Appendix 3 Surface Water Quality Data

PROGRAM FINDINGS – MONITORING AND DISCHARGE CHARACTERIZATION

Stormwater staff performed in-stream and outfall monitoring activities during the reporting period, collecting water quality data at 11 sites. The data was analyzed to characterize in-stream and stormwater quality. The City has not yet determined which statistical software package to purchase, so all analyses were conducted using Microsoft Excel. In future reports, the City intends to statistical tools that will make the data more visually accessible. These tools should help clarify whether results reported below are significant, or merely a function of the variability of the data. The data collected over the last year was compared to OAR Table 20 Water Quality Criteria and to data collected continuously since January 2000, mainly using median values for comparison. The information gained is intended to guide a number of City activities including ongoing revision of the monitoring program, developing the City's response to listing of species under the Endangered Species Act, and guiding future efforts to minimize pollution from runoff. Based on results to date, minor modifications are being made to the monitoring program and are included in this report.

REGIONAL COLLABORATION

Spring 2022 data analysis results were shared with neighboring jurisdictions, DEQ, and contracted consultant services. Additional regional collaborative efforts by monitoring program staff led to coordinated water quality-related projects with other permittees, municipalities, non-profit organizations, and schools, including:

- **Participation on the Johnson Creek Interjurisdictional Committee.** Gresham helped fund the TMDL-related assessment currently being conducted by USGS. Gresham also coordinated with members of the UC TMDL subcommittee to contract a CH2M HILL modeling expert who has participated in the TMDL discussions and provided occasional assistance in reviewing data.
- **Provision of monitoring services to the City of Fairview.** Though an Intergovernmental Agreement with Fairview, the City continued monthly monitoring at Fairview Lake to fulfill a request from DEQ. Constituents of interest include: pH, temperature, dissolved oxygen, conductivity, turbidity, E. coli, total suspended solids, hardness, total phosphorus, ortho phosphate, chlorophyll a (summer only), and total and dissolved metals.
- **Support of regional flow data collection.** The City helped fund regional efforts through USGS, to collect continuous flow data. The City sponsors this effort in two sites, on Johnson Creek at SE Regner Road and on Fairview Creek at NE Glisan. Additional real-time data continued to be collected through the City's rain gauge at the City Hall Fire Station; this information is made available to the region via the City of Portland website. Flow and rainfall data are useful for

evaluating the conditions under which various types of pollutants enter the water column and storm system. The flow data collected and logged on a continuous basis will also assist us in the design phase of capital improvement projects, and help calibrate models.

- **Contribution to Columbia Slough Watershed Projects.** Water quality outfall data for both conventional and priority pollutants along with staff support were provided to the Columbia Slough Watershed Council for the recent completion of the Watershed Data Gap Analysis and Watershed Action Plan. This work characterized the quality of aquatic/riparian habitat in the watershed, including watershed characteristics, history, current conditions, and impairments along with identifying opportunities through a priority list of projects and programs. A copy can be obtained by contacting the Columbia Slough Watershed Council at 503-281-1132.
- **Coordination of Fairview Creek Watershed Action Plan.** PY 8 marked the City's 2nd year of support for a three-year AmeriCorp placement with the Fairview Creek Watershed Council. The watershed assessment was completed in PY 7. The Action Plan was completed in PY 8 and is included on cd rom as an attachment to this report. In PY 9, the City will host and supervise the new AmeriCorp placement at City Hall. The new volunteer will work closely with the City of Gresham's AmeriCorp volunteer to implement elements of the Action Plan and to coordinate long-term stewardship efforts with various school groups in Gresham and Fairview.

Illicit Discharge Monitoring

Monitoring for illicit discharges was partly replaced during permit year 8 by an effort to develop an illicit discharge re-screening protocol that uses the best science available to re-prioritize illicit discharge detection target areas. As indicated in the supplemental package submitted to DEQ in December 2002, the re-screening protocol was based on findings in the study led by Robert Pitt titled *Potential New Tools for the Use of Tracers to Indicate Sources of Contaminants to Storm Drainage Systems*. Staff will screen approximately 60 outfalls and manholes for flow, based on results from the sampling conducted for the original permit submittal; plus results from screening that has taken place each year under the permit. If flow is present then samples will be collected for the analysis of MBAS, pH, temperature, total chlorine, ammonia, dissolved oxygen, conductivity, and turbidity. The planned Illicit Discharge Re-screening Protocol is provided in Appendix A. It is to be completed this summer to early fall, along with five miles of TVing for detection of illicit connections. The TVing has traditionally been conducted in July or August, then attributed to the previous permit year because June is often too wet to justify TVing. The City plans to report this summer/fall's TVing in PY 9 to bring the work and reporting into the same permit year. Consistent with other permit years, staff responded to illicit spills and connections identified by citizens, city staff, and through routine and storm monitoring efforts.

LONG-TERM, IN-STREAM DISCHARGE MONITORING

During the reporting period, Stormwater staff conducted long-term, in-stream monitoring on eight sites within the Kelly, Fairview, and Johnson Creek watersheds, as listed in Table 2.1 and shown in

Figure 2.1. While this monitoring is not a requirement of the NPDES MS4 permit, the City believes that it is useful to characterize the quality of water entering and exiting its borders so that progress can be detected over time, and the City can identify its contribution toward the quality of the waterbodies that pass through its boundaries. Bi-monthly grab samples were taken at each of the sites and analyzed for each of the parameters listed in Table 2.2.

Table 2.1: Long-term, In-stream Trend Monitoring Sites

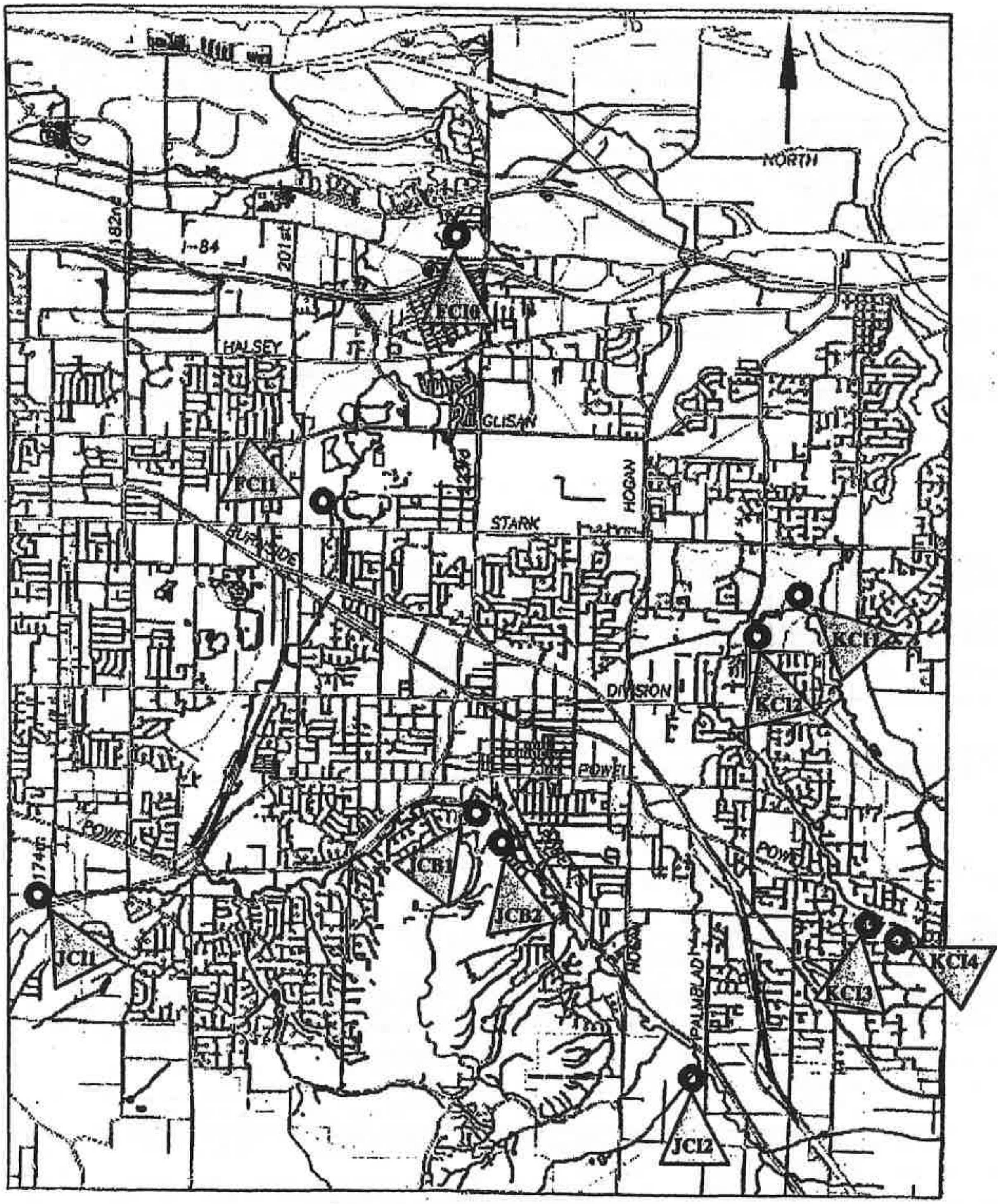
Site	Location	Reason for Selection
FC01	Fairview Creek between Sandy Blvd and Fairview Lake	Most downstream site prior to discharge to Fairview Lake
FC11	Fairview Creek north of Stark Street	Gresham downstream city limit
JC11	Johnson Creek at 174th	Gresham downstream city limit
JC12	Johnson Creek at 252nd	Gresham upstream city limit
KC11	Kelly Creek, outflow from Mt. Hood Community College Pond	Downstream of Mt. Hood Community College Pond (Identify impacts)
KC12	Kelly Creek, inflow to Mt. hood Community College Pond	Upstream of Mt. Hood Community College Pond (Identify impacts)
KC13	Kelley Creek, outflow from Kelly Creek Detention Pond	Upstream of Kelly Creek Detention Pond (Identify impacts)
KC14	Kelly Creek, inflow to Kelly Creek Detention Pond	Upstream of Kelly Creek Detention Pond (Identify impacts)

