# ENVIRONMENT INDICATORS

## Introduction

## I. Purpose of Environment Indicators

The following twelve indicators for the environment were chosen, because they represent many of the critical environmental issues facing King County today. The presence of a healthy and intact environment is an asset to this region. Food production, timber production, tourism, and recreation depend on the integrity of natural resources such as water bodies, forests, fish and wildlife and agricultural lands. A productive economy and a high quality of life are inseparably linked to the natural environment.

The purpose of establishing indicators for the environment is to evaluate progress toward the goals and outcomes outlined in the Countywide Planning Policies. Those outcomes include the protection and enhancement of the natural environment, improvement of air quality and the protection of water quantity and quality among others. With the help of environment indicators the Growth Management Planning Council will be able to evaluate the effectiveness of the Countywide Planning Policies, monitor trends and recognize successes and potential shortfalls.

## II. Key Observations

*Indicator #9* **Land cover changes in urban and rural areas over time.**

- 1998 Landsat data shows King County with 13.2% of its land cover in high and low density developed uses. Pierce County also has 13.2% of its land developed, while Snohomish County has 8.1% of its area in developed uses.
- The Landsat image shows that by far the largest proportion of development in King County has remained within the Urban Growth Boundary.
- Compared to the other two counties, Snohomish has shown the highest rate of growth in developed areas, but still has the highest proportion of undeveloped land.

*Indicator #10* **Air quality**

- Air quality has improved significantly since 1980. The number of good air quality days increased steadily from 73 in 1980 to 343 in 1998. The decline to 272 good days in 1999 reflects the higher federal standard for particulate matter adopted by the Seattle area beginning last year. This also accounts for the rise in the number of "moderate" days, and for the 5 days designated as unhealthy for sensitive groups. Before the change in standards only 1 day had been designated as "unhealthy" since 1980.
- Motor vehicles, with 55% of the total air pollutants, are by far the largest contributors to overall air pollution. New rules for the automobile industry, which will be phased-in starting with 2004 models, will assure that the "light truck" category (including sport utility vehicles, minivans and pickup trucks) will have to meet the same fleetwide average pollution level as standard cars. The allowable pollution for all vehicles will be more stringent than current standards. A related rule requiring cleaner gasoline will help car manufacturers to meet the new standards.
- Industry contributes 21% of pollutants, outdoor burning contributes 12%, and wood stoves and fireplaces contribute another 12%.

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*Indicator #11* **BTU consumption per capita**

- Per capita consumption of all energy sources has increased 6.2% since 1986. In 1999, total energy consumption per capita was the highest it has been since 1990. This total does not include diesel fuel, which has only been tracked since 1996.
- In the past year per capita natural gas, electricity, and diesel consumption have all risen sharply while per capita automotive gas has leveled off to approximately the same rate as 1986.
- Total energy consumption has increased 31.1% since 1986 due to population growth, economic growth, and higher per capita usage.
- Per capita diesel fuel usage rose nearly 12% during the four years (1996 – 1999) it has been tracked. Total diesel usage rose 15%. Most of the increase took place between 1998 and 1999. According to the Washington State Dept. of Transportation, this rise is due to an increase in commercial traffic.

*Indicator #12* **Vehicle miles traveled per year.**

- VMT includes travel by commercial and public vehicles as well as private automobiles. The increase in per capita VMT is caused by a combination of factors, including growth in County employment (at a rate considerably higher than population growth), increased travel to King County job centers by residents of adjacent counties, increased propensity to travel, and more commercial traffic. The result has been more vehicles on the road, traveling more miles per capita.
- While per capita VMT continues to increase modestly, total VMT has risen a rapid 19% from 1990 - 1999.
- Fuel consumption and gas tax collection are only partially correlated with VMT. Fuel efficiency on some vehicles has increased over the 1985 to 1999 time period, meaning that it is possible to drive more miles with no more fuel being consumed. With this greater fuel efficiency, the increase in tax revenues has been less than the increase in miles traveled. It is still unclear whether the recent popularity of larger, less fuel-efficient vehicles is affecting fuel consumption per mile and per capita.
- Commercial, pass-through, and non-resident commuters may account for the increase in VMT in King County while per capita gas consumption has remained steady or even dropped. Drivers of these vehicles may not purchase gas in King County in the same proportion as they drive within the County.

*Indicator #13* **Surface water and groundwater quality**

- Water clarity, as measured by the *trophic state index (TSI)* in the major King County Lakes is generally high. Lake Union, however, shows some signs of declining clarity.
- Among the 42 monitored small lakes in the region, about one-third have lowered water clarity, more algae, and higher total phosphorus values. This is a natural process, typical of aging lakes. However, deterioration over a short period of time may indicate that human activity is hastening the decline in a lake's water quality.
- Based on 1998 data, over half of King County's monitored streams are considered seriously or moderately degraded, based on the Benthic Index of Biotic Integrity (B-IBI) score. No new data on streams is available for 1999.

*Indicator #14* **Water consumption**

- In 1999 per capita water consumption, at 104 gallons per day, reached its lowest level since 1993. The 1992 drought brought about a dramatic drop in water consumption. Only 101 gallons per capita were used in 1992, and 103 gallons per capita per day were used in 1993.

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- Although per capita consumption rose to 112 gallons per day in 1994, it has shown a declining trend over the past six years. Overall, water consumption per capita is notably lower this decade than in the 1980's when it showed an upward trend.
- Total residential consumption has declined slightly in relation to commercial consumption. Residential uses represented about 44% of direct billed consumption in 1975 and about 40% in 1999.

*Indicator #16* **Change in wetland acreage and functions.**

- Based on the 1998 Landsat data analysis, King County has approximately 35,000 acres of moderate to large wetlands (i.e. about 5000 sq. feet or larger). New Landsat data should be available approximately every two years. This will allow for consistent monitoring of wetland acres over time.
- Because of the nature of this data, it needs to be complemented by on-the-ground wetland inventories or orthophotographic data, which can more precisely measure, locate, and classify existing county wetlands.

*Indicator #17* **Continuity of terrestrial and aquatic habitat networks.**

- Out of the 3,655 parcels within or adjacent to the wildlife habitat, 27% have had some type of permit activity recorded since 1994. 17% had permit activity that is covered by King County Code relating to the network.
- As habitats become more fragmented by development much of their function is lost. If habitats are fragmented, there may actually be less usable habitat available than a simple count of acreage would indicate. Many of our threatened and endangered species in King County require relatively large connected blocks of habitat. The designation of the wildlife habitat network by the King County Comprehensive Plan is a first step in helping to preserve that continuity. By tracking and limiting development within and adjacent to the network, fragmentation of the habitat can be prevented before it occurs.

*Indicator #18* **Change in number of wild stock salmon.**

*Chinook*

- In 1998 the listing of Puget Sound Chinook salmon as a threatened species under the Endangered Species Act was announced. In response to this listing, a Tri-County initiative has been underway to plan for improved Chinook survival, and for the restoration and preservation of salmon habitat throughout the Puget Sound region.
- The total number of natural adult Chinook in the Lake Washington System reached a new low of 240 in 1999. The number fluctuated between a low of about 450 and a high of over 2,000 through the 1970s and 1980s. Overall, the average of runs in the 1990s are about one-half the average during the 1980s.
- The number of natural Chinook in the Snohomish/Snoqualmie Watershed has shown a declining trend since the late 1970s, and natural Chinook is classified as depressed in the Snohomish basin. In 1998, however, adult Chinook returned to this watershed in their highest numbers – over 6,000 - since 1980. This trend has continued into 1999, with 6,374 adults returning to spawn last year.

*Coho*

- Thirty years ago, in 1970, a high of 30,000 natural Coho was recorded in the Lake Washington System. A low of 200 was recorded in 1994. After three years of relatively good returns, there were less than 500 natural adult Coho that returned to the Lake Washington Watershed in 1998, and just 733 in 1999.

- Coho in the Green River Watershed show similar fluctuation. After fairly health returns in 1994 – 1996, the numbers have again fallen off in 1997 – 1999. With the exception of a severe low in 1991, the past three years have had the lowest returns since 1973.

*Sockeye*

- A very high rate of return to Lake Washington in the summer of 2000 illustrates the volatility of the Sockeye population in this watershed. The combination of ideal spawning conditions in 1996 and a favorable marine climate during the next few years, favored the survival of that year's cohort. These conditions made it possible for hundreds of thousands of adult sockeye to re-enter Lake Washington during the 2000 season, on their way to spawning grounds throughout the Cedar River/Lake Washington Watershed. However, historically, a good year such as this, often alternates with very poor years. True trends can only be identified over the long term.
- In contrast to the current season, in 1998 there were only about 60,000 natural adult Sockeye returns in the Lake Washington/ Cedar River Watershed. This total was about 50% of the previous year's total. In 1999 there were only about 24,500 adult returns in the watershed. Even accounting for "good years" there appears to be a long-term trend toward a lower Sockeye population in the Lake Washington/ Cedar River Watershed.

*Indicator #19* **Rate of increase in noise from vehicles, planes, and yard equipment.**

*SeaTac International Airport*

- Based on its Noise Monitoring System, the Day-Night Sound Level (DNL) values at SeaTac have decreased from an average of 71 – 74 since the early 1990's (when a mediation agreement was developed to reduce overall noise) to 68 – 69 in 1999. By comparing the DNL values, it appears that the noise energy has decreased even though the number of departures and arrivals has increased. This decrease can be attributed to the increase in the number of quieter Stage 3 aircraft at the airport, and the phased elimination of noisier Stage 2 aircraft.

*King County International Airport (KCIA)*

- Day-Night Sound Level values at KCIA have decreased slightly from the 4$^{th}$ quarter of 1997 to the 4$^{th}$ quarter of 1999, dropping from 70 to 69 at one monitoring location, and from 68 to 66 at a second location.

*Indicator #20* **Pounds of waste disposed and recycled per capita.**

- While King County continues to do well in its recycling efforts, it has been less successful in reducing the total amount of waste generated.
- King County is now recycling close to twice as much per person as it was in 1990. After a leveling off from 1997 – 1998, waste recycled per capita rose substantially between 1998 and 1999. The per capita amount recycled has increased 86% from 1990 – 1999, an annualized growth rate of 6.4%.
- Although solid waste disposal per capita has declined about 4.5% over the past ten years, there has been a trend toward increased waste disposal since 1996. The amount of solid waste rose precipitously between 1998 and 1999, bringing it to its highest level since 1991.
- Total waste generated per capita (the sum of disposal per capita and recycling per capita) has increased by over 450 lbs. per person during the past ten years, or approximately 1.8% per year. It increased by over 100 lbs. during the single year from 1998 to 1999. Seattle and King County serve as employment and population centers for the region. The relatively high level of economic activity and the large number of individuals working in the region may be responsible for this increase in waste generation per capita.

# III. Discussion

Although many indicators are measured separately in this report, many linkages can be drawn among the indicators for the environment and between indicators in other sections of this report such as land use, transportation or economic development.

## *Air Quality*

King County's air quality has improved over the last 20 years. In 1980, 20% of all days in the year were characterized as good air quality days and in 1999, 75% of all days were "good", even with more stringent standards being applied. Not only does this add to the quality of life in the region, it also brings monetary benefits to residents of this county.

Better fuel efficiency, higher emission standards for industry and a large number of educational programs aimed at reducing energy consumption have contributed to better air quality. However, a rising population and an increase in the number of vehicle miles traveled (VMT) can increase the amount of pollutants released to the air. Total VMT has increased 88% between 1985 and 1999, although most of this increase occurred between 1985 and 1990.

The preservation of greenbelts and forests in the vicinity of urban areas is another critical aspect of maintaining or improving air quality, because of the capacity of trees to absorb pollutants such as $CO_2$. In order to achieve further improvements in air quality, measures that help reduce levels of pollution in the transportation, residential, commercial and industrial sectors have to be continued and improved where appropriate.

## *Energy Consumption*

While the per capita increase in energy use has been modest, total consumption continues to grow and to outpace population increase. The trend during from 1995 – 1999 has been toward an increasing per capita consumption of all types of energy, except for automotive gasoline. The apparent leveling off of per capita gasoline consumption is good news since gasoline represents about 40% of total per capita consumption, and has a strong impact on air quality.

The slight decline in per capita gasoline consumption in the past two years, at the same time that total and per capita vehicle miles traveled have increased, poses an interesting anomaly. While data discrepancies could account for some of this, the trend is strong enough in both cases to warrant an explanation. Two possible interpretations come to mind. One is that despite the recent popularity of larger, less fuel-efficient vehicles, the average efficiency of all cars on the road is improving. As older, less-efficient vehicles are replaced by newer, more efficient models, the total demand for gasoline could be declining, even with more vehicles on the road.

Another plausible explanation illustrates the interaction of various aspects of growth. Over the last four years, the rate of job growth in King County has outpaced the rate of population and household growth. In Pierce and Snohomish Counties household growth has increased more rapidly than would be expected by local job growth. Clearly more workers are commuting from adjacent counties to work in King County. These commuters, along with tourist, pass-through, and commercial traffic contribute to the higher VMT on King County roads. However, they do not necessarily purchase a proportionate amount of gasoline within King County. Many are likely to "fill up" in the counties of origin or residence. This could account for increasing VMT while gas consumption by County residents is declining or leveling off.

The sharp increase in diesel fuel consumption in '98 – '99 certainly suggests an increase in commercial traffic.

Infrastructure and land use planning that focuses development within urban growth areas, combined with public transit options for the majority of the population, can play a significant role in helping to reduce the number of vehicle miles traveled and thus further reduce impacts on air quality from vehicle emissions.

## *King County Lakes and Streams*

About two-thirds of King County lakes are classified as having very high or moderate water clarity (trophic status). The other one-third exhibit the eutrophication typical of aging lakes. Streams in King County appear to be in worse shape than its lakes, with over half of the streams classified as moderately or seriously-degraded in biological integrity. Streams in the Cedar River basin are in the best shape, while streams in the Soos Creek Basin of the Green River are the most degraded. New levels of urbanization in any of these basins could further threaten the water quality in the system's streams, and their value as aquatic habitat.

## *Water Consumption*

Total consumption fell from 146 million gallons per day (mgd) in 1990 to 134 mgd in 1999. Per capita water consumption in King County at 104 gallons per person per day, reached its lowest level since 1993. It is 19 gallons less than in 1975. Local and regional education efforts, state and federal policies aimed at reducing per capita and total consumption, and rising water prices have all had a significant impact on reducing water consumption. It has been observed in other regions that rising personal incomes is sometimes correlated with higher levels of residential water consumption. However, despite significant growth in personal income this past decade, this has not been the case in King County.

In anticipation of the pressures of growth, Seattle Public Utilities, which serves about 75% of the residents of King County, has implemented a substantial increase in water rates. This increase will insure that needed improvements in the system will be made and that water supply will be sufficient over next decade or more. It is expected that it will continue to moderate demand and lower per capita consumption.

