67	3.0	24,353	2.83	3.0	25,800
Chesapeake Beach	0.75	3.2		1.18	3.2		N/A			N/A			N/A		
County Portion-Rose Haven	0.08	3.2	800	0.14	3.2	1,300	0.20	3.0	1,800	0.14	3.0	1,256	0.20	3.0	1,800
Total Western Shore	16.06		212,200	21.78		292,800	35.23		321,600	28.96		264,722	35.23		321,600
Maryland City	1.13	7.9	27,200	2.50	7.9	60,100	2.95	3.0	26,900	3.33	3.0	30,441	4.18	3.0	38,100
Patuxent	5.45	3.0	49,800	7.50	3.0	68,500	13.42	3.0	122,600	10.00	3.0	91,323	13.42	3.0	122,600
Piney Orchard	0.52	2.8	4,400	1.20	2.8	10,300	0.98	3.0	9,000	1.60	3.0	14,619	0.98	3.0	9,000
Total Patuxent	7.10		81,400	11.20		138,900	17.35		158,500	14.93		136,383	18.58		169,700
Patapsco	59.27	18.0		73.00	18.0		N/A			N/A			N/A		
County Portion-Baltimore City	3.83	18.0	209,400	6.39	18.0	349,400	8.41	3.0	76,800	6.39	3.0	58,355	9.63	3.0	87,900
Cox Creek	11.54	8.0	281,000	15.00	8.0	365,300	22.67	3.0	207,000	20.00	3.0	182,646	22.67	3.0	207,000
Bodkin Point	0.01	40.0	700	0.01	40.0	700	0.09	40.0	8,800	0.01	40.0	700	0.09	40.0	8,800
Total Patapsco/Back	15.38		491,100	21.40		715,400	31.17		292,600	26.40		241,701	32.39		303,700
Total Flow within County:	**38.54**		**784,700**	**54.37**		**1,147,100**	**83.75**		**772,700**	**70.28**		**642,807**	**86.19**		**795,000**

Notes:

Data from Table 4-2 and 4-6 of the 2007 Master Plan for Water Supply and Sewerage Systems

Load for Bodkin Point system based on typical septic system effluent 40 mg/L using design capacity with an 80% Delivery Ratio

Baltimore City, Piney Orchard, Rose Haven/Holland Point are operated by other jurisdications or entities.

Calculations for non-County operated systems are based on 2005 flow information received from MDE on 3/17/08, concentrations based on 2006 data and Nutrient Caps based on 2005 Maryland Tributry Strategy.

Piney Orchard Future Design Capacity based on Nitrogen Treatment Load Cap

Table 10–4 Wastewater Treatment Plant Loads Phosphorus (TP)

Phosphorus

	2005 Total Flow (MGD)			Current Design Capacity			Build Out Based on 2004 Land Use Plan			Future Design Capacity (with ENR)			Build Out Based on 2009 Land Use Plan		
Facility/SSA	(MGD)	Current TP (mg/L)	TP (lbs/Year)	(MGD)	Current TP (mg/L)	TP (lbs/Year)	(MGD)	TP with ENR (mg/L)	TP (lbs/Year)	(MGD)	TP with ENR (mg/L)	TP (lbs/Year)	(MGD)	TN with ENR (mg/L)	TN (lbs/Year)
Broadneck	5.32	0.50	8,100	6.00	0.50	9,100	13.86	0.23	9,500	8.00	0.23	5,479	13.86	0.23	9,500
Annapolis	8.84	0.50	13,500	13.00	0.50	19,800	17.24	0.23	11,800	17.30	0.23	11,872	17.24	0.23	11,800
Annapolis City & USNA	4.85						8.20						8.20		
County Portion	3.99						9.04						9.04		
Mayo - Glebe Heights	0.59	0.80	1,400	0.64	0.80	1,600	1.10	0.23	800	0.85	0.23	582	1.10	0.23	800
Broadwater	1.23	0.50	1,900	2.00	0.50	3,000	2.83	0.23	1,900	2.67	0.23	1,826	2.83	0.23	1,900
Chesapeake Beach	0.75	0.86		1.18	0.86		N/A			N/A			N/A		
County Portion-Rose Haven	0.08	0.86	200	0.14	0.86	400	0.20	0.23	100	0.14	0.23	94	0.20	0.23	100
Total Western Shore	16.06		25,100	21.78		33,900	35.23		24,100	28.96		19,853	35.23		24,100
Maryland City	1.13	0.50	1,700	2.50	0.50	3,800	2.95	0.23	2,000	3.33	0.23	2,283	4.18	0.2	2,900
Patuxent	5.45	0.30	5,000	7.50	0.30	6,800	13.42	0.23	9,200	10.00	0.23	6,849	13.42	0.23	9,200
Piney Orchard	0.52	0.12	200	1.20	0.12	400	0.98	0.23	700	1.60	0.23	1,096	0.98	0.23	700
Total Patuxent	7.10		6,900	11.20		11,000	17.35		11,900	14.93		10,228	18.58		12,800
Patapsco	59.27	1.05		73.00	1.05		N/A			N/A			N/A		
County Portion-Baltimore City	3.83	1.05	12,200	6.39	1.05	20,400	8.41	0.23	5,800	6.39	0.23	4,377	9.63	0.2	6,600
Cox Creek	11.54	1.60	56,200	15.00	1.60	73,100	22.67	0.23	15,500	20.00	0.23	13,698	22.67	0.23	15,500
Bodkin Point			N/A			N/A			N/A			N/A			N/A
Total Patapsco/Back	15.37		68,400	21.39		93,500	31.08		21,300	26.39		18,075	32.30		22,100
Total Flow within County:	**38.53**		**100,400**	**54.37**		**138,400**	**83.66**		**57,300**	**70.28**		**48,156**	**86.10**		**59,000**

Notes:

Data from Table 4-2 and 4-6 of the 2007 Master Plan for Water Supply and Sewerage Systems

Load for Bodkin Point system based on typical septic system assumed to be near 0 for TP

Baltimore City, Piney Orchard, Rose Haven/Holland Point are operated by other jurisdications or entities.