Table 2.2: Constituents Analyzed for Long-term, In-stream Trend Monitoring

Constituent	Reason for Selection
Temperature	Fluctuations and ranges can affect aquatic species
Dissolved Oxygen	Indicator of ability to support aquatic species
pH	Range influences health of aquatic species, influences toxicity of metals
Conductivity	Indication of total contaminant load dissolved in water column
Turbidity	Affects feeding and spawning of aquatic species, at high levels can cause gill abrasion in fish; may indicate erosion
Total Suspended Solids	Affects feeding and spawning of aquatic species, may indicate erosion, and may serve as a proxy for toxics that are bound to particles.
E. coli	Bacterium that lives in the enteric system of mammals, indicates presence of human or animal waste
Biochemical Oxygen Demand	Indicates demand for oxygen by organic sources; potential indication of wastewater discharges
Ammonia-nitrogen	May indicate human or animal waste or fertilizers, contributes to algal blooms
Nitrate -nitrogen	May indicate human or animal waste, contributes to algal blooms
Total phosphorus	May indicate human or animal waste or fertilizers, contributes to algal blooms
Ortho-phosphorus	May indicate human or animal waste or fertilizers, contributes to algal blooms; it is the form that is most available to use by organisms
Chloride	Affects aquatic species
Chlorophyll a	Indicates presence of photosynthetic organisms; runoff from commercial or residential activities may carry nitrogen and phosphorus that aid plant growth
Hardness	Influences toxicity of metals
Total Copper	Harmful to fish; may indicate road runoff or runoff from commercial activities
Total Lead	Harmful to most living creatures; may indicate road or commercial activity runoff
Total Zinc	Harmful to aquatic life; may indicate road or commercial activity runoff

Figure 2.1 Long-Term, In-stream Monitoring Sites

City of Gresham – Instream Monitoring Sites – Stormwater Division



DATA ANALYSIS

To ensure that the monitoring program is as effective and efficient as possible, the City evaluated data collected during the last permit year to the Water Quality Criteria in OAR 340-41, Table 20 and to data collected over the last decade under previous and existing monitoring plans. Consistent with the findings of Year 7, there is inadequate data to see through the “static” of natural variability and the timing of sampling and changes in sampling methodology. Use of advanced statistics is therefore not warranted. (Refer to NPDES Permit Year 7, Section XX for consultant analysis of all data collected through 2001. A parameter-by-parameter analysis is provided below, but it should be recognized that statistically valid conclusions cannot be drawn. For each parameter, the relevant regulatory criteria are described and a description of PY8 sampling results is provided, together with a summary of historical data.

In-stream data collected during permit year 8 was reduced from monthly to bi-monthly monitoring. Monitoring is pre-scheduled for the last Tuesday of the month, consistent with previous monthly monitoring schedule. With the exception of one rainfall event of 0.1” all monitoring events occurred on dry days. Only general observations can be made with the limited data.

Total Suspended Solids (TSS)

Criteria: There is not state criterion for in-stream TSS, although there is a guidance level for Total Dissolved Solids of 100 mg/l.) EPA found that concentrations of 80 mg/L of TSS reduced the density of macroinvertebrates by 60 percent (EPA, 1986). Researchers have found that juvenile salmon avoided stream reaches with TSS above 25 mg/L; low population densities were found in reaches with TSS concentrations above 61 mg/L, respectively (DEQ, 2022). Used as a proxy for toxics, TSS values in Johnson Creek may result in stormwater TMDL allocations in the range of 60 mg/l, and 15 mg/l for instream concentrations.

PY8 Observations: The TSS results for Fairview, Johnson, and Kelly Creeks for 2002-03 were below 25 mg/L with the exception of one sample from Kelly Creek. The sample was collected on a dry day with a result of 26 mg/L of TSS.

Historical Results: Between January 2000 and June of 2002, Fairview Creek exceeded 25 mg/L of TSS on 5 occasions at one or more locations associated with a rain event of 0.21” or greater. TSS did not exceed 61 mg/L on Fairview Creek. Johnson Creek exceeded 25 mg/L of TSS on 8 occasions at one or more locations associated with a rain event of 0.17” or greater. Of those occurrences, 61 mg/L of TSS was also exceeded 6 times and 80 mg/L 5 times at one or more locations associated with rain events of at least 0.17” and 0.21”, respectively. Kelly Creek exceeded 25 mg/L of TSS on 8 occasions at one or more locations associated with a rain event of 0.19” or greater. Seven of those occurrences also exceeded 61 mg/L, while 6 also exceeded 80 mg/L associated with rain events of 0.21” or greater.

Generally for Fairview and Johnson Creeks, the median TSS increases as flow moves downstream for both data sets (years 00-02 and 02-03). However with Kelly Creek, the outflows of each pond generally have higher median TSS results than the inflows, but the median TSS at the inflow to the downstream pond (MHCC) is lower than the outflow to the upstream pond (detention pond), so the Creek apparently loses TSS as if flows between the two ponds. Refer to graphs in Appendix A.

Temperature

Criteria: Temperature criteria vary be date and location, dependent upon-life stage of salmonids that are found within a given waterbody. The rearing criterion is 64°F and applies to all Gresham streams due to the presence of resident trout. Because the trout are resident year-round, the rearing criterion applies at all times, whereas the spawning criterion does not. The criterion applies to stream within Gresham as follows, based on life-stage information provided by ODFW field staff:

Fairview Creek: 55%F March – May
Johnson Creek: 55%F February – May and August – October
Kelly Creek: 55%F February – May and September – November

PY8 Observations: During permit year 8, temperatures for Kelly Creek exceeded the rearing criterion of 64% in July at 3 of the 4 sampling sites. The 55°F-spawning criterion was exceeded in Kelly Creek during the September sampling event at 2 locations. Fairview Creek exceeded the spawning temperature criterion in May and exceeded the rearing criterion in July for both sampling locations. Johnson Creek exceeded the 55°F spawning criterion during the May and September sampling events at one or more locations. Johnson Creek also exceeded the rearing criterion during July at both sampling locations.

Similar to historical data, PY 8 temperature data shows a clear annual cycle, peaking in July.

Historical Results: In Fairview Creek, temperature generally exceeded the threshold about halfway through the spawning period, and by the end of spawning is roughly 5°C above the threshold. During non-spawning times, temperature also exceeds the threshold by up to 5°C. Tributary and outfall temperatures are similar to in-stream temperatures. In Johnson and Kelly Creeks, temperature exceeds the spawning threshold by approximately 2 to 3°C, but during non-spawning periods may exceed the threshold by up to 10°C.

