

V. RESERVOIR AND WATERSHED PROTECTION

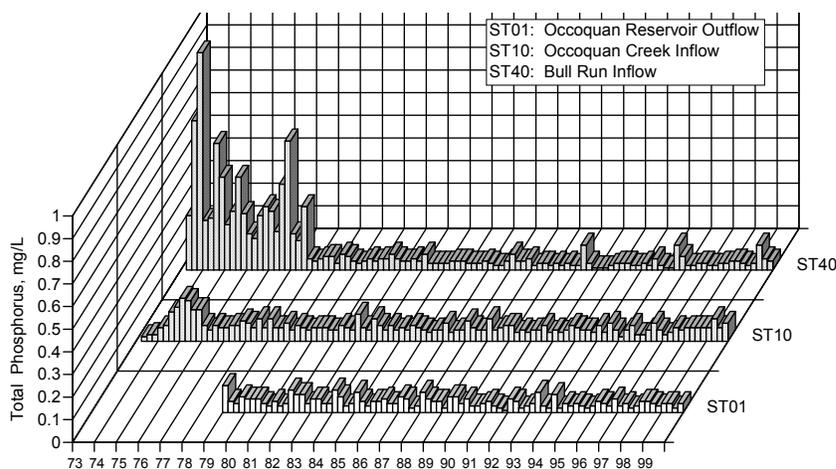
A. The Reservoir: Have We Successfully Protected Our Drinking Water Supply?

To answer the question, “Have we successfully protected our drinking water supply?” the Task Force examined two separate but interrelated issues -- Reservoir water quality and Reservoir storage capacity.

1. Reservoir Water Quality Trends

When placed in service in the summer of 1978, the UOSA Water Reclamation Facility (WRF) resulted in immediate improvements in Reservoir water quality. Because of the large fraction of Watershed nutrient loads that had previously originated from older treatment plants, the high performance of the UOSA WRF provided dramatic evidence of the reduction of nutrient concentrations in the Reservoir. Figure 7 shows a time series of seasonal average concentrations of total phosphorus at the points of entry of Bull Run (ST40) and Occoquan Creek (ST10) into the Reservoir, and the outflow point (ST01) from the Reservoir. As seen from the figure, prior to UOSA start-up in 1978, it was not uncommon for phosphorus concentrations in Bull Run to exceed 0.2 mg/L and, at times, to approach 1 mg/L. In order to place these values in context, the results of a nutrient criteria technical advisory group to the Virginia Department of Environmental Quality (DEQ) concluded that phosphorus concentrations should not exceed 0.1 mg/L in streams, and 0.05 mg/L in lakes and reservoirs.⁷ Sawyer (1947) concluded in studies of Lake Mendota in Madison, Wisconsin, that algal growth could not be effectively limited unless phosphorus concentrations were maintained below 0.02 mg/L.

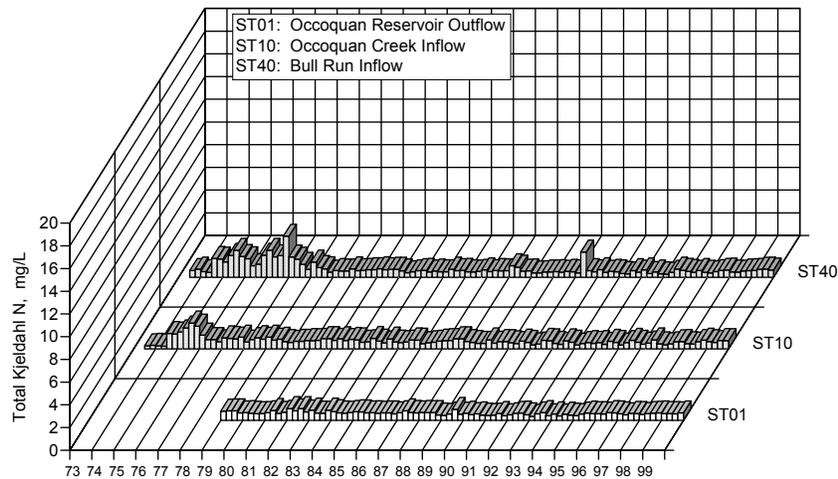
Figure 7. Seasonal time series of total phosphorus in Occoquan Reservoir inflows and outflows, 1973 – 1999. (Source: OWML).



⁷ Virginia DEQ, 1987.

Immediately following UOSA start-up, average phosphorus concentrations in the waters of Bull Run declined to values near 0.05 mg/L. Storm events may dramatically impact the concentrations (and the delivered loads of phosphorus from nonpoint sources), but the seasonal average concentrations in the figure are a good indicator of ambient water quality. Figure 8 shows a seasonal time series of total Kjeldahl nitrogen (TKN), which is the sum of ammonia and organic nitrogen forms, at the inflow and outflow points of the Reservoir. A similar trend to that previously described for phosphorus may be observed. Although domestic wastewaters contain large amounts of TKN, UOSA operates to convert them to nitrate (an oxidized form), which serves a useful function in further limiting the amount of phosphorus that may be recycled from the Reservoir sediments.

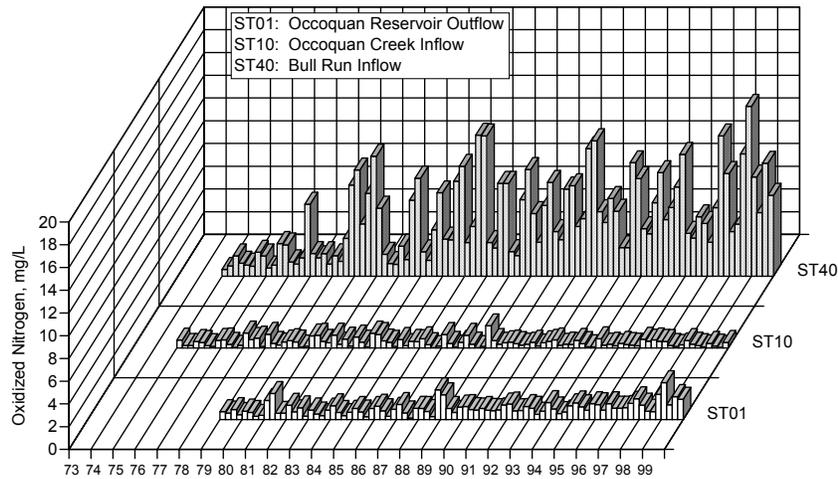
Figure 8. Seasonal time series of TKN in Occoquan Reservoir inflows and outflows, 1973 – 1999. (Source: OWML)



UOSA discharges most of its nitrogen as nitrate, and as a result the concentrations of nitrate in Bull Run have tended to rise since the start-up of the WRF, as shown in the seasonal time series in Figure 9. The most interesting feature of the data, however, is that the elevated concentrations of nitrate are not carried through to the lower Reservoir. By comparing the Bull Run inflow data to the observed concentrations at the outflow point (Station ST01), it is clear that some removal or conversion of nitrate is taking place in the main body of the Reservoir. Research conducted by OWML has conclusively shown that this *in situ* loss of nitrate provides an important water quality benefit in that it serves to maintain oxidizing conditions in the Reservoir bottom waters, and prevents the release of stored phosphorus from the deposited sediments.

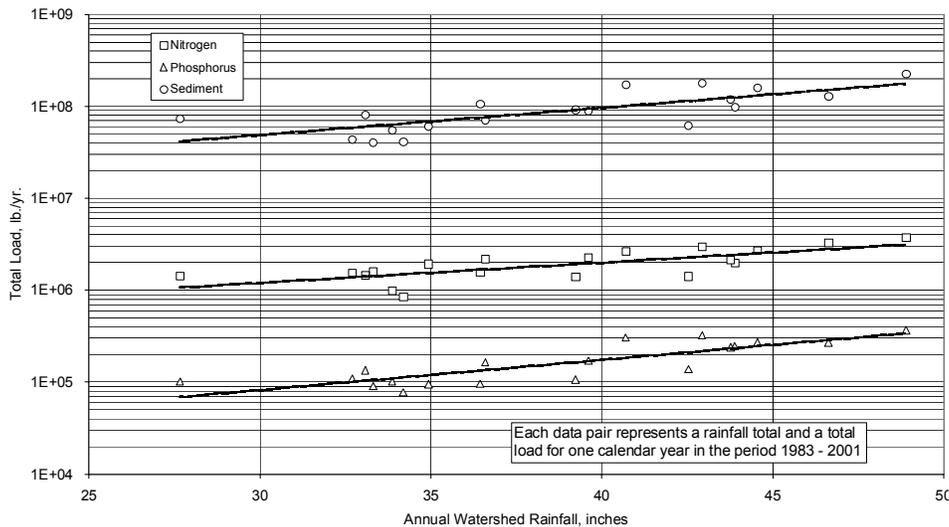
While important from the standpoint of limiting the algae growth potential of the Reservoir, the *in situ* nitrate removal is also of great interest with regard to the 40 percent nutrient reduction goal that is a centerpiece of the effort to restore the Chesapeake Bay. In-Reservoir nitrogen removal has been shown to have a dramatic impact on the net transport of nitrogen to the Potomac Estuary from the Occoquan Watershed.

Figure 9. Seasonal time series of oxidized nitrogen in Occoquan Reservoir inflows and outflows, 1973 – 1999. (Source: OWML)



Because OWML conducts a comprehensive stream gaging and sampling program throughout the Watershed, it is possible to construct an accurate budget of annual pollutant loads, and to evaluate the impacts of those loads on the enrichment state of the Reservoir. Figure 10 shows a plot of the annual loads of total nitrogen (TN), total phosphorus (TP), and total suspended sediment (TSS) entering the Reservoir from all sources as a function of Watershed rainfall for the period from 1983 through 2001. In the figure, each data pair represents a rainfall total for one of the years in the period and the total constituent load for that year. Because the trend lines for each constituent exhibit such a clear positive relationship to the annual rainfall, it may be reasonably concluded that rainfall, and the resulting nonpoint source runoff, are the principal driving forces in the delivery of key pollutants from the Watershed in the post-UOSA years.

Figure 10. Annual runoff loads of nutrients and sediment in the Occoquan Watershed as a function of rainfall, 1983 – 2001. (Source: OWML)



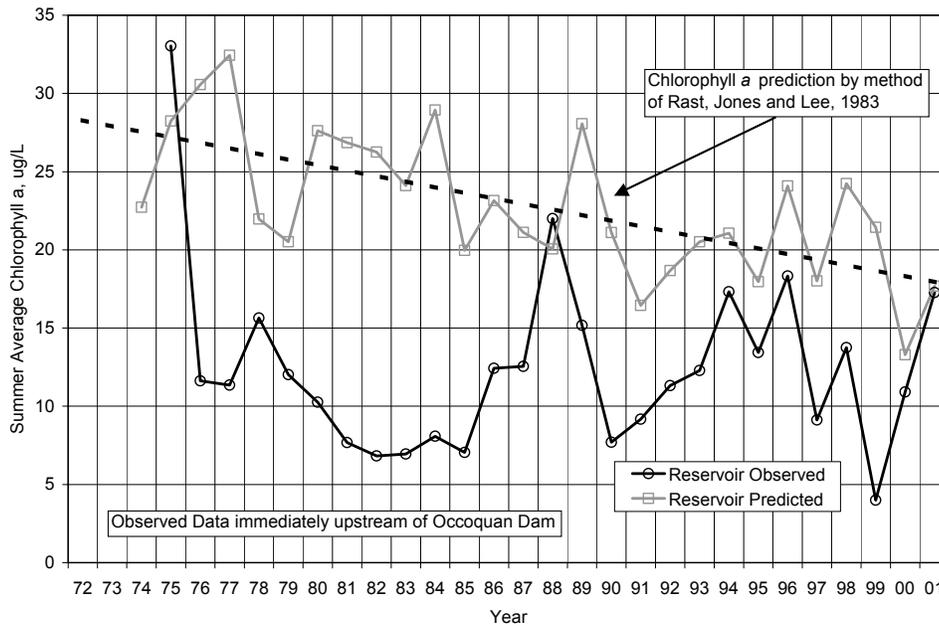
It is equally clear that the management actions taken over the last quarter century have had a positive impact in reducing the level of enrichment. However, the size of the Watershed, the range of human activity it supports, and nearly 50 years of nutrient accumulation in Reservoir sediments mean that nutrient supplies will always be sufficient to maintain the Reservoir in a nutrient-enriched, or eutrophic, state.

Since 1978, water quality in the Reservoir has remained stable, or has exhibited slight improvements. In addition to the impact of the UOSA WRF, the water quality improvements may also be attributed in part to the establishment of a range of regional nonpoint source pollution control measures. In addition to the 1982 downzoning in Fairfax County, these include the implementation of watershed-wide stormwater BMP requirements in developed areas, and educational programs that have resulted in voluntary adoption of improved conservation practices in remaining agricultural areas. It is important to note that these improvements have taken place in a period when the Watershed population nearly tripled.

A widely used measure of trophic state (level of nutrient enrichment) in lakes and reservoirs is the concentration of chlorophyll *a*, which is one of the photosynthesis pigments present in all algae. The U.S. EPA, in the National Eutrophication Survey (1974), proposed using 12 ug/L chlorophyll *a* as the lower boundary of eutrophic conditions in lakes and reservoirs. Rast, Jones, and Lee (1978) developed a widely used empirical relationship between phosphorus loading to lakes and reservoirs and the resulting amount of chlorophyll *a* to be expected during the summer algal growing season. Because of the extensive Watershed nutrient loading database developed by OWML, the method developed by Rast, Jones, and Lee may be applied for the period from 1974 through 2001. Figure 11 shows the annual summer average chlorophyll *a* to be anticipated as a result of the monitored phosphorus loads to the Reservoir during the period. The actual observed chlorophyll *a* values during the summer growing seasons are also plotted in the figure. A linear relationship fitted to the predicted data shows a substantial downward trend, which is consistent with other trophic state analyses by OWML (1997).

The observed summer average data, however, are more difficult to interpret. Clearly, the observed values also exhibit a generally downward trend, but they are generally lower than the model predictions. This may be explained by the continuing use of copper sulfate as an algaecide targeted towards blue-green species. In recent years, the values of the predicted and observed data have been more comparable. In the 1990s, lower copper sulfate doses were applied to the Reservoir; the summer average values of chlorophyll *a* were observed to drop into the mesotrophic range in 1990, 1992, 1997, and 1999. While these observations do not yet indicate an overall return to a less enriched condition, they are part of a general trend of improvement.

Figure 11. Predicted and observed trend in summer average Chlorophyll a in the Occoquan Reservoir. (Source: OWML)



2. Reservoir Storage Capacity

When the Occoquan Reservoir was originally impounded in 1957, the total available storage was estimated at 9.8 billion gallons (BG) at a pool elevation of 120 feet above mean sea level (ft. msl). While the original estimate was made using the standard of practice at the time, it was based on manual planimetric measurements from topographic maps with a 20-foot contour interval. As a result, these measurements are not thought to be directly comparable to measurements using current state-of-the-art field techniques. In addition, the overall accuracy of such estimates may be affected by the fact that the computations fail to capture the effects of any terrain features between contour lines. This effect may also have been exacerbated by the fact that the total analysis crossed only four contour lines: 60, 80, 100 and 120 ft. msl.

In the 1970s, OWML cooperated with the United State Geological Survey (USGS) to develop estimates of sediment accumulation rates from *in situ* measurements in the Reservoir. Unfortunately, the USGS protocol was not successful in producing useful sedimentation rate estimates, and the project was terminated.

Extrapolation of the original (1957) storage capacity curve to a pool level of 122 ft. msl indicated that a total storage of 11.2 BG, providing an increase of 1.4 BG, could be obtained by raising the elevation of the principal spillway by two feet. The estimated increase in storage is more reliable than the original volume estimate because it may be roughly approximated by multiplying the pool area by the two foot elevation increment. In 1982, the FCWA completed an increase in the principal spillway elevation in order to take advantage of the increased storage volume.

In 1989, a Reservoir survey was conducted by a contractor engaged by UOSA. Because the original purpose of the 1989 survey was to provide information on

horizontal water velocities at increments of Reservoir length, only 30 cross sections were established along a Reservoir length of over 10 miles. Nevertheless, the 1989 data provided an opportunity to perform a rough estimate of storage volume. Using the available data, and a mathematical curve fitting technique, OWML computed a storage volume of 7.75 BG at 122 ft. msl. Because this value differed so much from the original estimate, it prompted some immediate concern over (1) the accuracy of the estimate from the 1989 data, (2) the initial accuracy of the pre-impoundment volume determination, and (3) the magnitude of storage loss to sediment deposition.

