2006 Seattle Benthic Index of Biotic Integrity (BIBI) Results

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INTRODUCTION

Benthic macroinvertebrates are backbone-less, bottom-dwelling organisms that are large enough to see without magnification. They are frequently used as an indicator of biological integrity in streams because they are abundant, easy to collect, non-migratory, and their populations are sensitive to human disturbance. The Benthic Index of Biotic Integrity (BIBI) is a multi-metric index that indicates the degree of human impact on streams based on measurement of different factors, including taxonomic richness and composition, tolerance and intolerance, feeding group, and life cycle length. The 2006 BIBI samples were collected using a protocol based on the methods developed by Dr. James Carr at the University of Washington.

The 2006 volunteer samplers, their sampling locations, and the overall B-IBI score are summarized in Table 1.

Table 1. Sample sites and collectors

Station ID	Creek	Location	Collectors	B-IBI score
LF01	Longfellow	SW Brandon St btwn 27th and 28th Ave SW	Bob Antieau Cameron Chapman	20
LF03	Longfellow	SW Willow St./24th Ave SW	Kathy Devlin Chester Wilson John Kook	14
LF04	Longfellow	US of SW Adams St. btwn. 26th and 28th Ave SW	Derek Kuda James Day Kathy Gramann Lindy Peterson	16
MA01	Mapes	Upstream of Renton Ave S.	SPU staff	26
TA01	Taylor	Upstream of top culvert at 68th Ave. S. & Holyoke Way S.	SPU staff	20
TA03	Taylor	Between the arch culverts upstream of Rainier Ave S.	Mary Hedgecock Elizabeth Uding Marian Wolfe	20
FA01	Fauntleroy	In Fauntleroy Park upstream of the YMCA at 9140 California Ave SW	Kevin See Tara Roesberg	28
FA02	Fauntleroy	4539 SW Director St	Erin Howell Paul Yurky Shani Wilbur	32
SC01	Schmitz	Upstream of SW Admiral Way, mid-way up stream system (off-trail)	SPU staff	26

All data are preliminary and may contain errors. Final QA/QC review has not been completed.

METHODS

The 2006 BIBI samples were collected using a standard protocol based on the methods developed by Dr. James Carr at the University of Washington. Nine sites were sampled in 2006. For details, see Appendix B, Seattle Public Utilities Benthic Macroinvertebrate Sampling Protocol. There is also a Quality Assurance Project Plan (QAPP) for this monitoring effort. It is currently being updated as part of a new quality assurance documentation system.

<u>BIBI Stream Scores</u>

10 – 16 Very Poor
18 – 26 Poor
28 – 36 Fair
38 – 44 Good
46 – 50 Excellent

TAXONOMIC CHANGES IN 2006

Every year, there are slight changes to taxonomic names and characteristics of some macroinevertebrates, based on new scientific information. These changes affect the BIBI calculation. For example, some species may be determined to be long-lived, predators, clingers, or tolerant species when this information was not known before. There can also be species collected that were not found in prior years.

HOW THE BIBI IS CALCULATED

Each of the 10 metrics (total number of taxa, # mayfly taxa, # stonefly taxa, # caddisfly taxa, # long-lived taxa, # intolerant taxa, % tolerant individuals, % predator individuals, # clinger taxa, and % dominance of the top 3 taxa) is assigned a value. This value is based on the benthic macroinvertebrate community characteristics observed over a range of human disturbance. The values are added together to create a score for the site. The amount of change in a BIBI score year to year that can be considered significant depends on the number of years the site has been monitored.

HOW LOW ABUNDANCE AFFECTS THE B-IBI SCORE

A sample size of greater than 400 – 500 individuals is considered ideal for BIBI-type analysis. Conclusions can still be drawn from looking at samples with less than 400 individuals, but confidence decreases that the sample accurately reflects the conditions of the sample location. Fauntleroy and Schmitz Creeks had very low abundances, ranging from 87 individuals to 166 individuals per 9 square feet sampled. The data for these sites has been quality coded accordingly.