Numerous benefits can be derived from lowering rates of water consumption. One immediate, direct effect of reduced water consumption includes lower water and sewer bills for individual households. Since a majority of the water supplying this region comes from rivers such as the Tolt which support salmon and wildlife populations, lower water consumption will keep more water in the stream to benefit salmon and other species inhabiting the stream corridor. A reduction in consumption also reduces the amount of groundwater drawn from wells which prolongs the life of aquifers and helps keep a better balance between groundwater withdrawal and its natural capacity to get recharged.

## *Salmon*

With the listing of Puget Sound Chinook salmon as a *threatened* species under the Endangered Species Act (ESA) , monitoring the condition of salmon runs in King County has become more important than ever. The Puget Sound Basin provides habitat for a total of 209 salmon and steelhead stocks. In a 1992 assessment only about 44% of these stocks were considered healthy. The others were rated as depressed, critical, unknown, or extinct.

Even in undeveloped river systems, there are large natural fluctuations in salmon spawning and survival from year to year. These biological cycles are driven by changes in the conditions of freshwater and

marine environments. However, an analysis of long term trends in the major watersheds of King County indicate that the decline in wild Chinook, Coho, and Sockeye stocks is considerably more long-lived than would be expected from natural fluctuations. For instance, through the 1970s and 1980s the number of returning Chinook adults in the Lake Washington basin fluctuated between a low of about 450 and a high of over 2000. However, 1993, 1996, 1997, and 1999 showed exceptionally low returns, in the range of 200-350 fish. The average size of runs in the 1990s are about one-half the average size of runs during the 1980s.

The number of Chinook in the Snoqualmie-Snohomish watershed showed a declining trend from the late 1970s through the mid-1990s. But in both 1998 and 1999 adult Chinook returned to the Snoqualmie-Snohomish watershed in their highest numbers – about 6,300 – since 1980.

A long-term downward trend is also evident among wild Coho adults which return to spawn in the Lake Washington system. In 1970, a high of 30,000 fish was recorded while a low of 200 was recorded in 1994. After three years of relatively good returns, there were less than 500 adult Coho that returned to the Lake Washington watershed in 1998, and only 733 in 1999.

Despite occasional rebounds, wild Sockeye in the Cedar River basin have shown a downward trend since 1989, and are considered a depressed stock in that watershed. The spectacular return of 400,000 or more Sockeye to Lake Washington in the summer of 2000, due to exceptionally good conditions for that cohort, camouflages the longer term trend toward a declining stock. About 300,000 of those adults are expected to survive fisheries to spawn. However, in 1998 only 60,000 adults returned, and in 1999, only about 24,500.

It is difficult to determine the relative importance of each of the factors that influence the status of a particular salmon stock. There is little that can be done to affect the climatic conditions in the marine environment. Despite the natural fluctuations from year to year, many of the variations and declines in salmon populations that have been observed in the last several decades appear to be mainly the result of human impacts. In addition to the harvesting of wild salmon, habitat deterioration caused by urban and industrial growth, forest management practices, agricultural practices, municipal, industrial, and agricultural diversions, and hydropower have all contributed to diminishing the abundance and diversity of salmon.

Covering land with impermeable surfaces (e.g. building and paving) to accommodate residential, commercial and industrial growth decreases the filtration of storm and rainwater through the soil to groundwater, and increases the surface run-off to streams and lakes. The higher peaks and valleys in surface water flow can destroy spawning habitat, and cause flooding. Stormwater run-off can also carry pollutants such as automotive oil and fertilizers into surface water bodies. The cutting of shade trees, the loss of woody debris, and the creation of obstacles to the salmon's journey upstream, as well as other stream channel modifications and water diversions continue to reduce habitat quality for salmon and other aquatic life.

As a result of the listing of Puget Sound Chinook under the Endangered Species Act (ESA), a tri-county effort is now underway to find ways to improve conditions for salmon survival. A draft agreement between local jurisdictions and the federal government on policies to promote salmon recovery in this region (the "4-D Rule") is currently being reviewed. It will be implemented by January 2001, and is likely to have a significant impact on land use planning in King County.

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Salmon are an important symbol of the Pacific Northwest and provide cultural, economic, recreational and aesthetic values to residents in this region. Thus there is a strong link between habitat and salmon needs and the needs of humans.

## IV. General Information about Indicators and Data Sources

A total of twelve indicators for the environment were chosen for inclusion into the Benchmark Report. Some data is available for all but one of the indicators, and more complete data will be reported in future Benchmark Reports.

Indicator #15, *Change in Groundwater Levels.* The King County Groundwater Program has not yet developed a permanent funding source, and as a result has held in abeyance further hiring and full implementation of the program. However, through an interim funding called "Early Start" from Solid Waste Division, the Groundwater Program has enhanced database capability and hopes to conduct limited groundwater sampling in the future.

Ground water data for Indicator #13, *Water Quality*, and aquatic habitat data for #17 *Continuity of Terrestrial and Aquatic Habitat Networks* will be collected for future Benchmark Reports. Data on the terrestrial habitat network is available for the first time this year.

# ENVIRONMENT INDICATORS

***Outcome:*** *Protect and Enhance Natural Ecosystems*

**INDICATOR 9:** Land cover changes in urban and rural areas over time.

| Percent of County Land Area That Was Developed: 1984, 1991, 1998. | | | |
|---|---|---|---|
| **Counties** | **1984** | **1991** | **1998** |
| **King** | **10.4%** | **11.6%** | **13.2%** |
| **Pierce** | 7.3% | 8.6% | 13.2% |
| **Snohomish** | 3.3% | 4.0% | 8.1% |
| **Kitsap** | 6.9% | 8.8% | NA |
| **4 County Area** | 7.0% | 8.1% | NA |

***Definitions:***

- *These percentages are based on an analysis of Landsat image data. Earlier Landsat images were recorded and analyzed in 1984 and 1991. The most recently processed image was recorded in August 1998. The nature of this methodology may not make it strictly comparable to other methods of calculating developed areas – e.g. on the ground surveys or building permit data. The units of measurement are relatively large. Each "cell" is approximately1/5 of an acre in size (about ¼ of a football field), and is assigned a single land cover value, based on the predominant land use in that cell. Hence a paved school playground will be considered a "developed" land cover, while an adjacent park with a small building is likely to be designated a "grass" or "shrub" land cover.*
- *Developed land is made up of land in both urban and rural areas that has been converted from vegetative cover to low and high density developed land. It includes paved areas and buildings, small residential lawns, and shrubs, but it excludes wetlands, larger parks, and open spaces in urban and suburban areas.*
- *Landsat analysis is not always able to distinguish between natural land cover and landscaped subdivisions, which are considered a developed, urban use. On the other hand, extensive natural rock surfaces, such as those found in unforested mountain areas, show up as "developed area" because of their similarity to concrete and paved surfaces. On the balance, however, the estimate of total developed area should be reasonably accurate.*
- *For this indicator, the following sub-categories of Landsat data are considered "developed":*
    1. *High Density Development*
    2. *Low Density Development*
    3. *Low Density Development with Shrubs*
    4. *Developed Rural Areas (e.g. homes, residential lawns, tennis courts, parking lots)*
    5. *Urban Grass and Shrubs*

**Observations:**

- The accompanying land cover map shows that by far the greatest proportion of development in King County has remained within the Urban Growth Boundary.
- According to the table above, King County's developed area has increased from 10.4% in 1984, to 11.6% in 1991, to 13.2% in 1998. Although the earlier data is also based on Landsat images, the

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## INDICATOR 9:

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methods of analysis may not be strictly comparable, so the degree of change in developed land cover should be viewed with caution.

- Based on the latest data, Pierce County has 13.2% developed area, almost exactly the same as King County. While there are considerably fewer people and households per acre in Pierce County than in King County (i.e. the overall population density is lower), physical development may be spread out over a higher proportion of the County's land area.
- Snohomish County has 8.1% of its land area developed. Of the three adjacent counties, Snohomish has the smallest proportion of its total land developed. Although comparison with earlier data is imprecise, it may have twice as much land developed in 1998 as was developed by 1991.
- These development trends are consistent with the relatively rapid population growth that has occurred in both Pierce and Snohomish Counties over the last decade. Snohomish County population is growing at more than twice the rate of King County.
- Data based on an analysis of Landsat images from 1984 and 1992 were collected before the Growth Management Act began to have noticeable effects on land use patterns. New Landsat images, taken in the summer of 2000, will be analyzed in a similar manner to the 1998 data, providing better comparison over time. Current plans are to collect and analyze this data every two years in the future. This forthcoming data should provide a basis for evaluating whether patterns of development in the region have shifted, or been modified by the GMA.
- Vegetative cover types, especially forests, provide significant ecological functions. They absorb, filter, and slow surface water flow. This is particularly important over aquifer recharge areas. Approximately 10-15 percent impervious surface area (land cover not permeable to water) in a watershed typically yields demonstrable, and probably irreversible, loss of aquatic system functions. This loss results in larger and more frequent high flows, decreased base flows to streams, and increased water level fluctuation in wetlands and small lakes. Changes in flows result in alterations to channel shape and structure which often have significant adverse impacts on plants, fish, and wildlife.
- Forests provide wildlife habitat, cleanse air, and are aesthetically pleasing. Fish and wildlife depend upon continuous, undisturbed habitat. When ecosystems become highly fragmented as often occurs in the process of urbanization, fish and wildlife are prevented from meeting their need for food, water, cover, and space.

**Data Sources**: King County Surface Water Management Department, 1996*; Remote Sensing Project Land Cover and Change Detection*, Puget Sound Regional Council, April 1994. 1998 Landsat data was obtained from the interdepartment PRISM project at the University of Washington, and processed under its direction.

**Policy Rationale:** The policy rationale stems from Countywide Planning Policies FW-4, FW-5, CA-4, CA-7, CA-8 and CA-9. Conversion of land to urban uses (low and high density developed land) often results in the degradation and fragmentation of ecosystems.

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***Landcover map (1) 11 x 17***

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***Land Cover Map (back side)***

# ENVIRONMENT INDICATORS

***Outcome:*** *Improve Air Quality*

**INDICATOR 10**: Air quality.

| Number of Days in Each Air Quality Category by Year | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1980** | **1985** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** |
| **Good** | 73 | 150 | 239 | 256 | 238 | 251 | 315 | 313 | 324 | 321 | 343 | 272 |
| **Moderate** | 275 | 202 | 126 | 109 | 127 | 114 | 50 | 52 | 42 | 44 | 22 | 88 |
| **Unhealthful for Sensitive Groups** | 18 | 10 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| **Very Unhealthful** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

***Definitions:***

- *The Pollutant Standards Index (PSI) provides a nationally uniform method to report daily air quality levels. The PSI reflects the maximum levels of four key pollutants: carbon monoxide, suspended particulate matter (dust, soot, other particles 10 micrometers or less in diameter), sulfur dioxide and ozone. The concentration of each pollutant on a given day determines an Index value and the pollutant with the highest Index value determines the PSI on that day. The PSI values are then translated to a rating from "good" to "very unhealthful."*
- *In mid-1998 the federal standard for particulate matter was reduced to 2.5 micrograms per cubic meter. The number of healthy and unhealthy days in 1999 reflect this new, more stringent standard.*
- *The monitoring sites were chosen based on where the highest concentrations of pollutants were expected to occur. The highest values often occur in industrial areas and/or in the vicinity of heavy traffic. The majority of the monitoring sites are in urbanized areas. Since high ozone levels occur some distance downwind of Seattle, ozone levels are measured in downwind areas such as Enumclaw during the months of May through September.*

**Observations:**

- Air quality has improved significantly since 1980. The number of good air quality days increased from 73 in 1980 to 343 in 1998. The decline to 272 good days in 1999 reflects the higher federal standard for particulate matter adopted by the Seattle area beginning last year. This also accounts for the rise in the number of "moderate" days, and for the 5 days designated as unhealthy for sensitive groups. Before the change in standards only 1 day had been designated as "unhealthy" since 1980.
- Many factors including increased fuel efficiency, higher emission standards and improved regulatory enforcement are responsible for the long-term improvements in air quality. As an example, many gas stations in recent years have converted to using nozzles which collect more than 90% of all the harmful vapors thereby helping to control air pollution problems. Many public education programs also have contributed to the air quality improvements evident in King County.
- Although the Puget Sound region and King County are in compliance with air quality standards, the region still discharges about 1.5 million tons of pollutants into the air on a yearly basis. Motor vehicles are by far the largest contributors to overall air pollution with 55% of the total, followed by industry with 21%, outdoor burning with 12% and wood stoves and fireplaces with 12%. Outdoor burning, wood stoves and fireplaces contribute to the amount of particulate matter in the air.

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## INDICATOR 10:

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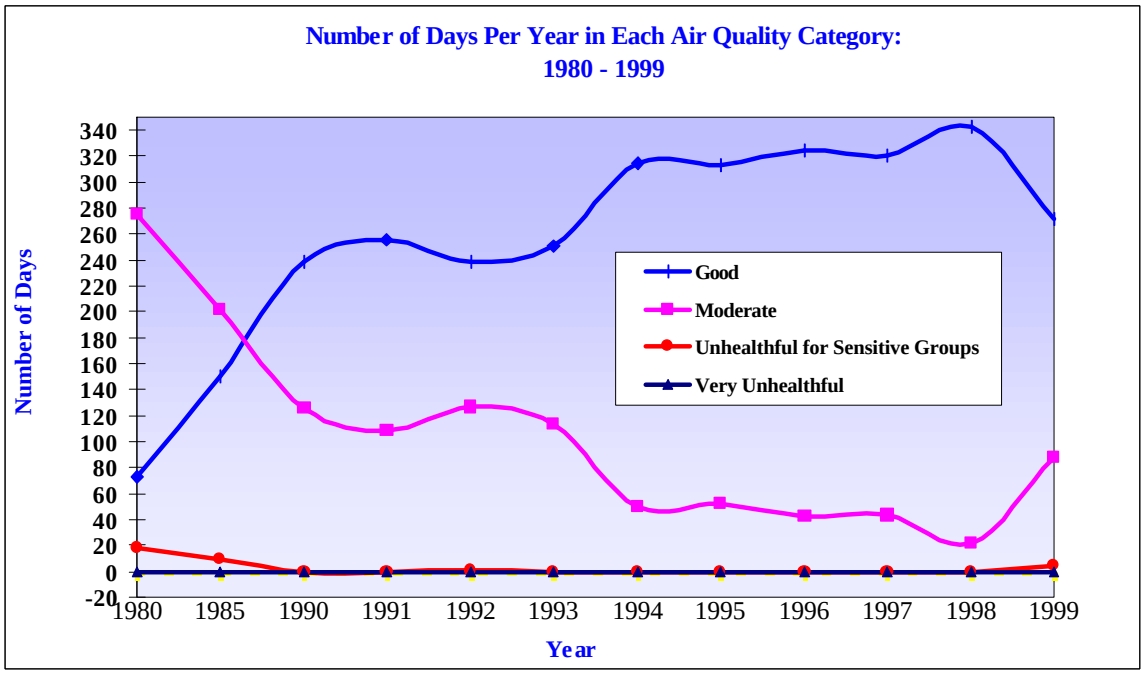
- The new air quality standard for particulate matter is now in effect in the Seattle area, and is reflected in the somewhat lower number of "good air" days. The EPA instituted a new air quality standard for ground level ozone in 1997. It is currently being challenged in the courts. However, once implemented, this tougher standard, combined with a rising population, increases in vehicle miles traveled (VMT), in truck traffic, in construction equipment usage, and in various urban activities, could result in King County being in violation of federal ozone regulations as early as the summer of 2000.
- Sports utility vehicles, minivans, and pickup trucks now exceed 50% of vehicle sales. These vehicles tend to emit pollutants at much higher levels than standard passenger cars. Current regulations allow them to produce up to three times more pollution per mile than a standard car.
- New rules, which will be phased-in starting with 2004 models, will assure that the "light truck" category will have to meet the same fleetwide average pollution level as standard cars. The allowable pollution for all vehicles will be more stringent than current standards. A related rule requiring cleaner gasoline will help car manufacturers to meet the new standards.
- To further improve or even maintain current air quality, increased efforts will have to be made to reduce the amount of pollutants reaching the air, by reducing reliance on cars, encouraging use of smaller, more fuel-efficient vehicles, reducing commute distances, and increasing availability of alternative forms of transportation.




