Clark County Environmental Services - Clean Water Program

2012 Monitoring Summary

Results from stormwater facilities and surface water quality monitoring

May 2013

Washougal River
Photo credit: Gary Piazza

Introduction

Clark County's Clean Water Program utilizes monitoring and assessment tools to better understand stream conditions, stormwater runoff impacts, performance of stormwater management practices, and how county programs influence the health of our local water bodies.

In 2012, the stormwater monitoring program included nearly 340 site visits to collect over 150 samples. Surface water monitoring accounted for another 217 site visits. Combined, these projects generated thousands of field measurements and laboratory results needed to inform program activities, meet regulatory requirements, and contribute to regional efforts to understand and manage our natural resources.

The monitoring program is organized as groups of Stormwater monitoring and Surface Water monitoring projects.

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Acknowledgements:
This report was prepared by Clark County Environmental Services staff in the Clean Water Program. Key staff include Ron Wierenga, Rod Swanson, Bob Hutton, Jeff Schnabel, Ian Wigger and Chad Hoxeng. More information about our monitoring programs can be found on our website:
www.clark.wa.gov/water-resources/index.html

Stormwater Monitoring

Overview

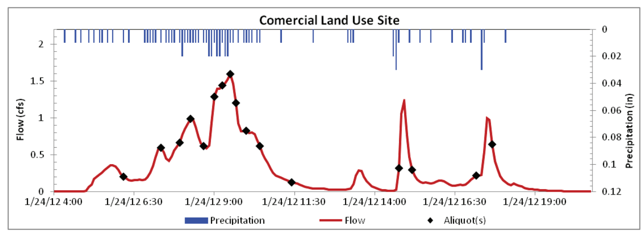
This year's stormwater monitoring included three projects focused on:

- Characterizing pollutants in stormwater runoff from buildings and county roads,
- Evaluating pollutant removal performance of county stormwater treatment facilities, and
- Testing the ability of permeable pavement designed to absorb rainfall

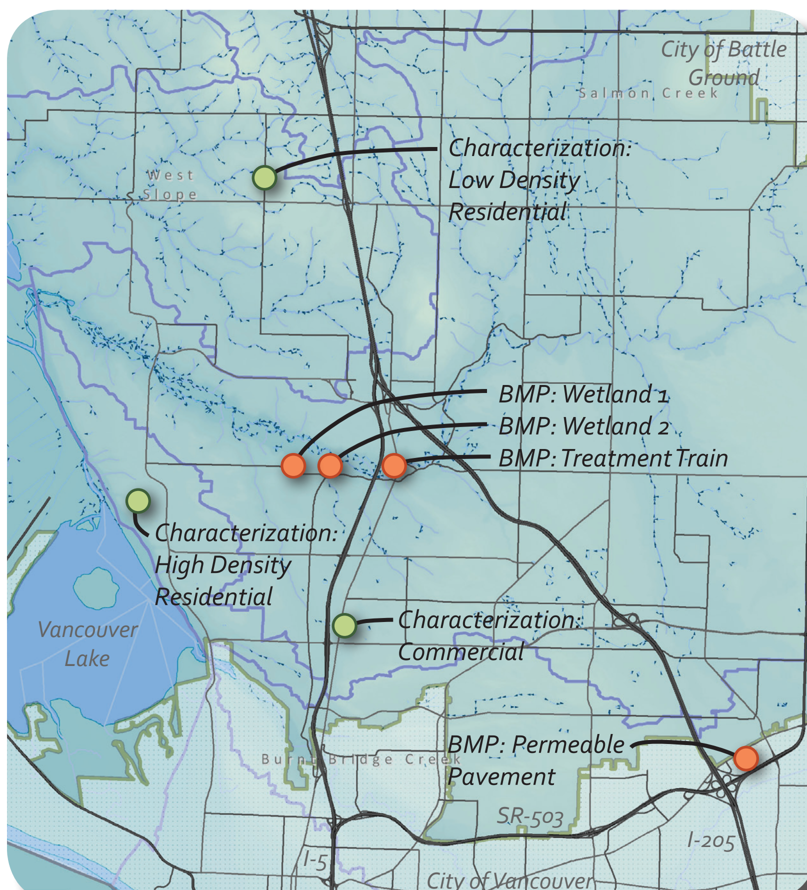
The locations of the stormwater runoff ('Characterization') and treatment facility ('BMP') sites are shown on the map below. Permeable pavement BMP monitoring was conducted at a local auto dealership near the intersection of Fourth Plain Road and Interstate 205.

