
Puyallup-White Basin Fecal Coliform Total Maximum Daily Load Work Plan 2019–2024

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King County

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EXECUTIVE SUMMARY

This document describes King County Stormwater Services’ plan to address its Phase I National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permit requirements for the Puyallup-White River fecal coliform total maximum daily load (FC TMDL). This document is called the Puyallup-White FC TMDL Work Plan, 2019–2024.

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1.0 INTRODUCTION

The King County Department of Natural Resources and Parks, Water and Land Resources Division, Stormwater Services Section, is responsible for planning and implementing actions to comply with the Phase I National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permit. Among the various actions required of King County in the permit are those intended to address the potential impacts of stormwater on impaired water bodies in the County's jurisdiction. In particular, violations of State water quality standards for fecal bacteria have led to the creation of a fecal coliform bacteria TMDL for the Puyallup and White Rivers. This document specifically describes King County's plan to respond to the FC TMDL requirements for the Puyallup and White River watersheds.

The purpose of this document is to provide guidance on the processes and procedures needed to perform the task(s) that are the subject matter of this work plan. The processes and procedures that are described are meant to apply to the ordinary performance of routine tasks, as well as to serve as a training aid for inexperienced staff being trained in performance of the task(s). Emergencies, complex situations, and other unique or non-routine situations may arise that require flexibility and even departure from the processes and procedures described herein, or taking additional measures that would not ordinarily be used in dealing with routine situations. This guidance document is not meant to act as a substitute for informed and prudent judgment, which must be diligently and carefully exercised at all times in the performance of the tasks described herein.

2.0 BACKGROUND

The Puyallup and White River watersheds together comprise Water Resources Inventory Area 10 (WRIA 10) in western Washington State. The White River watershed occupies the southernmost portion of King County and the northernmost portion of Pierce County, and the White River itself forms the border between these two counties for much of its length (see Figure 1). It empties into the Puyallup River just west of the City of Sumner, in Pierce County. The Puyallup River watershed is immediately south of the White River watershed, and is entirely within Pierce County. Thus, all of the work to be performed by King County as described in this document is to take place in the White River watershed, and none in the area draining to the Puyallup River.

Until 2019, the fecal bacteria water quality standard for these rivers, due to their designation as “primary contact recreation” water bodies, was a geometric mean fecal coliform level of 100 colony-forming units per 100 milliliters (cfu/100 mL), with not more than ten percent of samples exceeding 200 cfu/100 mL. In years 2006 and 2007, analytical work carried out by the Washington State Department of Ecology (“Ecology”) established that these rivers and some of their tributaries were in violation of these standards. Because of this, in 2011 Ecology implemented the Total Maximum Daily Load (TMDL) program for fecal coliform (FC) bacteria in the two watersheds (Ecology 2011).

The creation of the TMDL ultimately led to legal requirements for King County to address the problem. Under Appendix 2 of the 2013-2018 Phase I National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permit, King County was required to perform certain tasks to attempt to reduce bacterial loadings to these rivers and their tributaries. Specifically, King County was to prioritize the Boise Creek and Jovita Creek drainage basins as high-priority areas for illicit discharge detection and elimination. Field screening was to include screening for bacteria sources throughout these two creek basins, in both the wet season and the dry season. The group within the County responsible for this work is King County Stormwater Services (SWS).

King County SWS’s work in response to these requirements has been summarized in annual reports for the last five years. To recap, SWS was able to identify five failing on-site sewage systems (OSS) in the Boise Creek basin, four of which have been eliminated and one which is still being mitigated by the Department of Public Health Seattle-King County (DPHSC). King County SWS also identified several properties that were suspected of contributing domestic-animal fecal waste to Boise Creek, and referred these properties to the King Conservation District as well as the Department of Ecology, who are better equipped to provide technical assistance to agricultural property owners than is SWS.