**Data Source*:*** Puget Sound Air Pollution Control Agency*; Air Quality Data Summaries*, Puget Sound Air Pollution Control Agency.

**Policy Rationale:** The policy rationale stems from Countywide Planning Policies FW-4 and CA-14. This Indicator focuses on maintaining air quality sufficient for public health.

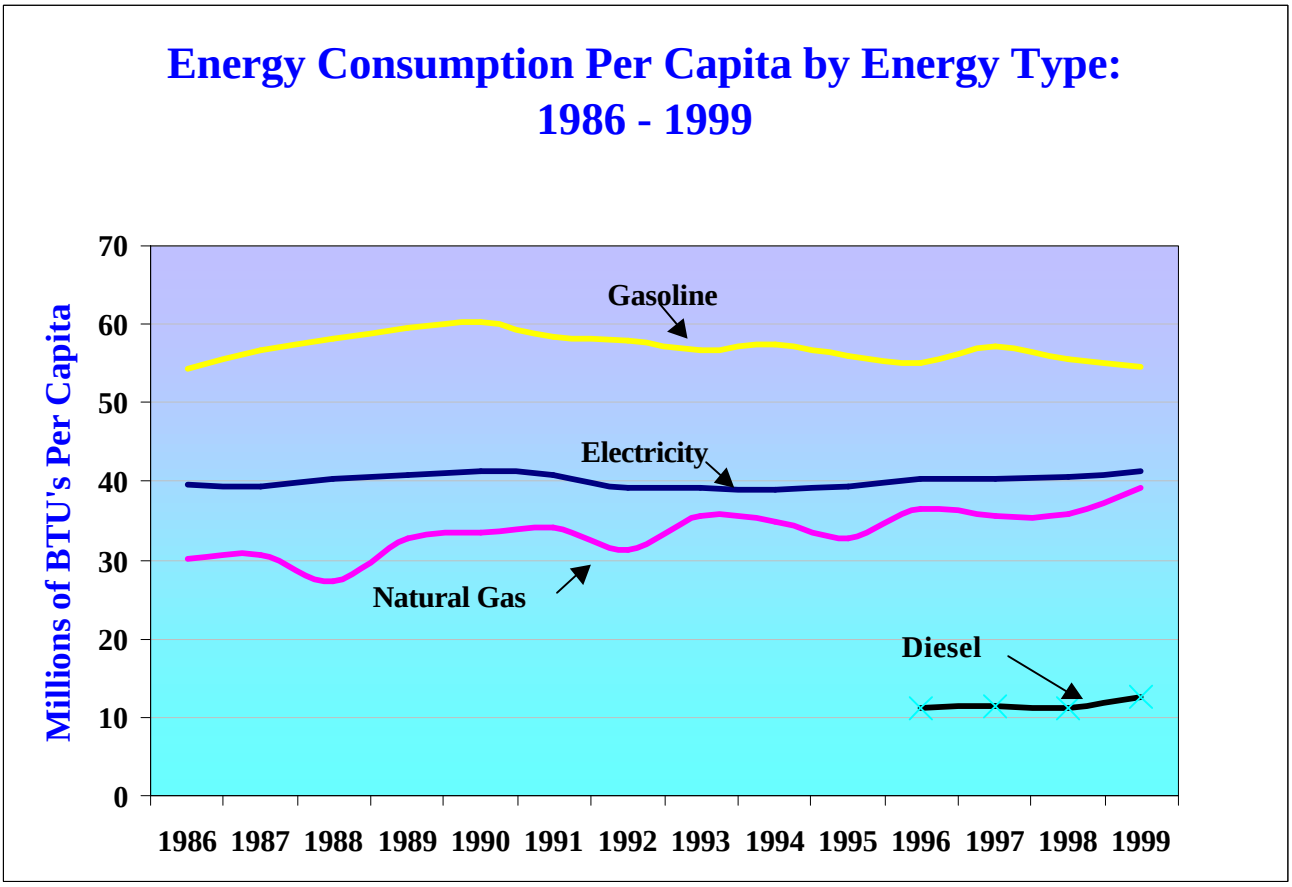
# ENVIRONMENT INDICATORS

***Outcome:*** *Improve Air Quality*

**INDICATOR 11:** Energy consumption.

| Energy Consumption in Million BTU's per Capita by Energy Type | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1986** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | **% Chg 1986-1999** |
| **Electricity*** | 39.61 | 41.24 | 40.72 | 39.23 | 39.1 | 38.94 | 39.49 | 40.25 | 40.39 | 40.48 | 41.33 | **4.3%** |
| **Natural Gas** | 30.02 | 33.51 | 34.11 | 31.26 | 35.66 | 34.81 | 32.79 | 36.43 | 35.68 | 35.72 | 39.16 | **30.4%** |
| **Gasoline** | 54.35 | 60.28 | 58.44 | 57.78 | 56.69 | 57.51 | 56.01 | 55.15 | 57.17 | 55.51 | 54.69 | **0.6%** |
| **Diesel Fuel*** | | | | | | | | 11.18 | 11.36 | 11.10 | 12.51 | |
| **Total Per Capita Energy Consumption*** | 124 | 135 | 133.3 | 128.3 | 131.5 | 131.3 | 128.3 | 131.8 | 133.24 | 131.70 | 135.18 | **6.2%** |

*Electricity includes both Seattle City Light and Puget Sound Energy consumption. Diesel fuel data was only collected for 1996 - 1999, so it is not included in the Total Per Capita for any year. Note that it has been corrected from the 1998 and 1999 Benchmark Report, where a total amount rather than a per capita amount was reported.



# ENVIRONMENT INDICATORS

## INDICATOR 11:

*(continued from previous page)*

***Definitions:***

- *BTU=British Thermal Unit. 3.413 Million BTU = 1 MegaWattHour*
- *Figures presented for electricity and natural gas include consumption in all sectors: residential, commercial, industrial, and government (street lights, etc). They do not include self-consumed, line loss or unbilled power. Numbers from Puget Sound Energy from 1999 are preliminary, and will be revised next year.*
- *The electricity comes from both non-renewable and renewable sources, the former include energy derived from coal, oil, gas and nuclear power plants and the latter from hydroelectric plants.*
- *Electricity supplied by Puget Power and Seattle City Light is generated in part in Washington State and in part, in other states, Canada and Mexico. Electricity generated outside King County, if it is derived from coal or oil power plants, only affects air quality in those areas and not within the county. Electricity generated in hydropower plants impacts streams and watersheds, but does not affect air quality.*
- *50% of the natural gas supplied by Washington Natural Gas is derived from domestic sources and 50% from Canadian sources.*

**Observations:**

- Per capita consumption of all energy sources has increased 6.2% since 1986. In 1999, total energy consumption per capita was the highest it has been since 1990. This total does not include diesel fuel, which has only been tracked since 1996.
- In the past year per capita natural gas, electricity, and diesel consumption have all risen sharply while automotive gas usage has fallen.
- Total energy consumption has increased 31.1% since 1986 due to population growth, economic growth, and higher per capita usage. The only energy source which has not increased in per capita usage is gasoline, which has leveled off to approximately the same rate as 1986.
- All energy providers have been actively promoting energy conservation since the 1980's. Some have installed thermal insulation in residences and promoted energy efficient appliances.

***Automotive Gasoline***

- Per capita automotive gasoline consumption declined for the second year in a row, reaching its lowest per capita level since 1986. The sharpness of the decline may be somewhat exaggerated due to a change in the method of collecting gasoline data in 1999. However, it appears that rising gasoline prices during 1999 may have partially offset the effects of increased ownership of larger, less fuel-efficient vehicles.
- Total automotive gasoline consumption has risen 22% from 1986 – 1999. This is almost exactly the same as the rate of population growth (22%) for this 13 year period. Gasoline is the only energy source where consumption has equaled rather than exceeded population growth over the past 13 years.
- Gasoline consumption was at an average of 44% of total energy consumption from 1986 to the mid-1990s. The use of vehicles is responsible for a significant part of total energy consumption and air quality effects. However, in 1999 automotive gasoline fell to just over 40% of total energy consumption.

# ENVIRONMENT INDICATORS

## INDICATOR 11:

*(continued from previous page)*

***Diesel Fuel***

- Per capita diesel fuel usage rose nearly 12% during the four years (1996 – 1999) it has been tracked. Total diesel usage rose 15%. Most of the increase took place between 1998 and 1999. According to the Washington State Dept. of Transportation, this rise is due to an increase in commercial traffic.

***Natural Gas***

- Per capita consumption of natural gas has increased just over 30% since 1986. Total natural gas consumption has increased 59% since 1986, rising at a much faster rate than population growth. The rise in consumption appears to be largely in the residential sector. It is likely that natural gas is replacing electricity or other energy sources for some residential uses. Industrial consumption of natural gas fell 42% from 1993 - 1997.

***Electricity***

- Per capita electricity usage has increased 4.3% over the 13 years between 1986 and 1999. It rose slightly from 1986 - 1990, declined from 1990 - 1994, and rose again from 1994 - 1999.
- Total electricity consumption in 1999 was 28% higher than in 1986, slightly outpacing population growth. It appears that the rise is occurring in all sectors, with residential use increasing faster in Seattle, and commercial and industrial use increasing more rapidly in areas served by Puget Sound Energy (in King County outside of Seattle).

**Data Sources**: Seattle City Light; Puget Sound Energy (formerly Puget Power); Washington Natural Gas; and Washington State Department of Transportation.

**Policy Rationale:** The policy rationale stems from Countywide Planning Policies ED-11, CO-2, CO-3 and CO-6. Most uses of energy have direct and indirect environmental impacts, which can include deterioration of air quality, water quality and natural resources. Public health can also be negatively impacted as a result of energy production and use. Energy conservation is critical for the protection of the region's environment and to postpone the need for the construction of new and expensive energy-producing facilities.

# ENVIRONMENT INDICATORS

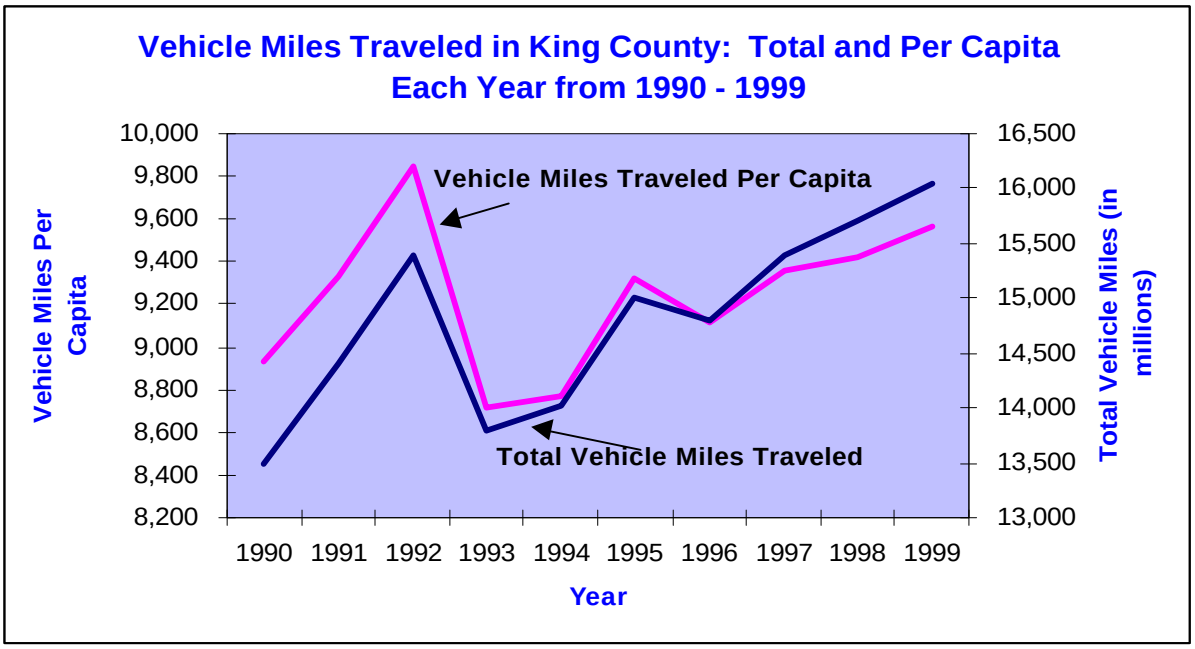
***Outcome:*** *Improve Air Quality*

**INDICATOR 12:** Vehicle miles traveled (VMT) per year.

| Vehicle Miles Traveled Per Year in King County | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **1985** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** |
| **Vehicle Miles Traveled per Capita** | 6,344 | 8,933 | 9,329 | 9,846 | 8,720 | 8,771 | 9,318 | 9,114 | 9,357 | 9,422 | 9,567 |
| **Total VMT Traveled (in billions)** | 8.5 | 13.5 | 14.4 | 15.4 | 13.8 | 14.0 | 15.0 | 14.8 | 15.4 | 15.7 | 16.0 |