How stormwater monitoring stations work

At each location, remotely-controlled instruments measure rainfall and stormwater flow and automatically collect stormwater samples. Each site can be remotely operated using cell phone technology, allowing county staff to collect samples and transfer data without actually visiting the sites.



In order to get a sample representing each unique storm, an automatic sampler is programmed to match the size of each storm. As stormwater flows past the sampler, it collects a set of small samples that are combined into a single large sample that is retrieved and sent to a commercial laboratory for analysis. Graphs of the amount of rainfall, stormwater flow, and the timing of each part of the sample summarize the sampling effort (*as shown in the graph to the right*).



Stormwater monitoring equipment

Map source: Clark County GIS

Pollutants measured in stormwater runoff

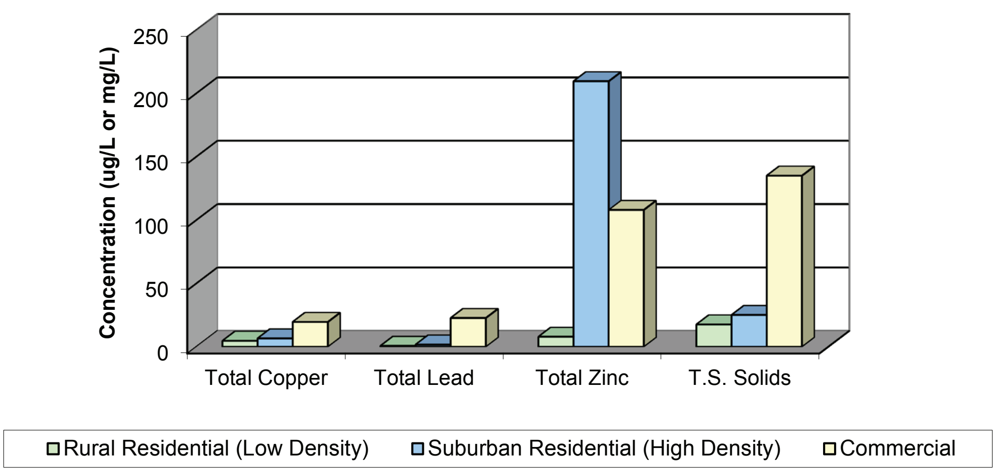
> Compared to national pollution results, Clark County residential stormwater pollution levels are lower, while many of the commercial levels are average.

The Clean Water Program measures pollutants in stormwater from three areas with typical land uses. One area is a commercial strip along Highway 99, another is a suburban residential area, and the third is a rural residential area.

Three years of results show distinct differences in the amounts of stormwater pollutants at the three sites. The differences reflect the degree of urbanization, traffic levels, and intensity of yard and landscaping management. For example, concentrations of metals toxic to fish (in parts per billion) and road dirt (suspended solids in parts per million) are generally lowest at the rural residential site area and highest at the commercial area.

Compared to nationwide results; county pollutant concentrations at both residential sites are typically lower while half the commercial site pollutant results were very similar to national values. Interestingly, the suburban residential site has higher zinc levels possibly from galvanized metal surfaces such as gutters on homes.

Stormwater Characterization By Land Use: Metals and Particles



Stormwater Characterization						
	Total cadmium	Total Copper	Total Lead	Total Zinc	Fecal Bacteria	Suspended solids
Rural Residential (Low Density)	0.03	5	1	8	175	18
Nationwide Open Space	2	9	10	80	3000	78
Suburban Residential (High Density)	0.1	7	2	210	500	25
Nationwide Residential	0.5	12	12	73	7000	49
Commercial	0.2	20	23	108	270	135
Nationwide Commercial	1.0	17	18	150	4600	43

Stormwater treatment facilities performance

Clark County measured the pollutant-removal effectiveness of several stormwater treatment facilities designed to meet the state's stormwater manual standards. These included two man-made treatment wetland ponds, a biofiltration swale (bioswale), and a two-stage treatment train facility consisting of the bioswale followed by a filter cartridge vault.

The basic approach is to use automated samplers to sample stormwater entering and leaving the stormwater facilities for the most common types of pollutants: toxic metals and suspended solids such as road dirt. The project sampled 35 storms at each facility between 2010 and 2012.