RESULTS BY CREEK

Fauntleroy Creek

Two sites were sampled on Fauntleroy Creek, one at 4539 SW Director Street (FA02) and one upstream in the new wood placement project in Fauntleroy Park (FA01). The upstream site scored a 28, while the downstream site scored a 32. These scores place these sites in the "fair" category, an improvement over 2004 when the most downstream site (FA03) was rated fair and FA02 was rated poor. In 2006, *Heleniella "long seta"*, a type of midge, was found in Fauntleroy Creek. This species is new to the Seattle sample set – it had never been collected before. Low numbers of tolerant species, a good number of predator species, and a greater diversity of species represented boosted the overall B-IBI score at these two sites. There were a number of long-lived and more sensitive invertebrates found in the samples from Fauntleroy Creek. However, the overall number of individual macroinvertebrates collected over nine square feet of creek bed was very low – 116 individuals at 4539 SW Director Street and 166 individuals in Fauntleroy Park. Some of the B-IBI metrics where these sites have traditionally scored higher are particularly vulnerable to being skewed by low abundance, so the high scores through time may be somewhat deceptive. The graph at the back of this report show the 2006 score for the downstream site on Fauntleroy, because this is the most long-term sampling location.

Longfellow Creek

Three sites were sampled in Longfellow Creek this year: upstream of the fishbone bridge in Longfellow Creek Greenspace near the Adams Street end (LF04); upstream of the Brandon Street crossing at the south end of the

West Seattle Golf course (LF01); and upstream of the SW Willow Street crossing (LF03). The B-IBI scores for these sites were: LF04 = 16, LF01 = 20, LF03 = 14. Compared to 2002, one site (LF04) decreased slightly and the others rose slightly. All of the sites were in the very poor to poor range. There was a high abundance of individual invertebrates at all of the sites, ranging from 1255 individuals to over 3000 per site. The difference between the Brandon St site and the Willow St and Adams St sites can be attributed to a community mixture that was a bit less dominated by two taxa (a disturbance-tolerant mayfly named *Baetis tricaudatis* and a black fly, *Simulium.*) The Brandon St. site also had a smaller percentage of tolerant individuals.

Mapes Creek

The B-IBI score for the Mapes Creek site declined slightly from the last time this location was sampled, from a score of 32 in 2004 to a score of 26 (poor) in 2006. The reason for this decline is unknown. The invertebrates in Mapes Creek paint an interesting picture: despite the score of "poor," there are more different types of mayflies and stoneflies at this site than the other sites sampled in the city in 2006, and the number of different taxa represented is high, with 39 different kinds of macroinvertebrates collected in the sample. A greater number of clinger taxa, a lower percentage of tolerant individuals, and less dominance of one particular taxa were the drivers. Also, the site had a high abundance of individual invertebrates (1,090) which means that the confidence in the B-IBI score is also correspondingly high.

Schmitz Creek

The BIBI score for the site located in Schmitz Creek was 26, the same score it received the last time this site was sampled in 2004. This places the site in the "poor" category. A kind of midge that is new to SPU's sample set, *Smittia,* and a type of crane fly, *Erioptera,* were found in Schmitz Creek, also for the first time. Unfortunately, the overall abundance of individuals at this site was quite low (only 87), making it difficult to tell whether the metrics that make this site score higher than other sites are truly due to better site conditions, or a sampling or mathematical artifact.