***Definitions:***

- *Vehicle Miles Traveled (VMT) is a measure of the total miles traveled by all vehicles on the road in a given year for a given period of time. Vehicle Miles Traveled per Year is based on approximate total miles traveled as reported in the "Highway Performance Monitoring Report", (HPMS) Washington State Department of Transportation. The data are based on a sample of actual highway mileage with expansion factors used for rural, small urban, and urbanized areas to arrive at totals. HPMS is not designed for use at the local jurisdictional level, but rather for use in determining the needs for roadways at the State level. The large increase in VMT between 1985 and 1990 shown in the table is based on sampling and expansion factors that were not designed to be aggregated at the County level. When thus aggregated, the figures overstate the increase in VMT between 1985 and 1990.*
- *Per Capita VMT means the total VMT divided by the number of King County residents. However, many of the total VMT are actually driven by non-residents of King County, including commuters from neighboring counties, commercial vehicles originating outside the County, or tourists passing through. This may explain why vehicle miles traveled in King County can be increasing while gasoline consumption in the County is decreasing or remaining about the same. These groups may not normally purchase gas within the County.*



## INDICATOR 12:

*(continued from previous page)*

**Observations**:

- Motor vehicles are the major source of carbon monoxide and hydrocarbon air pollutants. Regional air quality has improved over the last several years. At the same time, county annual VMT per capita has risen 7% from 1990 to 1999. Factors such as auto fuel efficiency and the availability of oxygenated gasoline in the wintertime account for improved air quality throughout this period.
- VMT includes travel by commercial and public vehicles as well as private automobiles. The increase in per capita VMT is caused by a combination of factors, including growth in County employment (at a rate considerably higher than population growth), increased travel to King County job centers by residents of adjacent counties, increased propensity to travel, and more commercial traffic. The result has been more vehicles on the road, traveling more miles per capita. (See definitions above).
- While per capita VMT continues to increase modestly, total VMT has risen a rapid 19% from 1990 - 1999.
- Fuel consumption and gas tax collection are only partially correlated with VMT. Fuel efficiency on some vehicles has increased over the 1985 to 1999 time period, meaning that it is possible to drive more miles with no more fuel being consumed. With this greater fuel efficiency, the increase in tax revenues has been less than the increase in miles traveled. It is still unclear whether the recent popularity of larger, less fuel-efficient vehicles is affecting fuel consumption per mile and per capita.
- Commercial, pass-through, and non-resident commuters may account for the increase in VMT in King County while per capita gas consumption has remained steady or even dropped. Drivers of these vehicles may not purchase gas in King County in the same proportion as they drive within the County.
- The primary contributor to air pollution in the County, by a large margin, is the single occupancy vehicle. Lessening SOV travel, as measured by reductions in VMT, is essential for protecting the environment of our region. Studies show that automobile traffic also significantly impacts water quality through runoff.
- The continued suburbanization of new population and employment in the county can mean a higher use of motor vehicles for all travel purposes. Autos are generally the mode of choice in the suburbs. By encouraging new development within urban growth areas, close to employment, and particularly within urban centers, the GMA and CPPs intend to decrease the need for motor vehicle travel, and to make alternative modes of transportation more accessible.

**Data Source**: *Highway Performance Monitoring Report 1981-1999*, Washington State Department of Transportation.

**Policy Rationale:** The policy rationale stems from Countywide Planning Policies T-8, CA-14 and CA-15. VMT is a general measure of travel demand that is used for both air quality management and Transportation Demand Management.

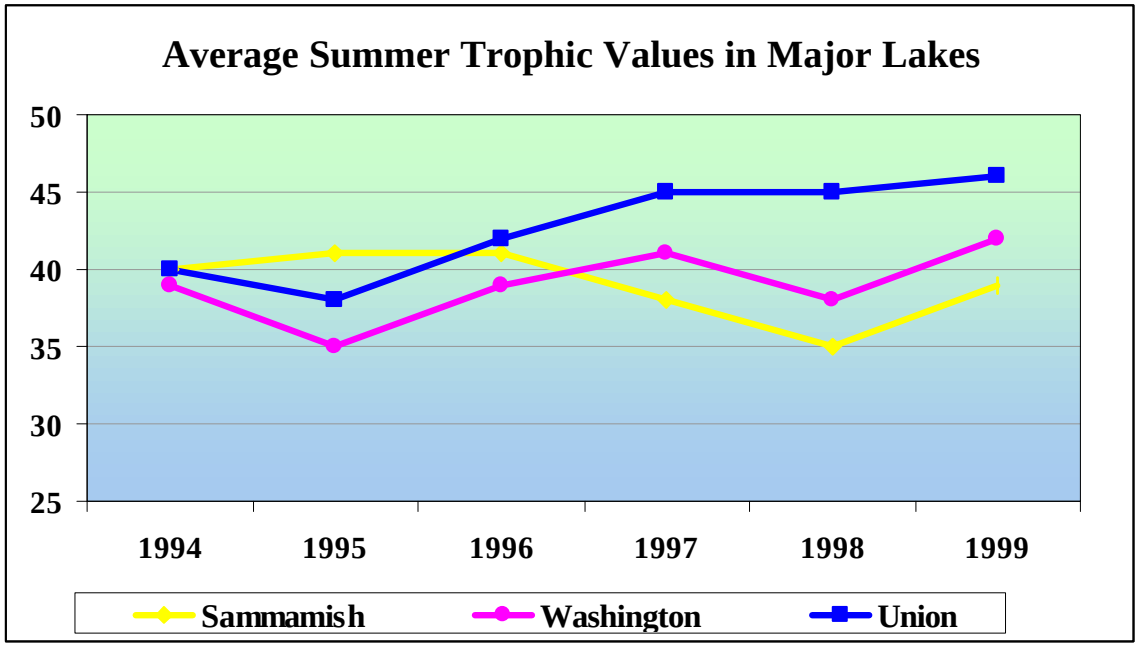
# ENVIRONMENT INDICATORS

***Outcome:*** *Protect Water Quality and Quantity*

**INDICATOR 13:** Surface water and groundwater quality.

## A. King County Lakes

| Major King County Lakes | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lake** | **Average Summer Trophic Index Values** | | | | | | **Classification** | |
| | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | | |
| Sammamish | 40 | 41 | 41 | 38 | 35 | 39 | Oligotrophic | Highest Water Clarity |
| Washington | 39 | 35 | 39 | 41 | 38 | 42 | Oligotrophic | Highest Water Clarity |
| Union | 40 | 38 | 42 | 45 | 45 | 46 | Mesotrophic | Moderate Water Clarity |




***Definitions:***

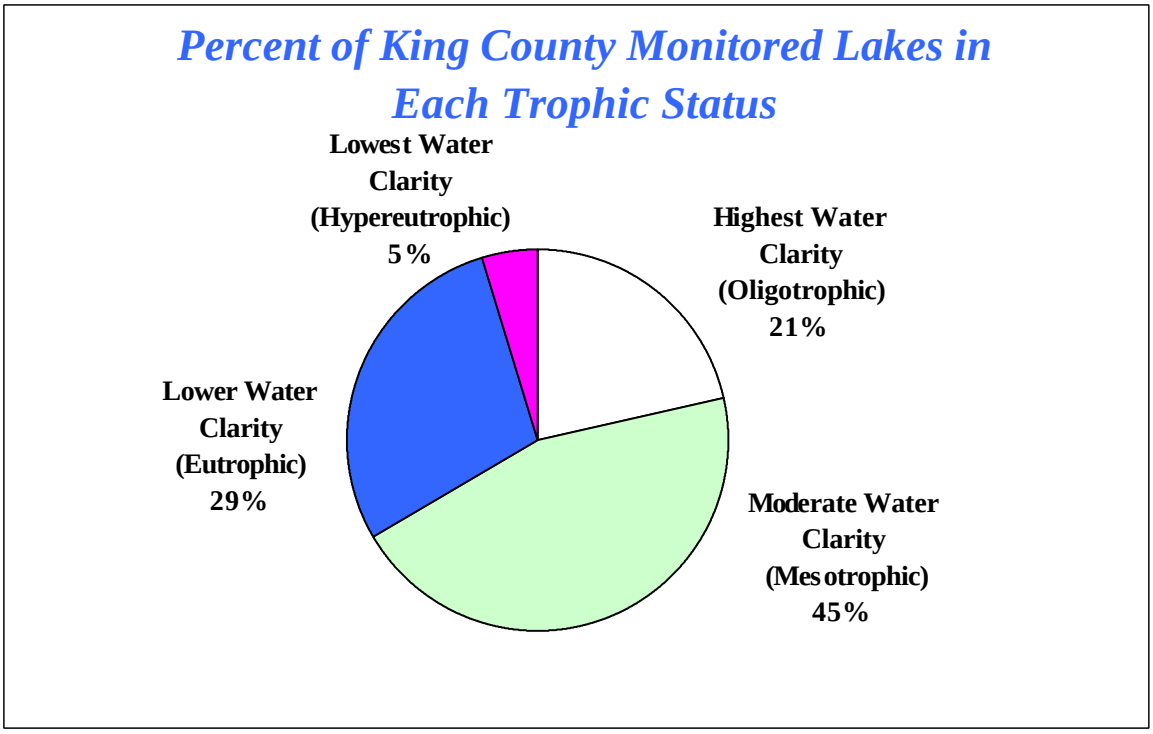
- *Eutrophication refers to the biological activity in a lake, reflecting the natural aging process. Lakes age over time and gradually fill in, becoming ponds, marshes, wetlands and eventually forests. Measuring lake eutrophication is one of the most common ways to assess lake health.*
- *Carson's (1977)* **trophic state index (TSI)** *is a method of quantifying this eutrophication on a scale of 0 - 100. The index integrates water clarity, total phosphorus, and algae measurements into a single value.*
- *Lakes with values around 40 or less (oligotrophic) have high water clarity, lower algae values, and lower total phosphorus values.*

# ENVIRONMENT INDICATORS

## INDICATOR 13:

*(continued from previous page)*

- *Lakes with TSI values between 40 and 50 (mesotrophic) have moderately good water clarity, algae and phosphorus values.*
- *Lakes represented by TSI values between 50 and 60 (eutrophic) typically have poorer summer water quality including lower water clarity, higher chlorophyll a values and higher total phosphorus values.*
- *Hypereutrophic lakes have TSI values greater than 60 and are very biologically productive. They have wetland-type attributes.*
- *The TSI values are a continuum and hence some lakes may be in a borderline range, exhibiting some qualities of upper and lower classifications.*




**Observations:**

- Factors that influence water quality vary significantly from lake to lake. Generally it is more useful to look at changes in a lake's water quality over time to assess the health of the lake. Comparing water quality among a group of lakes is also a useful evaluation method.
- Nine of the 42 monitored lakes in King County are classified as oligotrophic, having the highest water clarity. 19 of the lakes have TSI values between 40 and 50, classifying them as "mesotrophic" in water quality, and 12 are "eutrophic". (See table above) Two lakes (Allen and Panther-Kent) are classified as hypereutrophic, having the lowest water clarity. For lakes where data has been collected over several years, TSI values are fairly consistent and have generally remained in the same trophic state classification. This indicates stable lake health.
- Lake Union's trophic status was in the oligotrophic range from 1994 - 1995. However, its TSI values of 45 in 1997 and 1998, and of 46 in 1999, indicate that its water quality has declined. It is now classified as mesotrophic.

# ENVIRONMENT INDICATORS

## INDICATOR 13:

*(continued from previous page)*

| Level II Monitored King County Lakes | | | | | | |
|---|---|---|---|---|---|---|
| Trophic Values | | | | | | |
| | 1996 | 1997 | 1998 | 1999 | 95 - '99 Average | |
| Angle | - | 36 | 35 | 37 | 36 | Oligotrophic |
| Lucerne | 38 | 40 | 34 | 42 | 39 | Oligotrophic |
| Meridian | - | 40 | 38 | 39 | 39 | Oligotrophic |
| Pine | 41 | 40 | 39 | 38 | 39 | Oligotrophic |
| Pipe | 40 | 41 | 36 | 41 | 40 | Oligotrophic |
| Ravensdale | 40 | 41 | 39 | | 40 | Oligotrophic |
| Retreat | 39 | 40 | 35 | 32 | 38 | Oligotrophic |
| Star | 38 | 42 | 39 | 36 | 39 | Oligotrophic |
| Beaver 2 | 46 | 48 | 49 | 45 | 47 | Mesotrophic |
| Bitter | - | 48 | 43 | 46 | 46 | Mesotrophic |
| Boren | - | 47 | 45 | 42 | 45 | Mesotrophic |
| Burien | | | 42 | - | 42 | Mesotrophic |
| Geneva | 42 | 44 | 40 | 40 | 41 | Mesotrophic |
| Haller | - | 47 | 44 | 44 | 45 | Mesotrophic |
| Kathleen | 49 | 50 | 49 | 48 | 49 | Mesotrophic |
| Leota | - | - | 46 | 49 | 47 | Mesotrophic |
| Mirror | - | 48 | 46 | 49 | 47 | Mesotrophic |
| Morton | 43 | 43 | 40 | 41 | 41 | Mesotrophic |
| Neilson | 45 | 47 | 43 | 44 | 45 | Mesotrophic |
| North | 43 | 52 | 43 | - | 45 | Mesotrophic |
| Sawyer | 42 | 43 | 40 | 40 | 41 | Mesotrophic |
| Shadow | - | 44 | 45 | - | 45 | Mesotrophic |
| Spring | 44 | 51 | 43 | 43 | 45 | Mesotrophic |
| Steel | 43 | 47 | 45 | 43 | 44 | Mesotrophic |
| Twelve | 45 | - | 39 | - | 42 | Mesotrophic |
| Welcome | 52 | 48 | 50 | 48 | 50 | Mesotrophic |
| Wilderness | 44 | 45 | 40 | 42 | 43 | Mesotrophic |
| Beaver 1 | - | 56 | 52 | 51 | 53 | Eutrophic |
| Cottage | 54 | 52 | 48 | 53 | 52 | Eutrophic |
| Desire | 56 | 56 | 52 | 55 | 55 | Eutrophic |
| Dolloff | 60 | 59 | 57 | 53 | 57 | Eutrophic |
| Fivemile | 53 | 52 | 51 | 50 | 52 | Eutrophic |
| Francis | 50 | 49 | 53 | 50 | 50 | Eutrophic |
| Garrett | 60 | 59 | 59 | - | 59 | Eutrophic |
| Killarney | 51 | 53 | 53 | 47 | 51 | Eutrophic |
| McDonald | 55 | 55 | 55 | 54 | 55 | Eutrophic |
| Paradise | 52 | 56 | 52 | 55 | 54 | Eutrophic |
| Trout | 54 | 56 | 53 | 52 | 54 | Eutrophic |
| Webster | 54 | 50 | - | - | 52 | Eutrophic |
| Allen | 64 | 67 | 63 | | 65 | Hypereutrophic |
| Panther-Kent | 60 | - | - | - | 60 | Hypereutrophic |