Generally, the median temperature for both Fairview and Johnson Creeks increases as the flow travels downstream. However, with Kelly Creek the median temperature for PY8 is lower at the outfall of the downstream pond than it is at the inflow to the upstream pond. Additional analysis will be performed to determine if the time of sample collection caused this anomaly. This result is anomalous with historic data (00-02) that has revealed trends of increasing temperatures as the flow moves downstream and continues to increase at the outfall of the downstream pond.

pH

Criteria: The state water quality criteria for pH is 6.5 to 8.5, based on the needs of fish.

PY 8 Observations: The pH criteria are more often not met on the low side of the pH range, rather than the high side. This holds true in a year when none of the in-stream measurements were taken during precipitation. In May, the pH measured in Fairview Creek at Stark Street was outside the criteria range.

The pH was recorded as 6.11. The pH measured in Kelly Creek was outside the criteria range of several occasions. In May, the pH of 6.48 was measured at the inflow to Mt. Hood Community College Pond and 6.32 at the inflow to Kelly Creek Detention Pond. In January pHs of 6.47 and 6.45 were recorded at both the inflow and outfall to Kelly Creek Detention Pond, respectively. The pH results were within the criteria range in Johnson Creek. The low pHs are difficult to explain. They do not correlate with rainfall events, nor were they taken early in the morning when they could have been influenced by high CO_2 associated with the overnight respiration of plants. The meter was calibrated prior to use but drift may have occurred. For quality assurance, meters are now measured against known pH buffer after use to determine drift.

Historical Results: Data was collected on a monthly basis. Of the 26 monitoring events on Fairview, Johnson, and Kelly creeks, most pH values fell within the criteria range. The pH measurements in Fairview Creek fell below the criteria range on 3 occasions at one location. Only one event was associated with a rain event with an accumulation of 0.5”. In Johnson Creek, pH fell below the criteria range on one event only, with a reading of 6.45. Kelly Creek experienced pH outside the range on 3 events at one location only. One measurement was recorded below 6.5 and two measurements were above 8.5. Rainfall accumulation of 0.10” or less. Again, pH does not appear to correlate with rainfall events, nor were the measurements taken early in the morning.

Median pH for each of the creeks reacts differently as flow moves downstream. In Fairview Creek, the median pH increases slightly, where Johnson Creek decreases slightly, and Kelly Creek stays fairly constant for both historical and PY8 results. Refer to graphs in Appendix A.

Dissolved Oxygen (DO)

Criteria: As with temperature, DO criteria vary by date and location. DO cycles with temperature; as temperature increases, DO decreases, such that the lowest point in the DO cycle occurs in June and July. DO Criterion during spawning times is 11 mg/L and during non-spawning times is 8 mg/L.

PY 8 Observations: Because of equipment failures, DO data was not always collected. The equipment has since been repaired. DO failed to comply with the criteria for Fairview, Johnson, and Kelly Creeks on all sampling events during spawning periods with the exception of two sampling events on Kelly Creek. KC11 in May and KC12 in November met DO spawning criteria.

Historical Results: DO values below the threshold occurred throughout the spawning period, and decreased throughout spawning, such that by the end of spawning DO values as low as 6 mg/L were not uncommon (compared to the criteria of 11 mg/L). The most severe DO values were generally around 4 mg/L occurred during both spawning and non-spawning times.

E. coli

Criteria: The *E. coli* criteria is the log mean of 126 organisms/100 mL based on at least 5 samples within a 30-day period, or no single sample shall exceed 406/mL.

PY 8 Observations: 54% of the *E. coli* results were above the criterion of 126 organisms/mL. Fairview Creek exceeded the 126 organisms/100mL criterion 5 times, all but one occurring during summer months (July and September). Johnson Creek exceeded the criteria during each monitoring event occurring throughout the year. Typically, most of the occurrences were recorded at JC11 (at 174th), including the most extreme occurrence with a result of >24,000 organisms/100mL (the source was identified as a sanitary sewer overflow, which was resolved See BMP ILLX). Kelly Creek exceeded the criteria 13 times throughout the year, with 4 occurrences each at the inflow to both ponds.

Historical Results: Most in-stream *E. coli* results were above the criterion of 126 organisms/100mL. Of the 26 sampling events, the criterion was exceeded 18 times at one or more locations on Fairview Creek, 19 times on Johnson Creek, and 22 times on Kelly Creek. When rainfall exceeded 0.21”, the *E. coli* criterion was exceeded on all creeks. The highest values were estimated up to 6,000 CFU/100mL.

Fairview Creek median *E. coli* results increase as flow moves from upstream to downstream for the historical dataset (00-02), but decrease slightly from upstream to downstream in the PY8 dataset (02-03). In Johnson Creek, median *E. coli* results increase as flow moves from upstream to downstream. And with Kelly Creek, the median *E. coli* results decrease between in the inlet, the outlet of both ponds for both data sets (00-02 and 02-03) but increases significantly between the outlet of the upstream pong (detention pond) and the inlet to the downstream pond (MHCC). Refer to graphs in Appendix A for median *E. coli* results.

Total Copper, Lead, and Zinc

Criteria: Toxicity values are determined by the hardness of the water. Based on water quality criteria in OAR 340-41, Table 20, staff developed a spreadsheet to determine the toxicity of total metals at various levels of hardness. This spreadsheet was utilized to determine the number of exceedances for chromium (Cr), cadmium (Cd), copper (Cu), lead (Pb), and zinc (Zn). Because historical results did not exceed toxicity levels for Cr and Cd, they were eliminated for analytical cost savings.

PY 8 Observations: Toxicity levels for Cu, Pb, and Zn were not exceeded in any of the three creeks. This is not surprising if the main source of these metals is runoff, given that the in-stream monitoring is prescheduled on a set day, and on only one occasion did monitoring coincide with a rainfall event. (Rainfall on this event was recorded with an accumulation of 0.21”).

Historical Results: Between January 2000 and June 2002, Fairview Creek exceeded chronic criteria 7 times for at least one metal (Cu, Pb, or Zn) at one or more locations associated with a rain event of 0.17” or greater. Acute criteria were exceeded 6 times for at least one metal at one or more locations associated with a rain event of 0.21” or greater. Johnson Creek exceeded chronic criteria 5 times for at least one metal at one or more locations associated with a rain event of 0.17” of greater. Acute criteria were exceeded 7 times for at least one metal at one or more locations associated with a rain event of 0.21” or greater. Kelly Creek exceeded chronic criteria 6 times for at least one metal at one or more locations associated with a storm event of 0.17” or greater. Acute criteria were exceeded 8 times for at least one metal at one or more locations associated with a storm event of 0.19” or greater.

Median results for total metals react differently as flow moves from upstream to downstream for each creek. In Fairview Creek, copper increases, but lead and zinc decrease as flow moves downstream. There is no known reason why this should be the case, so it may be a function of variability and represent no real trend. In Johnson Creek, all the metals increase as flow moves downstream, with zinc significantly increasing. With Kelly Creek, total metals react differently at each of the ponds for each of the datasets. In PY8, both copper and lead increase slightly as flow moves through each of the ponds resulting in a slight overall increase from upstream to downstream. However, in the historical data (00-02) both copper and lead drop slightly from the inflow to the outflow at the upstream pond but with an overall increase as it moves from upstream to downstream. For both datasets, median total zinc results increase from inflow to outflow of each pond, with a decrease in the median total zinc between the outflow of the upstream pond and the inflow to the downstream pond. However, there is an overall increase from upstream to downstream.

Refer to graphs in Appendix A for median metals results.