Calculations for non-County operated systems are based on 2005 flow information received from MDE on 3/17/08, concentrations based on 2006 data and Nutrient Caps based on 2005 Maryland Tributry Strategy.

Piney Orchard Future Design Capacity based on Phosphorus Treatment Load Cap

Onsite Sewage Disposal System (Septic) Loads

Nitrogen loads were calculated for all existing OSDS Countywide without a treatment strategy and with a chosen treatment strategy. The recommended treatment strategies are the approaches assessed in the *OSDS Study* (sewer system extensions, cluster treatment facilities, enhanced nitrogen removal onsite septic disposal systems, or no action) and are based on the most cost-effective strategy identified in the study for each of the OSDS management areas in each watershed. Table 10-5 shows these nitrogen loads for the existing conditions and for built out conditions with and without treatment for each watershed. The loads without treatment do not assume implementation of the *Water and Sewer Master Plan*, while the loads with treatment assume full implementation of the *Water and Sewer Master Plan* and the OSDS Strategic Plan. The values are also aggregated

Table 10–5 Nitrogen Loads for Existing and Built Out Conditions for Septic Systems

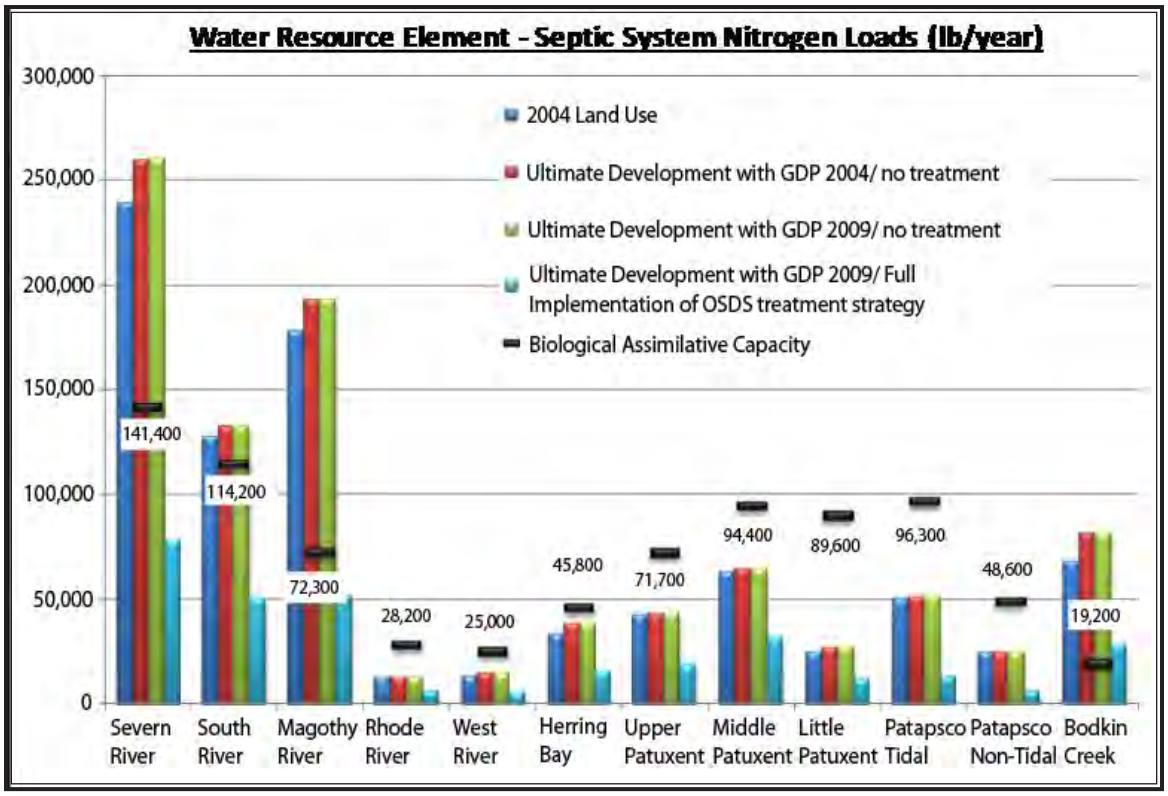
Watershed	Area	Existing Conditions Based on 2004 Landcover	Build Out based on GDP 2004 without Treatment		Build Out based on GDP 2009 without Treatment		Build Out based on GDP 2009 with the implementation of the OSDS Treatment Strategies	
	(Acres)	TN (lbs)	TN (lbs)	Departure from Existing	TN (lbs)	Departure from Existing	TN (lbs)	Departure from Existing
Severn River	44,200	239,300	260,456	8.1%	260,500	8.1%	77,700	-208%
South River	35,700	127,800	132,991	3.9%	133,000	3.9%	50,000	-156%
Magothy River	22,600	178,500	193,400	7.7%	193,400	7.7%	51,500	-247%
Rhode River	8,800	12,500	12,700	1.6%	12,700	1.6%	6,300	-98%
West River	7,800	13,600	14,400	5.6%	14,400	5.6%	5,500	-147%
Herring Bay	14,300	33,400	38,000	12.1%	38,000	12.1%	15,300	-118%
Total Lower Western Shore	133,400	605,200	651,950	7.2%	652,000	7.2%	206,300	-193%
Upper Patuxent River	22,400	42,100	43,300	2.8%	43,300	2.8%	18,700	-125%
Middle Patuxent	29,500	63,400	64,300	1.4%	64,300	1.4%	31,900	-99%
Little Patuxent	28,000	24,900	26,600	6.4%	26,600	6.4%	11,600	-115%
Total Patuxent	79,900	130,400	134,200	2.8%	134,200	2.8%	62,200	-109.6%
Patapsco Tidal	30,100	50,000	51,200	2.3%	51,200	2.3%	13,300	-276%
Patapsco Non-Tidal	15,200	24,800	24,800	0.0%	24,800	0.0%	6,300	-294%
Bodkin Creek	6,000	67,800	81,500	16.8%	81,500	16.8%	28,400	-139%
Total Patapsco/ Back	51,300	142,500	157,500	9.5%	157,500	9.5%	48,000	-197%

at the tributary basin scale. As can be seen, implementation of the various treatment strategies from the *OSDS Study* can result in significant nitrogen load reductions.