Taylor Creek

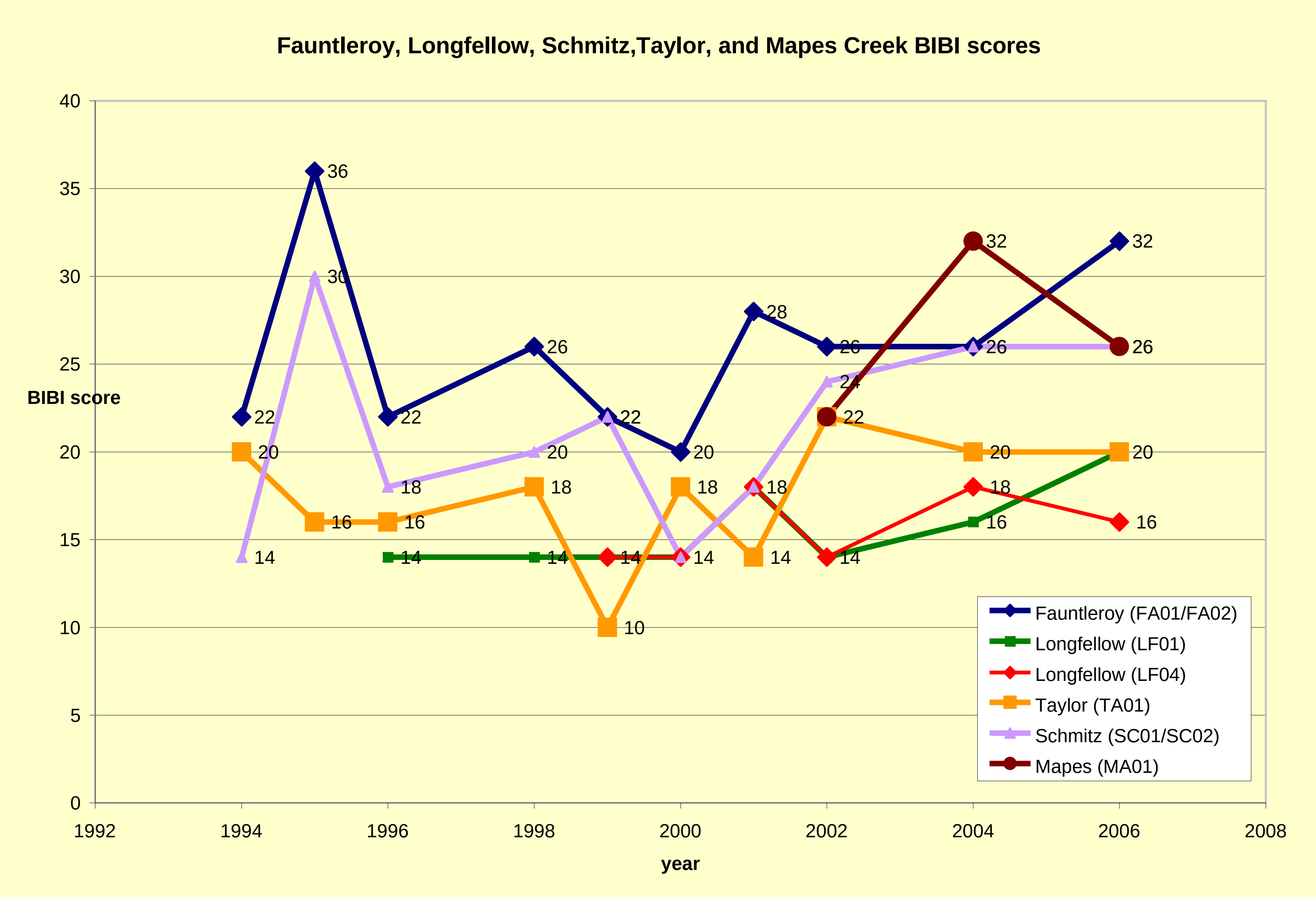
Two sites were sampled at Taylor Creek, one upstream of the culverts replacement project at 68th Ave SE and Holyoke Way SE (TA01), and one downstream between the two culverts (TA03). Both sites scored in the "poor" category, with a score of 20 for each site. Abundance was good at the site between the two culverts, but marginal in the upstream site. The B-IBI score for the downstream site improved from 14 to 20. This increase is significant, and may indicate that the site is finally stabilizing from the culvert replacement and restoration work that was done in 1999. While both sites scored the same, closer inspection of the results reveals that the downstream site appears slightly more disturbed than the upstream site, as indicated by the higher numbers of *Baetis tricaudatis* and the lower numbers of predators at the downstream site.