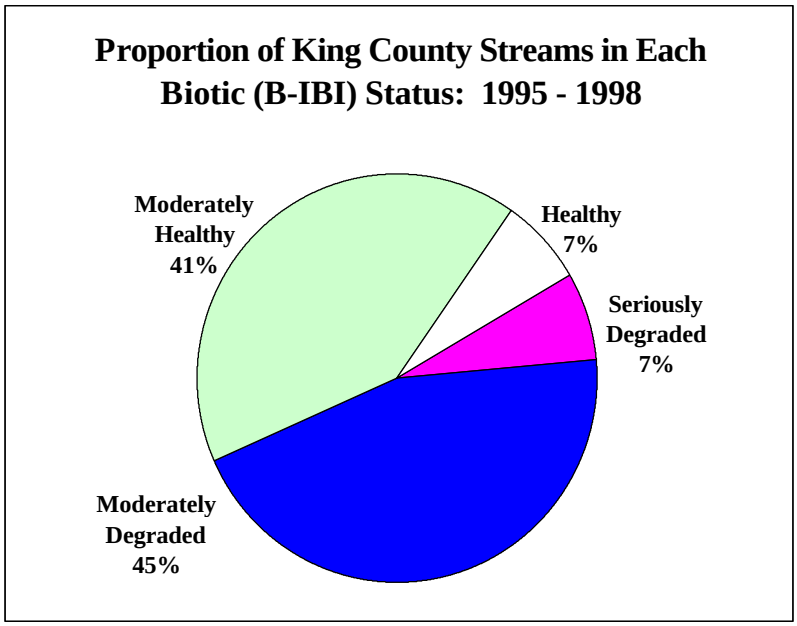
# ENVIRONMENT INDICATORS

# ENVIRONMENT INDICATORS

## INDICATOR 13:

*(continued from previous page)*

### B. King County Streams




***Definitions:***

- *The Benthic Index of Biotic Integrity (B-IBI) is a "report card" for the biological integrity of aquatic systems. Biological integrity is defined as "the ability to support and maintain a balanced, integrated, adaptive biological system having the full range of elements and processes expected in the natural habitat of a region" (Karr et al., 1996)*
- *The King County Water and Land Resources Division employs the B-IBI to determine the health of King County streams. The B-IBI evaluates the health of a stream by measuring the quantity of certain aquatic macroinvertebrates present in a stream sample. The number and condition of these macroinvertebrates yield 10 measures, each of which is assigned a score from 1 (severe degradation) to 5 (little or no degradation). The total score thus ranges from 10 (severe degradation by all measures) to 50 (little or no degradation by all measures).*
- *B-IBI scores for streams in four King County Basins are given in the table below. The graph above shows the percent of King County streams judged to be in each category based on their B-IBI score. Streams with values in the 41 – 50 range are considered to be "healthy", in the 31 – 40 range they are called "moderately healthy", in the 21 – 30 range they are termed "moderately degraded", and in the 10 –20 range they are designated as "severely degraded".*

**Observations:**

- As the graph above illustrates, over half of the monitored King County streams are designated seriously or moderately degraded based on the B-IBI score. Streams in the Snoqualmie Basin are currently not included in this monitoring effort.
- Average scores from King County streams range from 14 (Little Soos Creek) to 44 (Lower Rock Creek). See the table on p. 50 for B-IBI scores by stream. Some sites have only one or two years' worth of data. Biomonitoring data are most valuable when repeated sampling is performed to establish trends. No new data is available for 1999.

# ENVIRONMENT INDICATORS

## INDICATOR 13:

*(continued from previous page)*

*Lake Washington/Lower Cedar River Basin*

- There is a notable difference in the biological integrity of the streams from one basin to the next. In broad terms the streams in Cedar River Basin are in the best shape - healthy or moderately healthy. The Cedar River flows into the south end of Lake Washington. The Cedar River and its tributaries contain much of the best remaining aquatic habitat in the Lake Washington system, although over half of the historic fish habitat has been lost or degraded.
- The water quality of Lake Washington is largely dependent upon the high quality of the water from the Cedar River and upon the control of pollutants that enter the lake from other drainages. However, a significant amount of new development in the basin could threaten the system's water quality.

*Lake Sammamish/Issaquah Creek and Big Bear Creek Basins*

- Streams in the Issaquah Creek watershed are moderately healthy, except for one site at Holder Creek which is moderately to seriously degraded. Issaquah Creek empties into the south end of Lake Sammamish.
- Big Bear Creek flows into the Sammamish River just above the north end of Lake Sammamish. Streams in this basin are moderately to seriously degraded, with the exception of Lower Mid Bear. Water quality and fish habitat are in decline or threatened throughout the Sammamish watershed. Many streams that supported substantial runs of salmonids one or two decades ago now support far fewer of these fish. The watershed contains a mix of land uses that include urban areas, agriculture, numerous parks, and forest production zones. Approximately 50% of the watershed is within the Urban Growth Boundary.

*Green River/Soos Creek Basin*

- Five out of eight monitored streams in the Middle Green River Sub-Watershed are seriously to moderately degraded. While it is one of the largest remaining agricultural communities in King County, it is increasingly in demand as an affordable area for suburban and rural residences. Although the stream systems continue to support significant fish habitat, the urban designation of parts of these streams could lead to further degradation in water quality, stream flow, and habitat.

**Data Source:** King County Department of Natural Resources, Water and Land Resources Division, 1999. An Atlas of the Watersheds of King County, Washington, 1995.

**Policy Rationale:** The policy rationale stems from Countywide Planning Policies CA-5 and CA-6. The preservation of surface water quality is critical, because approximately 80% of the drinking water supplying this region comes from rivers such as the Tolt and the Cedar. Salmon and other aquatic life also require high quality water for their healthy development and survival. Groundwater quality is an important regional issue because groundwater provides approximately 20-30% percent of the water used in King County for private, municipal, industrial, and agricultural needs, and aquifers cross-jurisdictional boundaries. In the future, groundwater may provide an even greater percentage of our water supply needs.

# ENVIRONMENT INDICATORS

## Watersheds, Rivers and Major Streams

# ENVIRONMENT INDICATORS

## INDICATOR 13:

*(continued from previous page)*

**Biotic Integrity (B-BIBI) Scores for Streams in Four King County Basins**

| Basin | Biomonitoring Site | 1995 | 1996 | 1997 | 1998 | Average for Years with Data | Status by Average B-IBI |
|---|---|---|---|---|---|---|---|
| Green River | | | | | | | |
| | Little Soos Creek | 14 | | 14 | | 14 | Seriously Degraded |
| | Upper Soos Creek | 20 | | 20 | | 20 | Seriously Degraded |
| | Upper Jenkins | | | | 22 | 22 | Moderately Degraded |
| | Lower Soos Creek | 28 | | 28 | | 28 | Moderately Degraded |
| | Lower Jenkins | 30 | | 28 | 30 | 29 | Moderately Degraded |
| | Lower Covington Creek | 34 | | 30 | | 32 | Moderately Healthy |
| | Upper Covington Creek | * | | 32 | | 32 | Moderately Healthy |
| | Lower Soosette Creek | 36 | | | 34 | 35 | Moderately Healthy |
| Big Bear Creek | | | | | | | |
| | Lower Bear (mouth) | 22 | | | 20 | 21 | Moderately Degraded |
| | Mid Evans | * | 26 | 24 | 18 | 23 | Moderately Degraded |
| | Upper Bear Creek | 26 | | | | 26 | Moderately Degraded |
| | Mackey Creek | 26 | | | 32 | 29 | Moderately Degraded |
| | Cottage Lake Creek | 36 | 28 | 26 | | 30 | Moderately Degraded |
| | Trib 0111A | * | | 30 | | 30 | Moderately Degraded |
| | Low Mid Bear (133rd) | 34 | * | 28 | | 31 | Moderately Healthy |
| Issaquah Creek | | | | | | | |
| | Holder Creek | | | 28 | 32 | 30 | Moderately Degraded |
| | Issaquah Creek @ KC park across fro | | 30 | | 32 | 31 | Moderately Healthy |
| | North Fork Issaquah Creek | | 28 | | 34 | 31 | Moderately Healthy |
| | Issaquah Creek @ 56th St. | 36 | 28 | | 34 | 33 | Moderately Healthy |
| | East Fork Issaquah Creek | | 30 | | 36 | 33 | Moderately Healthy |
| | Issaquah Creek @ 165th | 32 | | | 36 | 34 | Moderately Healthy |
| | Carey Creek @ Iss-Hobart I | 36 | 34 | | 40 | 37 | Moderately Healthy |
| | Black Nugget Creek | | 46 | | 42 | 44 | Healthy |
| Cedar River | | | | | | | |
| | Upper Lower Peterson Creek | | 24 | | 26 | 25 | Moderately Degraded |
| | Lower Walsh Creek | | 26 | | 28 | 27 | Moderately Degraded |
| | Lower Lower Peterson Creek | | 28 | | 26 | 27 | Moderately Degraded |
| | Taylor Creek | | 30 | | 34 | 32 | Moderately Healthy |
| | Upper Rock Creek | | 32 | | 40 | 36 | Moderately Healthy |
| | Lower Rock Creek | | 38 | 46 | 48 | 44 | Healthy |

* Indicates that scores could not be calculated.

# ENVIRONMENT INDICATORS

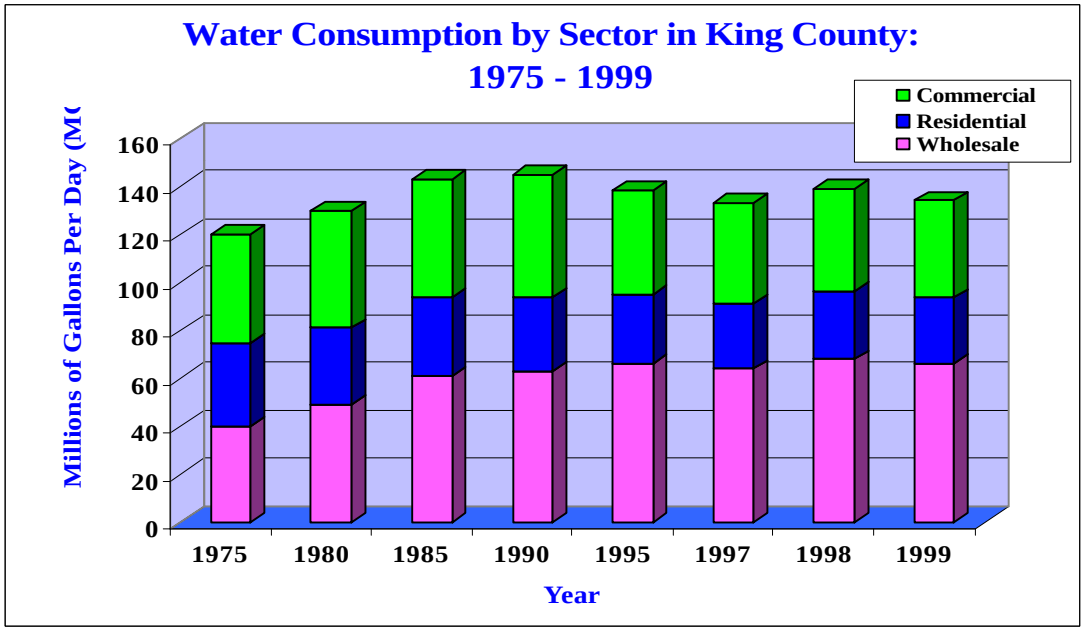
***Outcome:*** *Protect Water Quality and Quantity*

**INDICATOR 14.** Water consumption.

| Billed Water Consumption Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **1975** | **1980** | **1985** | **1990** | **1995** | **1996** | **1997** | **1998** | **1999** |
| Consumption per Capita in Gallons* | 123 | 124 | 130 | 122 | 110 | 109 | 106 | 109 | 104 |
| Total Consumption in Millions of Gallons | 120 | 130 | 143 | 146 | 138 | 137 | 134 | 139 | 134 |
| *** SPU supplies water to about 76% of KC residents. These per capita figures represent that population.** | | | | | | | | | |

***Definitions:***

- *The Seattle Public Utilities (SPU) supplies water, primarily from the Tolt and Cedar River watersheds, to about 76% of King County residents. This includes water that is sold wholesale to hundreds of smaller water purveyors that serve outlying areas of the County. Edmonds and Olympic View receive some of their water directly from SPU, although they are both outside King County. Water District 83, Redmond and Highline are also within the SPU service area, but have other sources of supply. Water from other sources amounts to about 7 million gallons per day which are not included in the table above or the graph below.*
- *The table represents total billed water consumption per capita and total billed consumption sold both retail and wholesale by SPU, which also includes purveyor non-revenue water. Billed consumption does not include unmetered (non-revenue) water such as main and reservoir flushing, leaks, etc.*
- *The graph below represents billed consumption in million gallons per day by residential and commercial customers, as well as wholesale water consumption.*



# ENVIRONMENT INDICATORS

## INDICATOR 14:

*(continued from previous page)*

**Observations:**

- In 1999 per capita water consumption, at 104 gallons per day, reached its lowest level since 1993. The 1992 drought brought about a dramatic drop in water consumption. Only 101 gallons per capita were used in 1992, and 103 gallons per capita per day were used in 1993.
- Although per capita consumption rose to 112 gallons per day in 1994, it has shown a declining trend over the past six years. Overall, water consumption per capita is notably lower this decade than in the 1980's when it showed an upward trend.
- The drought of 1992 forced the SPU to curtail water supply. In 1990, the utility had already implemented some conservation measures, and in 1992, it initiated more intensive measures. These included the installation of low-flow showerheads and faucets in 65% of households served. Along with other measures, these initiatives helped reduce the per capita water use. The summer of 1993 was marked by cold and rainy weather which further reduced water consumption. That year, the state passed plumbing codes that required the sale of low-flush toilets (1.6 gallons per flush) and set maximum flows for showerheads. These measures should continue to reduce water consumption in the long term.
- Total water consumption has decreased significantly since 1985. Total commercial consumption reached a high of 51 million gallons per day in 1990 and has declined steadily to 40.6 million gallons per day in 1999.
- The graph displaying water consumption by customer class shows that the largest increase has been in wholesale consumption, indicating an expanding distribution in the suburban and rural areas served by other purveyors. This is primarily due to population and employment growth in those regions. Wholesale consumption now accounts for about 50% of total SPU distribution.
- Total residential consumption has declined slightly in relation to commercial consumption. Residential uses represented about 44% of direct billed consumption in 1975 and about 40% in 1999.

**Data Source**: Seattle Public Utilities, 1999.

**Policy Rationale:** The policy rationale stems from Countywide Planning Policies CO-4, CO-5, CO-6 and CO-7. Adequate long- and short-term water supplies are critical for our region's residential, commercial and industrial uses. Water conservation measures including the use of efficient plumbing devices and native landscaping are being promoted in order to ensure long-term supply and to reduce costs of finding and developing additional water sources. Conservation also helps to protect fisheries and wildlife by allowing adequate in-stream flows in rivers and streams. Regional coordination and the protection of watersheds are essential elements in enhancing and promoting the economic and environmental integrity of this area.