Benthic Assessment Scores compiled from the County's random and targeted monitoring programs within non-tidal streams were regressed against the nitrogen load contribution from OSDS systems. This regression analysis resulted in an inverse linear relationship suggesting that higher pollutant loadings within the watershed correspond to degraded biological functions. For the purpose of establishing the nutrient loading assimilative capacity, the loading corresponding to fair biological conditions or benthic score assessments equal to 3 was selected at 3.2 lbs/acre/year. Pollutant loading values exceeding the assimilative capacities means that the land use condition or plan does not support biological health and in turn does not meet the water quality standards.

Figure 10-12 is a plot of the septic system nitrogen loads with the assimilative capacities depicted as horizontal lines for each watershed within the Anne Arundel County jurisdictional boundary. As can be seen from the chart, the implementation of the OSDS strategic plan will reduce the nitrogen loads to levels below the stream biological assimilative capacity for all watersheds with the exception of Bodkin Creek.

Figure 10–12 Septic System Nitrogen Loads (lb/year)



Nonpoint Source Loads and the Assimilative Capacity

Pollutant loadings from nonpoint source runoff were estimated by the County for use in preparing its Watershed Management Plans and Targeted Nutrient Reduction Implementation Plans. Nonpoint source nutrient loads were estimated for the existing conditions and build-out conditions based on current and future land use plans. The pollutant loading analysis was conducted using the Watershed Management Tool and utilized pertinent data layers such as landcover, the Land Use Plan, stormwater management coverage, impervious coverage, soil infiltration rates, rainfall, and pollutant event mean concentration, among other pertinent data layers. The build-out conditions are based on the more intense use of either existing conditions or the maximum allowable development density under the current 2004 Land Use Plan and the proposed 2009 Land Use Plan.

Benthic Assessment Scores compiled from the County's random and targeted monitoring programs were regressed against modeled nitrogen and phosphorous loads. This regression analysis resulted in an inverse linear relationship suggesting that higher pollutant loadings within the watershed correspond to lowered biological functions. For the purpose of establishing the nutrient loading assimilative capacity, the loading corresponding to fair biological conditions or benthic score assessments equal to 3 was selected. The assimilative capacity for Nitrogen is 2.7 lbs/acre/year. The assimilative capacity for phosphorous is 0.38 lbs/acre/year. Pollutant loading values exceeding the assimilative capacities means that the land use condition or plan does not support biological health and in turn does not meet the water quality standards. It should be noted that the stormwater load correlations to biological functions were stronger and steeper than nitrogen load contributions from septic systems. This is due to the fact that stormwater runoff result in flashy and intense pollutant load transports derived from the rainfall intensities and surface runoff conditions, while septic load is derived from slow base flow pollutant leachate from ground water runoff.

The nitrogen and phosphorus loads for existing conditions and the ultimate build out conditions based on the current and future land use plans are shown in Table 10-6 and 10-7 for each watershed in the County. As can be seen from the tables and charts, nutrient loads in all three watersheds experience little change between the current 2004 Land Use Plan and the 2009 Land Use Plan. However, there are significant decreases in TN loads in the Lower Western Shore and Patuxent watersheds when environmentally-sensitive site design requirements are implemented. For the purpose of this analysis, these requirements are assumed to be implemented fully with no variances or exemptions. Due to the Stormwater Act of 2007 requirement of a 50% reduction of existing impervious area for redevelopment projects, the buildout scenario that assumes full adoption of that Act generally shows a greater reduction of stormwater runoff loads. The smaller decrease in TN loads in the Patapsco/Back watershed may be due to the fact that the overall watershed has a greater percentage of impervious acres under existing conditions (29% impervious as compared to 16% in the Lower Western Shore and 11% in the Patuxent) and under build-out conditions. Also, the Patapsco/Back watershed has more land area planned

and zoned for industrial uses, which tends to result in higher impervious coverage than residential uses. As previously discussed, the County will continue to study the potential reductions in these nutrient loads that can be achieved using a variety of alternatives such as the implementation of enhanced stormwater management BMPs or expanding the regulatory stream buffers, among other alternatives, in order to meet the assimilative capacity and water quality standards for the receiving waterbody.

Figure 10–13 Stormwater Total Nitrogen Loads (lb/yr)