CONCLUSIONS

Although all the sites are located in heavily-impacted urban systems in the very poor to fair range only, most sites had the same or slightly higher scores than in previous years.

ACKNOWLEDGEMENT

This data could not have been collected without the hard work of dedicated volunteer samplers. Their contribution continues to increase the scientific knowledge regarding biological integrity in Seattle creeks, and is very much appreciated.



(For Fauntleroy graph line, score from FA02 used for 2004 and 2006, since that site is the more long-term monitoring location. For Schimitz, the SC01 site was sampled in 2004 and 2006.)

All data are preliminary and may contain errors. Final QA/QC review has not been completed.

APPENDIX A
Chronological record of protocol and site changes, SPU benthic macroinvertebrate monitoring program

1994 -1995: The collection program begins at 5 sites near the mouths of Puget, Fauntleroy, Schmitz, Taylor, and Thornton creeks. These sites are chosen to represent the most downstream locations on these creeks that meet the following criteria: they are located in a riffle on public property, are not tidally influenced, and are relatively lightly-impacted by immediate site conditions. Three replicates are collected per site from a 1 square foot area of creek bed using a Surber sampler and University of Washington B-IBI protocols. All collection and processing was carried out by staff. Macroinvertebrates are separated from sediment and organic matter by staff in the office, using no magnification, and then the macroinvertebrates are sent to Aquatic Biology Associates in Corvallis, Oregon for identification.

1996: Sites are added on Pipers, Venema, Longfellow, and Thornton Creeks.

1997: A preservation problem causes all the samples for this year to disintegrate before they reached the taxonomic laboratory. No data this year.

1998: Sites are added at Ravenna, Littles Creek (Thornton tributary), Thornton north branch and south branch, and Willow Creek (Thornton tributary.)

1999: Number of sites monitored jumps from 14 sites to 25 sites on eight creeks, most of which are short-term monitoring stations for creek restoration projects constructed by Seattle Public Utilities in 1999 and 2000. The Fauntleroy creek site FA01 is replaced by a downstream site outside the park with less foot traffic, FA02. Two temporary sites on a tributary to the south branch of Thornton Creek known as Willow Creek (TW01 and TW02) are discontinued and replaced by a more downstream site, TW03.

2000: The processing required for the number of sites being monitored becomes too time-consuming to continue in-house at SPU. Aquatic Biology Associates agrees to receive the whole samples (with organic and inorganic material) and begins separating them in the lab prior to identification. A site on Puget Creek (PU01) is discontinued when the creek is found to lack year-round flow.

2001: Trained volunteers begin to collect samples. Two sampling sites on the main stem of Piper's Creek, PI04 and PI01, are determined to be close enough together that PI04 can be discontinued. A site located in the headwaters of Taylor Creek (TA02) is discontinued due to poor flow conditions. TL01, the Littles Creek site, is discontinued due to poor substrate conditions (too sandy, few gravel or cobble.) A site on the south branch of Thornton Creek near Nathan Hale High School (TS01) is abandoned due to heavy bank erosion and foot traffic in that area.

2002: Based on statistical analysis of benthic macroinvertebrate data, sample collection is switched to every other year per site, alternating the north end and south end of the city. South end sites (Longfellow, Fauntleroy, Schmitz, and Taylor Creeks) are sampled. A site on Mapes Creek in Kubota Garden Park (MA01) is added to assess the productive capacity of that system. Sampling on Washington Creek through Arboretum Park is attempted, but no good sampling locations can be found.

A few sites are reviewed and discontinued for various reasons: a site on Longfellow Creek near SW Thistle St. (LF02) because of poor flow and large site-specific impacts; a site near the mouth of Piper's Creek (PI05) because of tidal influence; a Ravenna Creek site (RA01) because of too much dog and foot traffic at the site. One site on Schmitz Creek, SC01, is too contaminated with glass from bottles thrown off the SW Admiral St. bridge to be safe for sampling, and is replaced by another site futher upstream in the park (SC02.)