Plans were initiated to perform a more detailed hydrographic survey because of the uncertainty introduced by the 1989 estimate. In order to do this, OWML reviewed the techniques used in computing volumes of spoil material removed in harbor and navigable waterway dredging operations and found that recent advances in electronic survey techniques had made possible detailed direct mapping of the Reservoir bottom at relatively low cost.

In 1995, the FCWA provided funding to OWML for a hydrographic survey using differential global positioning system (GPS) measurements to position survey points in the horizontal plane, and ultrasonic sounding to provide bottom point elevations. These technologies made possible a survey that had horizontal positioning accuracy of less than one meter, and depth measurement accuracy of less than 0.1 foot. Most importantly, the new system made it possible to map the elevation of many more points on the Reservoir bottom (over 10,000), giving an accuracy that was unattainable with manual field sounding methods. The FCWA also funded an update of the 1995 survey in 2000, providing an opportunity to assess changes in storage capacity over a time interval of five years.

The latest survey in 2000 resulted in a full pool (122 ft. msl) Reservoir storage of 8.32 BG, which is 0.2 BG less than the value from the 1995 survey. While the latest data indicate a small storage loss, it is not yet clear how much of this difference is due to actual sediment deposition or to the precision of the survey method. OWML is planning to conduct another survey in 2005, the data from which will make it possible to perform a more accurate assessment of trends.

In evaluating the map-based and field-based estimates of storage capacity, the following conclusions seem appropriate:

- The map-based estimates of storage capacity from 1957 do not appear to be comparable to field measurement-based survey results using either manual or more recent electronic methods. As a result, the original estimates do not provide useful comparisons for estimates of trends in storage change.
- Anecdotal evidence provided by OWML seems to support the proposition that the long, narrow shape of the Occoquan Reservoir results in periodic scouring of deposited material during extreme high flow events, thereby increasing available storage.
- Information on storage trends, and the precision of the survey methods currently employed will be available in 2005.
- The current full pool storage of the Reservoir may be taken as 8.3 BG.

3. Future Concerns

With increasing population and development pressure, traditional nonpoint sources of pollution (nutrients and sediments) will continue to have the potential to threaten Reservoir water quality. In addition, other contaminants associated with human activity will increasingly have the potential to threaten water quality. Two recent initiatives will help the region to plan for these possibilities:

- The Fairfax County Water Authority, UOSA, OWML, and UOSA member jurisdictions to include Fairfax County have launched a long-term study of water quality issues referred to as the Global Strategy Initiative or “Global Study.” This initiative is a multi-phased study that intends to address water quality issues other than nutrients and conventional parameters, which have been the focus of water quality management for the past 30 years. The study will address the unique nature of industrial discharges to UOSA and their effect on the Reservoir. An additional focus will be human health related issues in the water treatment industry such as newly recognized pathogens and endocrine disrupting chemicals.
- The Water Authority has completed a Source Water Assessment as required under the federal Safe Drinking Water Act. This assessment consists of a GIS inventory of potential sources of contamination within a defined area upstream of the Reservoir, including discharges, hazardous materials sites, land use, and other relevant data.

Loss of Reservoir storage capacity, primarily due to sediment loads from the Watershed, is also a major long-term concern. While this threat has been recognized for many years, only recently has technology provided a means of performing detailed hydrographic surveys in a cost-effective manner. The first of these surveys was performed by OWML with funding from the FCWA in 1995. While a follow-up survey in 2000 indicated a 0.2 BG loss of storage capacity from 1995, the information is not of sufficient detail to establish a trend line. Another follow-up survey scheduled for 2005 should allow for a more accurate assessment of trends.

| RESERVOIR FINDINGS AND RECOMMENDATIONS | |
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| Findings | |
| 1. | The establishment of the Upper Occoquan Sewage Authority Water Reclamation Facility (WRF) in 1978 ameliorated extremely poor water quality conditions in the 1960s and 1970s and has largely eliminated wastewater, at least in terms of nutrient enrichment, as a threat to Reservoir water quality. |
| 2. | Since 1978, according to monitoring data from the Occoquan Watershed Monitoring Lab, water quality in the Reservoir has remained stable or has slightly improved. This can be attributed to region-wide nonpoint source (NPS) pollution controls, including Fairfax County’s 1982 downzoning and regional implementation of best management practices (BMPs). The accomplishment is particularly notable given that the Watershed’s population nearly tripled during the period of 1978 to 2000 and highlights the wisdom behind the County’s approach to Reservoir management. |

**RESERVOIR
FINDINGS AND RECOMMENDATIONS**

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| 3. | The Reservoir remains eutrophic (nutrient enriched), which can be attributed in part to naturally occurring conditions. The degree to which reductions from anthropogenic nutrient sources are needed for a healthy ecosystem is unclear; however, any additional reductions will need to come from nonpoint sources. According to OWML, two-thirds of nitrogen and 95% of phosphorus inputs to the Reservoir are from nonpoint sources. |
| 4. | Decisions concerning the need for additional pollutant reductions will likely be driven by State and federal clean water mandates and standards. |
| 5. | The Task Force is concerned about the impact of sediment loads on the Reservoir's long-term storage capacity. A hydrographic survey scheduled to be performed by OWML in 2005, building on surveys conducted in 1995 and 2000, should allow for trends analysis and provide information to the County on how storage loss from sediment inputs will affect drinking water supplies. |
| 6. | As development continues, non-traditional pollutants (those other than nutrients and sediments) have the potential to threaten water quality. The interagency Global Strategy Initiative will address emerging human health related issues in the water treatment industry such as pathogens and endocrine disrupting chemicals. The Fairfax County Water Authority's newly completed Source Water Assessment assesses potential sources of contamination including hazardous material sites, land use, and other relevant data. The data can be used to help set priorities for source water protection and identification of water protection strategies. |

Recommendations

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| 1. | The Task Force strongly endorses existing programs and policies aimed at maintaining acceptable levels of water quality in the Reservoir. The County should oppose any effort to weaken regional policies, particularly the State's Occoquan Policy governing wastewater treatment. |
| 2. | The County should strive to reduce nutrient and sediment contributions to the Reservoir above and beyond those being achieved through existing policies and ordinances. |
| 3. | The County should continue to be an active participant in State and federal regulatory and/or policy initiatives that might result in requirements for additional nutrient and sediment reductions in order to ensure that reduction strategies are based on sound policy and science. |
| 4. | The Task Force strongly endorses efforts such as the Global Strategy Initiative to predict and mitigate new pollutants of concern. |
| 5. | The Task Force encourages the continued sharing and coordination of information among UOSA, OWML, and FCWA and County staff to ensure that Reservoir water quality concerns are appropriately addressed. |

B. The Watershed

1. Health of the Watershed's Streams and Aquatic Ecosystems

The streams that feed the Occoquan Reservoir and the valleys they run through harbor valuable and complex aquatic and terrestrial ecosystems. These systems provide important ecological functions such as reducing nutrient loads, mitigating pollution, and providing wildlife habitat. Their role as stopovers and nesting habitat for migratory songbirds gives our stream valleys an international connection. They offer tremendous recreational and educational assets for nearby communities. Their ecological health can also be an early warning sign of problems that will affect downstream systems, including the Occoquan Reservoir.

a) Assessment of Stream Ecological Health

An assessment of the ecological health of Occoquan Watershed streams is critical to any understanding of the long-term trends affecting water quality. Fairfax County is fortunate to have a strong set of baseline data on the ecological integrity of its streams. The *Fairfax County Stream Protection Strategy Baseline Study*, released in 2001, provides a detailed assessment of biological communities and aquatic and riparian habitats throughout the County, including its portion of the Occoquan Watershed.

The study is the culmination of a two-year effort that included an extensive field assessment of County streams, using the U.S. Environmental Protection Agency's Rapid Bioassessment Protocols, 2nd Edition, and the Incised Channel Evolution Model. Additional data continue to be collected by volunteer stream monitors from the Northern Virginia Soil and Water Conservation District and the Audubon Naturalist Society. Monitoring efforts involved sampling benthic macroinvertebrate and fish communities, as well as assessing the surrounding habitat. Both the Stream Protection Strategy (SPS) and volunteer results provide an important indication of the health of tributary streams.

Benthic macroinvertebrates are stream-bottom dwelling organisms that lack a backbone and are visible to the naked eye. They include organisms such as aquatic insects, crustaceans, mollusks, leeches, and worms. They form permanent communities in streams that can be measured and tracked over time. Because they vary in their sensitivity to water quality, they make excellent indicators of water quality.

The presence of good numbers of sensitive benthic macroinvertebrates generally indicates good water quality, while a preponderance of tolerant forms indicates water quality problems. Fish serve a similar function as indicator organisms, although they are far more mobile than benthic macroinvertebrates and can temporarily escape some water quality problems.

In-stream and riparian habitats also provide important clues about water quality. Factors such as bank stability, stream morphology, forested buffers, canopy cover, channel flow, streamside vegetation, and sediment can indicate water

quality problems. Characteristics that indicate a healthy stream with good water quality include:

- Strong numbers and taxonomic diversity of benthic macroinvertebrates and fish, with sensitive forms well represented.
- For Piedmont streams, a regular sequence of pools and riffles, a large proportion of riffle area composed of cobble and gravel that are free of sediment, deep pools with cover for fish, and a water flow that fills most of the available channel most of the year.
- A meandering, natural channel that shows no evidence of artificial channelization or reinforcement.
- Well-vegetated stream banks that show little evidence of erosion and slope gently to the waterline.
- A tree canopy that mostly or entirely covers the stream channel.
- A wide forested buffer along the stream where human activities have had minimal impact.

b) Threats to the Ecological Integrity of Streams

The ecological integrity of streams in the Occoquan Watershed and elsewhere is vulnerable to the impact of human activities, particularly those that change land uses. As noted previously, the County has made tremendous progress in eliminating the impact of point source pollution on the Occoquan Reservoir and has aggressively pursued the control of nonpoint source pollution. The challenges now are to continue to prevent nonpoint source pollution from reversing the progress made in the last few decades and to ensure that streams in the Watershed will be better protected from the impacts of stormwater runoff.

As a watershed is developed, the land's ability to slow down and absorb precipitation is altered. Conversion of forests, fields, and meadows that absorb precipitation to roads, rooftops, parking lots, and other impervious surfaces that shed it causes increased runoff volume and velocity. The consequences to the ecological integrity of our streams include the following:

- Stream channels must change to accommodate increased volumes and velocity of flow from stormwater runoff. This involves downcutting into the streambed, which destroys habitat for benthic macroinvertebrates and other organisms.
- Steep, unstable streambanks are created as streams cut into their beds. As these banks erode, silt and sediment are released into the water column. As the sediment settles, it fills spaces under and between rocks and gravel where benthic organisms live.
- Collapsing banks carry away streamside vegetation, depriving the stream of shade that moderates water temperatures. Warmer temperatures reduce the amount of dissolved oxygen water holds. The loss of this vegetation also eliminates an important source of organic detritus that represents a major food source for aquatic ecosystems.
- Stormwater runoff can carry with it fertilizer, pesticides, herbicides, motor oil and other automotive fluids, sediment, fallout from air pollution, and other pollutants from roads and other impervious surfaces.

- Stormwater running off heated impervious surfaces causes direct thermal shock to aquatic organisms as well as reductions to dissolved oxygen levels.

An article from the Center for Watershed Protection (CWP)⁸ suggests that watersheds with impervious surface cover of 10 to 15% will show clear signs of degradation, while watersheds with impervious surface cover greater than 25% typically do not support a diverse stream community. For particularly sensitive aquatic organisms, impacts can occur at even lower levels of imperviousness than 10%. These impacts occur even with the use of current performance-based stormwater best management practices. A more recent review of research on the impact of imperviousness and mitigation by stormwater management facilities by the CWP suggests that the original conclusions are still valid, although stormwater ponds might have some mitigating effect at impervious cover ranges of 5 to 20%. The most recent detailed accounting of impervious surface cover, conducted by the Northern Virginia Regional Commission in 2000, estimates total Watershed imperviousness to be between 9 and 12%. Many of the Occoquan's subwatersheds are far in excess of 25% imperviousness.

Consistent with the CWP's research, in the downzoned areas of the watershed, impervious surface levels are generally low and overall stream health rankings, as identified in the SPS report, are high. Six of eight watersheds are rated as "excellent." However, outside the downzoned area only five of eleven streams are rated "excellent" or "good." Three are rated as "fair," while three are rated as "poor." This indicates a strong link between water quality and land use.

⁸ Schueler, T. 1994a. "The Importance of Imperviousness". *Watershed Protection Techniques* 2(4): 100-111).

Figure 12. Site condition ratings for Occoquan subwatersheds.

SPS Sites with Subsheds Located Primarily Within the Downzoned Area of the Occoquan Watershed

| Watershed | Stream Name and Site Code | Composite | | Environmental Variables | | | Projected Percent Impervious Surfaces ¹ |
|--------------------|----------------------------------|-----------------------|---------------------------|-------------------------|--------------------|-------------------------------------|--|
| | | Site Condition Rating | Index of Biotic Integrity | Habitat Score | Fish Taxa Richness | Current Percent Impervious Surfaces | |
| Bull Run | Bull Run Tributary (BLBT01) | Excellent | Excellent | Fair | High | 0.8 | 5 |
| Johnny Moore Creek | Johnny Moore Creek 1 (JMJM01) | Excellent | Good | Good | High | 2.6 | 6 |
| | Johnny Moore Creek 2 (JMJM02) | Excellent | Poor | Good | High | 2.4 | 5 |
| Popes Head Creek | Castle Creek (PHCC01) | Excellent | Fair | Good | High | 3.9 | 5 |
| Old Mill Branch | Old Mill Branch (OMOM01) | Excellent | Excellent | Fair | Low | 3.5 | 5 |
| Wolf Run | Wolf Run 1 (WRWR01) | Fair | Excellent | Fair | Very Low | 3.3 | 5 |
| | Wolf Run 2 (WRWR02) | Excellent | Excellent | Good | Moderate | 3.9 | 5 |
| Ryans Dam | Ryans Dam Unnamed Trib (RDRT01) | Excellent | Excellent | Fair | Moderate | 3.3 | 5 |
| Sandy Run | Sandy Run 1 (SASA01) | Excellent | Good | Good | High | 6.1 | 6 |
| | Sandy Run 2 (SASA02) | Excellent | Good | Good | Moderate | 4.4 | 5 |
| | Sandy Run Unnamed Trib. (SASA02) | Fair | Good | Fair | Very Low | 1 | 8 |
| Occoquan | Elk Horn Run (OCEH01) | Excellent | Excellent | Excellent | Low | 3.6 | 14 |

SPS Sites Within the Downzoned Area, But With Some Headwaters Outside the Downzoned Area

| | | | | | | | |
|------------------|-----------------------------|-----------|------|------|----------|------|----|
| Popes Head Creek | Piney Branch 1 (PHPI01) | Fair | Poor | Fair | High | 12.8 | 14 |
| | Popes Head Creek 1 (PHPH01) | Good | Poor | Fair | High | 13.1 | 20 |
| | Piney Branch 2 (PHPI02) | Fair | Poor | Poor | High | 8.3 | 9 |
| | Popes Head Creek 2 (PHPH02) | Fair | Fair | Poor | Moderate | 11.4 | 14 |
| | Castle Creek (PHCC01) | Excellent | Fair | Good | High | 3.9 | 5 |
| | Popes Head Creek 3 (PHPH03) | Good | Poor | Fair | Moderate | 8 | 10 |

SPS Sites with Subsheds Located Primarily Outside the Downzoned Area of the Occoquan Watershed

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|--------------------|-----------------------------|------|------|-----------|----------|------|----|
| Cub Run | Cain Branch (CUCB01) | Fair | Fair | Poor | Moderate | 16.8 | 51 |
| | Cub Run (CUCU02) | Good | Good | Fair | Low | 8.4 | 43 |
| | Flatlick Branch 1 (CUFB01) | Poor | Poor | Poor | High | 21.2 | 39 |
| | Flatlick Branch 2 (CUFB02) | Poor | Fair | Fair | Low | 22.6 | 49 |
| | Cub Run 2 (CUCU03) | Good | Poor | Good | Moderate | 10.4 | 46 |
| | Big Rocky Run 1 (CUBR01) | Good | Fair | Excellent | High | 27.4 | 47 |
| | Big Rocky Run 2 (CUBR02) | Fair | Fair | Fair | Moderate | 27.7 | 44 |
| | Elklick Run (CUER02) | Fair | Fair | Fair | Very Low | 2.2 | 5 |
| | Cub Run 3 (CUCU04) | Poor | Fair | Very Poor | Moderate | 12.2 | 32 |
| Cub Run 4 (CUCU05) | Good | Fair | Fair | Moderate | 12 | 31 | |
| Little Rocky Run | Little Rocky Run 1 (LRLR01) | Fair | Poor | Good | High | 14.6 | 27 |
| | Little Rocky Run 2 (LRLR02) | Good | Fair | Good | High | 17.7 | 32 |
| | Little Rocky Run 3 (LRLR03) | Fair | Poor | Good | Moderate | 19.1 | 33 |

¹ The method that was used in the SPS baseline study, to determine the projected percent of impervious surface, was not accurate enough to provide precise projections.

c) Future Concerns

While streams within the downzoned areas of the watershed show generally good water quality, many Occoquan Watershed tributaries extend beyond these areas into much more densely developed communities with higher levels of impervious surface. In almost all cases, streams that rank only “fair” or “poor” are also the streams in areas with the highest impervious surface cover. While other factors can have an influence, impervious surface levels in a watershed have been widely demonstrated to be good predictors of water quality and ecological health of streams.