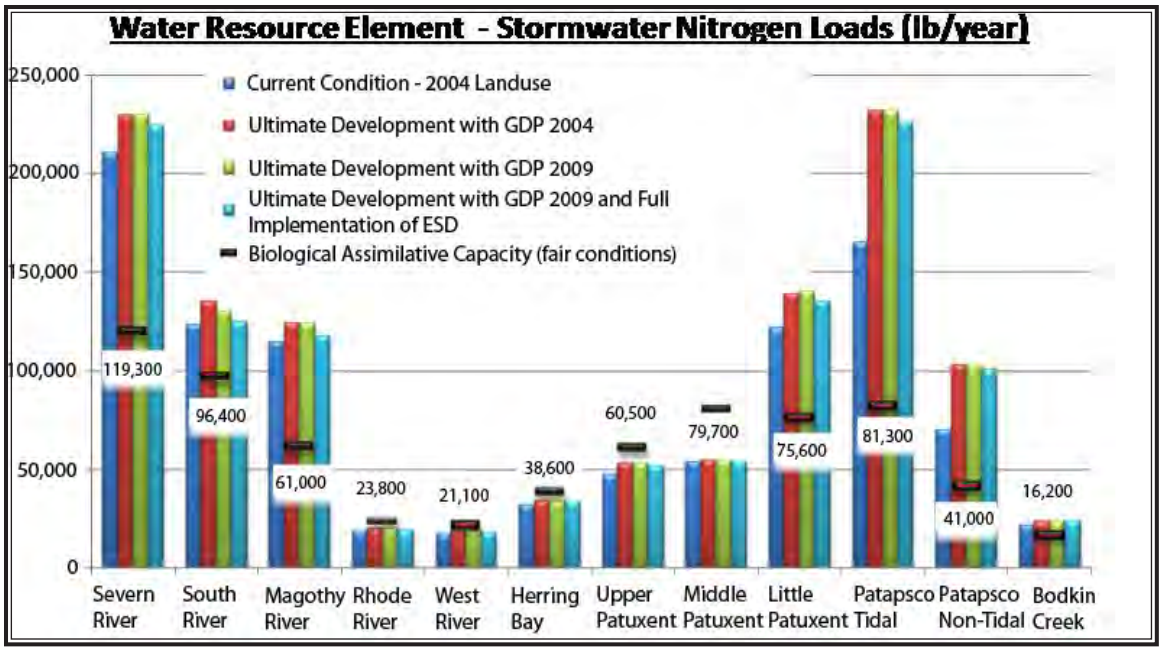


Figure 10–14 Stormwater Total Phosphorus Loads (lb/year)

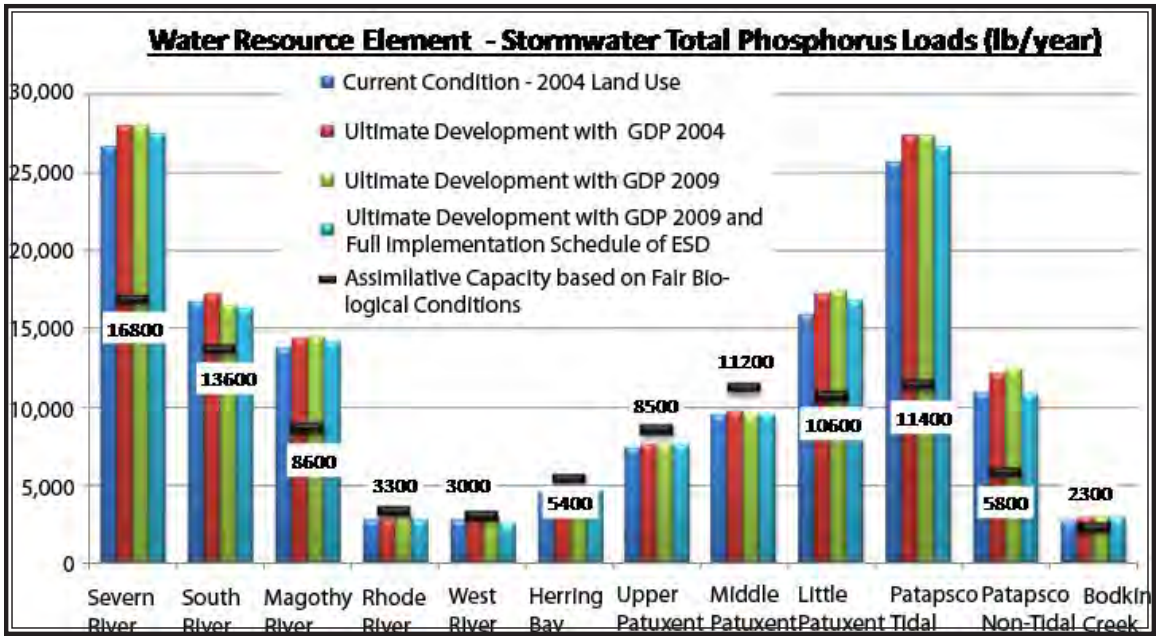


Table 10–6 Modeled Pollutant Load of Total Nitrogen for Existing and Future Conditions (GDP 2004 and GDP 2008) for Stormwater

Watershed	Area	Existing Conditions Based on 2004 Landcover		Build Out based on GDP 2004 Conditions with Implementation of MDE 2000 SWM Requirements		Build Out based on GDP 2009 Conditions with Implementation of MDE 2000 SWM Requirements		Build Out based on GDP 2009 Conditions with full adoption of Stormwater Act of 2007, Environmental Site Design	
Severn River	44,200	210,300	9,000	229,800	8.5%	229,800	8.5%	224,600	6.4%
South River	35,700	122,900	5,200	135,000	9.0%	130,000	5.5%	124,900	1.6%
Magothy River	22,600	114,700	4,600	123,700	7.2%	123,700	7.3%	117,300	2.2%
Rhode River	8,800	18,500	600	19,500	4.8%	19,500	5.1%	19,100	3.1%
West River	7,800	17,000	600	18,000	5.3%	18,000	5.6%	17,700	4.0%
Herring Bay	14,300	31,400	1,100	33,600	6.3%	33,600	6.5%	33,000	4.8%
Total Lower Western Shore	133,400	514,800	21,400	559,600	8.0%	554,600	7.2%	536,600	4.1%
Upper Patuxent River	22,400	46,700	1,800	52,800	11.5%	52,800	11.6%	51,400	9.1%
Middle Patuxent	29,500	53,200	1,700	54,500	2.3%	54,000	1.5%	53,800	1.1%
Little Patuxent	28,000	121,400	5,700	138,900	12.6%	140,200	13.4%	134,700	9.9%
Total Patuxent	79,900	221,300	9,200	246,200	10.1%	247,000	10.4%	239,900	7.8%
Patapsco Tidal	30,100	165,200	9,600	231,700	28.7%	231,700	28.7%	225,800	26.8%
Patapsco Non-Tidal	15,200	69,600	4,200	102,500	32.1%	103,000	32.4%	100,800	31.0%
Bodkin Creek	6,000	21,100	800	23,800	11.2%	23,800	11.3%	23,100	8.7%
Total Patapsco/ Back	51,300	255,900	14,600	358,000	28.5%	358,500	28.6%	349,700	26.8%
Total Patapsco/ Back	51,300	255,900	14,600	358,000	28.5%	358,500	28.6%	349,700	26.8%