In 2019, Ecology issued a new Phase I NPDES Municipal Stormwater Permit that will be in vigor from 2019–2024. Appendix 2 of this permit was updated to require King County to screen its MS4 in all portions of the Puyallup/White watershed not previously screened under the prior permit (i.e., in the

unincorporated portion of the White River watershed outside of the Boise and Jovita Creek basins). No deadline is provided for this work, so it is assumed that it will take place throughout the five-year permit period.

Also at the beginning of 2019, Washington State changed the regulatory parameter for fecal bacteria in freshwater from fecal coliform to *Escherichia coli*. The new water quality standard for the White River and the creeks flowing into it is a geometric mean *Escherichia coli* level of 100 cfu/100 mL, with no more than 10% of samples in any three-month period to exceed 300 cfu/100 mL.

Prior to the creation of the present document, SWS did not have a written plan outlining its work in the White River TMDL area. In brief, the work performed was a combination of dry-season/dry-weather reconnaissance (and sampling and analysis where non-stormwater flows were found in the MS4), and wet-season/wet-weather sampling and analysis at key locations in the MS4. The parameter measured most commonly was *Escherichia coli*. King County SWS believes it did thorough work in the Jovita/Boise basins, and interactions with Ecology staff have suggested satisfaction with the work performed. On the other hand, the Jovita and Boise Creek basins represent the first places King County SWS had ever done bacteria screening for a fecal coliform TMDL. The work carried out over the last several years has allowed SWS to formulate what it believes is an effective approach to this work; the experience also made clear that it is desirable to have a plan at the outset of the permit period, even if this delays the actual commencement of screening activities.

This document outlines SWS's work plan in the White River TMDL area for the 2019-2024 permit period. The general approach has been described in a separate standard operating procedures document (King County 2019). The present document gives more specific information on the work to be performed in the White River watershed.

The following section of this document provides a desktop analysis of the White River TMDL area, describing the geography/hydrography, land use, and infrastructure in the overall watershed. It also provides information on which portions of the watershed will be screened in each year during the permit cycle. Following the desktop analysis is a description of the reconnaissance, sampling, and analysis activities that will take place during each season. Following this is technical information regarding the analytical methods and tools to be used when screening for illicit bacterial discharges in the MS4. Finally, the appendices of the document provide detailed maps and field sheets needed for the field screening work to be performed. Appendix A provides maps and field sheets for the area to be screened in water year 2019-2020 (i.e., October 1, 2019 – September 30, 2020); the subsequent appendices, to be added in each subsequent year, will provide similar maps and field sheets, in preparation for each subsequent year's work.

3.0 DESKTOP ANALYSIS

King County shares jurisdiction of the White River watershed with several other legal entities. As mentioned above, the portion of the watershed north of the river (i.e., on the river's right bank) is generally in King County, and the portion of the watershed south of the river is in Pierce County. On the King County side, the cities of Enumclaw, Auburn, Algonia, Pacific and the Muckleshoot Tribal Reservation also occupy portions of the watershed. As a result, the part of the White River watershed that is actually in King County's legal jurisdiction—where the TMDL requirements apply—is discontinuous, being broken into three portions: (1) the middle-upper portion of the watershed (see Figure 2), which is by far the most extensive of the three areas (about 27 square miles), containing the mountains and foothills southeast of Enumclaw, as well as the Enumclaw Plateau, down to the County's borders with the City of Auburn and the Muckleshoot Reservation; (2) the Jovita Creek basin (see Figure 3)—but only that portion in unincorporated King County, an area of about 2 square miles (some of this creek basin is in the city of Pacific and some is in Pierce County); and (3) Stuck Junction, a small unincorporated area surrounded by the City of Auburn, located south of 29th Street SE, north of 32nd Street SE, east of A Street SE and west of D Street SE, and measuring around 20 acres (0.03 square miles) in extent. A map of the Stuck Junction neighborhood can be found in Appendix A. (Information discussed in this section relating to zoning, hydrography, and stormwater and sewer infrastructure all comes from the King County GIS library or from Stormwater Services' stormwater geodatabase.)