Analysis also indicates that the number of macroinvertebrates being collected per site each year is too low to have high confidence in the accuracy of the analysis. In order to address this problem, the amount of surface area sampled per site is increased from 3 square feet to 6 square feet and the samples are composited this year (no replicates.)

2003: North end sites are sampled this year (Pipers and Thornton.) Sample protocols are again adjusted upwards so that 3 square feet of creek bed per replicate, with 3 replicates making one sample (9 square feet of creek bed sampled.) Replicates are pooled for analysis. The first report on the analysis results for the volunteers is produced.

At a citizen's request, sampling is attempted at Licton Springs Park, but the sampling is unsuccessful because of excessive garbage and silt.

2004: South end sites are sampled this year. Analysis of 2003 samples indicates that corrective action has been successful and that the number of individual macroinvertebrates collected is now sufficient at most sites. The Mapes Creek site MA01 is discontinued due to excessive silt and replaced with a downstream site, MA02.

2005: North end sites sampled this year.

2006: South end sites sampled this year.

APPENDIX B
Seattle Public Utilities Benthic Macroinvertebrate Sampling Protocol

Remember, do not step in the water upstream from any sampling spot before or during sampling. Doing so will compromise the quality of your sample.

I. A metal washer with flagging will mark the downstream end of the riffle to be sampled, or your staff person will know where to sample.

II. Set up sampling area

- ♦ Find the most level spot with convenient access to the stream to set up. This location should be downstream of where you intend to sample. Lay out your tarp, and all of the equipment contained within your sampling duffel.
- ♦ Clearly fill in all required information (including replicate number) on 6 of the provided rite-in-rain labels using a pencil (2 for each sample jar, one inside and one outside). Lay these aside for future use.

III. Scan the area to be sampled

- ♦ The nine surber placements should be as evenly spaced as possible along the length of the riffle.
- ♦ All sampling should be done in the fastest, deepest part of the riffle, or, if the riffle is relatively uniform in depth, in the center of the stream.
- ♦ Always begin sampling at the downstream end, and proceed upstream from there.

Follow steps 1-13 below for collecting, cleaning, and preserving the sample. If for any reason you deviate from the protocol, take clear notes on what happened on your field data sheet.

IV. Sample collection

1) Place the sampler. Select the spot for the first placement of the surber (downstream end of the riffle), and with a teammate, carry the surber sampler, a watch or stopwatch, white dishpan, metal washer with flagging, gloves, and garden weeder to the first sampling location.

- ♦ Approach from downstream, avert your eyes from the stream bottom (to avoid bias in setting the net) and set the net down firmly in the substrate with the opening perpendicular to the flow.
- ♦ Brace the frame firmly on the bottom so the current won't carry invertebrates under the frame. If any large cobble lying under the edge of the frame prevents a good “seal,” pull it into the perimeter of the frame, even if part of the cobble lies outside the frame area.
- ♦ Lift the larger rocks resting within the frame. Place them in the dishpan for a closer look back on the streambank. If a rock is more than ½ inside the frame, you can add it to the dishpan.

2) Dig in the gravel. Use the garden weeder to disturb the creek bed within the frame for 60 seconds. Have the person who is not digging be the timer. Dig down to a depth of about 10 cm (marked with black tape on the weeder.) Pull the weeder back and forth within the frame in a back and forth pattern vigorously. This will bring up the invertebrates from the spaces between the gravel into the current and into the sampler.

3) Lift the sampler. After 60 seconds, lift the sampler, tilting the mouth of the sampler up out of the water, keeping the open end upstream. This helps to wash invertebrates into the cup.

4) Repeat steps 1 through 3 two more times, until you have placed the sampler on the creek bed and dug with the weeder a total of three times. If you switch jobs, make sure to do so when the net is out of the water.