Table 10–7 Modeled Pollutant Load of Total Phosphorous for Existing and Future Conditions (GDP 2004 and GDP 2008) for Stormwater

Watershed	Area	Existing Conditions Based on 2004 Landcover		Build Out based on GDP 2004 Conditions with Implementation of MDE 2000 SWM Requirements		Build Out based on GDP 2009 Conditions with Implementation of MDE 2000 SWM Requirements		Build Out based on GDP 2009 Conditions with full adoption of Stormwater Act of 2007, Environmental Site Design	
Severn River	44,200	26,600	9,000	28,000	5.0%	28,000	5.0%	27,500	3.3%
South River	35,700	16,700	5,200	17,200	2.9%	16,500	-1.2%	16,300	-2.5%
Magothy River	22,600	13,700	4,600	14,400	4.9%	14,400	4.9%	14,100	2.8%
Rhode River	8,800	2,700	600	2,800	3.6%	2,800	3.6%	2,700	0.0%
West River	7,800	2,700	600	2,800	3.6%	2,800	3.6%	2,400	-12.5%
Herring Bay	14,300	4,500	1,100	4,700	4.3%	4,700	4.3%	4,600	2.2%
Total Lower Western Shore	133,400	66,900	21,400	69,900	4.3%	69,200	3.3%	67,600	1.0%
Upper Patuxent River	22,400	7,300	1,800	7,500	2.7%	7,500	2.7%	7,500	2.7%
Middle Patuxent	29,500	9,500	1,700	9,600	1.0%	9,500	0.0%	9,500	0.0%
Little Patuxent	28,000	15,900	5,700	17,200	7.6%	17,400	8.6%	16,800	5.4%
Total Patuxent	79,900	32,700	9,200	34,300	4.7%	34,400	4.9%	33,800	3.3%
Patapsco Tidal	30,100	25,600	9,600	27,400	6.6%	27,400	6.6%	26,600	3.8%
Patapsco Non-Tidal	15,200	10,900	4,200	12,100	9.9%	12,400	12.1%	10,800	-0.9%
Bodkin Creek	6,000	2,600	800	2,900	10.3%	2,900	10.3%	2,800	7.1%
Total Patapsco/ Back	51,300	39,100	14,600	42,400	7.8%	42,700	8.4%	40,200	2.7%
Total Patapsco/ Back	51,300	39,100	14,600	42,400	7.8%	42,700	8.4%	40,200	2.7%

Mitigation Plans

Although the County experienced a steady, rapid increase in its population and housing over the last twenty years, the projected rate of growth will slowly begin to decline as the County reaches its maturity. The comprehensive 2009 Land Use Plan for the County focuses the remaining growth into targeted growth areas where infrastructure and capacity are available, encourages infill and redevelopment opportunities in the managed growth areas, and expands land preservation in the rural areas. Utilizing these types of "smart growth" techniques are the best that a mature, suburban County can achieve from a land use perspective in reducing nutrient loads in its watersheds. The goals, policies, and strategies outlined in the Environmental Stewardship and Quality Public Services chapters will also improve upon the ability for the County to provide a safe and adequate water supply, provide adequate wastewater capacity, and improve upon the impacts to the watershed from pollution. In addition to those actions, the strategies recommended in this section will further enhance the ability to improve the health of the watersheds.

Water Supply

In terms of planning for future growth, the potential constraints with regard to water supply are the ability to continue to purchase water from the City of Baltimore over the long term, and the adequacy of groundwater resources to serve additional growth in southern Anne Arundel County.

The County has optimized the use of its public water supply wells effectively, and has identified potential locations for new well fields so that future deficiencies in the public water supply are not likely to occur on a long-term basis, although short-term situations related to drought conditions can periodically occur. Due to concerns over the reliability and future quality of the Baltimore City water supply, the *2003 Comprehensive Water Strategic Plan* promotes a self-reliance strategy by expanding County infrastructure. By optimizing the use of existing and potential supply wells, reliance on the Baltimore City system will be minimized. Any future deficiencies between supply and demand can be met by purchasing water from the City.

Southern Anne Arundel County is part of the County's designated Rural Area, and large-scale or high-density development projects are not planned there. Still, there is additional development potential for low-density residential development that would be served by private individual wells. The long-term adequacy of groundwater resources is a regional issue that, as described below, is being comprehensively assessed by the State, U. S. Geological Survey, and the Maryland Geological Survey. The County will continue to participate in regional planning efforts to monitor and protect groundwater resources.

Since 2003, two separate Advisory Committees on the Management and Protection of the State's Water Resources were formed and charged with assessing the adequacy of existing resources to manage and protect the State's ground and surface water resources and with recommending the actions necessary to ensure that the management of the State's water

resources will provide for their long-term and sustainable use and protection. In addition, a pilot study of Southern Maryland area was conducted and a Water Quality Subcommittee was formed. The first committee found that a combination of factors such as drought, pollution of water sources, inadequate planning and infrastructure, incomplete information about water sources, and population growth could adversely affect the availability of water supply. The pilot study conducted for the Southern Maryland area recommended:

- A regional, multi-aquifer groundwater flow model to assess water supply and impacts of future applications for withdrawals,
- Additional monitoring of wells near large pumping centers to verify model predictability,
- Developing standard methods of data collection, storage and transfer on domestic wells, and
- Evaluating the appropriateness of the 80% management level in aquifers in close proximity to their recharge areas.

The second committee's final report recommends that:

- Maryland must develop a more robust water resources program based on sound, comprehensive data. A statewide water supply plan should be developed that includes a strong outreach program.
- Staffing, programmatic, and information needs of the water supply management program must be adequately and reliably funded. A permit fee to fund the cost of administering the permitting system should be established. Hydrologic studies should be funded with a separate appropriation. In addition, funding should be provided to local governments for water resources planning and to expand the network of stream and ground-water monitoring for both water quantity and quality.
- Specific legislative, regulatory, and programmatic changes should be implemented including codifying the State's water allocation policies, requiring local jurisdictions to protect source waters, promoting collaborative local planning, facilitating regional planning, and strengthening State and local programs for water conservation, water reuse, demand management, and individual wells. In addition, the use of individual wells in areas at high risk for well contamination should be discouraged, greater use should be made of the Water Management Strategy Areas, and administrative penalties for violations of water appropriation permits should be authorized..