The county found that all facilities provide substantial stormwater treatment by trapping metals and suspended solids. The figures on page 7 show typical (median) inflow and outflow concentrations of total copper, zinc, and suspended solids.

A more specific way to examine facility effectiveness is their pollutant reduction percentages compared to design performance goals. Both Washington State's basic and enhanced stormwater treatment facility goals apply to all the monitored treatment facilities since they drain to Salmon Creek, a salmon bearing stream. The basic performance goal is 80% total suspended solids (particles) removal. The enhanced goal is greater than 30% dissolved copper removal and 60% dissolved zinc removal. All of the goals assume moderate levels of these pollutants in the stormwater entering treatment facilities.

All monitored facilities provide substantial stormwater treatment by trapping metals and suspended solids.

Stormwater Treatment Facility Reductions in Dissolved Metals and Total Particles

Monitoring Station	Dissolved Copper	Dissolved Zinc	Total Suspended Solids
Wetland #1			
Inflow	4.3	24	26
Outflow	1.7	5	14
% Change	60%	79%	45%
Wetland #2			
Inflow	3.1	15	37
Outflow	1.8	9	5
% Change	42%	41%	86%
Bioswale			
Swale Inflow	4.2	18	80
Swale Outflow	4.4	17	25
% Change	-5%	6%	69%
Two-stage Treatment Train			
Two-Stage (Swale) Inflow	4.2	18	80
Two-Stage (Vault) Outflow	4.7	19	28
% Change	-12%	-6%	66%

All treatment facilities have practical limits on pollutant removal and tend to perform better when the incoming amount of pollution is quite high. They become less effective as the concentrations decrease below 100 parts per million for total suspended solids and 5 to 20 parts per billion for dissolved metals. A large portion of the monitored facilities' inflowing stormwater had relatively low pollutant concentrations compared to those assumed for the state goals.

Both wetlands achieved the state's basic performance goal but the treatment train facilities did not. Wetland #2, with an 86% reduction in its median total suspended solids, exceeded the basic performance goal. Wetland #1 also achieved the basic goal, even with 45% removal, because its median outflow concentration was below 20 parts per million. Particles from seasonal plant decay likely reduces the basic performance of all the monitored facilities. Wetland sediment accumulation rates showed that both wetlands' sediment may not need to be cleaned out for decades.

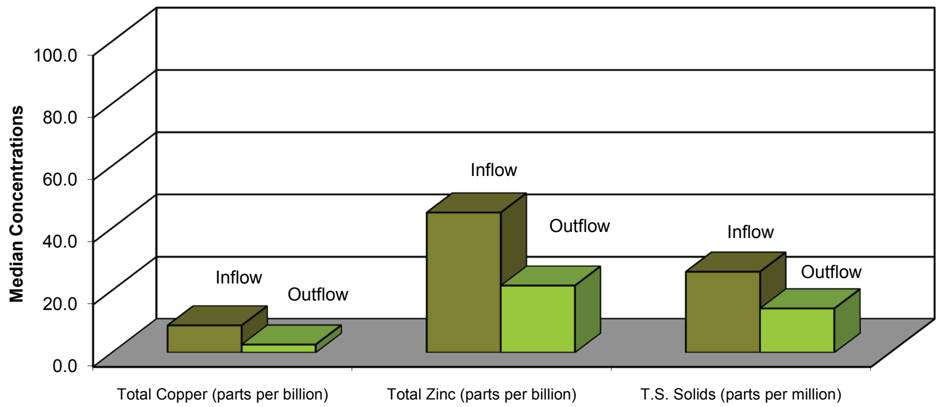
Comparing the facilities' median dissolved metal concentrations to the state's enhanced stormwater treatment performance goals; both Wetlands achieved the goal of 30% dissolved copper removal. Wetland #1 also achieved the 60% dissolved zinc removal goal. Based on their median values, neither the bioswale nor the two-stage treatment facility at the treatment train location achieved the state's enhanced treatment goals. Importantly, all the treatment facilities' typical (median) outflow dissolved metals concentrations were near or below EPA thresholds for freshwater life in streams. It is also important to recognize that these outflow concentrations are prior to any dilution in streams where the EPA thresholds apply.