Throughout the cleaning process, you will be using stream water to wash the sample. To avoid contaminating your sample with extra macroinvertebrates, remember:
any water poured on the sample must first pass through 500 micron mesh.

5) Standing in the stream, rinse down the sides of the surber sampler, shaking it to loosen organisms from the sides of the net.

- If you use unfiltered water, pour from the outside so the water goes through the mesh net of the sampler.
- Once the net has been washed down, move back to the stream bank and empty the contents of the sampler into one of the white buckets.
- Check over the inside of the net with tweezers for any bugs, including around the edge near the detachable "bucket" where insects may get trapped. You may want to use the squirt bottle to dislodge organisms.
- Remove and rinse any rocks or large organic debris (such as leaves or small branches) from the dishpan.

6) Pick over the large rocks in your dishpan that you removed from the frame area. Don't discard objects that appear to be small pebbles clinging to the rocks, as these may be case-building caddisflies.

- Before returning the rocks to the stream, rinse them over your dishpan with filtered water to dislodge any remaining invertebrates.
- As you clean your sample, remember to regularly rinse your hands with filtered water over the dishpan.

7) If you find mussels, crayfish, or fish, note the organism in the field data sheet and return the organism to the stream.

8) When you've finished removing the larger rocks and plant debris (don't accidentally throw rocks upstream of where you have yet to sample), a mixture of invertebrates, leaf bits, sand, and gravel will remain in the dishpan.

V. Preserving the sample

9) Removing excess water. By now your dishpans will have extra water in it from the successive washings. Swirl it around to agitate all the remaining material and pour off material and water into the 500 micron sieve. Set the sieve aside on a safe place on the tarp.

10) Assess the amount of material to be preserved, and decide which size sample jar works best. The sample jar should be filled only halfway with drained sediment and macroinvertebrates – the rest will be alcohol. This ensures that the sample is preserved correctly. When you fill the jar with the sample, if it is more than half full, select a bigger jar. If you have a bit more alcohol than material, it's ok. If you're using the biggest jar and it is still more than half full, use two jars for the sample and distribute the material between them. The label on the first jar should clearly say "1 of 2" and the second jar should say "2 of 2."

11) Using your spatula, directly transfer the sand and gravel remaining in the sieve directly into your sample jar. Give the dishpans one final rinse with filtered water to capture anything clinging to the sides, and again pour the water through the sieve and transfer to the jar. You may need to use the forceps to transfer the last few organisms from the sieve and spatula into the jar.

12) Check over the dishpans and sieve for bugs with tweezers in the best light available. Transfer any organisms found into the sample jar.

13) Labeling. Add one filled-out label to the jar, and attach one firmly to the outside with the black electrical tape. Fill the jar with alcohol to the rim, and seal the jar with electrical tape at the rim. Place in safe place where it won't get knocked over.

IV. Repeat steps 1 through 16 two more times, until you have 3 sample jars (3 replicates) total.

Last...

1) Complete your field form after the sample is taken.
2) Repack the duffel bag, cleaning off the equipment using the rag or paper towels provided in the bag.
3) Check off the equipment as you return it to the bag, so that the next team will have everything they need.
4) Return the sample jars and kit.