The watersheds of many of the streams outside the downzoned area that currently rate as “good” will probably experience significant increases in impervious surface as additional development occurs. The Stream Protection Strategy Baseline Study report provides projections of potential impervious surface conditions in watershed areas upstream of data collection points (see Figure 12). Care should be taken, however, in applying these projections; the method that was used to project impervious surface was not refined enough to produce precise results. As development proceeds in these areas, though, it is likely that there will be considerable stream degradation in the future unless additional stormwater management practices are employed over and beyond those currently employed by the County. In addition to increased volumes and velocities of stormwater runoff associated with increased impervious cover, land disturbance during construction results in increased silt loads on the streams. This impact varies based on the diligence of the contractors and abilities of the construction inspectors to enforce compliance in order to prevent silt-laden runoff from reaching the streams.

Both the Virginia Department of Transportation and the Metropolitan Washington Airports Authority (MWAA) have land-disturbing projects in the headwaters of the Occoquan Watershed. Both of these agencies are outside the regulatory authority of Fairfax County, although MWAA projects in Fairfax County must be consistent with the County’s Chesapeake Bay Preservation Ordinance. Soil erosion incidents associated with land disturbance for MWAA and VDOT projects result in the conveyance of silt laden runoff into the streams. These incidents are generally not immediately apparent to the County until complaints are raised by citizens or inspectors notice discolored streams and track the source to these projects. This has occurred in the past and resulted in the County working with those parties to resolve the problems. While the cumulative effect of these incidents on the Reservoir may not be substantial, they can have devastating effects on ecosystems in headwaters streams. Also, the incidents result in citizen perceptions that projects within the County are not being appropriately implemented, monitored, and enforced.

While the Task Force’s concern is primarily with areas outside the downzoned portion of the Watershed, there are also some concerns for areas in the downzoned portion. Tree removal for by-right development of single lots will result in increased runoff velocities and volumes into streams. Also, construction at these sites can release sediment pulses into the streams. Stream crossings used by all terrain vehicles, which are especially common along utility easements, are additional sources of silt and degrade stream bank stability.

While numbers for such crossings are not available, anecdotal evidence suggests that this concern merits further investigation. In addition, general turf management is a concern due to the potential for improper application and overuse of fertilizers and pesticides to negatively impact water quality.

Finally, horses are a common sight in downzoned portion of the Occoquan Watershed and are an important part of the Watershed's culture. While recognized as a beneficial use in County policy and planning documents, care must be taken to ensure that horse operations do not have adverse effects on nearby streams. These can include: excess nutrients from improperly managed manure, fertilizers, and pesticides used in pasture maintenance; riparian vegetation loss; bank erosion; and excess siltation and pollution from animals allowed access to streams. The U.S. Department of Agriculture recommends one horse per three acres; however, County regulations permit up to three horses per acre. Maintaining good water quality with such high densities requires rigorous management by horse farm operators. To this end, and pursuant to the County's Chesapeake Bay Preservation Ordinance, the Northern Virginia Soil and Water Conservation District works with residents to develop conservation plans to manage horse operations in an environmentally sound manner.

d) Tools for Reducing Impacts on Stream Ecosystems

Fairfax County has available a variety of tools to reduce current and potential impacts on streams both inside and outside the downzoned areas. These include:

- **Land Use Management:** The most effective tool for reducing impacts is to prevent the impacts in the first place through land use management policies that limit impervious surface.
- **Watershed Assessment:** The County's 2001 *Stream Protection Strategy Baseline Study* provides essential data for making management decisions to protect and improve the health of Occoquan Watershed streams.
- **Watershed Planning:** The Fairfax County Stormwater Planning Division is working towards developing and implementing Watershed Management Plans for all 30 watersheds throughout Fairfax County. The plans will evaluate strategies for mitigating problems affecting the environment, particularly water quality. They will be based on goals and objectives developed through stakeholder and public involvement.
- **Stream Buffers:** The County protects vegetated buffers along perennial streams as mandated by the State's Chesapeake Bay Preservation Area Designation and Management Regulations and through the County's EQC process. The value of these stream protection tools is being enhanced by a recent County initiative to more accurately designate perennial streams. This effort is likely to result in significantly more stream miles being protected by vegetated buffers.

- **Low Impact Design:** Low impact design (LID) describes a suite of techniques that attempts to reproduce pre-development hydrology so that there is no increase in runoff reaching streams and no loss of groundwater recharge. LID encompasses a wide range of construction, site design, and landscaping techniques such as: textured roof tiles; vegetated drainage swales; shared parking and structured parking; narrower street widths; clustering houses; and, biofiltration facilities/rain gardens. The Comprehensive Plan supports the use of LID. Some LID techniques, such as biofiltration, are included in the PFM. Careful evaluation of LID techniques is necessary, however, to ensure their applicability to local conditions. For example, some LID techniques are soil dependent and have not been proven effective on poorly drained Piedmont soils that characterize many portions of the Occoquan Watershed.
- **Stormwater Management:** While stormwater BMPs adopted for the Occoquan Watershed have prevented further deterioration of drinking water quality in the Reservoir, the County's BMP requirements were not developed with the explicit goal of protecting stream ecosystems. More recently, the County has begun working to make stormwater management facilities less degrading to stream ecosystems.
- **Watershed Stewardship:** Encouraging good stewardship by watershed residents is widely recognized as critical to protecting stream ecosystems. Fortunately, several stewardship programs are already active in Fairfax County, including in the Occoquan Watershed.

**STREAMS AND ECOSYSTEMS
 FINDINGS AND RECOMMENDATIONS**

| Findings | |
|-----------------|---|
| 1. | Many of the healthiest, most ecologically viable streams in Fairfax County are in the Occoquan Watershed. As demonstrated by the 2001 <i>Stream Protection Strategy Baseline Study</i> , however, the ecological health of streams inside and outside the downzoned portions of the Watershed vary significantly, with the former in mostly excellent condition while the picture for the latter is much more mixed. Stormwater runoff from areas with larger percentages of impervious surface is the major cause of stream degradation. |
| 2. | Significant investment was made in stormwater best management practices outside the downzoned areas to improve water quality in the Reservoir, control flooding and erosion, and reduce peak flows. Protection of stream ecosystems, however, was not an explicit goal for these facilities. More recently, the County has given the ecological viability of streams a much higher priority as reflected in the <i>Stream Protection Strategy</i> and watershed management planning programs. |

**STREAMS AND ECOSYSTEMS
 FINDINGS AND RECOMMENDATIONS**

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| 3. | The most cost-effective approach to preserving the ecological health of streams is to protect them in the first place, as demonstrated by the relatively good condition of streams wholly contained within the downzoned area. Restoration of aquatic ecosystems after degradation is expensive and never returns streams to their pre-development ecological conditions. Because of the low levels of impervious surface, with proper management the outlook for maintaining the ecological health of streams in the downzoned area is quite good. Horse operations and other potential sources of pollution need to be monitored. |
| 4. | Outside the downzoned area, maintaining or restoring the ecological health of many streams will be a greater challenge due primarily to large and increasing levels of impervious surface. Because they were designed primarily to protect Reservoir drinking water quality, the best management practices currently in place have, at best, a modest impact on the degradation of stream ecosystems. Strategies such as low impact design (LID), more stream-friendly stormwater pond design, retrofitting existing developed areas, and public education to encourage behavior changes offer some hope for future improvement. The watershed management planning process in combination with the Stream Protection Strategy offers a vitally important opportunity to examine and recommend ways to provide better stream protection and restoration outside the downzoned area. These County initiatives offer the most comprehensive, in-depth watershed management planning process focused primarily on preservation of stream integrity and water quality. |
| 5. | Streams protection effort both inside and outside the downzoned area benefit from continued assessments. The 2001 <i>Stream Protection Strategy Baseline Study</i> provided critical baseline data but could not offer insight into long-term trends. Only an ongoing assessment effort can provide data to keep track of stream health, identify new problems, and assess the effectiveness of stream protection measures over time. |
| 6. | LID techniques offer new options to reduce runoff from new and existing development. Some of these techniques are proven and are in use in the County now; however, questions remain about the applicability and/or effectiveness of some LID techniques. |

Recommendations

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| 1. | Rigorously maintain the integrity of the Occoquan downzoning. As demonstrated by the County's 2001 <i>Stream Protection Strategy Baseline Study</i> , the downzoning has been an effective measure for the protection of stream ecosystems. |
| 2. | Continue regular long-term stream assessments by the Stream Protection Strategy staff. Such assessments are critical to measuring the County's progress in protecting and restoring stream ecosystems. These assessments should include continued partnership with volunteer stream monitoring efforts. The County should ensure that the Stream Protection Strategy staff is adequately funded and staffed to handle its growing responsibilities. |
| 3. | Fully develop and implement the Stormwater Planning Division's watershed management planning process in the Occoquan Watershed, as well as all other County watersheds. This process represents the County's most focused and comprehensive approach to protecting and restoring stream ecosystems. |

**STREAMS AND ECOSYSTEMS
 FINDINGS AND RECOMMENDATIONS**

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| 4. | Study and adopt new stormwater management designs that have been demonstrated to protect or improve the health of stream ecosystems. |
| 5. | Encourage the use of those LID techniques that have been proven effective under local conditions, both where new development is planned and, to the extent feasible, for retrofitting of existing development. The County should further investigate the effectiveness and applicability of LID techniques. |

2. Land Use and Open Space Protection – The Key to Both Reservoir and Watershed Protection

Land use policy addressing Fairfax County’s portion of the Occoquan watershed is contained within the County’s Comprehensive Plan. Land use regulation is contained in the Zoning Ordinance and other chapters of the Fairfax County Code. It is important to note that the Zoning Ordinance and County Code are legal, regulatory documents while the Comprehensive Plan is a non-regulatory, policy document.

As noted earlier in this report, the Fairfax County Board of Supervisors undertook comprehensive land use actions in 1982 to implement its vision of the County’s portion of the Occoquan watershed. A primary goal of these actions, as established in the Occoquan Basin Study, was to ensure that there would be “no degradation of the Occoquan water quality resulting from urbanization and agricultural activity in Fairfax County, beyond the level projected for existing and committed development [as of the time of the study]” in the County’s portion of the watershed. Nearly 41,000 acres of the watershed were “downzoned” to the R-C (Residential-Conservation) District of the Zoning Ordinance. At the same time, over 1,600 acres of land in the Occoquan watershed near Dulles International Airport were “upzoned” to the I-3 (Light Intensity Industrial) District.

As stated in the Zoning Ordinance, the purpose and intent of the R-C District is:

“...to protect water courses, stream valleys, marshes, forest cover in watersheds, aquifer recharge areas, rare ecological areas, and areas of natural scenic vistas; to minimize impervious surface and to protect the quality of water in public water supply watersheds; to promote open, rural areas for the growing of crops, pasturage, horticulture, dairying, floriculture, the raising of poultry and livestock, and for low density residential uses; and otherwise to implement the stated purpose and intent of this Ordinance.”

One effect of the downzoning action was that it established clear boundaries between areas that were to be suburban in character (and that would be the focus of economic development efforts in the watershed) and areas that were to be of a rural or low density residential character. This action also facilitated the efficient provision of public facilities and services by concentrating development in roughly one-third of the watershed.

In addition to the downzoning action, a "Water Supply Protection Overlay District," or "WSPOD," was established in the Zoning Ordinance; the entirety of Fairfax County's portion of the Occoquan Watershed (more than 63,000 acres), excluding road and highway rights-of-way and the Town of Clifton, was placed in this District. This Overlay District established a Zoning Ordinance requirement for stormwater management "best management practices" (BMPs) for any use in the County's portion of the Watershed that requires either a subdivision plan or a site plan. In the R-C District portion of the Watershed, where the establishment of five-acre lots is not subject to the BMP requirement, the low density land use associated with the R-C District was determined to be the appropriate BMP. The Public Facilities Manual was amended in 1980 to require BMPs in the Occoquan watershed; this requirement was strengthened and formalized in the Zoning Ordinance two years later through the establishment of WSPOD. Essentially, structural BMPs were pursued as the primary water quality approach outside the R-C District, while a land use BMP approach was pursued within the R-C District.

Prior to the adoption of the County's Chesapeake Bay Preservation Ordinance in 1993, BMPs were not required outside the Occoquan Watershed, except in cases where such measures were proffered or conditioned in conjunction with the approval of zoning applications. Further, the BMP requirement that was established in WSPOD is more stringent than the BMP requirement that applies for new development outside the Occoquan Watershed; WSPOD requires projected phosphorus runoff pollution to be reduced by 50%, whereas a 40% reduction standard applies in the rest of the County.

The Board's 1982 vision for the County's portion of the Occoquan Watershed has, in general, been realized. The County's portion of the Watershed has developed largely as envisioned in 1982, and this pattern of development has made a positive contribution to the protection of water quality in the Occoquan Reservoir. While the County's portion of the Watershed is not yet built out, vacant and underutilized lands are not prevalent. Much of the development in this area has occurred since 1982; yet, as noted earlier in this report, there has been no evidence that water quality in the Occoquan Reservoir has degraded since 1982. The Task Force concludes that the land use and BMP approaches established by the Board in 1982 have been successful.

The success of the land use efforts in the Occoquan watershed should be celebrated. Yet, continued vigilance is needed to ensure that land use within the Watershed continues to support the protection of the Occoquan Reservoir. In addition, efforts are needed to ensure that high quality ecological conditions of streams in the Watershed are protected or restored. While stream protection was not a focus of the Occoquan Basin Study or the zoning actions that were taken pursuant to that study, it is the Task Force's view that stream protection and restoration should, in keeping with an Objective in the "Environment" section of the County's Policy Plan, be important goals both within and outside the Occoquan watershed.

The Task Force sees several areas where actions are needed in order to maintain and enhance the successful efforts to date. These areas focus on:

- Standards and guidelines associated with uses allowed within the R-C District through Special Permit, Special Exception, or “2232” (public facilities) approval;
- Stream valley/open space protection;
- Development of remaining vacant and underutilized land in the watershed; and
- Environmental stewardship within the watershed.

a) The Zoning, Planning, and Existing Land Use Context

Land use and open space issues need to be considered within the context of zoning and planning. This section of the report provides a brief overview of this context.

Existing Land Use

Much of the Occoquan Watershed in Fairfax County has been developed. Less than 18% of the land area of the County’s portion of the Watershed remains vacant, and less than 4% of the County’s portion of the Watershed contains underutilized residential land (residentially planned land that is not vacant but that has not been developed to the extent that could occur within planned density ranges as set forth in the Comprehensive Plan). Data regarding underutilized commercially planned land are not available, but it is not expected that such land would comprise a significant area of the Watershed. While redevelopment can potentially occur in some areas that are “built out” (particularly where there are Comprehensive Plan options that are much higher in density than the “low end” of the planned density range--the pending redevelopment of the Dix-Cen-Gato area is a notable example), much of the future development in the Watershed is likely to occur on the vacant and underutilized parcels.

It is important to stress that the terms “vacant land” and “underutilized land” do not reflect value judgments but rather reflect development potential. “Vacant” or “underutilized” land is not necessarily “underdeveloped” land; for example, there are vacant and underutilized parcels in the R-C District that support desirable and viable uses such as riding stables, agriculture, and residential properties greater than ten acres in size. From the standpoint of development potential, though, these properties are highlighted because they have not yet developed to the maximum residential potential allowed under the Zoning Ordinance. However, these same properties may be supporting desirable uses, other than residential, in accordance with the Comprehensive Plan.