STORMWATER OUTFALL MONITORING

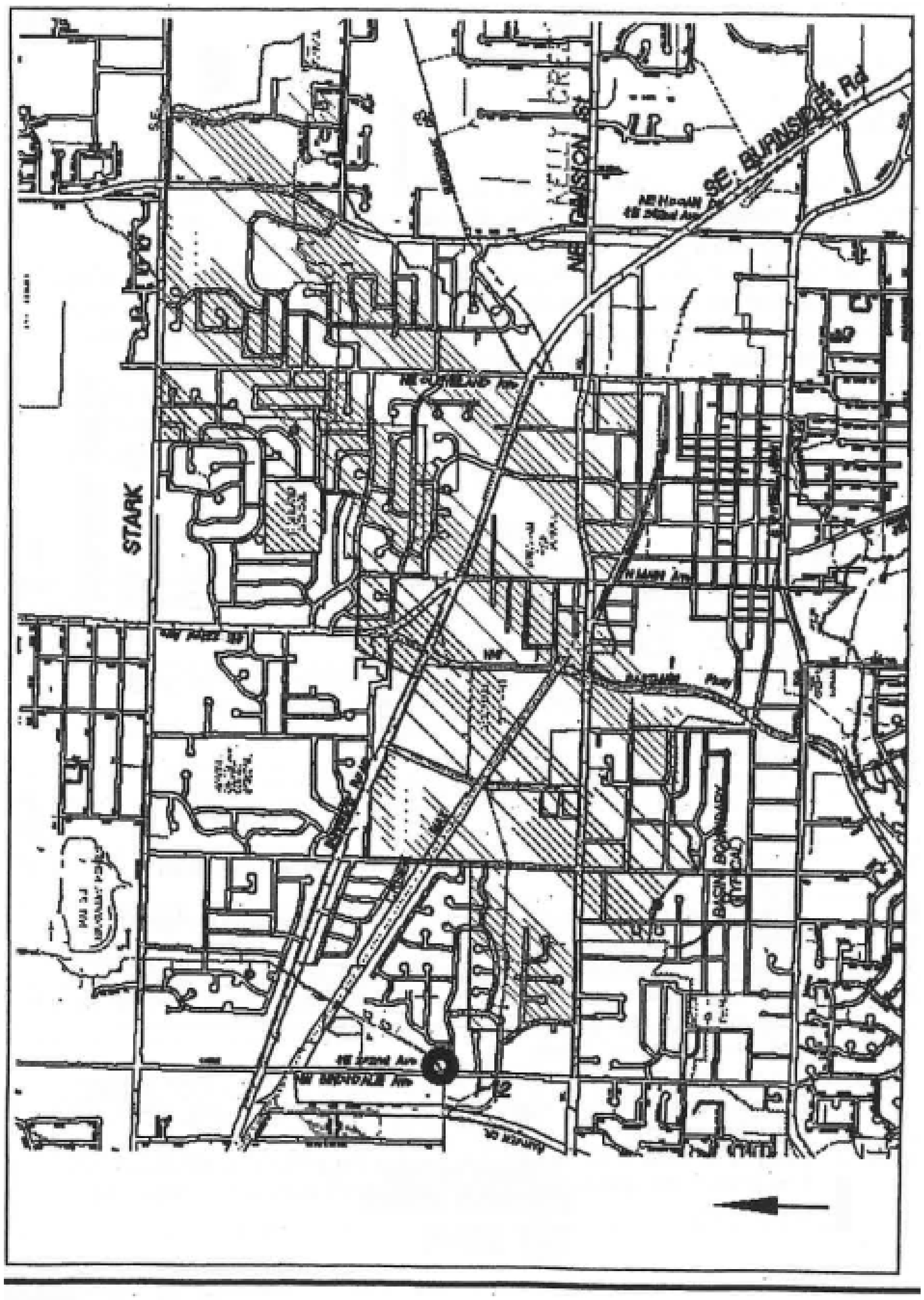
During the reporting period, staff conducted stormwater outfall monitoring at one major outfall within the Fairview Creek watershed. The constituents are identified in Table 2.3. The outfall locations and system are shown in Figure 2-2. One purpose of the storm monitoring was to determine whether the first flush of a storm in Gresham carries more pollutants than the remainder of the storm – a phenomenon that has been observed elsewhere in the country. If the first flush carries the most pollutants, that means that any storm monitoring must capture that first flush in order to adequately characterize pollutant loading during the storm. By contrast, if flow is more closely correlated with pollutant transport, one could monitor different flows and develop pollutant curves that could be used to predict pollutant loading based on flow. Another possible relationship is between particle size and pollutants – one would expect the greatest pollutant loads when the most surface area to which pollutants are absorbed is exposed to the water column.

Table 2.2: Constituents Analyzed for Stormwater Characterization Monitoring

Constituent	Reason for Selection
Temperature	Fluctuations and ranges can affect aquatic species
Dissolved Oxygen	Indicator of ability to support aquatic species
PH	Range influences health of aquatic species, influences toxicity of metals
Conductivity	Indication of total contaminant load dissolved in water column
Turbidity	Affects feeding and spawning of aquatic species, at high levels can cause gill abrasion in fish; may indicate erosion
Total Suspended Solids	Affects feeding and spawning of aquatic species, may indicate erosion
E. coli	Bacterium that lives in the enteric system of mammals, indicates presence of human or animal waste
Biochemical Oxygen Demand	Indicates demand for oxygen by organic sources; potential indication of wastewater discharges
Ammonia-nitrogen	May indicate human or animal waste or fertilizers, contributes to algal blooms
Nitrate -nitrogen	May indicate human or animal waste, contributes to algal blooms
Total phosphorus	May indicate human or animal waste or fertilizers, contributes to algal blooms
Ortho-phosphorus	May indicate human or animal waste or fertilizers, contributes to algal blooms; it is the form that is most available to use by organisms
Hardness	Influences toxicity of metals
Total Copper	Harmful to fish; may indicate road runoff or runoff from commercial activities
Total Lead	Harmful to most living creatures; may indicate road or commercial activity runoff
Total Zinc	Harmful to aquatic life; may indicate road or commercial activity runoff
Particle Size Distribution	May be useful to explain results of parameters that adhere to or are absorbed on particulates. Per unit mass, smaller particles should carry higher loads of such parameters.

Figure 2.2 Stormwater Monitoring Outfall

City of Gresham – Outfall Monitoring



Approach: Two different approaches were used to monitor an outfall that drains a large multi-use area within southwest Gresham. For the first storm, timed grab samples were taken. For the second storm, composite samples were taken based on a fixed flow volume. In both cases, instantaneous flows were recorded.

Results: Unfortunately, monitoring of the first storm did not catch the early period of the storm. However, the data show a potential relationship between 1-2 micron size particles and metals concentrations, as might be expected, and a less close relationship with particles larger than 100 microns. The full storm was monitored on the second occasion, and a first flush may have occurred, based on relatively high values of pollutants that occurred at the beginning of the storm – as compared to later values that were not as high for a given flow. More data is needed to validate whether these potential relationships in fact exist.

Refer to the graphs in Appendix A for a comparison of metals, TSS, and particle size distributions compared to flow for the two storms.

UNDERGROUND INJECTION CONTROL (UIC) STORMWATER MONITORING

In accordance with Oregon Administrative rules, municipalities that own 50 or more stormwater injection systems (e.g., drywells) were obligated to begin monitoring the effectiveness of stormwater BMPs during this last permit year. The DEQ rules require each municipality to monitor BMP effectiveness twice in the first 12 months of the stormwater management plan and annually at the onset of wet weather conditions thereafter. The rule specifies that grab samples are to be collected at the last available sampling point prior to stormwater injection into the subsurface for the following constituents: benzene, ethyl benzene, toluene, xylenes, benzo(a)pyrene, total nitrogen, fecal coliform, and total lead, chromium, and cadmium. The rules allow for an alternate protocol for sampling if approved by the Director.

MONITORING SUMMARY

ACWA orchestrated a statewide regional monitoring effort for interested municipalities. ACWA hired a consultant to assist with the development, coordination, and interpretation of the stormwater BMP effectiveness monitoring results. This collaboration resulted in an alternate monitoring proposal, which was submitted to and approved by DEQ. The alternate proposal requested that monitoring efforts concentrate its sampling efforts by attempting to sample more storm events at 6 locations for 11 participating municipalities. Table 2.4 provides a list of locations and devices.

Table 2.4: UIC Stormwater Monitoring

Location	Type of Device
City of Bend	Sedimentation manhole with BMPs
City of Eugene	Oil/Water separator catchbasin
City of Gresham	Stormceptor
Clackamas County	Sedimentation manhole with BMPs
City of Troutdale	Source control BMPs
TriMet	Oil/Water separator/Stormwater Management filter vault

Additional modifications proposed to and accepted by DEQ include the following:

- Manually collect time-weighted composite samples over a 6-hour period
- Collect dissolved metals in addition to total metals
- Analyze for nitrate-nitrogen instead of total nitrogen because there is a groundwater standard available
- Analyze for E. coli instead of fecal coliform
- Consider reducing organics analyses in storms 3 and 4 to reduce costs, based on results
- Modify storm criteria to require only 24 hours with no more than 0.12” rainfall prior to an adequate storm event of at least 0.20” rainfall

Each participating agency contributed funding and staff time to cover the costs associated with the development and implementation of the monitoring proposal. In addition to the City of Gresham participating in this monitoring study, staff chose to collect samples up and downstream of the BMP following the same protocol. (The rest of the BMP sites did not include upstream samples, based on the rationale that all structural and nonstructural BMPs contribute to the quality of the water that enters the sump.)

