# Monitoring: Indicators

## Good

*Natural stream channel*

*Healthy forest*

*Stream rehabilitation*

*Stormwater management on site, not pipes*

Natural stream systems are variable and complex, which enables them to recover from disturbances, if the disturbance ends. They are constantly changing and adjusting to a large number of factors. Geology, soil type, climate, food webs, chemical and physical properties, surrounding land cover, and human impacts all combine to determine how streams function.

In such a complex system, it would be too costly and time consuming to study every factor in detail. Instead, scientists often use indicators to describe stream conditions, identify and predict problems, and provide clues about how things might be improved. A good indicator is a stream component or feature that gives a reliable picture of current conditions. This report rates stream health based on three widely used stream health indicators:

- **Water quality** is an indicator of the chemical and physical condition of the water in our streams.
- **Biological health** is an indicator of how well the creatures living in our streams are doing.
- **Stream flow** is an indicator of whether our streams are getting the right amount of water to sustain healthy conditions.

Good indicators respond consistently and predictably to changes in stream condition. They must be able to represent very complicated processes, and yet be easily understood.

Since activities on land affect streams, current land cover is also useful for evaluating stream health. Research has shown that stream health responds predictably to changes in land cover. For example, stream health typically declines as trees are removed and hard surfaces like pavement, increase. Land cover is not used to rate stream health in this report; however, it provides context about how Clark County streams are likely to function. Land cover can be used to help explain observed stream conditions and to predict conditions in areas without monitoring data.

## Poor

*Untreated runoff and trash*

*Pollution draining to stormwater system*

*Urban streambank erosion*

# Monitoring: Metrics

## What are metrics?

Stream health indicators are measured by specific calculations, collectively called metrics. The metrics used in this report were developed and tested in the Pacific Northwest on streams similar to those in Clark County. The calculations use data gathered in Clark County from many different sampling locations to determine ratings for each stream.

### Water Quality

Water quality is scored based on a set of measures that includes temperature, dissolved oxygen, pH, sediment, nutrients, and bacteria (Cude 2001). The individual scores for each measure are combined to produce a single overall rating.

### Why are these water quality measures important?

- **Water temperature, dissolved oxygen, and pH** affect fish health
- **Sediment** affects water color, carries pollutants, and smothers fish eggs
- **Nutrients** can increase the number of plants and algae in the water
- **Bacteria** cause health problems and indicate animal waste or leaks in human waste systems

### Biological Health

Biological health is scored based on the number and kinds of macroinvertebrates found in the stream (Karr 1998). Macroinvertebrates are insects, or bugs, large enough to be seen by the unaided eye and which spend a large part of their life-cycle in streams. Because they are exposed to in-stream conditions for lengthy time periods during their development, macroinvertebrates are an excellent way to measure the combined effects of stream degradation.

### Stream Flow

Stream flow is scored based on the amount of time stream flow is above the yearly average flow (United States Geological Survey 2002, Booth et. al. 2004). Unhealthy streams have too much flow that is quick to rise and fall with storms, and often too little flow during non-storm periods. The result is increased erosion during high flows, and decreased habitat during low flows, which negatively affects water quality, groundwater recharge, and stream life. Scores are higher in streams with a gradually changing, “natural” flow pattern during storms, and lower in streams with a rapid change in flow. Larger streams often have higher scores because they are less impacted by runoff than smaller streams.

### Land Cover

Land cover is evaluated based on the amount of intact forest cover and “hard surface” (National Marine Fisheries Service 1996, 2003; Booth and Jackson 1997; Center for Watershed Protection 2003). Hard surface areas often increase the amount and speed of water flowing into streams, resulting in stream channel erosion and increased water pollution. Intact forest areas absorb large amounts of stormwater and allow the excess to soak into the ground, promoting healthy year-round stream flow. They also prevent erosion, provide shade to keep streams cool, supply food for macroinvertebrate bugs, and contribute wood debris for fish habitat. Historically, forest was the predominant land cover in Clark County. Changing the land cover changes how it manages rainfall. The greater the change, without creating new ways to mimic those lost natural processes, the greater the likelihood stream health will decline.

### Special Studies

In some areas, the county or other agencies have collected detailed information about one or two specific water quality measures in a special study. These measures are typically temperature, bacteria, or turbidity (water clarity). Special studies are usually short-term (one or two years), and are conducted to learn more about an area with a known water quality problem. Because they do not include the full set of water quality measures, special studies are not used to rate overall stream health. However, summary information is provided in boxes labeled ‘Special Study’.