In order to adequately address water quality issues, a Water Quality Subcommittee of the Advisory Committee on the Management and Protection of the State's Water Resources was formed to comprehensively address existing laws, regulations, policies, and programs. Their recommendations include:

- MDE and DNR initiate a comprehensive water quality monitoring program to assess the condition of Maryland's drinking water sources and track the progress of other programs designed to protect and improve water quality.

- MDE and DNR initiate studies designed to determine the occurrence and distribution of selected high priority contaminates in Maryland's source waters and their relationship to human health problems.
- MDE and DNR should coordinate the establishment of an electronic clearinghouse for water quality data.

In response to recommendations made by the Advisory Committees on the Management and Protection of the State's Water Resources, the Maryland Geological Survey and the U. S. Geological Survey developed a science plan for a comprehensive assessment to be used in allocating groundwater. Table 10-8 shows the phases and work activity for implementation of this effort that will take place over the next five years. The system, when fully developed, will be a web-based tool that will facilitate the use of groundwater management models when evaluating water management strategies.

Table 10–8 Implementation Schedule for a Comprehensive Regional Assessment of the Atlantic Coastal Plain Aquifer System in Maryland

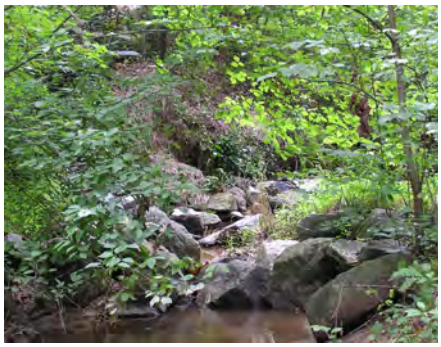
Phase I (2006-2008)	Phase II (2008-2012)	Phase III (2010-2013)
Develop a GIS-based aquifer information system Update the aquifer framework Refine water use information Assess existing water quality data Determine management criteria Identify information gaps, develop plans for addressing gaps Develop detailed plans for groundwater flow and management models Build partnerships and inform the public	Develop and test groundwater flow model Simulate flow system, conduct field studies of recharge and leakage from published information and field investigations Develop models in selected areas with heavy withdrawal rates and models to better understand flow in unconfined parts of the aquifer Enhance groundwater level and streamflow monitoring networks Conduct water quality studies	Develop optimization model Link flow and optimization models to create interactive management model Test water management scenarios Inform partners and stakeholders

Water Reclamation Facilities

The Maryland Department of the Environment (MDE) is using the Bay Restoration Fund to upgrade the 66 major wastewater treatment plants, which discharge to the Chesapeake Bay, with enhanced nutrient removal (ENR) technologies. Once upgraded, these plants are expected to reduce nitrogen and phosphorus in the wastewater down to 3 mg / l total nitrogen and 0.3 mg / l total phosphorus, achieving approximately one-third of the needed reduction under the Chesapeake Bay 2000 Agreement. Anne Arundel County recently agreed to execute a Memorandum of Understanding (MOU) with MDE establishing targeted project schedules and respective commitments toward completing ENR upgrades at the Cox Creek, Annapolis, Broadcreek, Broadwater, Mayo, Patuxent and Maryland City facilities. In addition, an overall grant agreement was executed with MDE governing grant participation and funding eligibility to achieve the ENR upgrade in compliance with the Bay Restoration Fund. Subject to the availability of funds, MDE shall provide 100% of the eligible cost of planning, design, construction, and upgrade of the County WRF's to achieve ENR. The projects will be completed in a phased approach consistent with the schedules defined as part of the watershed based nutrient discharge permits and compliance schedules.

Enhanced nutrient will reduce nutrient loadings and increase treatment capacity at the County's Water Reclamation Facilities.

The facilities will be designed in accordance with the ENR Strategy and the Bay Restoration Fund Act to meet 3mg/l Total Nitrogen (TN) and 0.3 mg/l Total Phosphorous (TP). However, total pound loadings as reported in the discharge permit will be calculated based on 4 mg/l TN and 3 mg/l TP at the current design rated capacity. This additional pound loading will allow the County to expand the hydraulic capacity another 33%. Once upgraded, the County shall operate each of the enhanced nutrient removal facilities in a manner that optimizes the nutrient removal capability of each facility. This may achieve better performance than the loading limits of the watershed nutrient discharge permits towards meeting a goal of 3 mg/l TN and 0.3 mg/l TP. It is estimated that once ENR is completed, the TN load will be reduced by 23% while processing capacity is increased 33%.



Project phasing will be implemented in order to achieve the above nutrient loadings while also allowing orderly expansion and growth to occur in accordance with a specific implementation plan. This will ensure that sufficient ENR upgrades have been implemented to accommodate the capacity increases. The County will make its best efforts to initiate the construction of all facilities by December 2011.

Under applicable federal and state law, the County may expand the capacity of the WRF in the future as long as the expanded capacities are in accordance with the County's most recent Water and Sewer Master Plan and the watershed-based nutrient discharge limits, or any more stringent local water quality based limitations are not exceeded by the expansion.

The MOU also established two watersheds for internal allocation of pollutant loads during ENR implementation. New capacity ratings and associated nutrient limits will be implemented through these watershed discharge permits. Two watershed nutrient discharge permits (one for Patuxent/Maryland City and another to cover Broadneck, Broadwater, Mayo, Annapolis, and Cox Creek) will be developed and issued which will govern the nutrient removal requirements, capacity ratings, and schedules for each of the County WRF. Each nutrient discharge permit will contain a permitted annual pollutant loading of TN and TP (in lbs/yr) permitted to be discharged in accordance with the previously described computation.