Nearly 70% of the vacant land in the County’s portion of the Occoquan Watershed is located in the R-C District. Over 79% of the underutilized residential land is likewise located in the R-C District. The total amount of vacant and underutilized land in the R-C District in the Occoquan Watershed represents about 24% of the area of the R-C District. Much of the vacant and underutilized land in the R-C District is located in areas with soils that are poorly suited to

traditional onsite sewage disposal systems (i.e., septic systems and associated drainfields). Some of the vacant and underutilized land is located in Agricultural and Forestal Districts. Vacant and/or underutilized areas of particular note are: areas west of Cub Run; areas between Braddock and Popes Head Roads; an area along Shirley Gate Road; an area south of Popes Head Road and west of Colchester Road; areas along Compton Road; and an area near Hemlock Overlook Regional Park. Other vacant and underutilized parcels are located in areas that are largely developed; the future development of these parcels will, therefore, be of an “infill” character. Almost the entirety of the R-C District is outside the approved sanitary sewer service area

Outside the R-C District, areas where vacant and underutilized parcels are prevalent include the Westfields area, other areas in the Dulles Suburban Center (the Route 28/Centreville Road and Route 50 corridors near Dulles Airport, and the industrially-zoned area between Westfields and Route 50), areas between I-66 and Route 29 east of Centreville (some of which are now being developed), and areas along Thompson and Oxon Roads. A number of vacant or underutilized “infill” parcels are also present. These areas are all within the area approved for sanitary sewer service.

The Zoning Process and By-Right Development

Every property in Fairfax County is zoned. Each zoning district in Fairfax County’s Zoning Ordinance has a list of “permitted uses,” a list of uses that can be allowed through the approval of a “Special Permit” by the County’s Board of Zoning Appeals (BZA), and a list of uses that can be allowed through the approval of a “Special Exception” by the County’s Board of Supervisors (BOS). In addition, each zoning district specifies, among other things, maximum allowable floor areas for nonresidential uses (expressed as a ratio of floor area of structures to lot area), minimum lot areas, and open space requirements. Land owners may pursue the development of “permitted uses” as long as such development meets all applicable zoning requirements and other County Code requirements; no special permission by the BOS or BZA is needed. In land use jargon, such development is referred to as “by-right” development.

If a developer or landowner requests a change to the zoning of a property, or if a developer or landowner applies for a use that requires a Special Exception, the proposed development will be subject to public hearings before the Planning Commission and BOS. The BOS may approve or deny such applications. In the case of rezonings, approvals are typically subject to a set of “proffers,” or voluntary commitments, offered by the applicant. In the case of Special Exceptions, approvals are typically subject to a set of Board-imposed development conditions. In the case of Special Permits, each application is subject to a public hearing before the BZA, and the BZA has the authority to approve or deny such applications. Approved applications are typically subject to development conditions imposed by the BZA. Of particular note regarding these processes is that County staff, the Planning Commission, the BOS, and the BZA have the ability to review applications for conformance with Comprehensive Plan policies and to seek commitments (or, in some cases, to impose conditions) that go above and beyond minimum zoning or County Code requirements. These opportunities are not available for by-right development.

b) The Open Space/Stream Valley Preservation Context

It is also important to understand the mechanisms through which open space/stream valley areas are, and can be, protected in order to better understand the implications of future changes to land use in the Watershed. To a significant extent, these mechanisms are tied to the process through which development occurs. Open space protection mechanisms can be characterized as being regulatory, policy driven, or voluntary.

Regulatory Mechanisms

Regulatory protection mechanisms include the County's Chesapeake Bay Preservation Ordinance (Chapter 118 of the Fairfax County Code) and the Floodplain Regulations of the Zoning Ordinance. The Chesapeake Bay Preservation Ordinance establishes designation and use criteria for Resource Protection Areas (RPAs). In the County's portion of the Occoquan Watershed, RPAs presently include "tributary" streams (perennial streams that are so depicted on U.S. Geological Survey maps), associated wetlands, and 100-foot buffer areas around these features.

New State regulations will require all perennial streams to be protected through RPA designation regardless of how they are depicted on maps; this requirement, which must be implemented by March, 2003, will result in a significant expansion to the County's RPA network. While a number of uses are either allowed within RPAs or exempt from RPA requirements, and while other uses can be pursued through applications to the County for exceptions, the RPA is an area that is generally protected from disturbance.

The Floodplain Regulations of the Zoning Ordinance have the effect of limiting the extent of land disturbance that can occur in floodplains. As defined by these Regulations, the "floodplain" includes all areas that would be flooded by the rainfall event that is expected to occur, on average, once every 100 years, for any stream that collects drainage from an area greater than 70 acres. "Minor floodplains" are associated with streams that collect drainage from areas between 70 and 360 acres. Floodplains associated with larger streams are commonly referred to as "major floodplains." While any use can technically be permitted in a minor floodplain, a set of "use limitations," including hydrologic and environmental considerations, limit actual encroachments. There is a limited list of uses that are allowed in major floodplains; however, additional flexibility is afforded through the Special Exception process.

All development activities in the County must comply with both the Floodplain Regulations and the Chesapeake Bay Preservation Ordinance, even if they are pursued through the "by-right" approach. While both of these regulatory approaches protect significant amounts of sensitive stream valley lands, they do not provide for comprehensive stream valley protection. For example, the required 100-foot buffer area associated with RPAs may or may not include the entirety of a steeply sloping area adjacent to a stream. Further, intermittent streams are not (and will not be) protected under the Chesapeake Bay Preservation Ordinance, and the Floodplain Regulations do not protect streams

with drainage areas of less than 70 acres. Further, the Floodplain Regulations do not ensure that streams will be provided with substantial vegetated buffer areas. Hypothetically, clearing could occur to the edge of a stream where the stream flows along a floodplain boundary and where the stream is not perennial.

Policy-Driven Mechanisms

Policy-driven open space protection includes the acquisition of park land by the County or other governmental entity, in that policy decisions are made regarding the type, character, and extent of land that warrants acquisition. The preservation of undisturbed open space is one of the most effective tools for ensuring good water quality in any watershed. The Fairfax County Park Authority and the Northern Virginia Regional Park Authority are the largest landholders and preserve thousands of acres of undisturbed open space in the Occoquan Watershed. Because of their extensive holdings of undisturbed open space, the Park Authorities are important land stewards in the Occoquan Watershed. The County's Board of Supervisors has been particularly active recently in the acquisition of park land in the R-C District of the Occoquan Watershed, and the Northern Virginia Regional Park Authority maintains substantial land holdings along the shoreline of the Occoquan Reservoir.

The County's Environmental Quality Corridor (EQC) policy is another notable policy-oriented approach to open space protection. The EQC system is an open space system designed to link and preserve natural resource areas and provide passive recreation. Unlike RPA requirements or the Floodplain Regulations, the EQC policy, which is within the Environment section of the County's Policy Plan, focuses on stream valley and other ecologically-valuable lands from a holistic perspective; the stream valley component of the policy recommends the protection of floodplains, associated wetlands, adjacent steep slopes (15% or greater slope gradients), and a slope-based minimum buffer area. The application of this policy is not limited to streams with specific drainage areas; indeed, the County has established EQCs in headwater areas of streams.

While the EQC policy provides a more comprehensive framework for the protection of stream valleys and other ecologically valuable land than do the Floodplain Regulations or Chesapeake Bay Preservation Ordinance, EQC protection is not required by County ordinance. Rather, the policy is implemented through negotiations with developers during the reviews of zoning applications such as rezonings, Special Exceptions, and Special Permits. During the reviews of zoning applications, staff from the Department of Planning and Zoning formulates recommendations regarding EQC designations, negotiates with applicants for commitments to the protection of these areas, and forwards recommendations to the applicable reviewing authority/ies. In general, zoning applications that propose disturbance to EQCs (allowing for unavoidable encroachments, such as some road crossings and utility lines, and allowing for trail construction) are not approved. The EQC policy can also serve as the basis for acceptance of Open Space Easements by the County. Where applied, the EQC policy has been successful in protecting stream valleys and other sensitive areas. However, EQC protection is not a requirement for by-right development, and landowners are not prohibited from clearing into areas of their properties that might otherwise qualify for EQC designation.

Voluntary Mechanisms

A number of voluntary measures can be taken by landowners to protect environmentally sensitive lands. Conservation and Open Space easements, for example, are effective tools for the long-term protection of open space. These easements can also heighten awareness of the importance of proper stewardship in protecting the Occoquan Reservoir. The County has established an "Open Space Easements" program through which the Board of Supervisors can accept easements donated by property owners; in some cases, property owners attain tax benefits by donating these easements. The County has also entered into a public-private partnership with the Northern Virginia Conservation Trust in order to enhance easement acquisition efforts in the County.

Fairfax County also has an Agricultural and Forestal District program. Eligible landowners may apply to the Board of Supervisors to place their land in such districts and to attain the tax benefits that are associated with the Agricultural and Forestal District designation. Through this program, environmentally sensitive areas of subject properties can be protected for the duration of the District designation (at least eight years). In addition, conservation plans are developed in coordination with the Northern Virginia Soil and Water Conservation District in order to minimize pollutant runoff from agricultural and forestal operations. Several of the larger vacant and underutilized properties in the Occoquan Watershed are located in Agricultural and Forestal Districts.

Another voluntary approach is environmental stewardship of private property. Environmentally sensitive lands need not be owned or regulated by the government in order to be protected; a strong environmental ethic among landowners in the Watershed can also serve to protect these areas. Government can foster such an ethic through educational efforts. A potential tool for increasing awareness of proper land stewardship is to enlist the services of volunteer organizations, the real estate industry, and homeowner associations to help with education.

c) Development Potential in the R-C District

By-Right Development

As noted earlier, most of the vacant and underutilized land remaining in Fairfax County's portion of the Occoquan Watershed is located in the R-C District. There are nearly 9,600 acres of such land in the R-C District, which is less than 24% of the area of this District. Much of this land remains undeveloped because of soil constraints to on-site sewage disposal systems. If alternative on-site sewage treatment/disposal technologies were to be applied (see the discussion later in this report), much of the remaining vacant and underutilized land in the R-C District would likely be developed at some time in the future. With the exception of Special Permit and Special Exception uses, however, this development would be of the "by-right" variety, as rezoning of land in the R-C District would be inconsistent with Comprehensive Plan policy and therefore would probably not be supported by the Board of Supervisors.

Because much of the future development in the R-C District will be by-right in nature, because regulatory approaches to open space protection will not protect all stream valley areas (and other environmentally sensitive areas) from disturbance associated with such development (see the discussion above), because much of the Watershed has already developed to its planned density, and because land stewardship efforts that can impact water quality (e.g., residential lawn care) fall outside the realm of government regulation, the need for voluntary stewardship efforts on the part of landowners will become increasingly important to the protection of the Occoquan Reservoir.

Special Exceptions and Special Permits

Since the downzoning action in 1982, the R-C District of the Zoning Ordinance has been amended twelve times; each of these amendments added new Special Exception or Special Permit uses in the District. Examples of some of the added uses include: accessory dwelling units, residence halls, golf driving ranges, home child care facilities, cultural centers and museums, bed and breakfasts, institutions providing housing and general care for the indigent, regional sewage treatment and disposal facilities, private clubs, temporary mobile and land based telecommunication testing facilities, nursery schools, private schools of general education, and places of worship with a nursery school or private school of general education. It is important to note that none of these uses was added as a “by right” use; all such uses require the approval of either the Board of Supervisors or Board of Zoning Appeals.

Since 1982, there have been several dozen Special Exception and Special Permit uses approved in the R-C District. These uses have included: religious institutions; private schools; plant nurseries; cluster subdivisions; electrical substations; sewage treatment and related facilities; and recreational uses such as athletic fields, golf courses, driving ranges, swimming and tennis clubs, and riding and boarding stables. Due to the scarcity of large, relatively inexpensive parcels of land, there are few areas of the County outside the R-C District that are available or feasible for larger Special Permit or Special Exception uses. As a result, there have been requests and approvals for relatively large regional-oriented uses or facilities in the R-C District. It is likely that new proposals for such uses in the R-C District will continue to be filed in the future.

The Zoning Ordinance allows floor area ratios of up to 0.10 for private nonresidential uses and up to 0.15 for public uses. For a hypothetical 20-acre parcel in the R-C District, therefore, up to two acres of floor space could be provided for a private school or religious institution and up to three acres of floor space could be provided for a public use. With respect to overall impervious cover on a site, the Zoning Ordinance establishes minimum parking requirements but does not establish any caps on impervious cover.

The Zoning Ordinance establishes a requirement of 50% open space in the R-C District for cluster subdivisions but does not establish any other open space requirements. The 50% open space for cluster subdivisions is not required to be undisturbed open space. Finally, the Zoning Ordinance requires the following for cluster subdivisions in the R-C District: “. . . the applicant shall demonstrate that the cluster subdivision and the use of its open space is designed to achieve

runoff pollution generation rates no greater than would be expected from a conventional R-C District subdivision of the property.” There are no specific water quality standards for other Special Permit or Special Exception uses in the R-C District.

Special Exception and Special Permit uses in the R-C District are reviewed for conformance with the Comprehensive Plan. Comprehensive Plan land use recommendations for planning sectors that are located, at least in part, in the R-C District typically include text similar to the following:

Non-residential uses requiring special exception or special permit approval should be rigorously reviewed. In general, these uses, if permitted at all, should only be located at the boundary of Low Density Residential Areas and Suburban Neighborhoods or where their impact on existing residences is minimal. These uses should be granted only if the following conditions are met:

- *Access for the use is oriented to an arterial roadway;*
- *The use is of a size and scale that will not adversely impact the character of the area in which it is located; and*
- *The use is designed to mitigate impacts on the water quality of the Occoquan Reservoir.*

The last bullet point is broad in nature and does not establish a quantifiable guideline; “mitigation of impacts” may mean different things to different people. In reviewing Special Exception and Special Permit applications in the R-C District, County staff typically pursues an approach whereby a minimum of 50% perpetually undisturbed open space is recommended along with structural BMP controls for the portion of the site that develops. In most, but not all, cases where this recommendation has been made, approved Special Permits and Special Exceptions have reflected this approach. Through the preservation of at least half of the subject property as perpetually undisturbed open space, the applicant can demonstrate that the BMP requirement of WSPOD can be satisfied through the protection of open space; in this manner, land use serves as a BMP.

This land use approach, along with the provision of structural controls for the developed portion of the site, ensures that water quality protection for the site will exceed the minimum WSPOD BMP requirement. However, this approach does not ensure that pollutant runoff rates from the developed site will be less than or equal to the pollution runoff rates that would be anticipated from a conventional R-C District residential development of the site. Impervious cover associated with Special Permit and Special Exception uses in the R-C District typically exceeds what would be anticipated for a five-acre lot residential development, and therefore pollutant runoff rates for such uses could conceivably exceed rates associated with a five-acre lot residential development, even with water quality efforts that exceed minimum WSPOD requirements. The increased impervious cover can also result in increased volumes of stormwater runoff. These increased volumes have a higher potential to degrade streams downstream of these sites than the volumes of stormwater runoff that would be associated with lesser amounts of impervious cover.

Public Facilities

Public facilities and utilities, including schools, parks, libraries, fire stations, and other facilities, are reviewed by the Planning Commission for general conformance with the County's Comprehensive Plan as provided under Section 15.2-2232 of the Code of Virginia. This Code section requires that the general location, character, and extent of a proposed public facility be determined by the local Planning Commission to be substantially in accord with the adopted comprehensive plan. Except for facilities and utilities that are a current feature identified on the Plan, the Planning Commission holds public hearings on all "2232 Review" applications. Facilities and utilities that are a current feature of the Plan are reviewed by the Commission without a public hearing under the "feature shown" process. While there are no explicit water quality-based guidelines for the review of public facility applications in the R-C District, County staff reviews public facility uses in a similar manner to Special Permit and Special Exception uses.

The Park Authorities provide some recreational facilities such as playing fields, golf courses, and marinas on a small percentage of the park landholdings in the Watershed. Any expansion of publicly owned recreational facilities requires standard planning and zoning approvals including a 2232 Review. The County reviews Park Authority applications in the same way that it does other Special Exception and Special Permit applications. Developed parklands are required to provide stormwater management BMPs to retain and treat runoff.

Road projects pursued by the Virginia Department of Transportation (VDOT) are reviewed locally through Citizen Information Meetings and the Location and Design public hearing process. Prior to approval by the Commonwealth Transportation Board (CTB), all projects are presented to the Board of Supervisors for endorsement. The general locations and design criteria of these projects are guided by the County's Comprehensive Plan, and the County's Department of Transportation coordinates closely with VDOT regarding design and engineering details.