Filter treatment cartridges

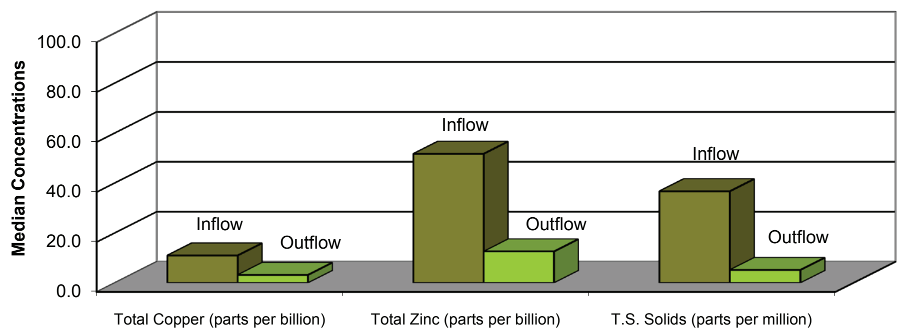
Wetland #1 in-flow

Stormwater facility study results suggest the various systems tested provide substantial treatment.

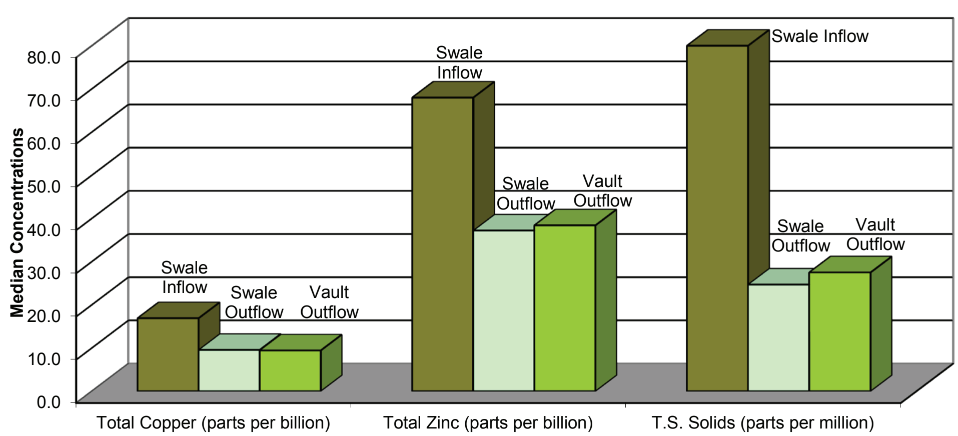
Wetland #1: Metals and Total Suspended Solids Removal



Wetland #2: Metals and Total Suspended Solids Removal



Treatment Train: Metals and Total Suspended Solids Removal



Permeable pavement performance

Monitoring suggests that when properly maintained, permeable pavers can substantially reduce runoff.

Clark County evaluated how well a newly installed 7-acre permeable pavement parking lot soaks up rainfall to prevent any stormwater runoff. Allowing stormwater to soak, or infiltrate, into the ground is the preferred method of managing stormwater because it not only eliminates pollutant discharges to streams, it also reduces stream channel erosion and replenishes groundwater. If properly done, infiltration systems remove pollutants by trapping them in soils above the water table.

The monitored parking lot system is designed to allow rainwater to pass through the spaces between the concrete pavers and into the underlying sandy soil. The lot is intended to soak up just over four inches of rainfall in a day, which is a storm that might only occur once in a hundred years.

During more than two years of on-site rain and runoff monitoring, virtually all rainfall soaked into the ground with almost none running off the site. A small amount of runoff was measured during one brief, very heavy storm.