Nutrient-based capacity limits will be determined from the total nutrient loading allocation for the individual watershed, not specific discharges from any one individual County WRF, unless a local TMDL or water quality requirement is more restrictive. This provides the County with flexibility to phase its ENR improvements and maintain pollutant total loadings within the permitted levels for each watershed.

Nutrient loads for each watershed can be increased through trading consistent with a statewide policy recently developed by MDE. The concept of nutrient trading allows a discharger of nutrients, faced with expensive nutrient reductions to meet water quality standards, to purchase "credits" (e.g., pounds of nitrogen) from a second nutrient discharger that has reduced its discharge below its legal requirement. This process allows dischargers with higher nutrient reduction costs to pay another discharger for equivalent reductions. Trading also enables entities with low clean up costs to reduce discharges below legal requirements and generate revenue.

MDE will consider this signed agreement as compliance by the County with the first phase of the implementation to meet the requirements of the TMDL program for both local water quality and Chesapeake Bay nutrients. By completing ENR upgrades at these plants the County will substantially reduce the contribution of nitrogen and phosphorous to the Chesapeake Bay while allowing for future expansion to accommodate planned growth and development.

Goal: Provide the highest level of wastewater treatment capabilities economically achievable in order to reduce pollutant loads to area tributaries.

Policy 1: Comply with the nutrient loads limits of all County Water Reclamation Facilities.

Actions:

- Complete ENR upgrades at Water Reclamation Facilities per Memorandum of Understanding with MDE.
- Determine the ability to increase treatment capacities at Water Reclamation Facilities using the "bubble permit" concept.
- Identify weaknesses in pipe infrastructure and explore the development of a more reliable power back-up solution for pumping stations.

Septic Systems

The following actions were recommended in the OSDS Evaluation Study for implementation of the treatment approaches:

- Meet with MDE and DNR to articulate the County's OSDS Strategy,
- Work with MDE, DNR and State legislators to revise the Chesapeake Bay Restoration Fund Act (CBRFA) language,
- Partner with MDE, DNR and others to update the science of OSDS load estimates, (concentrations, delivery ratios) and the Chesapeake Bay model,
- Partner with MDE and DNR to evaluate alternatives for new OSDS cluster treatment systems (new land application / reuse options, new outfall options in shellfish areas),
- Partner with MDE and DNR to develop a OSDS load credit mechanism for water reclamation (WRF) load caps,
- Develop OSDS Environmental Fee Study and Ordinance,
- Develop OSDS Maintenance Ordinance,
- Make revisions to the General Development Plan: identify changes in areas of planned sewer service (additions and deletions); identify priorities; identify areas designated for limited sewer service for managing areas of existing OSDS targeted either for sewer extension or cluster systems, and
- Summarize how this study can be used to address septic system component of Water Resources Element.

In addition, technical, policy, regulatory, and statutory issues were identified for consideration. These include:

- Need to improve the understanding of existing OSDS effluent nitrogen loads and delivery ratios
- Coordination with the General Development Plan,
- Environmental Fee for new onsite sewage disposal systems,
- OSDS reliability and sustainability of individual upgrades,
- Translating and applying tributary strategy goals,
- Chesapeake Bay Restoration Fund Act eligibility,
- Wasteload allocation for new cluster treatment facilities,

- Management of cluster system effluent, and
- OSDS hookup credits and the bubble permit.

Recent State legislation was passed that will help fund community sewerage systems. Specified fee revenue collected for the Bay Restoration Fund can be used to award grants or loans up to 100% of:

- The costs attributable to upgrading an onsite sewage disposal system and a system that utilizes the best available technology for the removal of nitrogen,
- The cost difference between a conventional onsite sewage disposal system and a system that utilizes the best available technology for nitrogen removal,
- The cost of repairing or replacing a failing onsite sewage disposal system that uses the best available technology for nitrogen removal,
- The cost, up to the sum of the costs authorized under number 2 for each individual system, or replacing multiple on-site sewage disposal systems located in the same community with a new community sewerage system that is owned by a local government and that meets enhanced nutrient removal standards.

Goal: Achieve significant reductions in nutrient loads from onsite septic systems.

Policy 1: Reduce total nutrient loads from onsite septic systems within the County with particular emphasis on reduction in the Severn River, South River, Magothy River and Bodkin Creek watersheds where nutrient loads are the most significant.

Actions:

- Develop a short and long-term strategic plan for implementing the recommendations from the OSDS Study to address problem septic areas, based on the priorities identified in that study for addressing first those areas that are potentially generating the most significant pollutant loads. This strategic plan will require feasibility and engineering studies, public outreach, and potentially other planning studies for the various OSDS management areas, and funding strategies to implement the projects.
- In conjunction with the above, apply for funding through the State's Chesapeake Bay Restoration Fund program to implement the OSDS strategies.
- Update the map of Onsite Wastewater Management Problem Areas in the Water and Sewer Master Plan to reflect the most current information.
- Explore additional funding techniques that can be used for community connections to public sewer or installation of private community systems in known problem septic areas.

Policy 2: For the benefit of reducing nutrient loads to local tributaries, communities served by onsite septic systems that are identified as problem septic areas, and areas with a high potential to generate significant pollutant loads from septic systems, should be placed in the Planned Sewer Service timing category if it is feasible to extend public sewer or install community treatment systems in those areas, regardless of the Land Use Plan and zoning. Extension of public sewer in such cases will not be considered justification in itself for changing the Land Use Plan or zoning in these areas, and should not be considered as inconsistent with the General Development Plan.

Actions:

- Identify communities served by onsite septic systems that are currently problem septic areas, and areas with a high potential to generate significant pollutant loads from septic systems, and amend the Water and Sewer Master Plan to include these areas in the Planned Sewer Service category if not already.
- In those cases where extension of public sewer is the most feasible alternative to address a problem septic area, determine whether the use of denied access sewer lines would be warranted, and incorporate policies and provisions into the Water and Sewer Master Plan as needed to indicate where denied access sewer lines are proposed.
- In addition, add these communities to the Priority Funding Area where possible so they will be eligible for Bay Restoration Fund grants for public sewer extension.
- Provide information to homeowners and business owners regarding the importance of regular maintenance to septic systems.
- Develop a more streamlined petition process for community connections to public sewer in order to better accomplish some of the OSDS strategies.
- Evaluate the feasibility of code revisions to require all new or replacement private septic systems to utilize the latest standards for denitrification. Currently this requirement applies only within the Critical Area. Determine whether it is feasible in other areas.