# ENVIRONMENT INDICATORS

***Outcome:*** *Protect Water Quality*

**INDICATOR 15:** Change in groundwater levels.

*The King County Groundwater Program has not yet developed a permanent funding source, and as a result has held in abeyance further hiring and full implementation of the program. However, through an interim funding called "Early Start" from Solid Waste Division, the Groundwater Program has enhanced database capability and hopes to conduct limited groundwater sampling in the future.*

**Policy Rationale:** The policy rationale stems from Countywide Planning Policies CA-5 and CA-15. This Indicator alerts officials and citizens of the need to monitor groundwater quantity to assure sustainability and prevent depletion. Groundwater supplies approximately 20-30% percent of the water used in King County for private, municipal, industrial and agricultural needs, and increasing amounts of groundwater are being withdrawn to meet human needs. A finite amount of precipitation is available to replenish groundwater supplies. As the area of impervious surfaces increases, a larger percentage of water flows into surface water bodies and therefore is no longer available to percolate through soil and recharge groundwater. Aside from human needs some of the groundwater supply is needed to provide base flows to sustain fish and wildlife habitat.

# ENVIRONMENT INDICATORS

## ***Outcome:*** *Protect Wetlands*

## **INDICATOR 16:** Change in wetland acreage and functions.

*The following data is based on an analysis of a 1998 Landsat image of King County, recorded in August of that year. See map on following pages.*

**Acres of Wetlands in King County by Type of Wetland (Based on 1998 Landsat Data)**

| Type | Acreage | Percent of County Land Area |
|---|---|---|
| Marsh | 9,510 | 0.6% |
| Forest Marsh | 4,904 | 0.3% |
| Deciduous Marsh | 17,401 | 1.2% |
| Shoreline Vegetation | 3,424 | 0.2% |
| Total | 35,239 | 2.4% |

***Definitions:***

- *The nature of Landsat data and the methods used to analyze it, make it not strictly comparable to other methods of calculating wetland areas – e.g. on the ground surveys or orthophotographic data. The units of measurement are relatively large. Each "cell" is approximately1/5 of an acre in size (about ¼ of a football field), and is assigned a single land cover value, based on the predominant land use in that cell. Thus a cell that contains an 1/8 of an acre of wetland will probably be classified as "wetland", while a cell that contains a smaller wetland, e.g. 1/10 of an acre, or 4,356 sq. ft. with heavy tree cover or dry grassland around it, may be classified as "grass" or "mixed forest".*
- *Because of the limitations of the data described above, this measure will be more accurate for moderate to large wetland areas. It will not include smaller wetlands, particularly if they are isolated.*

**Observations:**

- Based on the 1998 Landsat data analysis, King County has approximately 35,000 acres of moderate to large wetlands (i.e. about 5000 sq. feet or larger). New Landsat data should be available approximately every two years. This will allow for consistent monitoring of wetland acres over time.
- There are an additional 31,700 acres of land classified as "upland forest marshes" which are not included in the above summary.
- Because of the nature of this data, it needs to be complemented by on-the-ground wetland inventories or orthophotographic data, which can more precisely measure, locate, and classify existing county wetlands.
- Wetlands are highly valued for many of the functions they provide. Those include habitat, stormwater control, groundwater recharge, water quality protection and open space. Wetlands are biologically highly productive ecosystems and are essential to a vast diversity of species, including birds, fish, reptiles, invertebrates and mammals for feeding, nesting, cover and breeding. At least 1/3 of Washington State's threatened and endangered species require wetlands for their survival.

**Data Sources:** 1998 Landsat images recorded in August 1998. This data was obtained by the University of Washington's interdepartmental PRISM project. Data was cleaned, ground-truthed, and analyzed under the direction of that program.

**Policy Rationale:** The policy rationale stems from Countywide Planning Policy CA-3. This Indicator is designed to evaluate whether the policy of "no net loss" of wetland functions and acreage is being achieved. In the long term, the quantity and quality of wetlands should be increased.

# ENVIRONMENT INDICATORS

**Insert Map of Wetlands 8 ½ x 17**

# ENVIRONMENT INDICATORS

**Map of Wetlands 8 ½ x 17 (backside)**

# ENVIRONMENT INDICATORS

# ENVIRONMENT INDICATORS

Insert Terrestrial Habitat Network Map - 11 x 17 folded

# ENVIRONMENT INDICATORS

Terrestrial Habitat Map (11 x 17) folded (backside)

# ENVIRONMENT INDICATORS

***Outcome:*** *Protect the Diversity of Plants and Wildlife*

**INDICATOR 17:** Continuity of terrestrial and aquatic habitat networks.

| Development Activity within the Terrestrial Habitat Network: 1994 - 1999 | | | | | | |
|---|---|---|---|---|---|---|
| | **Parcels Within or Adjacent to Network** | **Parcels With Permit Activity of Any Type** | **Parcels with Activity Covered by Habitat Network Codes** | **Parcels with Subdivision Application** | **Parcels with Building Permit Application** | **Permits Reviewed for Compliance with Network Codes** |
| **Number** | **3655** | **974** | **623** | **32** | **591** | **105** |
| **Percent of Total** | **100%** | **27%** | **17%** | **1%** | **16%** | **3%** |

***Definitions:***

- *The wildlife habitat network is designated in the 1994 King County Comprehensive Plan, and is implemented through KCC 21A.14.260 - .270. The map on the following page shows all existing land parcels within 150 feet of the network on each side. The network code requirements would not necessarily apply to all of these parcels since the code only requires a minimum total network width of 150 feet (or 75 feet on each side). However, since the code aspires to a network width of 300 feet, all parcels within that range are shown.*
- *Many of the parcels potentially affected by the network are currently in public ownership, and most are also affected by sensitive areas ordinances since those were two important criteria in the selection of the habitat network route.*
- *Some types of permit activity, such as clearing and grading permits, and other miscellaneous categories, are not covered by the network code.*

**Observations:**

- Out of the 3,655 parcels within or adjacent to the habitat network, 27%, have had some type of permit activity recorded since 1994. 17% had permit activity that would be covered by the network codes.
- 16% of the parcels had building permit applications and 1% had plat subdivision applications.
- As habitats become more fragmented by development much of their function is lost. If habitats are fragmented, there may actually be less usable habitat available than a simple count of acreage would indicate. Many of our threatened species in King County require relatively large connected blocks of habitat. The designation of the wildlife habitat network by the King County Comprehensive Plan is a first step in helping to preserve that continuity. By tracking and limiting development within and adjacent to the network, fragmentation of the habitat can be prevented before it occurs.
- No data is currently available to determine continuity of aquatic habitat. The information above deals only with terrestrial habitat.

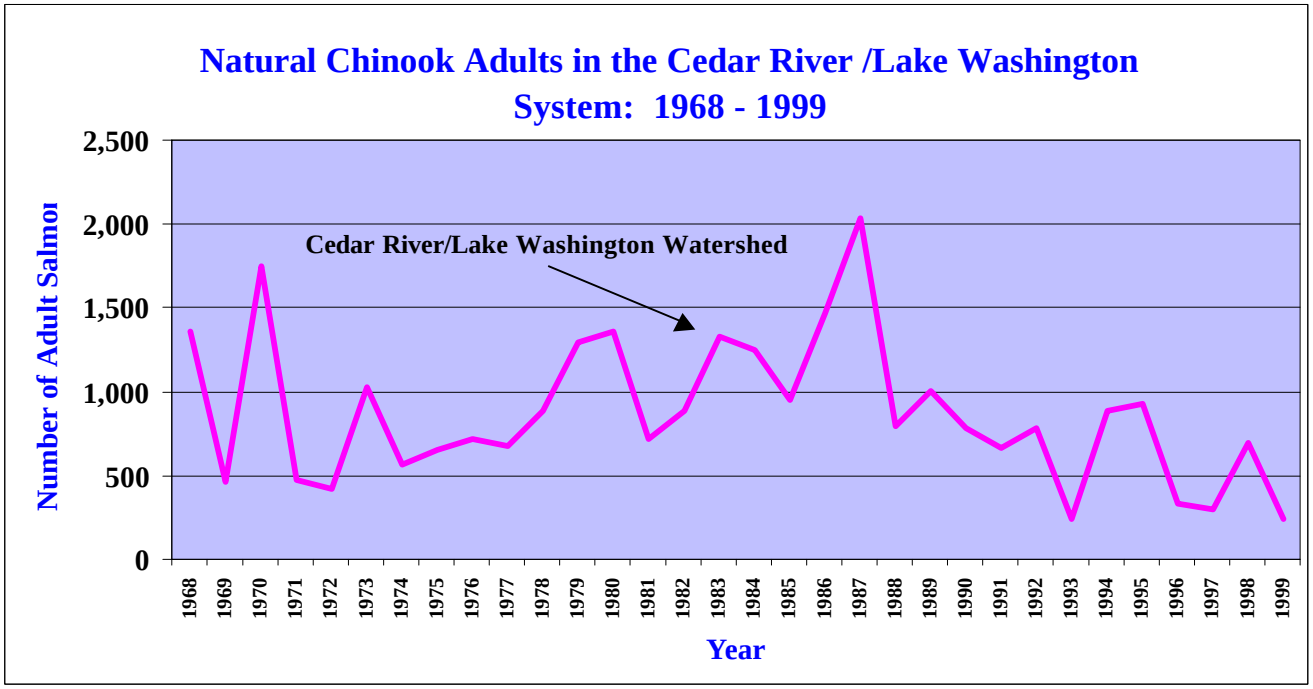
**Data Sources:** Open Space and Land Resource Section, Department of Natural Resources, 1998 & 1999.

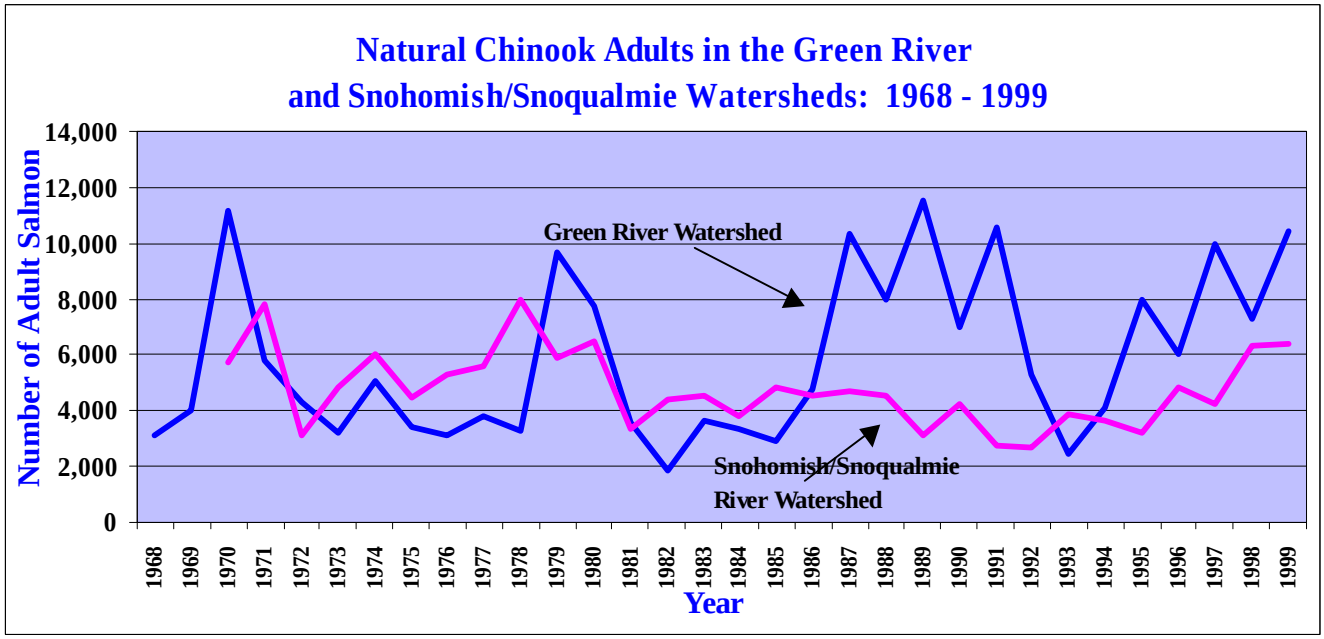
**Policy Rationale:** The policy rationale stems from Countywide Planning Policies CA-7 and CA-8. Obstacles/barriers such as roads and buildings can interfere with the intent of a continuous countywide habitat network. They interfere with a species' space requirement and its ability to seek adequate food, cover, and water. Any obstacles/barriers need adequate mitigation to reduce impacts to wildlife/fish species. Jurisdictions will promote wildlife protection and integrate native plant communities and wildlife with other land uses where possible, according to Countywide Planning Policy CA-7.