## Where does the data come from?

Each metric was calculated based on actual data collected in Clark County. The Clark County Clean Water Program (CWP) and citizen volunteers collected water quality samples, macroinvertebrate bugs, and stream flow measurements from many different sampling locations. The City of Vancouver, Washington Department of Ecology (Ecology), Clark Public Utilities (CPU) and the United States Geological Survey (USGS) also contributed data and analysis used in this report [Figure 3]. Land cover data was produced by Clark County, Ecology, and the National Oceanic and Atmospheric Administration (NOAA).

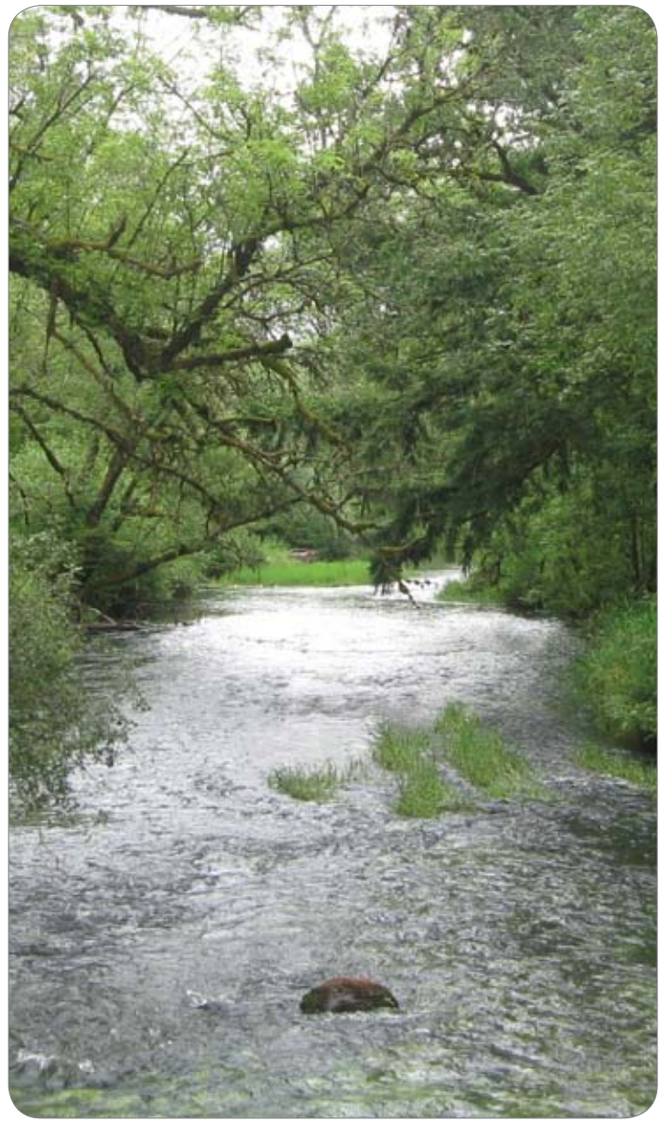
Samples were collected using widely accepted methods, and sent to certified laboratories to produce the data. All data were evaluated for quality by professional scientists.

Monitoring often focuses on areas where more intensive human activities take place, to track how they may change stream health. Thus for example, Salmon Creek has been studied more extensively than the Washougal River, in part because it is largely within the Urban Growth Boundary. Identifying potential problem areas enables Clark County Environmental Services to focus efforts, use staff and funding resources more effectively, and to collect the most informative data. This approach also results in slightly different data sets for each watershed.

The county's monitoring design determines what, where, when, how, and how often data are collected. The design balances the need to collect high quality, representative data, with the available staff and funding resources. Based on these needs, the county collects the best available information about current health and long-term trends, both of which are presented in this report.

*Collecting data about biological health*

*Macroinvertebrate bug*



*Healthy stream*

# Steps Used To Determine Stream Health

## Water Quality

**Sampling:** Scientists and volunteers collected 870 water quality samples at 81 sites since 2004. Data collected at 24 of these sites in 2008/2009 were used to score water quality in this report. The remaining sites were part of special studies.

**Analysis:** The samples provided data for the following measures of water quality: water temperature, dissolved oxygen, pH, sediment, nutrients, and bacteria.