The rural Enumclaw Plateau is one of the more important agricultural areas in King County. It is extremely flat and is generally comprised of poorly-drained soils originating from the Osceola mudflow originating on nearby Mount Rainier (ca 3500 BCE). The zoning in much of the unincorporated portion of the plateau is agricultural, and many of the properties are large in extent. The most common land use in this area is livestock grazing and farming of hay and silage. There are twelve known dairies licensed by the Washington State Department of Agriculture in the portion of the plateau draining to the White River, as well as a dairy manure digester (Rainier Biogas). There are also some small residential neighborhoods in the unincorporated area, with houses on small lots, especially around the perimeter of the City of Enumclaw. Drainage from the Enumclaw Plateau to the White River is generally from the north and east to the south and west. There are numerous creeks (often ditched and straightened) draining the plateau, but only Boise Creek (and, to a lesser extent, Red Creek) has significant flow year-round.

The Jovita Creek basin is suburban, with almost completely residential land use. Much of the construction in the basin took place in the 1940s, 1950s, and 1960s. Zoning is almost completely R-4, or four residential lots per acre. There is one business in the unincorporated portion of the basin, a convenience store. There are also two County parks in the basin: Five Mile Lake Park and the South County Ballfields, which are important recreation sites. Jovita Creek itself is the outflow from Trout Lake, which nearly dries up in the summer. Trout Lake receives the outflows from Five Mile Lake and Spider Lake, located in the northwest and northeast portions of the basin, respectively. There is no outflow from Five Mile Lake or Spider Lakes in the summer.

The Stuck Junction area of the White River watershed is also zoned R-4, and houses were generally built in the same time period as those in the Jovita Creek basin. There are no natural watercourses in the area, and stormwater from the County's MS4 enters the City of Auburn's MS4 before flowing to the White River.

Figures 4 and 5 illustrate stormwater and sanitary sewer infrastructure in the Enumclaw Plateau and Jovita Creek areas. There are generally no sanitary sewer lines in any unincorporated portions of the White River basin, and wastewater in the entire area is managed by on-site sewage systems (OSS); the exceptions are:

- Enumclaw Plateau: The entire unincorporated portion of the plateau is served by on-site sewage systems. The Muckleshoot Tribal Reservation is served by sanitary sewer; sewage from the Reservation flows into the City of Auburn's sanitary sewer system via the State Route 164 right-of-way.
- Jovita Creek basin: Lakeland Elementary School (35827 32nd Avenue South): The wastewater line from the school runs west on South 364th Street and enters the City of Federal Way (Lakehaven Water and Sewer District).
- Jovita Creek basin: houses along 38th Avenue South between South 380th Street and South 384th Street: Wastewater lines from these houses drain west across Military Road South and enter the City of Federal Way (Lakehaven Water and Sewer District).
- Stuck Junction: It appears that properties around the perimeter of the unincorporated area are served by the City of Auburn's sewer system, but properties on the interior of the unincorporated area might be served by OSS.

Generally, the stormwater infrastructure in the TMDL area has already been well mapped by SWS. The Enumclaw Plateau area is dominated by ditch-and-culvert stormwater conveyance, though there are some areas served by pipe-and-catch-basin networks, mainly in the more residential areas near the City of Enumclaw. The Jovita Creek basin is also mostly served by ditch-and-culvert stormwater conveyance, with pipe-and-catch-basin conveyance mostly found where there is newer development served by stormwater flow-control facilities. The Stuck Junction stormwater conveyance is completely pipe-and-catch-basin, and drains into to the City of Auburn's MS4.

There are few stormwater (flow control) facilities in the TMDL area, owing to the lack of recent and/or dense development. Most of the facilities are privately owned; there are only six County-owned stormwater facilities, all of which are in the Jovita Creek basin. All of these facilities, both County-owned and private, are inspected annually or semiannually by Stormwater Services.

A more detailed desktop analysis of the area to be screened in 2019-2020 can be found in Appendix A. Additional appendices will be added in ensuing years with more detailed desktop analyses for each year's focus area.