Monitoring well in permeable pavement

Surface Water Monitoring

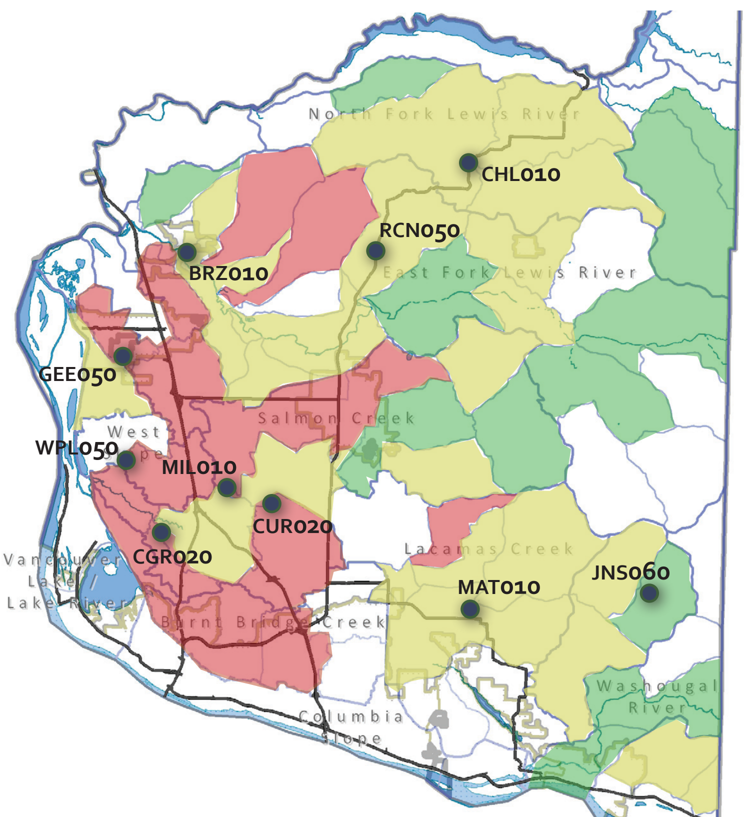
The Clean Water Program began a stream monitoring program in 2001. For more than ten years, the program has collected water quality measurements, stream bugs, and flow data at locations throughout Clark County.

County staff, other agencies, students, and consultants use this data to better understand stream conditions, determine long-term water quality trends, and to help find and fix problems.

The county also uses the data to create reports, such as the 2010 Stream Health Report (www.clark.wa.gov/water-resources/stream.html), to help plan stormwater improvement projects and increase public knowledge about stream health and actions they can take.

The map below from the 2010 report shows basin stream health scores based on a variety of data sources. Basins are assigned stream health scores of good (green), fair (yellow), or poor (red). The data indicates that many streams are degraded and that our community faces challenges in improving these valuable resources.

Monitoring in 2012 included ten long-term sites, each labeled on the map with a three letter abbreviation of the creek name and a three digit number indicating its general location above the creek mouth. The ten long-term sites are locations sampled every month since 2001. Also, additional locations are sampled each year to fill gaps in our knowledge about the rest of the county and build baseline information for future monitoring result comparisons.



Stream Health Scores (2010)

Stream water quality and long-term sites

Ten-year monitoring trends indicated stream sites are:

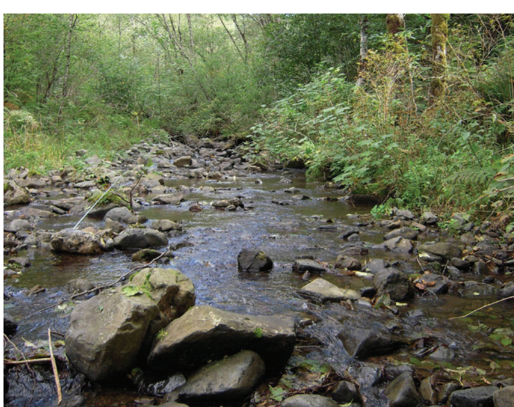
- 40% improving
- 20% declining
- 40% unchanged

Monthly water quality results are used to calculate a water quality index score for each station. The index includes seven different water quality measures, and is a way of presenting a large amount of data as a single number. Index scores range from 10 (worst) to 100 (best). The lowest seasonal average score (Fall-Winter-Spring average or Summer average) is used to rate annual water quality on a scale from very poor (<60) to excellent (90+) for each stream.

Status at the ten stations ranged from Very Poor to Excellent; reflecting the range of conditions from degraded urban streams to pristine forested basins. Many of the low scores in 2012 were due to levels of bacteria and nutrients (nitrogen and phosphorus) that are higher than desirable. Oxygen levels, pH, and temperature were typically good to excellent, while the amount of material (dirt and particles) suspended in the water depended on season and stream flow.

A recent ten-year trend analysis of these long-term monitoring site streams suggests overall: 40% are improving, 20 % are declining, and 40 % are not statistically changing. The trend analyses show overall mixed results. The fact that two of the three good to excellent monitored streams are declining underscores the need to protect water quality.