APPENDIX C. MAPS OF THE SAMPLING SITES

Figure 1. Fauntleroy Creek sites

Figure 2. Schmitz Creek sites

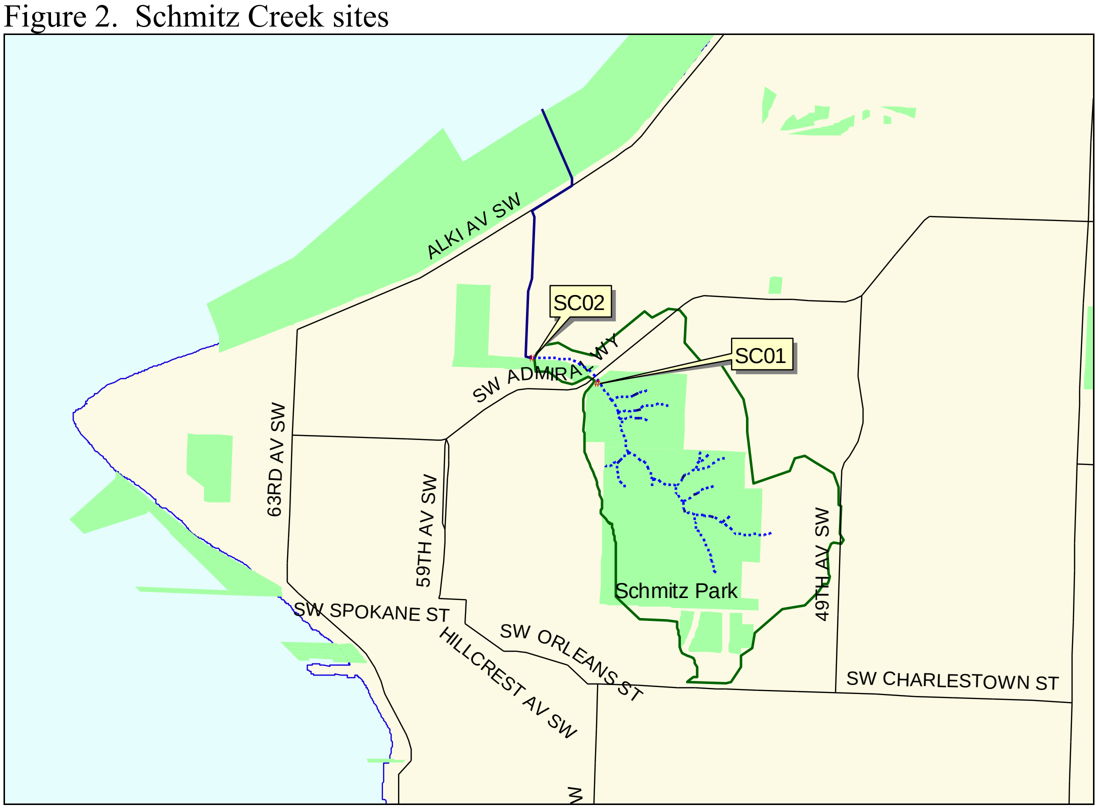


Figure 3. Mapes Creek site