MONITORING RESULTS

Because a summary report is not due to DEQ until June 30, 2004, the regional data has not yet been reviewed and analyzed. However, Gresham staff reviewed the data collected from the 2 storm events in PY8 at the site located within the City. Only limited conclusions can be drawn from the data. What the limited data does show is that only chromium and cadmium are somewhat consistent. Chromium appears to decrease slightly after the BMP and cadmium does not appear to change. Both TSS and lead appear to increase after the BMP in the first storm event, and decrease in the second storm event. However, lead does not appear to track TSS. Refer to the graph in Appendix A for the raw data results.

POLLUTANT LOAD MODELING FOR FAIRVIEW CREEK BASIN

Pollutant Load modeling was performed by HDR Engineering in conjunction with the development of the Fairview Creek Master Plan, May 2003. An XPSWMM water quality model was built to predict pollutant loading for the City of Gresham “water quality” design storm (approximately a 6-month storm). The model simulation was intended to provide approximate concentrations to identify potential pollutant “hot spots” within the Fairview Creek Basin. The values provided are not based on a basin-wide data collection effort. The modeled constituents, results, and problem locations are provided below.

WATER QUALITY CONSTITUENTS

The modeled parameters included total phosphorus, TSS, and total Cu, Pb, and Zn. Median concentrations obtained from the 1997 Association of Clean Water Agencies (ACWA) study were used to develop the land-use based runoff model. The ACWA study was conducted from 1990 through 1996.

MODEL SUMMARY

Full build-out assuming future land use identified through the City's current zoning was used in the model. However, in some locations (e.g., current residential areas) existing and future land uses are the same. There are some locations in the Basin that are currently open space or low-density residential that are zoned for commercial or industrial land uses. Major roads (e.g., Division Street, Burnside Avenue, Stark Street, and Glisan Street) were included in the model and analysis even though these roads are owned and maintained by Multnomah County.

Water quality analysis sites were delineated by using outfalls to Fairview Creek as the downstream location and then identifying the sub-basin areas that contribute to the outfall runoff. The water quality analysis sites contain one or more modeled sub-basins.

The model is conservative in that it cannot model pollutants "leaving" the system (e.g., settling out of TSS). In addition, the model was not developed to include best management practices (e.g., street sweeping, catch basin cleaning, structural facilities) that have been implemented since the ACWA study was conducted. As a result, the model is considered a conservative approach to estimating and identifying water quality problem locations. However, the model does predict the relative loading of analysis sites and was used to identify locations for site-specific water quality improvements or other recommendations.

The peak concentrations and total load over the design storm were used to identify outfall locations with elevated concentrations and high pollutant loads. Elevated concentrations were determined using Oregon water quality standards or guidance limits.

MODEL RESULTS

The water quality model computed peak concentrations and total pollutant load for each model segment for future conditions. The model included both the "closed" system (i.e., pipes) and open channels such as Fairview Creek. The model results were not analyzed outside the Gresham city limits. Conduits were identified that exhibited peak concentrations greater than the previously described "limits." The model showed a majority of the piped and open channel systems exceeded concentration limits.

The model showed that Fairview Creek exceeded the phosphorus, copper, lead and TSS "limit" at Division Street, and had elevated concentrations downstream to Glisan Street. Copper concentrations were elevated from Division Street to Birdsdale Avenue, but then dropped below the acute criteria. This is because the large discharge from the 969-acre sub-basin (central core and Red Sunset Study Areas) diluted the concentration in the creek, without adding substantial additional concentrations.

WATER QUALITY ANALYSIS

Because concentrations in the creek were elevated for a majority of the reach, the larger outfalls that discharge into the creek were reviewed for loading contributions. These water quality analysis sites were delineated using outfalls to Fairview Creek as the downstream location and then identifying the sub-basins that contribute to those outfall locations.

The water quality analysis areas and corresponding sub-basins are:

- **Upstream Fairview:** East of Fairview Creek just north of Powell Blvd
- **NW 5th Street:** East of Fairview Creek, north of Upstream Fairview
- **Division:** East of Fairview Creek, just south of Division Street
- **Birdsdale:** Area east of Eleven Mile Road, and south to the creek
- **Birdsdale East:** Area east of Birdsdale Road and south of Burnside
- **Burnside East:** Burnside Street east of Fairview Creek
- **Burnside West:** Burnside Street west of Fairview Creek
- **Stark East:** Stark Street east of Fairview Creek
- **Stark West:** Stark Street west of Fairview Creek
- **Stark and 202nd:** Intersection of 202nd Ave and Stark and southeast area
- **Glisan:** Glisan Street and area south

Areas that discharge to the creek via overland routes or that are serviced by dry wells were not included in the analysis. These areas do not provide a direct pollutant loading contribution to the creek, and indirect runoff loads will be reduced through subsurface flow. In addition, discharge from the LSI or Microchip (Fujitsu) properties were not reviewed. At the onset of this project both of these industrial properties had a NPDES 1200-Z stormwater discharge permit, and water quality from this site was under DEQ jurisdiction. In November 2002, however Microchip (Fujitsu) transferred pond ownership and maintenance to the City. Table 2.5 summarizes the water quality areas and pollutant loads generated for the modeled storm event.

Table 2.5 Modeled Water Quality Area Constituents

Area Description	Area (acre)	Phosphorus Load (kg)	TSS Load (kg)	Lead Load (kg)	Copper Load (kg)	Zinc Load (kg)
Upstream Fairview	**22**	**0.22**	**37**	**0.0106**	**0.009**	**0.048**
NW 5th Street	**21**	**0.18**	**32**	**0.008**	**0.007**	**0.041**
Division Street	**29**	**0.24**	43	**0.010**	**0.011**	**0.054**
Birdsdale	6	0.35	97	0.007	0.110	0.029
Birdsdale East	969	9.16	1991	0.343	0.501	2.386
Burnside East	19	0.266	73	0.009	0.009	0.015
Burnside West	9	0.15	54	0.003	0.013	0.068

Area Description	Area (acre)	Phosphorus Load (kg)	TSS Load (kg)	Lead Load (kg)	Copper Load (kg)	Zinc Load (kg)
Stark East	36	0.56	112	0.023	0.028	0.135
Stark West	11	0.11	21	0.004	0.005	0.025
Stark and 202nd	15	0.24	66	0.007	0.090	0.015
Glisan Street	57	0.63	140	0.025	0.031	0.177

Notes:
1. Model results are approximate and based on best available information.
2. Model results are conservative and do not show losses (e.g., sediment settling).
3. Model does not reflect BMPs (structural or programmatic) implemented to reduce pollutants post 1997

The water quality areas were then evaluated based on loading per area. The intent of this analysis was to identify outfalls to Fairview Creek with the highest loads, since treating these areas would have the greatest net benefit per unit area. Table 2.6 shows the loading per area for phosphorus, TSS, lead, copper, and zinc.

Table 2.6 Water Quality Area Loads per Acre

Area Description	Area (acre)	Phosphorus Load per acre (kg)	TSS Load per acre (kg)	Lead Load per acre (kg)	Copper Load per acre (kg)	Zinc Load per acre (kg)
Upstream Fairview	22	0.010	1.7	7×10^{-4}	4×10^{-4}	2×10^{-3}
NW 5th Street	21	0.009	1.5	4×10^{-4}	1×10^{-3}	2×10^{-3}
Division Street	29	0.008	1.5	3×10^{-4}	4×10^{-4}	2×10^{-3}
Birdsdale	6	0.058	16.2	1×10^{-3}	2×10^{-2}	5×10^{-3}
Birdsdale East	969	0.009	2.1	4×10^{-4}	5×10^{-4}	2×10^{-3}
Burnside East	19	0.014	3.8	8×10^{-4}	5×10^{-3}	8×10^{-4}
Burnside West	9	0.017	6	3×10^{-4}	2×10^{-3}	8×10^{-3}
Stark East	36	0.015	3.1	6×10^{-4}	8×10^{-4}	4×10^{-3}
Stark West	26	0.004	0.8	2×10^{-4}	2×10^{-4}	1×10^{-3}
Stark and 202nd	15	0.016	4.4	8×10^{-4}	6×10^{-3}	1×10^{-3}
Glisan Street	57	0.011	2.5	4×10^{-4}	5×10^{-4}	3×10^{-3}

Notes:
1. Model results are approximate and based on best available information.
2. Model results are conservative and do not show losses (sediment setting) in the creek
3. Model does not reflect BMPs (structural or programmatic) implemented to reduce pollutants post 1997

In ranking the water quality areas by total loads, three areas were identified as the highest pollutant contributors: Birdsdale East, Glisan Street and Stark East. Stark West had the lowest total load and the remaining areas varied in their contribution by constituent.