**Score:** Data were used to score each measure.

**Rating:** Scores were combined into a rating for each sampling location. Ratings range from:

- = very poor to poor water quality
- = fair water quality
- = good to excellent water quality

## Biological Health

**Sampling:** Scientists and volunteers collected over 125 macroinvertebrate bug samples at 50 sites from 2004-2009.

**Analysis:** For each sampling location, scientists sorted the bugs, classified them into 10 groups based on types, and counted the bugs in each group.

**Score:** The number of bugs in each of the ten groups was used to score the group.

**Rating:** Scores were added together to obtain a rating for each sampling location. Ratings range from:

- = low biological health
- = moderate biological health
- = high biological health

## Stream Flow

**Monitoring** Clark County and agency partners collected hourly stream flow data from 19 sites.

**Analysis:** Scientists used the stream flow data to measure how stream levels rise due to storms.

**Score:** Data were used to assign scores for each location based on the amount of time stream flows were higher than the yearly average.

**Rating:** Scores were compared to data from streams similar to those in Clark County to obtain a rating for each location. Ratings range from:

- = unhealthy flow pattern
- = intermediate flow pattern
- = healthy flow pattern

*Figure 3: Summary of the steps used to collect stream health information*

# How to use this report

## How to read the score card

Stream health is presented in color-coded score cards, like the example on this page [Figure 4]. It is possible to read the score cards in several ways depending on the information desired:

Each watershed has its own score card. Ratings are assigned a color that corresponds to health quality:

= poor health

= fair health

= good health

### By subwatershed

Reading the score card from left to right shows the subwatershed scores for each indicator. These are combined to give the Subwatershed Rating; this rating is shown in color on the accompanying map for each subwatershed. The Subwatershed Rating gives us our most complete picture of overall stream health by taking into account all of the available data for each subwatershed.

### By indicator

Reading the score card from top to bottom shows the available scores by indicator for the whole watershed. These are combined to give the Indicator Rating. Use these ratings to find out about overall water quality, biological health, or stream flow.

### By watershed

The Indicator Ratings are combined to provide the Overall Watershed Rating. This rating is shown at the bottom of the score card. Use this rating as a general estimate of stream health.

### Example Watershed Score Card

**Salmon Creek Stream Health Score Card**

| Subwatershed | Water Quality | Biological Health | Flow | Subwatershed Rating |
|---|---|---|---|---|
| Mill Creek | ● | ● | ● | ● |
| Cougar Creek | ● | ● | ● | ● |
| Salmon Creek (r.m. 03.83) | -- | ● | ● | ● |
| Salmon Creek (r.m. 08.96) | ● | -- | ● | ● |
| Salmon Creek (r.m. 14.66) | ● | -- | ● | ● |
| Curtin Creek | ● | ● | ● | ● |
| Woodin Creek | ● | ● | -- | ● |
| Rock Creek | -- | ● | -- | ● |
| Morgan Creek | ● | ● | -- | ● |
| Salmon Creek (r.m. 22.20) | ● | ● | ● | ● |
| Salmon Creek (r.m. 00.60) | ● | -- | -- | ● |
| Indicator Rating | ● | ● | ● | |
| **Overall Watershed Rating:** | | | | **Fair** ● |

*Figure 4: Watershed score card example, showing ratings for each indicator, each subwatershed, and the overall watershed*

## How accurate are the ratings?

**Things to remember:** Ratings are very accurate for the location where the samples were collected. However, stream health is dynamic and can change a lot in a short distance as land cover and other factors change from one location to another. Therefore, it becomes less accurate to apply the ratings further from their original sampling location, or to combine ratings from several locations together. The more the ratings are combined, the less certain we can be about the result. Thus the overall watershed rating is less accurate than a subwatershed rating, which in turn is less accurate than the rating for a particular indicator in a subwatershed.

## How to read the land cover tables

Land cover tables are provided for each watershed. The tables show the amounts of forest and hard surface (such as pavement and rooftops) as percentages of the total land cover within each subwatershed. Compare the percentages to the following definitions to help predict stream conditions within the subwatersheds. This is particularly helpful for looking at areas that do not have monitoring data. The subwatershed boundaries are shown on the watershed health maps for reference.

Likely forest cover conditions:

| | |
|---|---|
| < 50% forest cover = | Poor stream conditions likely |
| 50 to 65% forest cover = | Fair stream conditions likely |
| > 65% forest cover = | Good stream conditions likely |

Likely hard surface conditions:

| | |
|---|---|
| > 15% hard surface = | Poor stream conditions likely |
| 5 to 15% hard surface = | Fair stream conditions likely |
| < 5% hard surface = | Good stream conditions likely |