Station	Stream	Lowest Seasonal Score	2012 Water Quality Rating	2001-2011 Water Quality Trend
BRZ010	Brezee Creek	84	Fair	Improving
CGR020	Cougar Creek	45	Very poor	Improving
CHL010	Chelatchie Creek	81	Fair	No Trend
CUR020	Curtin Creek	25	Very poor	Improving
GEE050	Gee Creek	65	Poor	No Trend
JNS060	Jones Creek	95	Excellent	Declining
MAT010	Matney Creek	87	Good	Declining
MIL010	Mill Creek	73	Poor	No Trend
RCN050	Rock Creek North	88	Good	Improving
WPL050	Whipple Creek	61	Poor	No Trend



Jones Creek

Monitoring Rock Creek

West Slope watershed water quality study

As part of a county-wide stream assessment over time, six streams in western Clark County were monitored monthly during 2012. The poor to very poor ratings for these streams are influenced by runoff containing suspended solids, nutrients and bacteria from urban and agricultural areas.

Station	Stream	Lowest Seasonal Score	2012 Water Quality Rating
ALN040	Allen Canyon Creek	72	Poor
GEE030	Gee Creek (Lower)	64	Poor
GEE070	Gee Creek (Upper)	55	Very poor
PCK010	Packard Creek	45	Very poor
WPL010	Whipple Creek (Lower)	61	Poor
WPL080	Whipple Creek (Upper)	75	Poor

Stream Bugs (macroinvertebrates)

Macroinvertebrates are insects, or bugs, large enough to be seen with the unaided eye and which spend a large part of their life cycle in streams. Macroinvertebrates are an excellent tool to measure stream health since they are exposed to in-stream conditions for lengthy time periods and thus measure the combined effects of pollutants over time.

To get a bug score, or index, a sample of bugs from a stream bottom is sent to a laboratory for identification. The number and kinds of bugs are summarized to calculate an index of biological health for each station. The index includes ten different measures, each of which can score either 1, 3, or 5 points. The total score is used to rate biological health as low (10-24), moderate (25-39), or high (40+).

Although many scores are in the moderate range, indicating reasonably good conditions, the land cover in the sampled stream basins suggests that many of these scores could be higher. This strongly suggests there is room for improvement in biological health if habitat is improved.

Caddisfly

Station	Stream	Total Index Score	2011 Biological Health
BRZ010	Brezee Creek	34	Moderate
CGR020	Cougar Creek	16	Low
CHL010	Chelatchie Creek	38	Moderate
CUR020	Curtin Creek	24	Low
GEE050	Gee Creek	32	Moderate
JNS060	Jones Creek	46	High
MAT010	Matney Creek	34	Moderate
MIL010	Mill Creek	24	Low
RCN050	Rock Creek North	36	Moderate
WPL050	Whipple Creek	22	Low

Stream flow and Rainfall

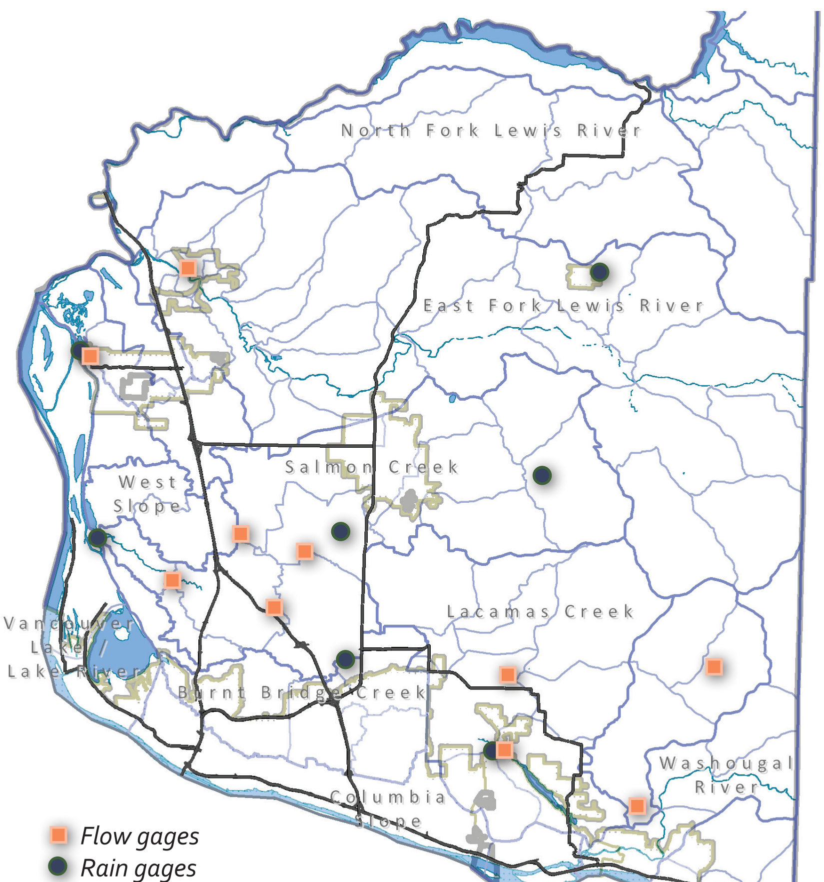
Clark County operates a network of 10 stream flow and seven rainfall gages county-wide. Most were constructed in 2003 and 2004.