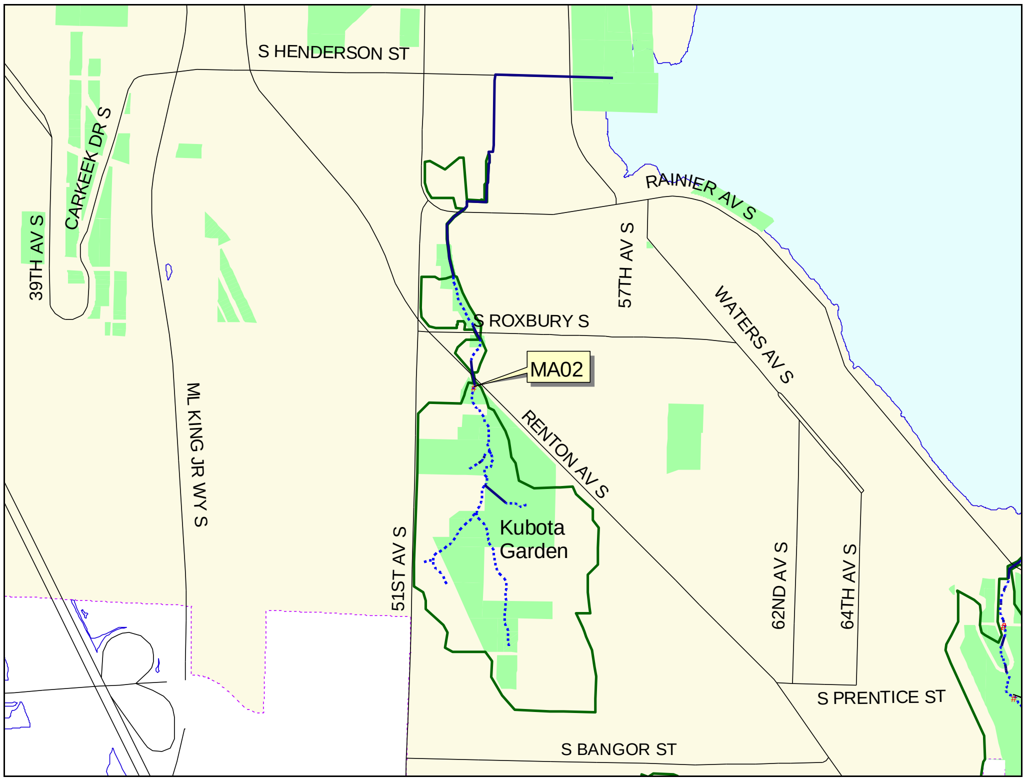


Figure 4.Taylor Creek sites

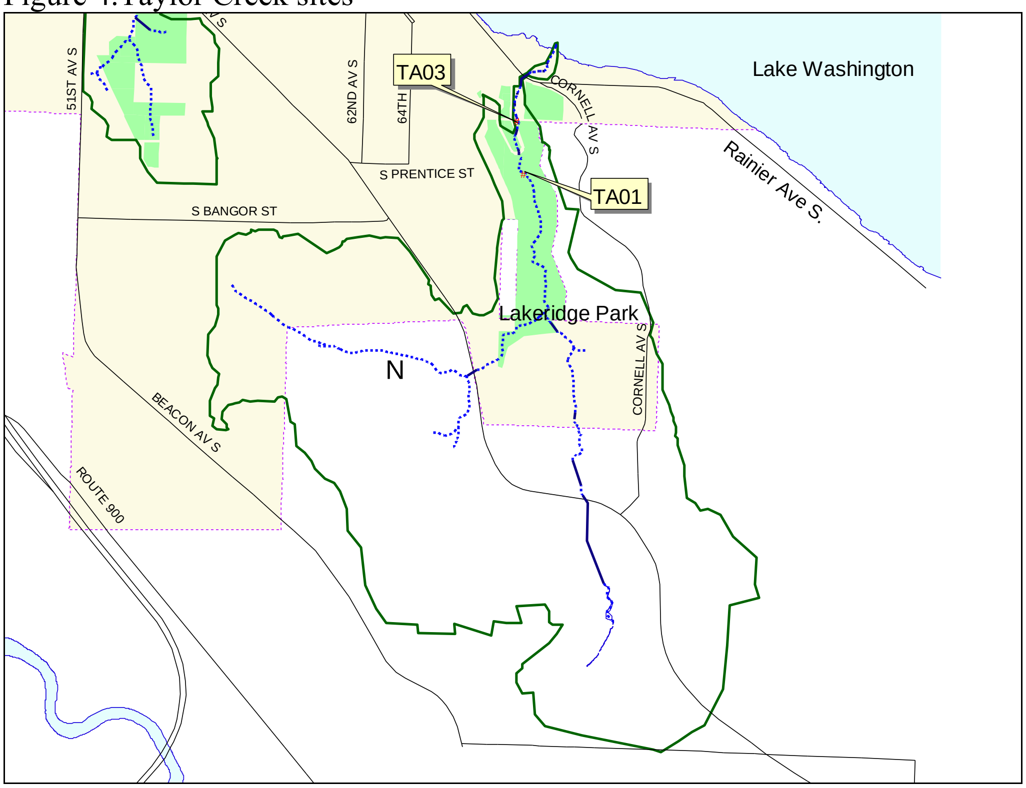


Figure 5. Longfellow Creek sites

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