# ENVIRONMENT INDICATORS

***Outcome:*** *Increase Salmon Stock*

**INDICATOR 18:** Change in the number of salmon



# ENVIRONMENT INDICATORS

## INDICATOR 18:

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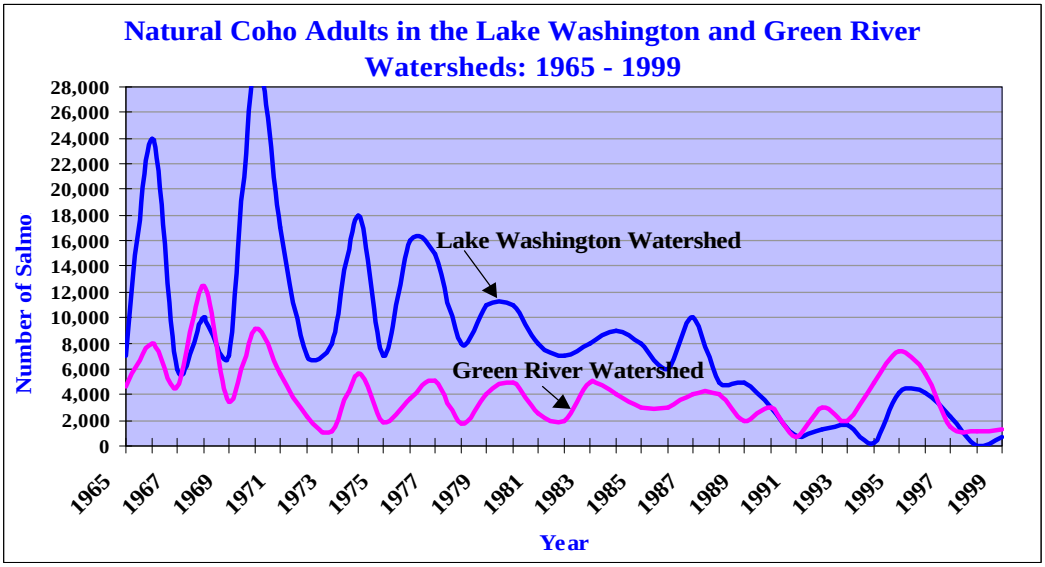
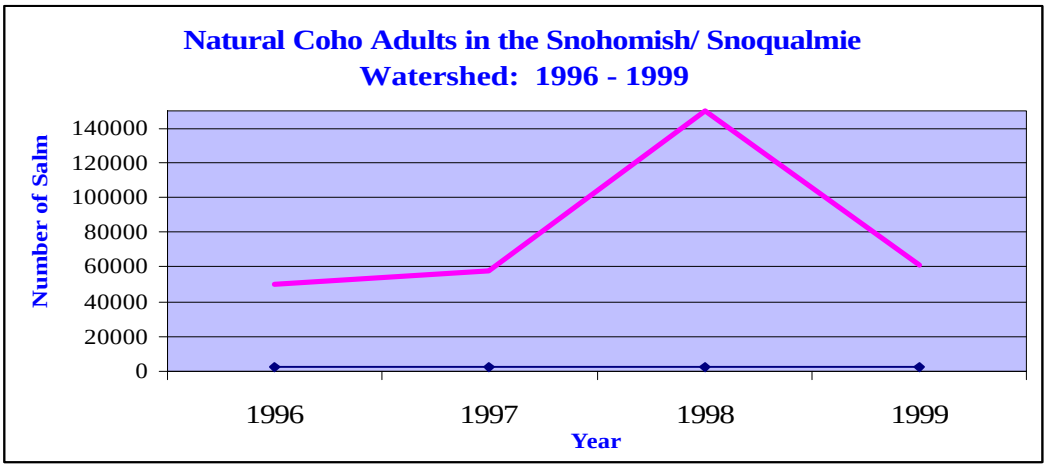
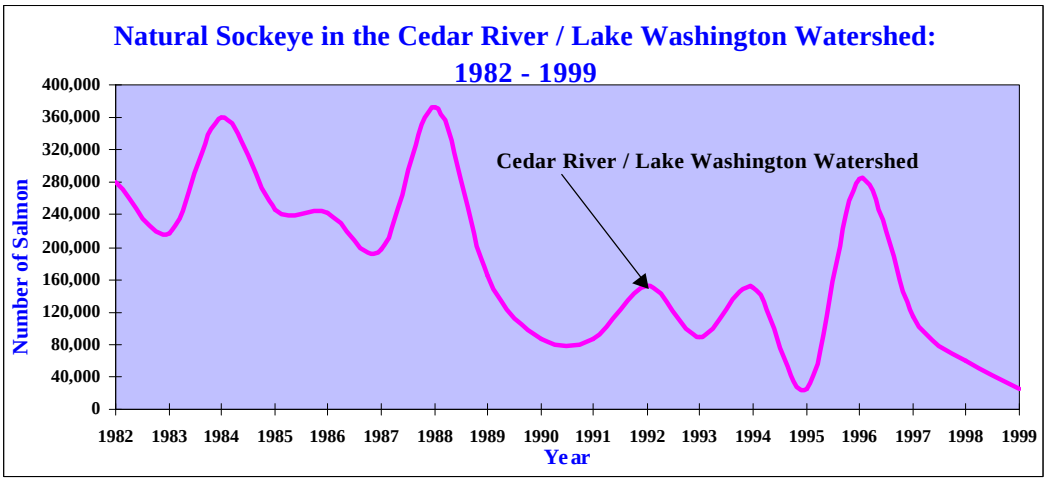


# ENVIRONMENT INDICATORS

## INDICATOR 18:

*(continued from previous page)*

***Definitions:***

- *For salmon and steelhead stocks, the term escapement refers to those mature fish that have returned to freshwater, have survived all fisheries and constitute the spawning population for a given stock. All data presented in the graphs are escapement data.*
- *A native stock is defined as an indigenous stock of fish that has not been substantially impacted by genetic interactions with non-native stocks, or by other factors and is still present in all or part of its original range. A non-native stock is one that has become established outside of its original range.*
- *A wild stock is one that is sustained by natural spawning and rearing in the natural habitat, regardless of parentage. A hatchery-raised stock depends upon spawning, incubation, hatching or rearing in a hatchery or other artificial production facility.*
- *The term natural fish refers to those fish that spawn naturally whether or not they originated in a hatchery or in the wild.*
- *According to the 1992 SASSI (Washington State Salmon and Steelhead Stock Inventory), a healthy stock is defined as a stock of fish that experiences production levels consistent with its available habitat and within the natural variations in survival for the stock. A depressed stock of fish exhibits production levels below expected levels. A critical stock of fish experiences production levels that are so low that permanent damage to the stock is likely or has occurred already. On stocks rated unknown there is insufficient information to rate the stock status, and an extinct stock is one that is no longer present in its original range or as a distinct stock elsewhere.*
- *The Lake Washington System is comprised of the Cedar River and its tributaries, Bear Creek, Issaquah Creek, Lake Sammamish and the Lake Washington and North Lake Washington tributaries.* ***See Indicator #13 above for a map of King County watersheds.***
- *The Green River Watershed includes the Duwamish River and the Green River and its tributaries.*
- *The Snoqualmie-Snohomish Watershed includes the Skykomish, Snoqualmie, and Snohomish sub-basins and their tributaries. Over one-half of this watershed lies in King County.*

**Observations:**

<u>*General*</u>

- The five graphs depict large yearly variations in salmon returning to spawn in both native and non-native species. Some of that variation is due to natural variability unrelated to human influences. However, the decline in wild Chinook, Coho, and Sockeye stocks is considerably more enduring than would be expected from natural fluctuations. Habitat deterioration caused by urban and industrial growth, forest practices, agricultural practices, municipal, industrial and agricultural water diversions, and hydropower have all contributed to diminishing the abundance and diversity of salmon. In addition, resource management policies related to harvesting will impact many wild stocks.
- It is often very difficult to determine the relative importance of any single factor or combination of factors that can influence the status of a particular stock. Therefore this analysis will highlight observations regarding certain salmon species in watersheds within King County without attempting to link them to specific factors.
- The Puget Sound Basin provides habitat for a total of 209 salmon and steelhead stocks. According to the 1992 SASSI (Washington State Salmon and Steelhead Stock Inventory) assessment, 44% of these stock are rated healthy, 21% depressed, 5% critical, 29% unknown and 0.2% extinct.

# ENVIRONMENT INDICATORS

## INDICATOR 18:

*(continued from previous page)*

*Chinook*

- In 1998 the listing of Puget Sound Chinook salmon as a threatened species under the Endangered Species Act was announced. In response to this listing, a Tri-County initiative has been underway to plan for improved Chinook survival, and for the restoration and preservation of salmon habitat throughout the Puget Sound region.
- The total number of adult Chinook in the Lake Washington System reached a new low of 240 in 1999. The count of adult Chinook has been quite low compared to other stocks since data collection began in 1968. The number fluctuated between a low of about 450 and a high of over 2000 through the 1970s and 1980s. However, 1993, 1996, 1997, and 1999 have shown exceptional lows in the range of 200 - 350. In 1998, the number of adult Chinook rose to nearly 700, but fell precipitously to 240 again this past year. Overall, the average of runs in the 1990s are about one-half the average during the 1980s.
- The number of Chinook in the Snohomish/Snoqualmie Watershed has shown a declining trend since the late 1970s, and wild Chinook is classified as depressed in the Snohomish basin. In 1998, however, adult Chinook returned to this watershed in their highest numbers – over 6,000 - since 1980. This trend has continued into 1999, with 6,374 adults returning to spawn last year.
- Chinook in the Green River Watershed is classified as healthy. 1999 saw the return of nearly 10,400 adults. However, there is considerable mixing of hatchery and wild fish in the Green River Watershed, which may make the count of natural spawning fish somewhat inflated over the actual number of wild fish.
- Flooding and the associated high flows in the region's rivers and streams during 1994 - 1996 caused considerable damage to spawning grounds and to the survival of salmon eggs. Chinook spawn in main-stem channels where flood damage is most severe. Low yields from spawning grounds in those years could have lead to low escapement numbers in 1998 - 2000 when the four-year olds returned to spawn as adults. However, in both 1998 and 1999 it appears that various other favorable conditions have moderated that effect.

*Coho*

- The graph above depicts Natural Coho in the Lake Washington System and the Green River Watershed. In 1970, a high of 30,000 fish was recorded in the Lake Washington System while a low of 200 was recorded in 1994. After three years of relatively good returns, there were less than 500 adult Coho that returned to the Lake Washington Watershed in 1998, and just 733 in 1999.
- Coho in the Green River Watershed show similar fluctuation. After fairly health returns in 1994 – 1996, the numbers have again fallen off in 1997 – 1999. With the exception of a severe low in 1991, the past three years have had the lowest returns since 1973.
- As with the Chinook, the presence of considerable numbers of hatchery fish in the Green River Watershed make accurate counts of wild fish difficult to achieve. Although methods for getting an accurate count of wild salmon have improved, it is likely that the Green River count of "natural" fish is higher than the actual presence of the wild stock.

*Sockeye*

- Sockeye in the Cedar River are considered wild and non-native. As the last graph above shows, escapement numbers exhibit considerable fluctuation with a downward trend since 1989.

# ENVIRONMENT INDICATORS

## INDICATOR 18:

*(continued from previous page)*

- Sockeye in Big Bear Creek and Issaquah Creek (Lake Washington/Sammamish tributaries) are considered a stock of unknown origin with wild production. However, in Big Bear Creek, very high adult returns in 1992, 1994, and 1996 have alternated with historically low numbers, making it difficult to evaluate the status of Sockeye in that tributary.
- A very high rate of return to Lake Washington in the summer of 2000 illustrates the volatility of the Sockeye population in this watershed. The combination of ideal spawning conditions in 1996 and a favorable marine climate during the next few years, favored the survival of that year's cohort. These conditions made it possible for hundreds of thousands of adult sockeye to re-enter Lake Washington during the 2000 season, on their way to spawning grounds throughout the Cedar River/Lake Washington watershed. However, historically, a good year such as this, often alternates with very poor years. True trends can only be identified over the long term.
- In contrast to the current season, in 1998 there were only about 10,000 adult Sockeye returns in Lake Washington and in all of the Cedar River tributaries, and about 50,000 in the Cedar itself. This total was about 50% of the previous year's total. In 1999 there were only about 2,500 in all of the tributaries, and about 22,000 in the Cedar itself. As the graph shows, even accounting for "good years" there appears to be a long-term trend toward a lower Sockeye population in the Cedar River Watershed.

*Hatcheries*

- The Washington Department of Fish and Wildlife operates hatcheries on the Cedar River, Issaquah Creek and Soos Creek in King County. The Muckleshoot Tribe operates hatcheries on Keta Creek and Crisp Creek. Hatcheries raise fish primarily for human consumption and serve an important role in protecting wild fish from being overharvested.

**Data Sources**: Washington Department of Fish and Wildlife; *1992 Washington State Salmon and Steelhead Stock Inventory (SASSI) - Appendix One, Puget Sound Stocks, South Puget Sound Volume.*, Washington Department of Fisheries, Washington Department of Wildlife and Western Washington Treaty Indian Tribes.

**Policy Rationale:** The policy rationale stems from Countywide Planning Policies FW-4, FW-5, CA-8, CA-9, CA-10, CA-11 and CA-15. Salmon are a symbol of the Pacific Northwest. They have important recreational, economic, cultural and environmental values for residents of King County. The health of salmon populations is an Indicator of environmental quality because these populations are affected by land use policies and actions within the watershed. The status of salmon populations indicate the overall health of rivers, lakes and streams, because salmon are very sensitive to deterioration in water quality, sediment and temperature changes and changes in the flow regime.

# ENVIRONMENT INDICATORS

## INDICATOR 18:

*(continued from previous page)*

**Indicator 18: Background Information**

| | Natural Coho | | | | Natural Chinook | | | | Natural Sockeye | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Lake Washington Watershed | Green River Watershed | Snohomish/ Snoqualmie River Watershed* | | Lake Washington System | Green River Watershed | Snoqualmie River Watershed | | Cedar River | Big Bear Creek | Issaquah Creek | Cottage Creek | Lake WA Beaches & Other |
| 1965 | 7,000 | 4,600 | | | | | | | | | | | |
| 1966 | 24,000 | 8,000 | | | | | | | | | | | |
| 1967 | 6,000 | 4,600 | | | | | | | | | | | |
| 1968 | 10,000 | 12,500 | | | 1,363 | 3,110 | | | | | | | |
| 1969 | 7,000 | 3,400 | | | 466 | 4,035 | | | | | | | |
| 1970 | 30,000 | 9,100 | | | 1,745 | 11,171 | 5,724 | | | | | | |
| 1971 | 17,000 | 5,700 | | | 471 | 5,832 | 7,824 | | | | | | |
| 1972 | 7,000 | 2,300 | | | 419 | 4,343 | 3,128 | | 225,862 | | | | |
| 1973 | 8,000 | 1,100 | | | 1,025 | 3,180 | 4,841 | | 314,194 | | | | |
| 1974 | 18,000 | 5,600 | | | 560 | 5,095 | 6,030 | | 114,472 | | | | |
| 1975 | 7,000 | 1,900 | | | 656 | 3,394 | 4,485 | | 114,106 | | | | |
| 1976 | 16,000 | 3,700 | | | 719 | 3,140 | 5,315 | | 138,949 | | | | |
| 1977 | 15,000 | 5,100 | | | 675 | 3,804 | 5,565 | | 410,020 | | | | |
| 1978 | 8,000 | 1,700 | | | 890 | 3,304 | 7,931 | | 262,733 | | | | |
| 1979 | 11,000 | 4,000 | | | 1,289 | 9,704 | 5,903 | | 172,300 | | | | |
| 1980 | 11,000 | 5,000 | | | 1,360 | 7,743 | 6,460 | | 347,827 | | | | |
| 1981 | 8,000 | 2,500 | | | 721 | 3,606 | 3,368 | | 90,694 | | | | |
| 1982 | 7,000 | 2,000 | | | 885 | 1,840 | 4,379 | | 253,658 | 17,871 | 9,842 | | |
| 1983 | 8,000 | 5,000 | | | 1,332 | 3,679 | 4,549 | | 193,338 | 20,720 | 2,937 | | |
| 1984 | 9,000 | 4,000 | | | 1,252 | 3,353 | 3,762 | | 336,960 | 21,335 | 2,437 | | |
| 1985 | 8,000 | 3,000 | | | 949 | 2,908 | 4,873 | | 223,745 | 20,160 | 2,054 | | |
| 1986 | 6,000 | 3,000 | | | 1,470 | 4,792 | 4,534 | | 217,133 | 22,982 | 2,491 | | |
| 1987 | 10,000 | 4,000 | | | 2,038 | 10,338 | 4,689 | | 177,841 | 18,844 | 1,000 | | |
| 1988 | 5,000 | 4,000 | | | 792 | 7,994 | 4,513 | | 359,000 | 8,779 | 5,536 | | |
| 1989 | 5,000 | 2,000 | | | 1,011 | 11,512 | 3,138 | | 162,000 | 1,795 | 1,306 | | |
| 1990 | 3,000 | 3,000 | | | 787 | 7,035 | 4,209 | | 76,000 | 10,115 | 707 | | |
| 1991 | 800 | 700 | | | 661 | 10,548 | 2,783 | | 77,000 | 7,691 | 1,588 | | |
| 1992 | 1,300 | 3,000 | | | 790 | 5,267 | 2,708 | | 100,000 | 27,533 | 23,979 | | |
| 1993 | 1,600 | 2,000 | | | 245 | 2,476 | 3,866 | | 76,000 | 9,848 | 3,351 | | |
| 1994 | 200 | 5,000 | | | 888 | 4,078 | 3,626 | | 109,000 | 39,645 | 700 | | |
| 1995 | 4,100 | 7,400 | | | 930 | 7,939 | 3,176 | | 22,000 | 2,329 | 385 | 382 | 1,100 |
| 1996 | 4,127 | 5,701 | 50,000 | | 336 | 6,026 | 4,851 | | 230,000 | 51,518 | 2,278 | 6,117 | 12,580 |
| 1997 | 2,300 | 1,500 | 58,200 | | 294 | 6,949 | 4,272 | | 104,000 | 6,714 | 2,832 | 882 | 1,580 |
| 1998 | <500 | 1,200 | 150,000 | | 697 | 7,312 | 6,300 | | 50,000 | 10,000* | | | |
| 1999 | 733 | 1,244 | 61,000 | | 240 | 10,397 | 6,374 | | 22,000 | 2500* | | | |

Data for the Snohomish-Snoqualmie basin were not collected for this report until 1998. Only the Snoqualmie portion, and parts of the Skykomish portion, of the Snohomish Watershed lie within King County.