Flow gages work by measuring the depth of water in the stream and applying a mathematical formula, called a rating curve, to calculate flow. Staff periodically checks the formula by comparing stream depth with actual stream flow measurements taken with a flow meter.

Rain gages operate using a tipping-bucket that self-empties and tallies every time 0.01 inch of rain falls.

Stream hydrology measured as flow is strongly influenced by human activities, such as clearing forests and building stormwater drainage systems. As land cover changes from forest to agriculture to urban, stormwater runoff increases to streams causing the streams to erode at higher rates. This is especially true in areas that were built out before developments began including facilities to control rates of stormwater runoff starting in the 1990's.

Over the course of many years, flow and rainfall data provide reliable information for evaluating stream health, tracking changes due to land use, and calibrating computer stream flow models.



Hydrology monitoring sites

Hard surface areas and de-forested areas are particularly prone to increasing the volume and speed of stormwater flows to streams, resulting in erosion and increased water pollution. Forested areas tend to absorb rainfall before it can run off, decreasing erosion and supplying water slowly to streams, sustaining them during dry periods.

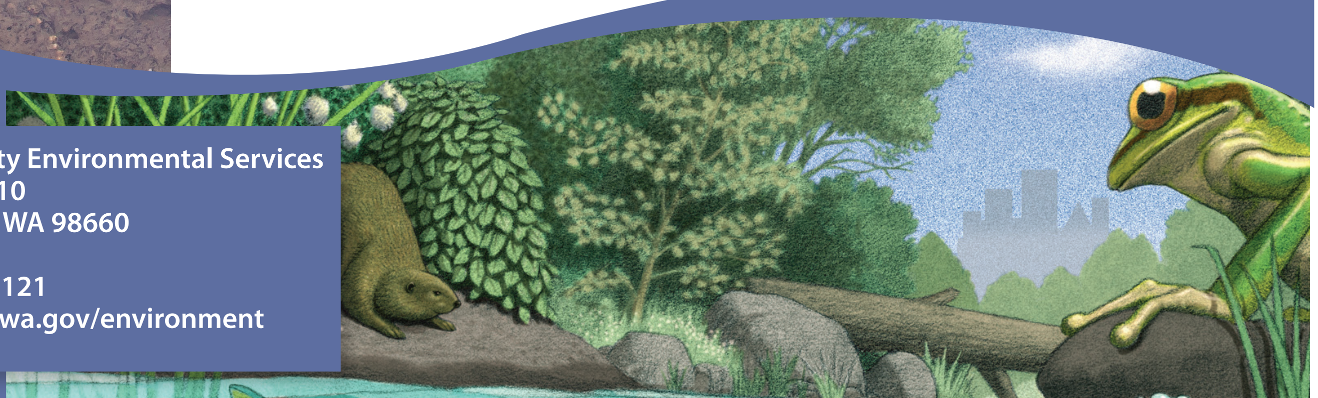
Generally, streams in forests are most stable and streams in recently urbanized areas are least stable, with rural areas falling somewhere in between. A similar pattern is often seen with water quality and biological health.

Like most areas in western Washington, Clark County streams tend to follow this pattern. Smaller urbanized drainages like those in the lower Salmon Creek watershed, and heavily cleared areas like Gee Creek typically have the least healthy stream flows. Undeveloped, forested areas like Jones Creek have the most natural flow patterns.

Jones Creek flow gage

Rain fall gage

End of Summary Report



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