With respect to environmental protection, VDOT road projects are exempt from local ordinances adopted pursuant to Virginia's Chesapeake Bay Preservation Act but are subject to Virginia's Erosion and Sediment Control Law and Virginia's Stormwater Management Regulations (which include stormwater management and water quality control requirements). Engineering reviews for VDOT projects are undertaken at the State level of government with coordination and input from the County Department of Transportation staff.

d) Development Potential Outside the R-C District

As noted earlier in this report, only 17% of the Occoquan Watershed is located in Fairfax County. As such, much of the Watershed's development potential outside the R-C District lies outside Fairfax County. However, this section of the report will focus on that portion of the Watershed that is located within Fairfax County and that is outside the R-C District.

As noted earlier, the majority of vacant land and underutilized residential land in the Occoquan Watershed in Fairfax County is located in the R-C District. However, there are over 3,300 acres of vacant land and nearly 500 acres of underutilized residential land in that portion of the Occoquan Watershed in Fairfax County that is outside the R-C District. Some of this land is already being developed. It is not known how much of the remaining land will develop through a by-right process and how much will go through a zoning process (rezoning, Special Exception, or Special Permit). However, some of the development in this area will be of an infill character. The potential for the redevelopment of existing developed parcels is also possible. The Rockland Village and Dix-Cen-Gato areas are two examples where such redevelopment is occurring, and other older developed areas may follow suit. There may be opportunities for water quality improvement in these areas, as older developed parcels without water quality controls are replaced with newer developments with controls. With the exception of minor development projects (e.g., additions to existing structures that don't require site plans; construction of individual houses on existing lots), all development outside the R-C District will be subject to the BMP requirement of WSPOD.

It is likely that the development of vacant and underutilized parcels in the Occoquan Watershed outside the R-C District will result in significant increases in impervious cover on these parcels. The additional volumes of stormwater runoff that will be generated by the increased impervious cover may, in turn, result in increased stream degradation in downstream areas.

As noted earlier in this report, increases in stormwater runoff volumes can be reduced through the application of low impact site design techniques such as the minimization of impervious surfaces (e.g., reduction in off-street parking, provision of narrow roadways, siting buildings to reduce impervious cover, use of pervious parking surfaces) and the conveyance of runoff from impervious surfaces into pervious areas (e.g., elimination of curb and gutter, conveyance of drainage into biofiltration facilities/rain gardens, conveyance of drainage into infiltration swales). The Comprehensive Plan was amended by the Board of Supervisors in 2000 to support the application of such techniques. While the County has taken actions to support some of these techniques (e.g., recognition of biofiltration facilities and other innovative stormwater management efforts in a Letter to Industry), there are a number of impediments to the application of these techniques, including site, process, and regulatory constraints. County staff has begun to investigate such impediments as they relate to current County process and regulatory requirements.

Another effort that can serve to address stream protection and restoration in a comprehensive manner is watershed management planning. The Department of Public Works and Environmental Services has initiated a multi-year watershed management planning effort that picks up from the recently completed Stream Protection Strategy Baseline Study.

**LAND USE AND OPEN SPACE
 FINDINGS AND RECOMMENDATIONS**

| Findings | |
|-----------------|--|
| 1. | With the successful implementation of the UOSA Water Reclamation Facility (WRF), land use management and open space protection are the County's major tools for protecting the Occoquan Watershed's streams and ensuring the long term viability of the Occoquan Reservoir as a drinking water supply. |
| 2. | The County's strategy for land use protection and development in the Occoquan Watershed has been largely implemented—The Board of Supervisors' 1982 vision for the County's portion of the Watershed has, in general, been realized, with large lot residential development characterizing the downzoned area of the Watershed and higher density development concentrated in the 1/3 of the Watershed area that wasn't downzoned. |
| 3. | The pattern of development established pursuant to the Board's 1982 zoning actions has made a positive contribution to protecting water quality in the Occoquan Reservoir. |
| 4. | One effect of the downzoning action was that it established clear boundaries between areas that were to be suburban in character (and that would be the focus of economic development efforts in the watershed) and areas that were to be of a rural or low density residential character. This action also facilitated the efficient provision of public facilities and services by concentrating development in roughly one-third of the Watershed. |
| 5. | While the County's portion of the Watershed is not yet built out, vacant and underutilized lands are not prevalent. Less than 18% of the land area of the County's portion of the Watershed remains vacant, and less than 4% of this area contains underutilized residential land. The vacant and underutilized land is not necessarily "underdeveloped," in that some of this land in the R-C District contains desirable and viable uses (e.g., riding stables, agriculture, large residential parcels). Most of the vacant and underutilized land is located in the R-C District; however, less than 24% of the land area of the R-C District in the Occoquan Watershed remains vacant or underutilized. There are a few areas characterized by large areas of vacant land (particularly in unsewered areas where soil conditions are not conducive to onsite sewage disposal); however, much of the remaining development that will occur in the County's portion of the Watershed will be of an infill or redevelopment nature. |
| 6. | With the exception of Special Permit and Special Exception uses, future development in the R-C District will be of a by-right character. This has implications for the mechanisms through which unregulated sensitive environmental areas can be protected, as there will be limited opportunities to seek protection of such areas through the zoning process. |
| 7. | While most of the area outside the R-C District in the Occoquan Watershed in Fairfax County has been developed, there is still some development potential remaining on vacant and underutilized parcels in this area. In addition, established communities in the Watershed are being redeveloped (e.g., the Rockland Village and Dix-Cen-Gato areas), and other developed areas of the Watershed may redevelop in the future. It is likely that future development outside the R-C District will result in significant increases in impervious cover on the sites that will be developed. If low impact site design techniques were to be applied (where feasible and appropriate), some of the adverse impacts that could be anticipated as a result of the increased impervious cover may be reduced. |

**LAND USE AND OPEN SPACE
 FINDINGS AND RECOMMENDATIONS**

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| 8. | Because much of the Watershed has developed, voluntary stewardship efforts on the part of landowners will become increasingly important to the continued protection of water quality in the Occoquan Reservoir. Nonregulatory approaches to the protection of open space (e.g., easement agreements, education) will also become increasingly important. |
| 9. | By preserving thousands of acres of undisturbed open space, the Fairfax County Park Authority and Northern Virginia Regional Park Authority are important land stewards in Fairfax County's portion of the Watershed. The County's Board of Supervisors has been particularly active recently in the acquisition of park land in the R-C District of the Occoquan Watershed |
| 10. | The Comprehensive Plan supports the use of low impact site design techniques. The application of such techniques in the Occoquan Watershed can reduce water quality impacts of development and provide additional protections to water quality in the Occoquan Reservoir. |
| 11. | Fairfax County has initiated a multi-year, comprehensive watershed management planning effort. This effort will enable the County to determine how to optimize stormwater management, water quality controls, and stream protection throughout the Occoquan Watershed in Fairfax County. |
| 12. | Special Permit and Special Exception uses that have been approved in the R-C District of the Occoquan Watershed have often been more intense (in terms of impervious cover and, conceivably, pollutant runoff rates) than conventional R-C District residential development would have been. With the exception of R-C cluster subdivisions, there are no clear water quality based standards or guidelines (e.g., pollutant loadings, impervious cover, undisturbed open space protection) for Special Permit and Special Exception uses in the R-C District of the Occoquan Watershed. |

Recommendations

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| 1. | At a minimum, continue the County's commitment to the successful strategy for water quality protection of the Occoquan Reservoir that was established through the comprehensive zoning actions that were taken in 1982. |
| 2. | <p>Establish a broad-based advisory committee, to include stakeholders, County staff, and one or more members of the County's Planning Commission, to review standards and guidelines associated with Special Permit, Special Exception, and public uses that may be approved in the R-C District in the Occoquan Watershed and to report its findings and recommendations to the Board of Supervisors. The advisory committee should:</p> <ul style="list-style-type: none"> • Review the maximum allowable floor area ratios currently allowed in the R-C District in light of overall impervious surface implications, public use/facility needs, institutional use needs, recreational needs, and the purpose and intent of the 1982 downzoning action. • Recommend zoning standards, performance standards, and/or Comprehensive Plan guidelines for total impervious cover and/or undisturbed open space. • Review the combined impact of the facility footprint and total impervious surface cover, including parking. • Determine if it would be appropriate to establish clearer guidance in the Comprehensive Plan |

**LAND USE AND OPEN SPACE
 FINDINGS AND RECOMMENDATIONS**

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| | regarding the circumstances under which Special Exception and Special Permit uses (as well as public uses reviewed during the 2232 process) can be considered to be “designed to mitigate impacts on the water quality of the Occoquan Reservoir.” |
| 3. | Establish a more proactive easements program that provides for outreach efforts to owners of land in the Occoquan Watershed that contains environmentally sensitive resources, particularly where these resources would not otherwise be protected by regulation. |
| 4. | Fully fund watershed management planning efforts as well as the implementation of adopted plan measures. As part of the planning process: <ul style="list-style-type: none"> • Investigate the effectiveness of existing stream valley protection mechanisms. Identify additional regulatory and/or non-regulatory measures, if any, that may be needed in order to ensure that stream valleys will be protected adequately. • Identify additional performance requirements that may be appropriate to ensure that by-right development in the R-C District will not adversely affect stream quality. |
| 5. | Complete the ongoing review of impediments to the application of low impact site design techniques and identify disincentives and policy/regulatory conflicts associated with the implementation of these techniques. Determine if and how these disincentives, impediments, and conflicts can be overcome so as to increase the application of such techniques in the Occoquan Watershed. Investigate incentives and requirements that could be pursued to increase the application of these practices. |

3. Impervious Surfaces

Although discussed in the previous section, issues associated with impervious surface cover in the Occoquan Watershed deserve additional focused attention. One of the purposes of the R-C District, as stated in the Zoning Ordinance, is “to minimize impervious surface and to protect the quality of water in public water supply watersheds.” Further, it states the R-C District will “promote open, rural areas for the growing of crops... and for low density residential uses.” The Zoning Ordinance does allow certain non-residential uses in the R-C District. For these uses, it sets maximum floor area ratios (FARs) of 0.10 for private non-residential uses and up to 0.15 for public uses in the R-C District. In addition the Ordinance establishes minimum parking requirements. However, despite the purpose laid out in the R-C District, the Ordinance does not set a limit on impervious cover. The result could be an allowed use that covers a significant portion of a parcel with impervious surface, primarily in the form of a parking lot.

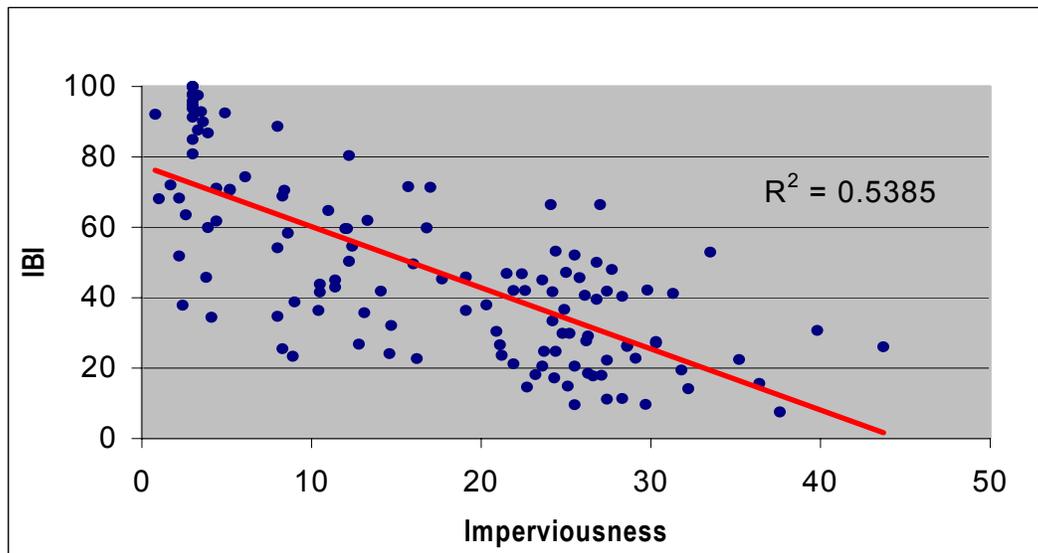
The Comprehensive Plan provides that non-residential uses in the R-C District requiring Special Exception or Special Permit approval should be rigorously reviewed and should be granted only if, among other conditions, “the use is designed to mitigate impacts on the water quality of the Occoquan Reservoir.” As stated earlier in this report, impervious cover associated with Special Permit and Special Exception uses in the R-C District typically exceeds what would be anticipated for a five-acre lot residential development, and therefore pollutant runoff rates for such uses can be

expected to exceed rates associated with a five-acre lot residential development, even with water quality efforts that exceed minimum WSPOD requirements. The increased impervious cover can also result in increased volumes of stormwater runoff. These increased volumes have a higher potential to degrade streams downstream of these sites than the volumes of stormwater runoff that would be associated with lesser amounts of impervious cover.

As forests and undeveloped open spaces are converted to roads, rooftops, parking lots and other impervious surfaces, the land is less able to absorb rainfall and mitigate runoff. The result is that stormwater runoff will increase in volume and velocity, carrying with it various pollutants, such as fertilizer, pesticides and herbicides, and vehicular contaminants, that will both degrade stream water quality and erode stream banks and beds.

The percentage of impervious surface has a related impact on downstream properties and waterways, i.e., the greater the amount of impervious surface the greater the impacts. According to an analysis conducted by the Northern Virginia Regional Commission in 2000 of the impervious surface cover in the Occoquan Watershed, both within and outside the R-C District, the total imperviousness was 9 to 12%. However, the imperviousness of many of the Occoquan subwatersheds was far in excess of 25%. According to the 2001 Stream Protection Strategy Baseline Report, in those parts of the Watershed with a low percentage of impervious surface, the quality of the streams tended to be Good to Excellent whereas those streams in the Watershed outside the R-C District were mostly Poor to Good. Figure 13 shows the relationship between percent imperviousness versus Index of Biotic Integrity as taken from the 2001 *Stream Protection Strategy Baseline Study*.

Figure 13. Percent imperviousness versus Index of Biotic Integrity in Fairfax County. (Source: Stream Protection Strategy Baseline Study)



The potential exists for the development of 3,300 acres of vacant land and nearly 500 acres of underutilized residential land in the Occoquan Watershed in Fairfax County outside the R-C District. All development in this area except for individual homes on

existing lots will be subject to the WSPOD requirement for BMPs. It is likely that such development will result in significant increases in impervious cover on these parcels. The additional volumes of stormwater runoff that will be generated by the increased impervious cover may, in turn, result in increased stream degradation in downstream areas in terms of water quality, stream bank erosion, and sedimentation.

As already noted in this report, increases in stormwater runoff volumes can be reduced to some degree through the application of low impact site design techniques such as the minimization of impervious surfaces (e.g., reduction in off-street parking, provision of narrow roadways, siting buildings to reduce impervious cover, and use of pervious parking surfaces) and the conveyance of runoff from impervious surfaces into pervious areas (e.g., elimination of curb and gutter), conveyance of drainage into biofiltration facilities (also known as "rain gardens"), and conveyance of drainage into infiltration swales.

See related findings and recommendations in section 1. "Streams and Ecosystems" and section 2. "Land Use and Open Space" above.

4. Tree Cover

While not specifically addressed in the 1982 downzoning effort, the preservation of tree canopy is an important component of the health of the Occoquan Watershed. This is of special concern because the County has only limited legal authority to prevent the removal of much of this canopy through permitted development or redevelopment.

Even with the stormwater management and erosion and sediment control initiatives described above, there will be little clear authority to regulate clear cutting of large stands of existing urban forests associated with permitted land disturbing activities. While the Chesapeake Bay Preservation Ordinance stipulates that only clearing necessary for the proposed use be allowed in a Resource Management Area, applicants who propose uses that require large cleared areas on their property have the ability to gain approval to do so. This has been evidenced by the recent clear cutting and development of several large residential projects outside the R-C District of the Occoquan Watershed.

Loss of individual trees, specimen trees, historic trees, and/or forests or stands of trees can result in a major change to an existing environment. Not only are the trees lost, but so is "neighborhood open space." While the land is not owned or controlled by the community, undeveloped or underdeveloped property does provide open space benefits to a community. Tree preservation can lessen the impacts of new construction. Once trees are removed and construction commences, the impact of change becomes readily evident; even when the process has included public input, citizens may still be unhappy with the resultant development, especially with the loss of open space.