* These numbers represents the total in the Cedar River tributaries, other than the Cedar River itself.

# ENVIRONMENT INDICATORS

***Outcome:*** *Decrease Noise Levels*

**INDICATOR 19:** Rate of increase in noise from vehicles, planes and yard equipment.

| Day-Night Average Sound Levels (DNL) at SeaTac Monitoring Stations: 1990 - 1999* | | | | | | |
|---|---|---|---|---|---|---|
| **Monitoring Location** | **Nov-92** | **Nov-93** | **Nov-94** | **Nov-97** | **Nov-98** | **Jun-99** |
| **Parkside School - S. 247th St. Des Moines** | 73.2 | 69.7 | 69.4 | 69.1 | 68.7 | 68.7 |
| **13th Ave. S. and S. 120th St.** | 74.4 | 72.1 | 70.5 | 68.9 | 69.7 | 69.0 |
| **Glendale School - S. 104th St. & 13th Ave S.** | 70.8 | na | 64.0 | na | 67.9 | NA |
| *All numbers are average DNL's for the preceding 12 months, except the Glendale site in '98 which is an average of the preceding 7 months. Because the Port of Seattle is in the process of acquiring and installing a new noise monitoring system, gaps exist in the Sea-Tac data. The old noise monitoring system was taken out of service in the summer of 1999, and the new system was not fully operational until 2000. There is no noise data available for the 3rd and 4th quarters of 1999. | | | | | | |

***Definitions:***

- ***Day-Night Average Sound Level (DNL, previously known as Ldn)*** *is a noise measure used to describe the average noise exposure levels over a 24-hour period, typically an average day over the course of the year. It is based on an A-weighted (dBA) sound level scale* (see below***).*** *It considers aircraft operations that occur between the hours of 10 PM and 7 AM to be 10 decibels louder than they actually are to account for increased annoyance. DNL is currently the accepted measure for aircraft noise analysis. Generally a DNL of 65 or greater is considered significant noise exposure, while a DNL of 75 or greater is considered severe noise exposure.*
- ***DNL (or Ldn)*** *is also subdivided into aircraft only* ***(LDNA)*** *and community* ***(LDNC)*** *levels.*
- ***A-Weighted Sound (dBA)*** *is a measurement representing a sound generally as the human ear hears it, by filtering out as much as 20 to 40 decibels of sound below 100 hertz (Hz). It is used for evaluation of most community noise levels and impacts, as well as aircraft noise evaluations.*

| Day-Night Average Sound Levels (LDNA) at King County Intl. Airport Monitoring Stations: 1997 - 1999 | | | | | | |
|---|---|---|---|---|---|---|
| **Monitoring Locations** | **2nd Qtr. 1997** | **4th Qtr. 1997** | **2nd Qtr. 1998** | **4th Qtr. 1998** | **2nd Qtr. 1999** | **4th Qtr. 1999** |
| **Ruby Chow Park School** | 71.7 | 70.1 | 69.9 | 69.6 | 70.4 | 69.4 |
| **Duwamish Park - 44th Ave. S.** | na | 67.7 | 67.0 | 67.8 | 66.4 | 65.8 |
| ***Numbers are average LDNA for the quarter.** | | | | | | |

# ENVIRONMENT INDICATORS

## INDICATOR 19:

*(continued from previous page)*

- ***Noise Contour*** *lines connect geographic points with the same average annual noise exposure. Noise contour maps have been generated to show the areas affected by Day-Night Average Sound Levels (DNL or ldn) of 60, 65, 70, and 75 in the region around Sea-Tac Airport*
- ***Equivalent Sound Level (L Eq)*** *is the constant sound level that, in a given situation and time period, conveys the same sound energy as the actual time-varying A-weighted sound. The time period applicable must be specified.*
- *The Federal Aviation Administration certifies aircraft by noise levels. Stage 1 aircraft, the oldest and noisiest (e.g. B707) have been phased out of the fleet of aircraft operating in the U.S.*
- *Stage 2 jet aircraft include models such as the Boeing 727, Boeing 737-200 and DC9. Stage 3 jets, the quietest in operation today, include the Boeing 757, Boeing 777, DC10 and others. Stage 3 jets also include aircraft that were Stage 2 when manufactured, but have since been hushkitted or re-engined to meet Stage 3 noise standards.*

**Observations:**

***General***

- There are a number of sources of excess noise exposure in the community. Among the most significant are construction activity noise, traffic noise, transit vehicle noise, and poorly muffled yard and commercial maintenance equipment. Examples of approximate noise readings for typical urban occurrences are a jackhammer at 100 decibels or a fire engine at 103 decibels. The variability and randomness of many noise incidences make quantitative assessment of their individual contributions to community noise exposure exceedingly difficult.
- This report includes limited information about ongoing noise monitoring activities at Seattle - King County International Airport and Sea-Tac Airport. There is no source of comprehensive data available for other types of community noise.
- High noise exposure is linked to hearing loss, sleep deprivation and other stress related health concerns.
- More than four straight hours of exposure to noise levels between 80 and 110 decibels causes permanent damage that could eventually lead to significant hearing loss.

***Sea-Tac Airport***

- Based on its Noise Monitoring System, the DNL values at SeaTac have decreased from an average of 71 – 74 since the early 1990's (when a mediation agreement was developed to reduce overall noise) to 68 – 69 in 1999. By comparing the DNL values, it appears that the noise energy has decreased even though the number of departures and arrivals has increased. This decrease can be attributed to the increase in the number of quieter Stage 3 aircraft at the airport, and the decrease in the number of noisier Stage 2 aircraft.
- The Federal government has phased out the use of Stage 2 aircraft in the U.S. as of January 1, 2000.
- The Port of Seattle has stricter local rules than the federal rules, and restricts use of Stage 2 jets between the hours of 10:00 p.m. and 7:00 a.m.
- The Port of Seattle's Noise Budget Program has helped to phase out the Stage 2 jets sooner than the federal schedule.

***King County International Airport (KCIA)***

- LDNA values at KC IA have decreased slightly from the 4$^{th}$ quarter of 1997 to the 4$^{th}$ quarter of 1999, dropping from 70 to 69 at one monitoring location, and from 68 to 66 at a second location.

# ENVIRONMENT INDICATORS

# ENVIRONMENT INDICATORS

## INDICATOR 19:

*(continued from previous page)*

- In June 1998, new legislation was approved by the King County Council and Executive to protect airport neighbors from aircraft noise. Under the legislation, the county will spend $5.5 million for the design and eventual construction of a "hush house" (insulated hanger) to reduce engine testing noise. Additional highlights of this new effort are that it:
  - Directs the KCIA to begin an EIS, a land use compatibility study, and a noise remedy study;
  - Directs the KCIA to prepare and submit to the Council an extensive noise reduction program;
  - Appropriates $500,000 for additional master planning work, following approval of the final work plan;
  - Calls for the development of a noise insulation program to help abate noise;
  - Requires that long-term leases at the airport provide for periodic review of compliance with relevant noise reduction regulations and policies.

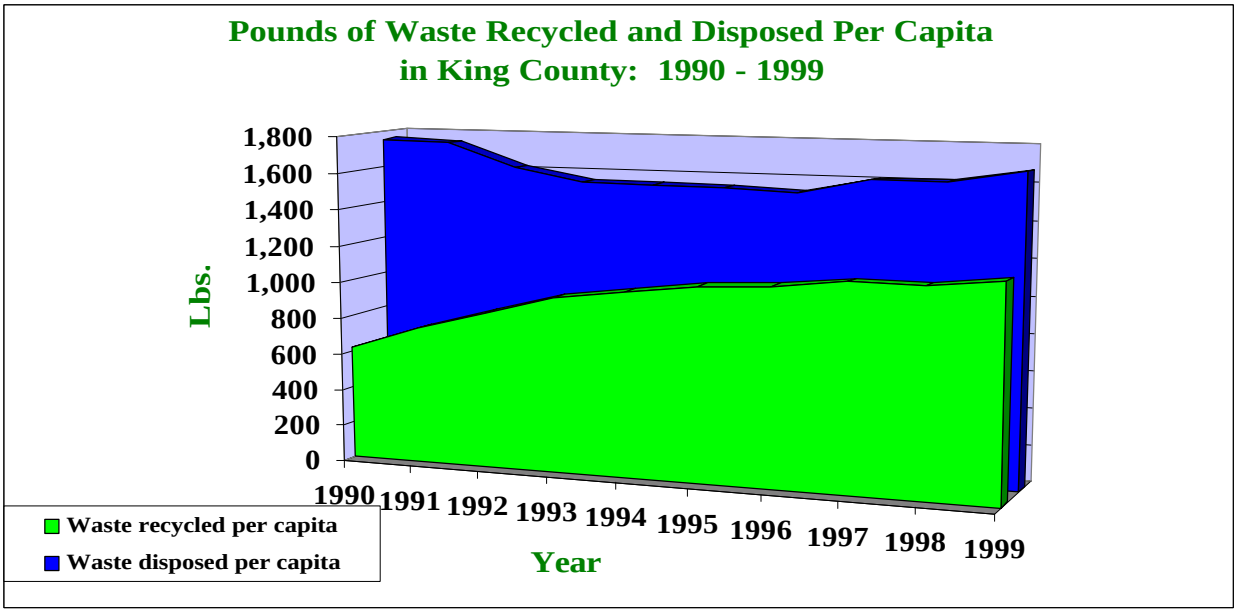
**Data Source:** Seattle Department of Construction and Land Use: King County International Airport; Sea-Tac International Airport Community Program.

**Policy Rationale:** Although the Countywide Planning Policies do not contain specific policy direction for noise, the Benchmark Task Force added this Indicator because there were concerns about noise levels in King County. The Task Force also wanted to monitor how noise levels were affected by growth management issues.

# ENVIRONMENT INDICATORS

***Outcome:*** *Decrease Waste Disposal and Increase Recycling*

**INDICATOR 20:** Pounds of waste disposed and recycled per capita.




***Definitions:***

- *All figures are estimates.*
- *Waste disposed includes residential and commercial waste.*
- *Total waste disposal figures exclude construction and land clearing debris, which was banned from the King County system in September 1993. Special waste figures are also excluded.*
- *Recycling figures exclude ferrous metals.*

| Pounds of Waste Per Capita Disposed and Recycled in King County by Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** |
| **Recycled Per Capita** | 622 | 748 | 859 | 959 | 1,032 | 1,093 | 1,086 | 1,120 | 1,119 | 1,160 |
| **Waste Disposed Per Capita** | 1,757 | 1,746 | 1,619 | 1,552 | 1,540 | 1,543 | 1,536 | 1,609 | 1,608 | 1,675 |
| **Total Waste Generated Per Capita** | 2,379 | 2,493 | 2,479 | 2,511 | 2,572 | 2,635 | 2,623 | 2,729 | 2,727 | 2,835 |

# ENVIRONMENT INDICATORS

## INDICATOR 20:

*(continued from previous page)*

**Observations:**

- While King County continues to do well in its recycling efforts, it has been less successful in reducing the total amount of waste generated.
- This indicator measures both the amount of materials recycled per person each year and the amount of waste disposed of (and thus, not recycled or reused). The "total waste generated" includes both the amount recycled and the amount disposed. Ideally, both the amount disposed and the total amount of waste generated would be declining, while the amount recycled would rise, or remain the same. For example, conservation and creative re-use of materials, and less use of excess (or non-recyclable) packaging might help to decrease the overall amount disposed, without necessarily affecting the amount recycled.
- King County is now recycling close to twice as much per person as it was in 1990. After a leveling off from 1997 – 1998, waste recycled per capita rose substantially between 1998 and 1999. The per capita amount recycled has increased 86% from 1990 – 1999, an annualized growth rate of 6.4%.
- Although solid waste disposal per capita has declined about 4.5% over the past ten years, there has been a trend toward increased waste disposal since 1996. The amount of solid waste leveled off in 1998, but it rose precipitously between 1998 and 1999, bringing it to its highest level since 1991.
- Total waste generated per capita (the sum of disposal per capita and recycling per capita) has increased by over 450 lbs. per person per year during the past ten years, or approximately 1.8% per year. It increased by over 100 lbs. during the single year from 1998 to 1999. Seattle and King County serve as employment and population centers for the region. The relatively high level of economic activity and the large number of individuals working in the region may be responsible for this increase in waste generation per capita, since growth in business activity (which produces waste) has outpaced growth in County population.

**Data Sources**: Solid Waste Division, King County Department of Natural Resources: Resource Planning division; Seattle Public Utilities Department.

**Policy Rationale:** Although the Countywide Planning Policies do not include policy direction for reducing solid waste or promoting recycling programs, the Benchmark Task Force added this Indicator, because recycling and reductions in solid waste save resources, save landfill space and reduce the potential for soil and water contamination due to leakage from landfills.