Nonpoint Source Loads

The Anne Arundel County Watershed Ecosystem and Restoration Services (WERS) Division has developed comprehensive and preliminary mitigation implementation plans with varying degrees of detail for the Severn, South, Upper Patuxent, Magothy, and the Patapsco Tidal and Non Tidal Watersheds. The Environmental Capital Improvement Project fund has been the primary vehicle for implementing restoration projects as recommended by the available mitigation plans. These restoration projects are reported annually to the Maryland Department of the Environment to fulfill the County's NPDES

permit requirement for assessment, planning, and restoration. WERS has engaged in publishing the watershed assessments, problem area ranking, and mitigation recommendation in Geographic Information System (GIS) enterprise mapping applications. This information should be consulted by future new development and redevelopment projects to ensure that stormwater mitigation plans include stretch goal requirements for correcting downstream water capacity, quality, and infrastructure deficiency issues within the proximity of the project and to the greatest extent feasible as a contingency to development.

In addition, the County is currently revising Articles 16 and 17 of the County Code to implement the State's Stormwater Management Act of 2007. The Act requires new development to use environmental site design (ESD) and to control stormwater runoff using nonstructural best management practices and other low impact site design techniques to the maximum extent practicable. MDE is currently addressing the requirements of the Act including changes to State regulations as well as the State's 2000 Stormwater Design Manual. Prior to this Act, ESD was encouraged through a series of credits found in the 2000 Stormwater Design Manual.

Implementation of the Stormwater Management Act of 2007 will have an important role in addressing water resource restoration and mitigation requirements. The Stormwater Management Act of 2007 features the following core principles:

- Increase Onsite Runoff Reduction Volumes (predevelopment hydrology)
- Require a Unified Early Environmental Site Design (ESD) Map
- Establish Nutrient-Based Stormwater Loading Criteria (nutrient discharge limits), where:
  - development > 40% Impervious TN< 2.68 lbs/acre/year
  - development < 40% Impervious TN < 0.28 lbs/acre/year
- ESD Applies to Redevelopment – 50% reduction in existing impervious
- Fast track implementation

By adopting the Environmental Sensitive Design criteria for new developments and stretch goal redevelopment criteria for existing developments as promulgated by the Stormwater Management Act of 2007, the County expects to see fewer impacts from future development and even an improvement to the current conditions through site redevelopment under stricter stormwater management regulations.

As is the case with mitigating pollutant loads from septic systems, the financial challenge in dealing with stormwater runoff is significant. Existing stormwater infrastructure needs identified by the County are discussed in Chapter 11 along with their associated capital improvement costs. However, the additional costs related to reducing nonpoint source pollutant loads to meet TMDL requirements are more difficult to quantify. Some of this cost will certainly be incurred by private developers, but the County will need to explore other potential funding alternatives, such as establishing a stormwater utility, in order to

accomplish its nonpoint source pollution reduction goals.

The County is actively engaging in coordination efforts with the Maryland Department of Environment aimed at formulating guidelines and developing implementation plans to address these mitigation requirements. Some of the important technical and policy questions currently under discussion pertain to defining the assimilative capacity for all watersheds, load allocation issues, implementation schedule, local government versus state/federal/private responsibilities, available restoration technologies, and financial strategies, among many other issues.

Goal: Improve stormwater management practices throughout the County to reduce nonpoint source pollutant loads and achieve water quality standards.

Policy 1: Be proactive in achieving the greatest reduction in nonpoint source loads attainable.

Actions:

- Develop additional data layers and input needed to model and assess the effectiveness of existing and future stormwater management practices in reducing nonpoint source pollutant loads.
- Complete and maintain an accurate database of all privately and publicly owned and maintained stormwater management facilities in the County.
- Conduct field monitoring to assess the effectiveness of current stormwater management practices in reducing nonpoint source pollutants. Report inspection and maintenance findings to the facility owner and the watershed assessment and planning program for retrofit action recommendations, prioritization, and implementation.
- Evaluate alternatives for improving, enforcing, and funding long-term inspection and maintenance programs of both private and public stormwater management facilities.
- Work with the Departments of Inspections and Permits and Public Works to secure condition assessment data and maintenance schedules for all privately and publicly owned stormwater practices. Incorporate the data within the Watershed Management Tool to assess the effectiveness, prioritize retrofit actions, and develop retrofit implementation plans.
- Update standards and specifications for innovative stormwater management practices based on lessons learned from inspection, maintenance, and monitoring.

- Revise the County's Stormwater Practices and Procedures Manual to address new requirements of the State's 2007 Stormwater Management Act and to incorporate specific criteria for environmentally sensitive site design.
- Develop strategies to promote greater use of Green Buildings, by developers as well as individual homeowners, as a key strategy in reducing stormwater runoff loads to local tributaries. Evaluate the Code to make sure that Green Building technologies are not impeded by existing code requirements.
- Provide incentives to promote the use of permeable paving surfaces in new developments and redevelopment to decrease stormwater runoff.
- Explore the possibility of increasing the requirement from 20% to 50% for treatment of impervious area on redevelopment sites.
- Develop design guidelines and specifications for the Regenerative Coastal Plain Outfall and Wetland Seepage system. Incorporate the information into the County's Stormwater Design Manual.
- Consider the use of tax credits to encourage soft tidal edge erosion control techniques such as marsh planting.
- Explore the use of a stormwater utility fee on impervious surface areas.

Finally, the goal of achieving or exceeding Federal and State mandated water quality standards in all watersheds in the County was established in Chapter 5. The policies and actions identified for meeting this goal constitute the additional planning steps for implementing the Water Resources Plan.