In 1995, the Board of Supervisors established the Tree Preservation Task Force, which then identified a number of initiatives to provide for additional tree preservation during the development process. Task Force initiatives relevant to land

development, as well as other proposed changes to the development standards and processes, were incorporated into the staff recommendations contained in the Infill and Residential Development Study.

The Infill Study's tree preservation initiatives were designed to build upon the previous Tree Preservation Task Force initiatives and have resulted in additional recommended efforts to reduce tree loss by:

- Reducing grading to increase tree preservation
- Studying and enhancing, where possible, the heritage and specimen tree legislation
- Requesting conservation easements where appropriate

A common misperception about the County's authority to regulate tree cover and tree removal is that there is a specific County Tree Cover Ordinance. In reality, there are a series of requirements governing preservation and planting within the County Code. This grouping of requirements encompass the following parts of the County Code:

- PFM, Chapter 12, "Tree Preservation and Planting:" Technical specifications for conservation plans, tree cover, and field standards.
- Section 13 of the Zoning Ordinance "Landscaping and Screening:" Covers parking lot landscaping, transitional screening, and tree cover.
- Chapters 104 and 118: Require tree conservation indirectly via erosion and sedimentation control and water quality management requirements.
- Chapter 101: Requires that tree cover requirements of the Zoning Ordinance and PFM be met.
- The Policy Plan of the Comprehensive Plan: States that tree preservation should be maximized as a development criterion in zoning cases.

The Tree Preservation and Planting Requirements allow Fairfax County Government to minimize the removal of vegetation during the land development process and to ensure that trees and associated vegetation are conserved in a manner that maximizes their ecological, environmental, and socio-economic benefits for both the new and existing communities. Unless specifically proffered or protected by a Conservation Easement or Chesapeake Bay Preservation Area, however, there is little authority to require preservation of existing tree cover. The County has and continues to pursue State enabling legislation to better protect existing vegetation and to encourage land developers to use existing tree cover to meet their tree cover requirements rather than through replanting.

Re-establishment of native forest cover within the Occoquan Watershed can be achieved largely through citizen and private group efforts. Fairfax ReLeaf, Inc. is a non-profit organization that is supported by Fairfax County and is dedicated to planting trees on public lands and providing educational programs about the values of trees. Fairfax ReLeaf, Inc., founded in 1991 and associated with Global ReLeaf (a program of American Forest), has planted over 100,000 tree seedlings along public highways and in riparian stream valley settings in our community. Other agencies and organizations are also very involved in tree planting efforts.

**TREE PRESERVATION
 FINDINGS AND RECOMMENDATIONS**

| Findings | |
|------------------------|--|
| 1. | The loss of tree canopy results in increased erosion and sedimentation and stormwater runoff. The County does not currently have all the tools necessary to adequately address tree preservation and conservation. |
| Recommendations | |
| 1. | Continue to press for tree conservation and preservation enabling legislation. |
| 2. | Establish tree canopy goals for the Occoquan Watershed and determine appropriate implementation measures for attaining those goals. Tree preservation, not removal and replacement, should be the primary means of achieving the goal. |
| 3. | Encourage the revegetation of lost riparian stream buffers with native woody vegetation by identifying potential reforestation areas, providing citizen education, and encouraging citizen reforestation efforts. |

5. Erosion and Sediment Control and Stormwater Management

The need to control erosion and sediment, as well as the need to manage stormwater runoff, are directly related to the removal of tree canopy and increased impervious surfaces. Since a significant proportion of future development in the Occoquan Watershed will be infill in nature, the Task Force turned to the County's Infill and Residential Development Study. The Study covered numerous facets of infill and redevelopment, including challenges regarding stormwater management and erosion and sedimentation. As a result, the Study provided a framework for discussion of issues as well as policy and regulatory reform concerning residential development in the Occoquan Watershed.

Recommendations presented in the Infill and Residential Development Study that will benefit the Occoquan Watershed included:

- An enhanced erosion and sediment control program involving improvements in education, policy, regulations, and enforcement as well as implementation of innovative practices.
- Adoption of innovative BMP practices to reduce impact during development and allow greater flexibility in the engineering of proposed sites.
- Improved design and performance of proposed stormwater management facilities by implementing a technical review of certain components during the rezoning process.
- Continued policy of requiring additional development conditions associated with stormwater detention/water quality waivers to address potential problems associated with land disturbance.

- Enhanced requirements and better definitions during the design process for design professionals for evaluating the adequacy of stream channels for increased runoff due to new developments.
- Recommendations to amend the Public Facilities Manual to:
 - Include technical definitions pertaining to the adequate outfall of stormwater from developments;
 - Require a formal adequate outfall analysis in conjunction with review of proposed construction plans;
 - Give the Director of DPWES discretion to require additional measures where a proposal will discharge into an inadequate channel; and,
 - Better define the design procedure for pipe outlets and suggest consideration of a recent Virginia Department of Conservation and Recreation proposal pertaining to hydrologic design/stormwater design.
- Additional guidance on BMP selection and enhanced design standards in the PFM.
- Establishment of a County-wide monitoring program to assess BMP performance.
- Allowance of BMP credit for contributions to a "land trust fund."
- Enablement of the implementation of bioretention/biofiltration facilities ("rain gardens"), underground sand filters in residential areas, and Manufactured or Ultra Urban BMP systems in Fairfax County as acceptable privately maintained BMPs.
- Linkage of enhanced design features for extended detention and retention pond BMPs to increased pollutant removal efficiencies.
- Recommendations for the retrofitting of existing stormwater detention-only ponds for water pollution treatment.
- Identification and survey of water impoundments downstream of a proposed development that could be impacted by a proposed development, and assignment of accountability for impact resolution.
- Adoption of a program to retrofit existing stormwater control facilities that were not initially designed to perform a water quality benefit to provide this added function as well.

In addition to implementation of the erosion and sedimentation initiatives recommended in the Infill Study, the County has developed and is implementing an Alternative Erosion and Sediment Control Inspection Program, in accordance with the State of Virginia's guidelines. This Alternative Inspection Program identifies proposed new or redevelopment land disturbing projects according to proximity to sensitive environmental features and prioritizes the inspections accordingly. Prioritization then enables the inspector to visit sites adjacent to such features on a more frequent basis to help ensure that the erosion and sediment controls are maintained and properly functioning.

Although these many stormwater and erosion and sediment control initiatives have been and will continue to be beneficial to the Occoquan Watershed, challenges will continue with regard to increased stormwater volumes from creation of additional impervious areas on single lot developments.

**EROSION AND SEDIMENT CONTROL AND
 STORMWATER MANAGEMENT
 FINDINGS AND RECOMMENDATIONS**

| Findings | |
|------------------------|---|
| 1. | The County's Infill and Residential Development Study, accepted by the Board of Supervisors in January, 2001, has particular relevance to the Occoquan Watershed, where much of the new development will be in the form of infill and where existing older land uses throughout the Watershed have the potential to be redeveloped. |
| 2. | The Task Force remains concerned that current staff resources are not sufficient to enforce the Erosion and Sediment Control Ordinance. This issue needs and deserves further consideration. |
| 3. | Redevelopment is an opportunity to improve water quality and habitats by reducing nutrient pollution and the impacts of impervious surface cover. |
| Recommendations | |
| 1. | The Task Force supports the stormwater management findings of the Infill and Residential Study and urges implementation of its recommendations. |
| 2. | Ensure that frequency of County inspections is sufficient to enforce the Erosion and Sediment Control Ordinance. |

6. Onsite Sewage Disposal

a) Maintenance and Management of Onsite Sewage Disposal Systems/Alternative Wastewater Treatment Systems

Approximately 22.8 million gallons of raw or partially treated sewage from more than 30,000 homes is discharged into Fairfax County soils daily. It is estimated that at least 17%, or 3.8 million gallons, is discharged into the soils of the Occoquan Watershed. Properly designed, installed, and maintained onsite sewage disposal systems are unlikely to present adverse effects to the Occoquan Reservoir. However, systems that are improperly designed, improperly installed, and poorly maintained are likely to have limited life spans, eventually resulting in system failure and presenting potential adverse impacts on the Watershed.

Fairfax County's onsite sewage disposal systems are regulated at the State level by the Virginia Sewage Handling & Disposal Regulations and the Virginia Alternative Discharging Systems Regulations, and at the County level by Chapter 68 of the Fairfax County Code and the Chesapeake Bay Preservation Ordinance. The County does have enabling authority to adopt local regulations that are more restrictive than the State regulations.

Fairfax County is one of only a few counties to require permits for all repairs of septic systems. In Fiscal Year 2001, 1,042 onsite septic systems were evaluated

for system repair as a result of referrals and complaints County-wide. Of these evaluations, 891 repair permits were issued for repair or replacement of mechanical components, with only 1.3% of the permits requiring complete replacement of failed septic systems. Statistics specifically for the Occoquan Watershed are not available.

There is an increasing trend in the development community to request the use of technologically advanced, high maintenance alternative onsite sewage disposal systems in order to develop lots and parcels with marginal to poor soil conditions. Marginal soils and poor percolation no longer impede development of properties, thus allowing for potential development of lots previously determined to be "non-buildable" because of a lack of sewage disposal by traditional means. One hundred nineteen (119) permits for installation of alternative systems (with another 14 permits pending) have been issued in the past five years in Fairfax County. In the prior five-year period, only 18 permits were issued for alternative onsite sewage disposal systems. Technology has advanced more quickly than codes, regulations, or the maintenance industry. Some types of alternative systems, because of their shallow installations, are more prone to damage by lawn irrigation systems, lawn tractors, and other yard work. These systems include large numbers of mechanical components, which also increases the potential for malfunction. The eventual owners of the properties with such systems are usually unaware of the high maintenance requirements. Many of the technologically advanced individual alternative onsite sewage disposal systems are designed and operated much as a mini sewage treatment plant, with a discharge of treated effluent into a waterway, into a sub-soil disposal system, or spray irrigated onto the ground surface.

Most alternative systems have intensive maintenance requirements. Failure to maintain and properly manage these systems can lead to premature, catastrophic failure. Although onsite sewage disposal systems are required by County Code to have preventative maintenance, enforcement is largely gained by voluntary compliance. The Chesapeake Bay Preservation Ordinance requires that all septic tanks be regularly maintained. Therefore, the Health Department sends written notification for septic tank pump out and turning of flow diversion valves to affected properties. Septic tank pump out letters are sent to properties every five years. Notification to turn flow diversion valves is sent annually. Approximately 8,000 septic tanks were pumped last year, or about 1/5 of all tanks. Failure to maintain a septic system is a violation of the County Code and enforceable as a criminal offense. In severe cases, the Health Department may initiate legal action through the court system. The County currently only has the authority to perform routine septic tank pump-out for system maintenance and back-charge the property owner after notification is made to the owner to have the maintenance performed. Unless there is an actual demonstrated health hazard present on a property, the County does not have the authority to perform other necessary system maintenance and back-charge the property owner if the owner refuses to properly maintain the system.

Upon request, the Health Department provides presentations concerning onsite sewage disposal systems and their management to interested parties. Sewage disposal information programs have been broadcast on Government Access Channel 16. Video copies of septic systems programs are available in Fairfax

County libraries. Written pamphlets are available to the general public via request to the Health Department. The Health Department will be working to update existing written materials and include additional information on its web site. The Health Department is also working to identify and target specific potential "stakeholder" audience populations such as property owners, homeowners associations, builders, developers, real estate agencies, and mortgage lenders as a public education outreach effort to inform interested parties about the importance of proper septic system maintenance.

b) Future Concerns

Onsite sewage disposal systems are the sewage treatment and disposal solution for over 30,000 households without access to public sewer in Fairfax County. Even with proper maintenance, septic systems will ultimately require rehabilitation or replacement. However, a lack of appropriate monitoring and maintenance leads to premature system failure. Failures lead to loss of real property values, environmental degradation, and increased risk of water and vector borne disease. Furthermore, it can cost up to \$40,000 to repair or replace a failing system. Suitable sites for structures to be served by traditional onsite sewage disposal systems are diminishing and the existing population of onsite sewage disposal systems is aging. The introduction of technologically sophisticated systems has allowed for the construction of increasing numbers of structures on sites that were previously non-buildable utilizing traditional onsite sewage disposal methods. A drawback of sophisticated sewage systems is the increased maintenance and monitoring requirements. Because of the aging population of existing systems and the introduction of high maintenance wastewater treatment and disposal technologies, the need for reliable maintenance service for these systems is expanding rapidly.

All septic systems require periodic maintenance. Rapid technological advancements in onsite wastewater treatment system design have left most service companies without the expertise to provide monitoring and maintenance services to system owners. A small monitoring and maintenance industry exists; however, the onsite sewage disposal maintenance industry is largely undeveloped and unregulated. No minimum credentials or certifications are required to provide monitoring or maintenance for septic systems.

Regionally, 22 companies with specific abilities provide septic tank pump out service for onsite septic systems. Of these 22 companies, one holds 35% of the market share. As technology has advanced to provide more sophisticated and complex onsite sewage disposal systems, the scope and skills of these companies have not advanced. Only three small companies provide limited services for technologically advanced systems. Of these three service providers, one holds 90% of the market share. These companies do not offer services to maintain or monitor the less complex systems. Currently, there is no referral service to match the needs of system owner with the services offered by private companies.

A private sector niche market should develop around the need and demand for management of onsite sewage disposal systems, and competition within the industry is expected to increase once existing service providers and sewage

system installation contractors recognize the rise in numbers of systems requiring increased maintenance. The specific time frame for development of this industry sector is unknown and may be long term.

The maintenance issues associated with onsite sewage disposal systems are not unique to Fairfax County. This is a national issue that is coming to the forefront as technologies in onsite wastewater treatment are developed and utilized. The U.S. Environmental Protection Agency (EPA), in the Draft EPA Guidelines for Management of Onsite/Decentralized Wastewater Management Systems, describes five separate model management programs presented as a progressive series in which the management requirements become more rigorous as the system technologies become more complex and/or as the sensitivity of the environment increases. There are many case studies available demonstrating the success of such management programs. The EPA program levels are:

- Model Program Level 1: The objectives are (1) to ensure that all onsite sewage disposal systems are sited, designed and constructed in compliance with state and local regulations and (2) to ensure that homeowners are informed of maintenance needs of the systems.
- Model Program Level 2: The objective is to ensure that maintenance contracts with trained operators are maintained by property owners where more complex and maintenance-intensive system designs are used.
- Model Program Level 3: The objective is to ensure that onsite systems continually meet the prescribed performance standards where systems are designed to meet specific effluent requirements.
- Model Program Level 4: The objective is to achieve continuous monitoring and reliable operation and maintenance of onsite systems by issuing an operating permit to a utility or “authority” instead of the property owner.
- Model Program Level 5: This model is a variation of Level 4, except that ownership of the onsite systems is no longer with the property owners.