4.0 SCREENING PLAN

As outlined in SWS’s general SOP for its fecal bacteria TMDL projects, screening work will be focused in a different part of the White River watershed during each year of the permit cycle, and the specific work to be conducted will vary by season. The principal goal of screening work is to identify specific sources of fecal bacteria entering the County’s MS4 that can be eliminated or minimized through technical assistance and enforcement.

4.1 Geographic areas by year

Figure 6 illustrates the geographic areas to be screened in each year. To summarize, the first year (2019-2020) will focus on the Boise Creek drainage basin and all unincorporated areas draining to the White River above Boise Creek. Although Boise Creek was already a focus of screening work in the previous permit cycle, the inclusion of it in the first year of the present cycle will lessen the work load in the first year, allowing more time for planning of the five-year project; it will also allow the new TMDL SOP to be employed in a familiar area. (Additionally, some of the Boise Creek basin was already screened using the new SOP in early 2019.)

The second year will focus on all unincorporated areas draining to the White River downstream of Boise Creek and above the Second Creek drainage basin. The third year will focus on the Second Creek drainage basin, and the fourth year will focus on the Pussyfoot Creek drainage basin and all unincorporated areas draining to the White River downstream of Pussyfoot, to the Auburn city limits. The fifth year will allow for additional investigation at any sites of concern discovered during the previous years.

The Jovita Creek basin, having been thoroughly screened during the previous permit cycle, will be afforded time only as available. The Stuck Junction area will be visited during the first year of work.

4.2 Screening work: dry season, dry weather

In the dry season, SWS will prioritize areas draining to the White River as high-priority areas for IC/IDDE screening, within SWS’s already established conveyance screening program (CSP). All locations in the White River watershed where water leaves the County’s MS4 will be visited in dry weather and inspected for indicators of illicit discharges, including discharges impacted by fecal bacteria. At locations where flowing water is found, the water will be analyzed for SWS’s basic suite of screening parameters (temperature, specific conductance, pH, *E. coli*, and fluoride—the latter only in the Jovita and Stuck Junction areas, as drinking water on the Enumclaw Plateau is not fluoridated) to determine whether or not the water is an illicit discharge. Additional investigation will be initiated wherever measurements exceed SWS’s screening thresholds.

Much of this work was already performed in the previous permit cycle, including in the portions of the White River watershed newly covered under the current permit. Figures 7 and 8 illustrate the locations inspected in the Enumclaw Plateau and Jovita areas, respectively—each orange or green point indicates a location where stormwater leaves the County’s MS4. As can be seen in these figures, there is only one such location that has not yet been visited. There are three locations that have been visited and flowing water has been found, with no indicators of a problem, but no measurements were taken. These sites will be prioritized for screening and follow-up in the dry season of 2020. At all other locations where dry-season flow in the MS4 has been encountered in past years, analytical readings of the water have already been made.

4.3 Screening work: wet season, wet weather

At the beginning of the wet season, storms commence washing sediments (and bacteria, and other pollutants) accumulated on the landscape into receiving waters. Loadings of fecal bacteria to receiving waters are highest during these early-season storm events. SWS will collect samples during this part of the year at the largest watercourses in the White River watershed, with the intention of determining which watercourses are the most impaired, and which animals are most likely responsible for the impairments. Collectively, the watercourses to be sampled represent much of the unincorporated (King County) portion of the White River watershed.

The initial sampling will take place between late October and late November 2019, in three separate, scheduled events. Twenty sites will be sampled, and all samples analyzed for *Escherichia coli*. Samples from a subset of eight of these sites, representing the largest streams, will also be analyzed for Hu-2-Bacteroidales and Rum-2-Bacteroidales (see Figures 9 and 10 for a map of these sites; Table 1 has a description of each site). After the initial three events, up to four more sites (with relatively high EC results) will also have samples analyzed for these two biomarkers, in at least one more event. In sum, at least four events will take place; additional events may take place later in the 2019-2020 wet season, and/or in ensuing years, if there is sufficient sampling budget available. Generally, these events will need to take place after late October, as many of these watercourses do not flow year-round. Even larger streams such as Pussyfoot and Second Creeks do not flow until well into the wet season, due to the lack of impervious surfaces on the Enumclaw Plateau.