The lowest contributing water quality areas by acre were NW 5th Street and Division Street. Birdsdale Avenue had the highest load per acre followed roughly by Stark and 202nd, Stark East, and Burnside East.

An alternatives analysis was conducted and can be referenced in the Fairview Creek Master Plan.

NEW DEVELOPMENT

A development-tracking database was implemented as of January 2003 in association with the erosion prevention and sediment control program. The database also tracks new development acreages and the proposed water quality BMPs. Table 2.7 shows the total number of acres developed by land use and proposed BMP for water quality treatment. The table only includes development within areas that discharge to surface waters and does not include development discharging to either surface or subsurface infiltration. The acreage that is being reported for PY8 has not been completed, but is either in the plan review or construction phase. In PY9, completed development acreage and associated BMPs will be reported.

Table 2.7 New Development Acreage & BMPs – Developing Area since January 2003

Land use	Area* Acre	Type of BMP	# of BMP	Estimated % Redn**							
				TSS Low	TSS High	Metals Low	Metals High	P Low	P High	Bact Low	Bact High
Resid	46.51	(total)									
		Veg Swale	2	60	80	60	80	20	40	0	0
		Sed Manh		20	40	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
		Centrifugal	5	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
		Pond	2	60	100	20	80	40	80	0	0
		Combined***		60	90	40	80	30	60	0	0
Comm	28.76	(Total)									
		Veg Swale	3	60	80	60	80	20	40	0	0
		Sed Manh		20	40	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
		Centrifugal		Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
		Pond	1	60	100	20	80	40	80	0	0
		Combined		60	90	40	80	30	60	0	0
Ind	54.00	(Total)									
		Veg Swale	2	60	80	60	80	20	40	0	0
		Sed Manh		20	40	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
		Centrifugal	1	26	99	28 (cu)		11	32		
		Pond		60	100	20	80	40	80	0	0
		Combined		60	90	40	80	30	60	0	0
Parks++	1.00	(Total)									
		Veg Swale		60	80	60	80	20	40	0	0
		Sed Manh		20	40	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
		Centrifugal		Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
		Pond	1	60	100	20	80	40	80	0	0
		Combined		60	90	40	80	30	60	0	0

*Area represents land that in process of development since January 2003, It does not include areas that discharge through surface or subsurface

**Percent reduction were not available per land use, so the same values have been applied across land uses, with the exception of centrifugal devices- for which only industrial and parking lot data were available.

***This category represents treatment facilities that include either a pond with a release orifice or a swale with a CDS manhole

+This category includes areas listed as transportation; we're not sure what this includes, but have assumed 95% imperv.

++This category includes parks, open space, and ag land

Ponds may be either wet or dry; we don't know which.

Public detention facilities (pipe with control-release manhole) were not considered to provide WQ treatment

Ref from Tom for Runoff Coeff assoc w Rational Method

HABITAT MONITORING

The City made substantial progress on an environmental baseline study of our riparian system during Permit Year 8. All major creeks were analyzed and data sets were then compiled on riparian vegetation parameters and in-stream physical channel parameters. During the summer of 2003, interns will complete the baseline study by providing comparable data on the smaller tributaries to Johnson Creek and Kelly Creek.

Through this process, data on the following parameters was either field checked for accuracy or newly gathered by professional biologists:

- Land Use
- Habitat Type
- Habitat Quality/Pool frequency and quality/large woody debris presence and recruitment potential, refugia
- Gradient
- Substrate
- Floodplain: Hydro Modifications and floodplain disconnection, bank hardening, dams and barriers
- Riparian conditions, composition, and age
- Confinement
- Rosgen stream type
- Channel cross section profiles
- Sinuosity

To date the City has begun to use this data for:

- Cataloging sensitive resource areas;
- Correcting, through field verification, the Metro-created GIS stream map;
- Assessing existing channel type and conditions;
- Evaluating natural resource features that should be considered in future City planning efforts.

If fiscal resources are available to do so, it is the intent of the City to repeat this environmental evaluation every 5 years to coincide with NPDES permit renewal and with other periodic reports and/or evaluations done for our ESA program.

OVERALL CONCLUSIONS DRAWN FROM ANALYSIS

Generally, it is recognized that in-stream and outfall data collection needs to continue to build more data for future trend analysis and pollutant loading calculations. Only minor monitoring modifications have been proposed below. New MS4 NPDES permit requirements may necessitate further changes to the monitoring program.

MONITORING PROGRAM REVISIONS

Monitoring is most useful to the City of Gresham and other regional stakeholders when it is designed to answer specific questions such as: is water quality improving or declining; how effective is a given BMP at removing target pollutants; and which sources are responsible for which contaminant loads. Towards that end, Water Quality staff will continue with the monitoring proposal as submitted in the permit year 7 annual report (including the Addendum submitted mid-year in permit year 8) with only minor modifications. At the time the new permit is issued, City staff will evaluate the current monitoring program to ensure compliance with any new requirements. Table 2.8 outlines the monitoring program as proposed in 2002 and includes modifications for the permit year 9.

Table 2.8 Water Quality Monitoring Proposal

Permit Year 7 Proposal	Modifications Proposed for Implementation in Permit Year 9
1. Illicit Discharge Monitoring a. Continue work with O&M staff to target high prior for TVing b. Distribute educational materials for targeted businesses with fact sheets about business-specific pollutants c. Work w/Business Licensing to provide educational materials at time of license application/renewal.	1a. Add re-screening for MBAS of approximately 60 locations identified in the initial dry weather screening for the original NPDES permit and through annual dry weather of outfalls to target high priority areas. 1b. No changes. 1c. No changes.
2. Bi-monthly long-term, in-stream monitoring at 8 sites on 3 streams to allow for: a. Characterization of water quality entering and existing the city, b. Future trend analysis, c. Incidental storm monitoring to support DEQ interest in TSS and total Cu, Pb, and Zn storm loadings.	2a. Continue with all monitoring listed in items a through and add particle size distribution to constituents list and ensure monitoring is performed during at least one storm event. 2b. No changes. 2c. No changes.
3. BMP Effectiveness a. ACWA UIC/BMP Monitoring b. WQ Facility Construction c. Main City Park Line Replacement Monitoring	3a. No changes 3b. No changes, but construction delayed until 2004 3c. No changes
4. CB Cleaning a. Operations to continue to quantify volumes b. Implement sediment analysis on controlled target areas in conjunction with quantified volumes	4a. No changes. 4b. No changes.
5. High Priority Outfall Monitoring a. Monitoring three storm events at one outfall location. Four discrete samples collected from each storm event (may be outfall for item 3b above) b. Based on findings from 5a, potentially monitor three outfalls for one storm event	5a. Monitoring in PY 8 wasn't conclusive to determine whether and how significant a "first flush" phenomenon might be in Gresham. Therefore, additional effort will be placed on this study and monitoring of three outfalls for one storm event may be delayed until a future year.

Gresham 2002 Proposal	Purpose of New Monitoring (numbers correspond to items in 2002 Proposal)
6. Outside Agency Monitoring a. City of Fairview; Fairview Lake b. City of Wood Village; Visual inspections of five outfalls twice yearly and detection sampling as needed for suspected illicit discharges	6a. No changes. 6b. No changes.
7. Literature Search of latest science and technologies for stormwater monitoring	7. No changes.
8. SWM Model for Fairview Creek comparison to items 3b and 5a above	8. No changes, but construction delayed until 2004.
9. USGS Flow Stations a. Fairview Creek at NE Glisan Street b. Johnson Creek at SE Regner Road	9a. No changes. 9b. No changes.
10. Future TMDL Monitoring a. Columbia Slough: Continue funding of City of Portland instream monitoring and additional monitoring as directed by the TMDL permit b. Johnson Creek: Preliminary monitoring as requested	10a. No changes. 10b. No changes.
11. Miscellaneous Monitoring	11. Complete new study of Fujitsu ponds, begun in PY 8 at DEQ request. The purpose of the study is to determine whether the ponds stratify, and what effect they have on water quality at two times during the year (summer and winter). The ponds may provide an opportunity to improve water quality through re-directing flow, changing outfall location, or other management action.