**ONSITE SEWAGE DISPOSAL
 FINDINGS AND RECOMMENDATIONS**

| Findings | |
|-----------------|--|
| 1. | Inadequate maintenance of on-site sewage disposal systems by property owners, failure of septic systems that have outlived their life expectancy, and the aging population of existing on site sewage systems pose a growing potential for nonpoint source contamination of streams and the Reservoir. |

**ONSITE SEWAGE DISPOSAL
 FINDINGS AND RECOMMENDATIONS**

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| 2. | Emerging technology in the field of onsite sewage disposal can produce better quality sewage effluent for disposal, if properly maintained, but may also allow for construction on lands previously deemed as non-buildable properties due to marginal or poor soil conditions that will not support a conventional septic tank and drain field. Current policy does not encourage the use of higher technology sewage disposal systems because of the intensive maintenance requirements of these systems. |
| 3. | The present level of regulation of onsite sewage disposal systems in Fairfax County relies heavily upon voluntary homeowner compliance and is insufficient to enforce preventative maintenance. Enforcement action, if necessary, is typically initiated upon presentation of a health hazard due to a failed system. |
| 4. | No mechanism exists for routine inspection of existing onsite septic systems. Inspections of systems are only initiated through homeowners' self reporting of problems, complaints, and voluntary evaluations for real estate property transfers. |
| 5. | Technologically advanced systems utilizing innovative disposal methods are fragile and require frequent maintenance. There are very few qualified maintenance service providers available at present, and property owners have no way of identifying these companies. |
| 6. | Fairfax County is currently operating consistent with the U.S. EPA Model Program Level 3 through the enforcement of State and local regulations governing onsite sewage disposal. However, effective onsite sewage disposal system management is the key to ensuring that the requisite level of environmental and public health protection is achieved. It is the single most important factor in any comprehensive onsite sewage disposal management program. Without effective management, even the most costly and advanced technologies will fail to perform as designed, and efforts to protect public health and the environment will be compromised. |

Recommendations

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| 1. | <p>Establish a Commission to investigate necessary legislation and ordinances to establish a self-supporting "Onsite Sewage Disposal System Management Authority" to move Fairfax County and potentially the region into the EPA Model Program Level 4. Invite participation by appropriate representatives from other Watershed jurisdictions. The Commission should be sensitive to the existing private septic haulers and should include them as an integral part of a management program.</p> <p>The "Authority" is envisioned to be structured similar to a utility that may be public, private or a public-private partnership. The "Authority" would perform routine maintenance and provide regular monitoring of all onsite systems. The system owners would pay a recurring fee to the "Authority" for routine maintenance and regular monitoring of the onsite sewage disposal systems by qualified professionals.</p> <p>The existence of an "Authority" would guarantee continuing preventative maintenance and would encourage the increased use of technologically advanced systems on lots and parcels with marginal to poor soil conditions. This would also allow those properties to be developed without creating future liabilities to the County due to failed onsite sewage disposal systems.</p> <p>Creation of an "Authority" would require the following:</p> |
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**ONSITE SEWAGE DISPOSAL
FINDINGS AND RECOMMENDATIONS**

- Identify and benchmark “Management Authorities” that may already be in place in other areas;
- Research how “Management Authorities” are funded;
- Research the need for legislation and/or local ordinances and prepare necessary legislation or ordinances;
- Determine steps necessary to create and implement the “Management Authority; and,
- Determine service levels necessary for different types of systems.

VI. WATERSHED STEWARDSHIP

The residents living within the Occoquan Watershed have a variety of programs available to them that can provide an introduction to their watershed community. Citizens can play a key supporting role as the County continues its watershed management planning and stream mapping efforts. As stakeholders, their support is critical to the successful development and implementation of County Watershed Management Plans. Citizens can also be stewards of the Occoquan Watershed in and near their communities not only by participating in organized programs but also by being informed of the principles of good stewardship and taking actions to ensure the Watershed’s protection.

A. Citizen Education

Watershed education can change people’s behavior toward protection of the Watershed. Many people who get involved will more likely contact County offices with questions about whom to call when they see dumping or inappropriate environmental activities. However, although there are many opportunities for citizen involvement, average citizens rarely attend meetings unless they have a personal interest. Outreach to the average citizen can happen through a variety of approaches, including both one-time and on-going programs.

1. Education about watersheds and water quality is critically needed. According to a national poll, only about 40% of those surveyed could define a watershed. A Chesapeake Bay Foundation poll found that few Bay watershed residents believed that their activities have any impact on water quality. Personal behaviors, such as lawn and garden care techniques, horse farm operations, vehicle maintenance and transportation mode choices, have a significant impact on water as well as air quality.
2. County staff and various organizations sponsor and co-sponsor seminars and workshops on topics related to stewardship of environmental resources. The participants in these educational programs become partners in protecting the resources and in turn teach others to participate in natural resource protection.

3. The Northern Virginia Soil and Water conservation District provides the following educational programs:
 - Teaching horse farm owners about development of conservation plans to prevent pollution of streams on and near their properties;
 - Educating and assisting landowners with soil erosion and drainage problems, pond maintenance, stormwater management, and stream stabilization;
 - Providing an educational manual, "You and Your Land," to citizens;
 - Selling seedlings with information about the value of trees in filtering rainwater and preventing erosion and sedimentation of streams;
 - Educating the public on the importance of protecting the Chesapeake Bay with storm drain stenciling programs noting the drains are for stormwater only;
 - Providing onsite education through watershed walks;
 - Providing programs for K-12 and college students and teachers about the importance of conservation; and,
 - Providing tours of water and sewage treatment plants to educate citizens about the origin and destination of water.

4. The Audubon Naturalist Society offers a number of programs to educate residents about water quality, such as:
 - *Explore Your Local Stream* walks to acquaint residents with local streams as living systems; these walks are usually conducted in partnership with other organizations and County agencies.
 - *Living Waters* slideshow presentations to civic associations, schools, and other groups interested in learning about stream ecosystems and water quality issues.
 - Water quality workshops for teachers and stream ecology programs for students and youth groups.
 - Interpretive signage at the Webb Sanctuary in Clifton explaining how land can be managed to enhance water quality.

5. In addition to offering County residents the opportunity to take a direct role in protecting the Occoquan Watershed by placing their property under a conservation easement, the Northern Virginia Conservation Trust provides watershed education and stewardship opportunities such as naturalist-led canoe trips, hikes, tree plantings, and invasive exotic species removal.

B. Citizen Volunteers

There are a number of programs in the County providing opportunities for volunteers, sponsored by both public agencies and non-profit organizations, which involve citizens in protecting sensitive environmental areas.

1. Stream Monitoring Program: The Northern Virginia Soil and Water Conservation District (NVSWCD) and the Audubon Naturalist Society sponsor and coordinate a stream monitoring program that educates citizens about watersheds, explaining basic concepts and teaching people how to monitor the health of streams. They provide training, equipment, quality control and communication. The NVSWCD program involves about 150 active volunteers who monitor about 45 sites, including the Cub Run, Sandy Run, Johnny Moore Creek, and Little Rocky Run sub

watersheds and Bull Run in the Occoquan Watershed. Other organizations in the County are also involved in volunteer monitoring. Volunteer monitoring is a crucial source of reliable and relatively inexpensive water quality data. While Fairfax County has staff focused on stream issues, there are not enough staff to monitor all streams regularly. The County's Stream Protection Strategies Baseline Study provided an excellent snapshot of our streams, but data gathered by volunteers provide on-going trend information.

2. "Friends" Groups: The Fairfax County Park Authority has a number of programs involving the community, both as volunteers and as students of the environment. There are a number of "friends" groups throughout the County, one of which is in the Occoquan Watershed - Friends of Little Rocky Run. While these groups are not monitoring streams scientifically, they protect their streams and waters by being vigilant about the condition of stream valleys, bank erosion problems, sedimentation, etc., and by endeavoring to protect these sensitive environmental areas.
3. Parks Volunteers: The Park Authority also has an active program of about 150 volunteers who serve at parks throughout the County and help with education, maintenance, and enhancement programs. The Park Authority also sponsors a number of educational programs on numerous topics related to all aspects of the natural environment.
4. Citizen Advocacy Groups: There are also many citizen advocacy groups and organizations that are involved to some degree with the protection of the Occoquan Watershed. Activities include advocating for environmental stewardship to attempting to influence County policies on land use and the environment. Examples of Occoquan-specific organizations include the Occoquan Watershed Coalition and the Friends of the Occoquan, while examples of more broad-based organizations include the League of Women Voters, the Fairfax County Federation of Civic Associations, the Western Fairfax County Citizens Association, and many, many others.

Communication is the key to a successful program. For citizens to feel vested in a program, it is necessary to communicate with them regularly and to give them volunteer options, such as a choice of days and times to work. They must see that a program is vibrant. For example, the NVSWCD communicates continuously using a variety of tools, including two web pages, one hosted through Fairfax County that provides basic information about the program and another that provides detailed information. The NVSWCD also has newsletters and, most importantly, frequent e-mail updates.

Attracting citizens to the importance of watershed protection and participation in this effort can be accomplished through press releases, community newsletters, meetings, festivals, and word of mouth, the last being the most successful. It is important to offer citizens a variety of programs and various options for participation. In general, citizens are truly concerned about their natural environment. As an expression of this concern, it is not difficult to attract their participation in hands-on environmental programs. However, it is essential that citizen volunteers see that their efforts lead to accomplishments, such as their stream monitoring data being utilized in a meaningful way.

C. Citizen Roles in Reporting and Enforcement

Citizens have always had a role in reporting environmental problems and identifying enforcement issues for follow-up by County staff. Whether it is an individual reporting sediment-laden stormwater coming from a construction site, or a community group banding together on a specific issue, citizens have long helped to enforce County ordinances.

The potential to expand citizen roles in environmental enforcement as a way of stretching County staff resources and strengthening environmental protection is a concept that is worth exploring and not without precedent. In 1999, a Neighborhood Volunteer Program was piloted in the Richmond Highway corridor in response to growing signs of property deterioration and blight. Recognizing the potential for citizens to play a role in code enforcement, County inspectors (Health, Zoning, and Public Works and Environmental Services) trained citizen volunteers to visually identify code violations. The volunteers would write a letter to a property owner requesting that the violations be corrected. At a designated time, the volunteers would return to the site to check if violations were corrected. As a result of the program, code violations achieved voluntary compliance over 85% of the time. The remainder of the violations were turned over to County staff for enforcement. In addition to increasing the County’s ability to enforce its ordinances, the program also created a heightened sense of awareness that likely prevented violations from occurring in the first place.

The Neighborhood Volunteer Program is only one example of an existing program that could be applied to water quality protection in the Occoquan Watershed and County-wide. Examples of ordinances that could benefit from citizen involvement include the Chesapeake Bay Preservation Ordinance (encroachments into Resource Protection Areas) and the Erosion and Sediment Control Ordinance (insufficient or non-existent controls). While the Task Force had insufficient time to make specific recommendation with respect to enhancing the role of citizens in enforcing these regulations, it is an area that deserves further exploration.

**CITIZEN INVOLVEMENT
 FINDINGS AND RECOMMENDATIONS**

| Findings | |
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| 1. | Citizen education about the impact of personal behaviors on water quality is critically needed. |
| 2. | Citizen and community involvement are critical to helping protect water quality and habitats in the Occoquan Reservoir and Watershed, as well as throughout the County. |
| 3. | Regular communication with interested citizens, groups and organizations is essential to keep them informed and interested in participating in volunteer projects and ongoing programs. |
| 4. | An effective outreach program for citizens requires a variety of venues and opportunities for involvement. |
| 5. | Community and citizen participants in voluntary programs must see that their efforts produce accomplishments, i.e., their work is useful and their work product is used – and appreciated. |

**CITIZEN INVOLVEMENT
 FINDINGS AND RECOMMENDATIONS**

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| 6. | Citizens play an important role in helping the County to enforce water quality ordinances that could be expanded to stretch limited staff resources. |
| Recommendations | |
| 1. | The County should strengthen partnerships with appropriate public and citizen organizations to broaden participation in education and stewardship activities aimed at changing attitudes and behaviors. The mass media may be helpful in this effort. |
| 2. | The County should encourage growth of the network of organizations and citizen groups concerned with and/or actively involved in watershed and water quality issues, and seek assistance on methods of reaching more citizens to seek participation in stewardship activities. |
| 3. | The County should sponsor or become partners to sponsor more programs, meetings, seminars and festivals on water quality and natural resource protection that attract people who may become active volunteers in existing or new programs and help to educate others on the value of good stewardship. |
| 4. | The County should support in any way possible the expansion of existing outreach and education programs, such as those sponsored by the Northern Virginia Soil and Water Conservation District, the Audubon Naturalist Society, and the Fairfax County Park Authority. |
| 5. | The County should investigate proactive outreach to property owners who have property in or abutting Resource Protection Areas (RPAs) and/or other stream valley areas. The County may use its GIS to identify these parcels and to deliver stream-specific information RPA responsibilities, stewardship, and easement opportunities. |
| 6. | The County should develop a strategy for strengthening the role of citizens in code and ordinance enforcement. This task should be assigned to County agencies responsible for environmental code enforcement with input from environmental and community watershed stakeholder groups. |

VII. REGIONAL COORDINATION

While the primary focus of the Task Force’s work was on the Fairfax County portion of the Watershed, there was also an early and explicit recognition that Watershed protection would have been impossible without a larger regional effort. Without coordination, or the establishment of regional expectations, efforts in one locality can be undone by another. The major regional accomplishments have been the Occoquan Policy and the establishment of BMP requirements throughout the Watershed by individual jurisdictions. The primary public mechanisms for coordination are the Occoquan Policy Board and the Occoquan Basin Nonpoint Pollution Management Program, administered through what is now the Northern Virginia Regional Commission. The Occoquan Policy Board is presently undertaking a multi-year project to prepare a regional Watershed management plan. This can be a mechanism for achieving or implementing Task Force recommendations that are more regional in scope.

| REGIONAL COORDINATION FINDINGS AND RECOMMENDATIONS | |
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| Findings | |
| 1. | As Fairfax County represents only 17% of the entire Occoquan watershed, Reservoir water quality cannot be maintained without continued regional cooperation among the Watershed's local governments and authorities. This cooperation is fostered primarily through the Northern Virginia Regional Commission's Occoquan Basin Nonpoint Pollution Management Program Policy Board and Technical Advisory Committee. |
| Recommendations | |
| 1. | The Task Force strongly endorses continued support of regional approaches to Occoquan Watershed protection. The Task Force recommends that the County request the Northern Virginia Regional Commission to develop a plan to address identified issues of greater than Fairfax County concern. One approach could be to incorporate recommendations and findings into NVRC's multi-year effort to develop a regional watershed management plan for the Occoquan. |

VIII. SUMMARY AND CONCLUSIONS

As Fairfax County celebrates the 20th anniversary of the landmark decision by the Board of Supervisors to downzone nearly 41,000 acres of the Occoquan Watershed, it can also celebrate the success of that effort in protecting the Occoquan Reservoir. Today, the Reservoir is a reliable source of clean water, which along with the Potomac River, serves the needs of over 1.2 million Northern Virginians. While the implementation of the Upper Occoquan Sewage Authority (UOSA) Water Reclamation Facility resulted in significant water quality improvement, the 1982 downzoning and regional implementation of stormwater BMP requirements have maintained water quality in the Reservoir despite significant growth and development. According to the Occoquan Watershed Monitoring Lab (OWML), water quality in the Reservoir has remained stable or has slightly improved since 1978 when UOSA went on-line. During the same time period, population in the entire Watershed (including the counties of Prince William, Loudoun, and Fauquier, and the cities of Manassas and Manassas Park) nearly tripled.

This success can be attributed to the efforts of many local, regional, and State government agencies that play a role in Reservoir protection, as well as the vigilance of community and environmental organizations and a host of individual concerned citizens. The Board of Supervisors recognized these stewards of the Reservoir and Watershed at a ceremony on July 22, 2002.

Despite the County's enormous accomplishments, there is more work to be done. Through research, monitoring, and modeling, the County now has a better understanding of the science of water quality protection and what it will take to ensure that the Reservoir continues to serve future generations of Northern Virginians. New State and federal mandates and programs, such as the Clean Water Act Total Maximum Daily Load requirements and Virginia's Tributary Strategies, will continue to push Reservoir management in new and ambitious directions. The Reservoir remains nutrient enriched. While this can in part be attributed to naturally occurring conditions, the County should continue to seek ways to reduce anthropogenic sources of

nutrient pollution. Finally, as development continues, non-traditional pollutants and spilling and dumping also have the potential to threaten Reservoir water quality.

The agencies charged to implement the County's original Reservoir protection strategy are now rising to address these new challenges. The Fairfax County Water Authority, the Occoquan Watershed Monitoring Lab, and the Upper Occoquan Sewage Authority have created an interagency Global Strategy Initiative to address emerging health related issues in the water treatment industry such as pathogens and endocrine disrupting chemicals. The Fairfax County Water Authority's newly completed Source Water Assessment identifies potential sources of contamination including hazardous material sites, land use, and other relevant data. On the policy side, the Northern Virginia Regional Commission is leading efforts to coordinate regional strategies to address new State and federal initiatives. All of these efforts are critical to the long-term protection of the Occoquan Reservoir and require the County's continued support.

Protecting the region's drinking water supply remains at the forefront of the County's concerns. However, it is increasingly recognized that the Watershed is much more than just a source of water for the Reservoir. In addition to being home to residents of the Centreville, Chantilly, Clifton, Pleasant Valley, Fairfax Station, Butts Corner, Westfields and Sully Station communities, the Watershed contains exceptional natural habitats and many of the County's recreational resources. Numerous streams run through the downzoned area of the Watershed. There are twenty-one Fairfax County parks in the Watershed and five regional parks, including Fountainhead, Hemlock Overlook, and Bull Run Marina.

As a result, much of the Task Force's discussions centered on the County's role in managing the Occoquan Watershed as a logical extension of Reservoir protection efforts. Fairfax County has already begun an aggressive County-wide watershed planning effort that will eventually lead to the development of watershed plans for each of the County's 30 subwatersheds. That effort began with the establishment of a Stream Protection Strategy (SPS) and the completion of an SPS Baseline Study in 2001 to document biological, chemical, physical, habitat, and flow regime conditions within the County's watersheds. The results of the SPS Baseline Study have provided critical insights into what has and hasn't worked with respect to the County's efforts to protect natural habitats and provided the Task Force with a launching point for investigating possible solutions to identified issues.

According to the SPS Baseline Study, many of the County's healthiest streams are located in the downzoned portion of the Occoquan Watershed. This can chiefly be attributed to the large-lot development pattern, which has served to maximize tree canopy and minimize impervious surface cover. However, the Baseline Study paints a much different picture of streams located outside the downzoned area. Many of these streams are considerably degraded, both in terms of habitat and physical appearance. The major questions faced by the Task Force then became: (1) how to best preserve the rich habitats within the downzoned portions of the Watershed; and, (2) how to prevent further degradation and restore streams outside the downzoned area.

While a majority of the land area in the downzoned portion of the Watershed is built out, according to County staff approximately 24% of the downzoned portion of the Watershed contains vacant or underutilized residential land. From a parcel-level standpoint, it is unlikely that any individual development project will significantly affect habitat or water quality. However, from a cumulative perspective, development potential within the downzoned area could have significant impacts. The Task Force has two primary concerns with respect to new development and redevelopment in the downzoned area of the Occoquan Watershed: (1) to minimize stream

impacts during the actual process of development; and (2) to minimize stream impacts after the development process is completed. The primary impact during development is erosion and sediment. The primary post-development impact is increased stormwater volume and velocity caused by the removal of tree canopy cover and the replacement of pervious surfaces with impervious surfaces (parking lots, rooftops, driveways, etc.).

With the exception of Special Permit and Special Exception uses, future development in the R-C District will be of a by-right character. This has implications for the mechanisms through which unregulated sensitive environmental areas can be protected, as there are limited opportunities to seek protection of such areas through the zoning process. The same is true for limiting the amount of impervious surface cover. However, there may be a need for the County to develop and implement performance requirements for by-right development in the R-C District, and these should be explored during the County's watershed management planning process.

In terms of the potential for the County to minimize the impacts of new development in the R-C District, the Task Force focused on Special Permit and Special Exception Uses. Special Permit and Special Exception uses approved in the R-C District have often been more intense in terms of impervious cover than conventional R-C District residential development allowed by-right. The Task Force found that with the exception of R-C District cluster subdivisions, there are not clear water quality based standards or guidelines (e.g., pollutant loadings, impervious cover, undisturbed open space protection) for Special Permit and Special Exception uses. This is an issue that needs to be addressed. As a result, among the Task Force's recommendations is that the Board of Supervisors should establish a broad-based advisory committee to make recommendations on guidelines and standards to be used with Special Permit, Special Exceptions, and public uses that may be considered in the R-C District.

While most of the area outside the R-C District in the Occoquan Watershed has been developed, according to County staff there are still over 3,300 acres of vacant land in this area. In addition, established communities in the Watershed are being redeveloped (e.g. the Rockland Village and Dix-Cen-Gato areas), and other developed areas of the Watershed may redevelop in the future. The focus of the Task Force was on how to prevent further degradation of already impaired streams, and to restore degraded streams where possible to support diverse aquatic habitats. Recommendations associated with preventing further degradation and promoting restoration are Watershed-wide (and indeed County-wide) in application.

As noted before, there is a direct correlation between stream health and impervious surface cover and tree canopy. There is also a direct correlation between adequate erosion and sediment control during development and stream health. Reducing the impacts of erosion and sediment on local streams is a County-wide issue and is addressed largely in the Infill and Residential Development Study accepted by the Board in 2001. The Task Force endorses the recommendations made in the Study and encourages their full implementation.

Minimizing impervious surface cover is critical to the protection of the County's streams. According to studies performed by the Center for Watershed Protection, watersheds with impervious surface cover of 10 to 15% will show clear signs of degradation, while watersheds with impervious surface cover greater than 25% typically do not support a diverse stream community. The Northern Virginia Regional Commission, which surveys land use in the Occoquan Watershed every five years, estimates Watershed-wide impervious cover of between 9 to 12%. As a result, how development in the Watershed is carried out in the next few years is critical to determining the long-term health of the Watershed's streams.

The County is already pursuing efforts to encourage low impact design (LID) techniques aimed at minimizing the impervious surface cover necessary for a specific land use. To the extent possible, voluntary implementation of LID should be supported and augmented through the County's Public Facilities Manual and other regulatory mechanisms.

Maintaining tree canopy cover is also critical to the protection of the County's streams. Loss of trees and forest stands in general can result in major changes to local hydrology, while loss of riparian forest buffers can significantly impact aquatic habitats. While the County possesses the authority to require tree replacement after development, it lacks comprehensive authority to require tree conservation. Gaining this authority is essential to allow the County to prohibit unnecessary clear-cutting during the development process. The Task Force recommends that the County continue to seek enabling authority from the General Assembly, as it has done in the past, to require that tree conservation be a part of tree canopy cover requirements. In addition, because tree canopy cover is integral to Reservoir water quality protection, the Task Force recommends that tree canopy goals for the Occoquan Watershed be developed and that appropriate implementation mechanisms for implementing these goals be identified.

A final water quality issue discussed by the Task Force is concern over the use of alternative wastewater treatment systems and the maintenance of onsite sewage disposal systems in general. According to County staff estimates, approximately 3.8 million gallons of sewage are treated by Watershed soils daily. Properly designed and maintained, these systems are unlikely to have adverse impacts on the Occoquan Reservoir. However, systems that are improperly designed, improperly installed, and/or poorly maintained are likely to have limited life spans, eventually resulting in system failure and presenting potential adverse impacts on the Watershed. Rapid technological advances in onsite wastewater treatment are also making it possible to build on lots in the Occoquan Watershed R-C District that only a few years before were thought to be undevelopable. While these systems can produce quality sewage effluent disposal, these advanced systems are fragile and require frequent maintenance. At present, there are very few qualified maintenance service providers and no certification process for ensuring that existing companies are qualified to perform the maintenance.

The maintenance issues associated with onsite disposal systems are not unique to Fairfax County, and the U.S. Environmental Protection Agency has developed guidance on how localities can better manage these systems. The Task Force recommends that the Board of Supervisors investigate whether to establish an "Onsite Sewage Disposal System Management Authority" to ensure that routine maintenance is performed on all systems and to ensure that implementation of advanced onsite systems does not create a future liability to the County.

Ultimately, no program or regulation at the County level will succeed without the participation of its citizens. Residents living in the Occoquan Watershed have a variety of programs available to them and the County should continue to promote, sponsor, and encourage these efforts. The County also should proactively engage citizens who live in or abutting Resource Protection Areas or other environmentally sensitive areas. For instance, the County could use its Geographic Information System (GIS) to identify these parcels and to deliver stream-specific information. The County should also explore the potential for citizens to become more involved in helping County staff enforce existing ordinances and regulations. Often, water quality problems are caused not so much by a lack of regulation but by a lack of staff resources to implement the regulations. The Task Force finds that this is particularly true in the case of enforcing the Erosion and Sediment Control Ordinance. The use of citizens as extended "eyes and ears" of County staff is not new, with one successful example being the Neighborhood Volunteer Program established in 1999 in response to growing signs of blight in the Richmond

Highway corridor. The County should develop strategies for strengthening the role of its citizens in enforcement.

Finally, while the primary focus of the Task Force’s work was on the Fairfax County portion of the Watershed, it is explicitly recognized that Reservoir protection is impossible without the cooperation of the entire region. The County coordinates with its regional partners both on an individual basis and through the Northern Virginia Regional Commission’s Occoquan Basin Nonpoint Pollution Management Program. The Task Force endorses the continued support of regional approaches and recommends that the County request NVRC to present the findings of the Task Force to the Program’s Policy Board for incorporation into future work plans.

The following is a summary of the Task Force’s recommendations. Many of these recommendations are endorsements of ongoing County efforts. However, the Task Force also makes specific recommendations designed to highlight emerging issues and to establish new mechanisms for addressing these issues. As such, this report is meant to serve as a launching point, rather than an end point. To ensure follow-through, the Task Force requests that the Board of Supervisors ask the County Executive to track and report to them on the implementation of Task Force recommendations at least annually.

| Reservoir Recommendations | |
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| 1. | The Task Force strongly endorses existing programs and policies aimed at maintaining acceptable levels of water quality in the Reservoir. The County should oppose any effort to weaken regional policies, particularly the State’s Occoquan Policy governing wastewater treatment. |
| 2. | The County should strive to reduce nutrient and sediment contributions to the Reservoir above and beyond those being achieved through existing policies and ordinances. |
| 3. | The County should continue to be an active participant in State and federal regulatory and/or policy initiatives that might result in requirements for additional nutrient and sediment reductions in order to ensure that reduction strategies are based on sound policy and science. |
| 4. | The Task Force strongly endorses efforts such as the Global Strategy Initiative to predict and mitigate new pollutants of concern. |
| 5. | The Task Force encourages the continued sharing and coordination of information among UOSA, OWML, and FCWA and County staff to ensure that Reservoir water quality concerns are appropriately addressed. |
| Streams and Ecosystems Recommendations | |
| 1. | Rigorously maintain the integrity of the Occoquan downzoning. As demonstrated by the County’s 2001 <i>Stream Protection Strategy Baseline Study</i> , the downzoning has been an effective measure for the protection of stream ecosystems. |
| 2. | Continue regular long-term stream assessments by the Stream Protection Strategy staff. Such assessments are critical to measuring the County’s progress in protecting and restoring stream ecosystems. These assessments should include continued partnership with volunteer stream monitoring efforts. The County should ensure that the Stream Protection Strategy staff is adequately funded and staffed to handle its growing responsibilities. |

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| 3. | Fully develop and implement the Stormwater Planning Division's watershed management planning process in the Occoquan Watershed, as well as all other County watersheds. This process represents the County's most focused and comprehensive approach to protecting and restoring stream ecosystems. |
| 4. | Study and adopt new stormwater management designs that have been demonstrated to protect or improve the health of stream ecosystems. |
| 5. | Encourage the use of those LID techniques that have been proven effective under local conditions, both where new development is planned and, to the extent feasible, for retrofitting of existing development. The County should further investigate the effectiveness and applicability of LID techniques. |
| Land Use and Open Space Recommendations | |
| 1. | At a minimum, continue the County's commitment to the successful strategy for water quality protection of the Occoquan Reservoir that was established through the comprehensive zoning actions that were taken in 1982. |
| 2. | <p>Establish a broad-based advisory committee, to include stakeholders, County staff, and one or more members of the County's Planning Commission, to review standards and guidelines associated with Special Permit, Special Exception, and public uses that may be approved in the R-C District in the Occoquan Watershed and to report its findings and recommendations to the Board of Supervisors. The advisory committee should:</p> <ul style="list-style-type: none"> • Review the maximum allowable floor area ratios currently allowed in the R-C District in light of overall impervious surface implications, public use/facility needs, institutional use needs, recreational needs, and the purpose and intent of the 1982 downzoning action. • Recommend zoning standards, performance standards, and/or Comprehensive Plan guidelines for total impervious cover and/or undisturbed open space. • Review the combined impact of the facility footprint and total impervious surface cover, including parking. • Determine if it would be appropriate to establish clearer guidance in the Comprehensive Plan regarding the circumstances under which Special Exception and Special Permit uses (as well as public uses reviewed during the 2232 process) can be considered to be "designed to mitigate impacts on the water quality of the Occoquan Reservoir." |
| 3. | Establish a more proactive easements program that provides for outreach efforts to owners of land in the Occoquan Watershed that contains environmentally sensitive resources, particularly where these resources would not otherwise be protected by regulation. |
| 4. | <p>Fully fund watershed management planning efforts as well as the implementation of adopted plan measures. As part of the planning process:</p> <ul style="list-style-type: none"> • Investigate the effectiveness of existing stream valley protection mechanisms. Identify additional regulatory and/or non-regulatory measures, if any, that may be needed in order to ensure that stream valleys will be protected adequately. |

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| | <ul style="list-style-type: none"> • Identify additional performance requirements that may be appropriate to ensure that by-right development in the R-C District will not adversely affect stream quality. |
| 5. | Complete the ongoing review of impediments to the application of low impact site design techniques and identify disincentives and policy/regulatory conflicts associated with the implementation of these techniques. Determine if and how these disincentives, impediments, and conflicts can be overcome so as to increase the application of such techniques in the Occoquan Watershed. Investigate incentives and requirements that could be pursued to increase the application of these practices. |
| Tree Preservation Recommendations | |
| 1. | Continue to press for tree conservation and preservation enabling legislation. |
| 2. | Establish tree canopy goals for the Occoquan Watershed and determine appropriate implementation measures for attaining those goals. Tree preservation, not removal and replacement, should be the primary means of achieving the goal. |
| 3. | Encourage the revegetation of lost riparian stream buffers with native woody vegetation by identifying potential reforestation areas, providing citizen education, and encouraging citizen reforestation efforts. |
| Erosion and Sediment Control and Stormwater Management Recommendations | |
| 1. | The Task Force supports the stormwater management findings of the Infill and Residential Study and urges implementation of its recommendations. |
| 2. | Ensure that frequency of County inspections is sufficient to enforce the Erosion and Sediment Control Ordinance. |
| Onsite Sewage Disposal Recommendations | |
| 1. | <p>Establish a Commission to investigate necessary legislation and ordinances to establish a self-supporting "Onsite Sewage Disposal System Management Authority" to move Fairfax County and potentially the region into the EPA Model Program Level 4. Invite participation by appropriate representatives from other Watershed jurisdictions. The Commission should be sensitive to the existing private septic haulers and should include them as an integral part of a management program.</p> <p>The "Authority" is envisioned to be structured similar to a utility that may be public, private or a public-private partnership. The "Authority" would perform routine maintenance and provide regular monitoring of all onsite systems. The system owners would pay a recurring fee to the "Authority" for routine maintenance and regular monitoring of the onsite sewage disposal systems by qualified professionals.</p> <p>The existence of an "Authority" would guarantee continuing preventative maintenance and would encourage the increased use of technologically advanced systems on lots and parcels with marginal to poor soil conditions. This would also allow those properties to be developed without creating future liabilities to the County due to failed onsite sewage disposal systems.</p> <p>Creation of an "Authority" would require the following:</p> <ul style="list-style-type: none"> • Identify and benchmark "Management Authorities" that may already be in place in other areas; |

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| | <ul style="list-style-type: none"> • Research how “Management Authorities” are funded; • Research the need for legislation and/or local ordinances and prepare necessary legislation or ordinances; • Determine steps necessary to create and implement the “Management Authority; and, • Determine service levels necessary for different types of systems. |
| Citizen Involvement Recommendations | |
| 1. | The County should strengthen partnerships with appropriate public and citizen organizations to broaden participation in education and stewardship activities aimed at changing attitudes and behaviors. The mass media may be helpful in this effort. |
| 2. | The County should encourage growth of the network of organizations and citizen groups concerned with and/or actively involved in watershed and water quality issues, and seek assistance on methods of reaching more citizens to seek participation in stewardship activities. |
| 3. | The County should sponsor or become partners to sponsor more programs, meetings, seminars and festivals on water quality and natural resource protection that attract people who may become active volunteers in existing or new programs and help to educate others on the value of good stewardship. |
| 4. | The County should support in any way possible the expansion of existing outreach and education programs, such as those sponsored by the Northern Virginia Soil and Water Conservation District, the Audubon Naturalist Society, and the Fairfax County Park Authority. |
| 5. | The County should investigate proactive outreach to property owners who have property in or abutting Resource Protection Areas (RPAs) and/or other stream valley areas. The County may use its GIS to identify these parcels and to deliver stream-specific information RPA responsibilities, stewardship, and easement opportunities. |
| 6. | The County should develop a strategy for strengthening the role of citizens in code and ordinance enforcement. This task should be assigned to County agencies responsible for environmental code enforcement with input from environmental and community watershed stakeholder groups. |
| Regional Coordination Recommendations | |
| 1. | The Task Force strongly endorses continued support of regional approaches to Occoquan Watershed protection. The Task Force recommends that the County request the Northern Virginia Regional Commission to develop a plan to address identified issues of greater than Fairfax County concern. One approach could be to incorporate recommendations and findings into NVRC’s multi-year effort to develop a regional watershed management plan for the Occoquan. |
| Implementation and Reporting | |
| 1. | To ensure follow-through, the Task Force requests that the Board of Supervisors ask the County Executive to track and report to them on the implementation of Task Force recommendations at least annually. |