INTRODUCTION

MWH Energy & Infrastructure was contracted by the City of Gresham to examine historical surface water quality data. Data examined were collected from 42 locations between 1996 and 2001, under a variety of monitoring projects. The analysis examined separately the three watersheds within Gresham: Fairview, Johnson, and Kelly Creeks. All data were compiled into a single Microsoft Access database, and then that database was used in the subsequent analyses. The various monitoring projects that the City has conducted have used different location labeling systems, and different units of measure. In creating the database, MWH used consistent units for each constituent. In addition, we selected a single location labeling system, so that all data from a given location can be readily output to a spreadsheet for analysis. The original labeling systems remain intact in the database through a cross-linking table. This study examined the frequency with which each constituent exceeded criteria in OAR Chapter 340, Division 41 and criteria adopted in the Columbia Slough TMDL. For ten constituents, detailed plots were generated in order to examine spatial and temporal trends and anomalies.

COMPARISON TO CRITERIA

Water quality criteria were obtained from Table 20 of OAR Chapter 340, Division 41 and the Columbia Slough TMDL. Table 1 lists all the constituents in the database, along with applicable criteria. The Microsoft Access database was utilized to compare all samples to criteria. For hardness-dependent metals criteria, hardness data collected at the same time as the metals data were used to calculate sample-specific criteria. Criteria are generally applicable to total concentrations. Where dissolved concentrations were available, they were compared to criteria for total concentrations. Results of the comparison are summarized in Table 2. Constituents that exceeded criteria in more than 50% of the samples were E. coli, fecal coliform, ortho-phosphate, mercury, and total lead. Constituents that exceeded criteria in between 24% and 49% of the samples were total copper and total zinc. Only eleven mercury samples were collected, and all were collected in 1996. All results were at or near the detection limit, which means there is a possibility of "false detects." Since 1996, the criteria for mercury have been lowered dramatically, and the laboratory and field methods have been improved in order to obtain correspondingly low results. Because the "old methods" cannot be precisely compared to the new criteria, and because of the likelihood of false detects, no further evaluation of the mercury data was conducted.

RESULTS

In addition to the seven constituents listed above, total suspended solids (TSS) was examined in detail, because of its usefulness as an "indicator parameter," and temperature and dissolved oxygen (DO) were examined in detail, because of their importance to the Columbia Slough TMDL. For each of the ten constituents identified in this screening process, plots were generated showing all sample results. Separate plots were generated for each watershed.

Because of the large number of locations in the Fairview watershed, three plots were generated. One plot shows all locations upstream of Fairview Lake, one plot shows outfalls and tributaries upstream of the lake, and the third plot shows outfalls downstream of the lake. In addition, a plot was generated for each constituent showing the land use-based monitoring results. These plots were examined for spatial and temporal trends, and for uncharacteristically high results ("anomalies").

Total Suspended Solids (TSS)

TSS results (figures 1a-1g) were generally below 300 mg/L, with a few higher results that ranged as high as 1,140 mg/L on October 27, 1999 at location CS1. Location CS1 is the upstream location for a construction monitoring effort; on this date there was 0.77 inches of rain. In addition, there was an uncharacteristically high result (886 mg/L) at location CSO5 on April 13, 2000. This location is downstream of the Gresham Wastewater Treatment facility, and there was 0.62 inches of rain on that date.

Data recently (since October of 2001) collected at the Fairview Lake outfall (OWEBll-O) seem to indicate that TSS is slightly reduced as water flows through the lake. Upstream resu1ts·during this time period are often in the 25 to 50 mg/L range, and go as high as 150 mg/L, whereas outfall results range from 6.7 to 48 mg/L. In the Kelly Creek watershed, the uppermost locations (KCI4 and KCI3) tend to have the highest TSS, although there are many exceptions. Concentrations at outfalls tended to be similar to instream concentrations, and no other trends were apparent in the TSS data.

Temperature

Temperature criteria vary by date and location, dependent upon spawning periods. This is reflected in the "broken lines"-in the figures (2a-2f). Temperature data show a clear annual cycle, peaking in June or July. In Fairview Creek, temperature generally exceeds the threshold about halfway through the spawning period, and by the end of spawning is roughly 5°C above the threshold. During non-spawning times, temperature also exceeds the threshold by up to 5°C. Tributary and outfall temperatures are similar to instream temperatures. In Johnson and Kelly Creeks, temperature exceeds the spawning threshold by approximately 2° to 3°C, but during non-spawning periods may exceed the threshold by up to 10°C. Tributary and outfall temperature data have not been collected for Johnson and Kelly Creeks.

Dissolved Oxygen (DO)

As with temperature, DO criteria vary by date and location. DO cycles with temperature; as temperature increases, DO decreases, such that the lowest point in the DO cycle occurs in June and July (figures 3a-3e). DO values below the threshold occurred throughout the spawning period, and decreased throughout spawning, such that by the end of spawning DO values as low as 6 mg/L were not uncommon (compared to the criteria of 11 mg/L). The most severe DO values were generally around 4 mg/Land occurred during non-spawning times, when the criteria is 8 mg/L. DO in tributaries tended to be about the same or better (higher) than instream DO, although there were exceptions, such as location CSO5. These trends apply to all three watersheds.

DO was also compared to a 90% saturation threshold (Figures 3f-3j). The theoretical 90% saturation was calculated based on sample temperature and elevation. In this set of plots, the measured concentration is plotted on the y-axis, and the 90% saturation is plotted on the x-axis. If a point is above the 1:1 line (that is, the line of measured concentration equal to 90% saturation), then the measured concentration is greater than the 90% concentration. Thus, points below the line are below criteria. Note also that saturation decreases as temperature increases. Thus, points with lower saturation values (to the left in the plots) are from samples taken during the warmer part of the year. In general, DO tends to be below 90% saturation more frequently in warmer samples. For example, in the Johnson and Kelly Creek watersheds, if 90% saturation was less than 10 mg/L, then the measured DO was at less than 90% saturation. Some locations seem to have better DO levels than others. For example, location 96TMDL-O and 96TMDL-5-I were consistently "above the line." However, this may be an artifact of the measurement equipment used at the time, because it is easy to introduce bias in DO monitoring either due to field methods or equipment used. That is, this result may be due to differences in procedures or equipment, rather than a "real" difference. In the Fairview watershed, locations FCI1, FCI2 and OWEB6-I tend to be below the line, and in Johnson Creek location JCI1 tends to have DO further from the line than other locations.

E. coli

Most E.coli results (62%) were above the criteria of 126 organisms/100 mL (figures 4a-4h): The most extreme result was nearly 25,000 organisms/100 mL, obtained at a storm line outfall (CS02) on February 26, 2002. There was no rain on that date. High results (6,000 to 13,000 organisms/100 mL) were obtained all along Johnson Creek on August 22 and 23, 2001, corresponding to a 0.73-inch storm event. All other concentrations were less than or equal to 6,000 organisms/100 mL. Concentrations at outfalls tended to be similar to instream concentrations, and no other trends were apparent in the E.coli data.

Fecal Coliform

Most of the focal coliform data (figures 5a-5e) were collected in the Johnson Creek watershed. High results, ranging from 6,000 to 12,000 MPN/100 mL were obtained on August 22-23, 2001. This is the same 0.73-inch storm event that corresponded to high E.coli levels. In addition, a result of 30,000 MPN/100 mL was obtained for the Boeing landuse-based location. No trends are apparent in the data, although it should be noted that there are very few outfall data results.

Ortho-phosphate

Ortho-phosphate in Fairview Creek generally ranged from 25-100 µg/L. Outfall and tributary concentrations seem to be slightly higher than instream concentrations. Although for the most part outfall and tributary concentrations were below 200 µg/L, concentrations at locations FCOS1, OWEB7-1, CSO3, and CSO5 were often in the 100-150 µg/L range. The two highest values were 720 µg/L at FCOS1 and 1,680 µg/L at location CSO5 (Gresham Wastewater Treatment Plant storm outfall). Both samples were collected on July 18, 2000, a day with no rain.

Concentrations in the Johnson and Kelly Creek watersheds were generally below 50 µg/L; lower than those in the Fairview watershed. Also, ortho-phosphate tended to decrease downstream in the Johnson Creek watershed, although there were a few exceptions. No other trends were apparent in the ortho-phosphate data.

Total Phosphate

Uncharacteristically high total phosphate levels were observed in the 1996 TMDL study (Figures 7a and 7c), ranging from 3,500 to 10,000 µg/L. In the recent data, the two uppermost locations (FCI3 and FCOS1) in the Fairview watershed tend to have the highest concentrations, although there are many exceptions. Instream results were generally less than 1,000 µg/L. Outfall in tributary results were generally similar to instream results, although there were five samples from locations CS1 (upstream construction site) and CSO5 (Gresham Wastewater Treatment Plant storm outfall) with results in the

1,000 - 3,000 µg/L range. Three of these results were obtained during storm events (0.62 to 0.8 inches rainfall), and two during dry weather.

In the Johnson Creek watershed, the three highest results were obtained from location JCI2; however, this location also often exhibited very low total phosphate. Similarly, location KCI3 in the Kelly Creek watershed resulted in three uncharacteristically high total phosphate results, but often was among the locations with the lowest concentrations. Location KCI3 corresponds to a detention facility that is frequented by numerous dogs and birds, a possible source of phosphate.

Total Copper

Instream copper concentrations were generally less than 10 µg/L. There were 17 results between 10 and 20 µg/L (Figures 8a-8e). Of these, one occurred during dry weather, one with a rainfall of 0.02 inches, one with a rainfall of 0.21 inches, and the rest occurred during rainfall of 0.5 inches or more. Two instream results exceeded 20 µg/L: 20.7 µg/L .on August 22, 2001 (0.5 inches rain) at location FCI3 and 37.8 µg/L on August 29, 2000 (no rain) at location KCl2. Outfall concentrations were generally similar to instream concentrations. Concentrations in about half of the land use-based samples were above 10 µg/L, and ranged as high as 32 µg/L. No trends were apparent in the copper data.

Total Zinc

Based on 50 µg/L hardness, most in-stream results were below criteria. The majority of the high values (above 65 µg/L) were found in the land use-based sampling, where there were several values above 100 µg/L, up to a maximum of 310 µg/L at Fairview Park. There were 9 instream samples with zinc concentrations above 65 µg/L; all corresponded to storm events, ranging from 0.5 to 0.88 inches rainfall. None of the outfall or tributary sample concentrations was above 65 µg/L; thus outfall and tributary concentrations seem to be better (less) than in-stream concentrations. No other trends were apparent in the zinc data.

Total Lead

Lead exceeded the drinking water limit of 50 µg/L once with a value of 140 µg/L during the 1996 TMDL sampling. A lead result above the acute aquatic toxicity criteria occurred at the Boeing site - all other results were below the acute criteria, although there were numerous results above the chronic level (based on 50 mg/L hardness). Within the instream Fairview locations, the upstream locations (such as FCI3, FCI2 and FCL1) tend to have higher values (between 5 and 20 µg/L), whereas some downstream locations, such as OWEB6-I and FCI0 tend to have lower values, although too much scatter to identify a downstream trend. Fairview tributary and outfall concentrations were similar to instream concentrations with one exception, a result of 30.9 on April 13, 2000 at location CS05, a day with 0.62 inches rainfall. Lead concentrations in the Johnson and Kelly Creek watersheds were generally less than 4 µg/L. There were approximately 50 instream, outfall and tributary sample results in the three watersheds that were above 5 µg/L, only one of which occurred during dry weather, and most occurred during storms of 0.5 at least inches rainfall.

Recommendations

Monitoring programs should be designed with underlying "drivers" in mind. Drivers may include regulatory requirements for monitoring, regulatory limits that may apply, known issues or sources, or indicator parameters (such as TSS). Where there is sufficient history of sample results at acceptable levels, monitoring may be decreased (either in frequency or number of locations). Decreased monitoring can then be used to track long-term trends. Where "event- monitoring" (storm runoff, industrial source, etc.) is desired, higher frequency is required, because a short-term event is unlikely to be captured during, for example, quarterly monitoring. What follows are general recommendations. The detailed regulatory requirements applicable to the City of Gresham have not been thoroughly reviewed, and any changes to monitoring should be taken only in the context of such requirements.

Most of the organic analyses (including oil and grease) currently conducted do not have specific limits, and could reasonably be decreased or even eliminated. At a minimum, infrequent oil and grease sampling is recommended as an indicator parameter. The City may wish to determine the types of organics (pesticides, for example) commonly used in Gresham, and target some sampling towards those organics. "Traditional" suites of organics, such as EPA Method 601, generally do include "modern" pesticides. E.coli and/or fecal coliform monitoring should continue.

Ongoing monitoring of nutrients, including nitrogen, is recommended as indicator parameters, although some reduction, particularly for nitrogen, may be possible. TSS and pH are also valuable as indicator parameters, and laboratory costs are relatively inexpensive.

Monitoring for chloride, if not required for outfall monitoring, could be decreased.

The metals copper, lead and zinc should continue to be monitored. Nickel seems to not be problematic and sample frequency and/or number of locations could be decreased. Also, most regulators are concerned with total concentrations. While occasionally analyzing the dissolved fraction may be interesting, and help to determine how much of the metals are being transported with sediments, there is generally not a regulatory driver for dissolved metals, and thus these analyses could be eliminated. It is important to continue to collect hardness data concurrent with metals analyses.

Conclusions

A few general observations can be made based on the above analysis:

- There is very little indication that outfall concentrations are greater than instream concentrations.
- Where notably high concentrations occur, either instream or in outfalls, they are almost always associated with storm events of more than 0.5 inches.
- There is potential for the City of Gresham to streamline its monitoring program by targeting constituents with a history of values above criteria, and scaling back monitoring for constituents with sufficient data to indicate that they are unlikely to be of concern.

Table 1. Summary of water quality criteria exceedances. Where multiple criteria existed, the most extreme criteria was used to create this summary.

	pH	E. Coli	F. Coli	Chloride	NO3	Ortho-Phosphate	Total Phosphate	Toluene	Total Mercury	Total Phenols
# Samples	547	644	163	179	286	503	566	1	11	13
# Exceed.	54	400	119	0	4	385	269	0	11	0
% Exceed.	10	62	73	0	1	77	48	0	100	0

	Arsenic	Total Cadmium	Total Chromium	Total Copper	Total Lead	Total Nickel	Total Zinc
# Samples	11	181	212	238	512	221	221
# Exceed.	0	0	0	84	270	2	53
% Exceed.	0	0	0	35	53	1	24

	Dissolved Cadmium	Dissolved Chromium	Dissolved Copper	Dissolved Lead	Dissolved Nickel	Dissolved Zinc
# Samples	179	200	208	476	208	208
# Exceed.	0	1	19	28	0	19
% Exceed.	0	1	9	6	0	9

Table 2. Water quality criteria

Constituent	Fresh Acute Criteria	Fresh Chronic Criteria	Drinking Water MCL	Columbia Slough
1, 1, 1-trichloroethane				
BOD				
BOD5				
Butanone				
Cd				
Cd-Dissolved				
Cd-Total	1.8+	0.66+	0.01 mg/L	
Chloride	860 mg/L	230 mg/L		
Chlorophyll-a				15 ug/L
COD				
Color				
Conductivity				
Cr-Dissolved				
Cr-Total	16	11	0.05 mg/L	
Cu	9.2+	6.5+		
Cu-Dissolved				
Cu-Total				
Diesel Hydrocarbons				
Dis. Oxy				
E. Coli				126/100 mL
Fecal coliform				200/100 mL
Fecal Strep				

Constituent	Fresh Acute Criteria	Fresh Chronic Criteria	Drinking Water MCL	Columbia Slough
Gasoline Hydrocarbons				
Hardness				
Heavy Oil Hydrocarbons				
NH3-N			8.2 mg/L	
Ni-Dissolved				
Ni-Total	789+	88+		
Nitrates			10 mg/L	
Nitrites				
NO3-N				
Particle Size Distribution				
Pb				
Pb-Dissolved				
Pb-Total	34+	1.3+	0.05 mg/L	
P-Diss				
pH				Less than 6.5 or greater than 8.5
P-Ortho				0.02 mg/L
P-Total				0.1 mg/L
Res. Chlorine				
TDS				
Temperature				
Tetrachloroethene				
TKN				
TOC				
Toluene	17500			
Total Arsenic	360	190		
Total Mercury	2.4	0.012	0.002 mg/L	
Total O/G				
Total Organic Nitrogen				
Total Phenols	10200*	2560*		
TSS				
Turbidity				
Vol Organics				
Zn-Dissolved				
Zn-Total	65+	59+		