4.4 Screening work: wet season, dry weather

Most of the properties in King County’s jurisdiction are served by on-site sewage systems (OSS), and not by sanitary sewers. The White River watershed is no exception, as mentioned above. As laid out in SWS’s general FC TMDL, the best time to screen for inputs of fecal bacteria to the MS4 due to failing OSS is on dry days when the ground is wet due to recent rains. Due to the importance of finding failing OSS in the TMDL watershed, SWS will devote considerable time and resources to screening its MS4 when these hydrologic conditions prevail.

Work will be divided year-by-year into the geographic areas illustrated in Figure 6. The appendices of this document include more details on the work to be performed in each year, including maps of each

sampling/screening module (with the potential sampling points to be visited in each module). While the general FC TMDL SOP suggests creating work modules based on hydrologic catchments, the MS4 in many parts of the White River watershed does not lend itself to such delineation. As an example, the ditches and culverts in the SE Mud Mountain Road right-of-way constitute the only MS4 found in the upper portion of the watershed. This road cuts across several catchments of Red Creek (and other, unnamed creeks), and water from the roadside ditches is simply shunted to one side of the road or the other. As such, screening modules in many cases are focused on a stretch of roadway, rather than on a hydrologic catchment.

When screening work is conducted during the wet season, field procedures will vary slightly depending on whether the MS4 in the vicinity is “open conveyance” (ditches, with culverts at driveways and road crossings) or “closed conveyance” (subsurface drainage in pipes that can only be accessed via catch basins and manholes).

In areas of open conveyance, potential screening/sampling points will be mapped at locations where (known, mapped) private pipes and ditches enter County ditches, as well as at locations where water leaves the MS4. Each County ditch will be walked by County staff, with a focus on the previously mapped potential screening points. Likewise, any previously unmapped private pipes or ditches entering the MS4 will be mapped and also screened/sampled. (If a roadway has ditches on both sides of the road, it will only be walked once, and if only one staff member is conducting the work, s/he will inspect both sides of the road as s/he proceeds.)

In areas of closed conveyance, potential screening/sampling points will be mapped at locations where (known, mapped) private pipes enter the MS4, at locations where water leaves the MS4, and also at major nodes in the subsurface drainage network. Not all catch basins will be opened—only those where private pipes are mapped as entering, or if there is some other reason to believe private discharges are entering the MS4.

The locations of houses and fields are also important in determining screening locations. If there are no houses or agricultural fields abutting the MS4, it is unlikely that a private discharge will be found. On the other hand, where fields and houses are adjacent to the MS4, it is not uncommon to find a roof downspout leader, field tile, or ditch conveying water away from the private property. SWS considers its MS4 feature data to be fairly complete, but there is always the possibility of an unmapped feature.

At each screening location, staff will note whether there is flowing water at the site or not. Where flowing water is found, staff will qualitatively describe the amount (trickle, moderate, substantial), collect the water in a clear vessel and inspect it with eyeball and nose, and take a single, five-milliliter aliquot of water for *Escherichia coli* (EC) analysis with Coliscan Easygel. (If no flowing water is found, staff will still look for signs of illicit discharges.)

Coliscan Easygel results will be interpreted based on the location where the sample was taken, as well as the contributing basin. Additional investigation will be carried out where high results cannot be explained by known conditions upstream of the sampling point. Any site with a very high initial Easygel result will be revisited and a laboratory sample will be taken for EC analysis and qPCR prep (King County 2019). At sites with moderately high results, the site will be revisited and a second Easygel sample acquired; this will be analyzed before deciding whether to take a lab sample. In the Jovita Creek basin and in Stuck Junction, fluoride measurements also will be taken when following up on sites with initially high Easygel results.

Whenever following up at a given site due to a high result, staff will thoroughly consider what animals, land uses, or activities in the basin could have contributing to the high result. It is important to keep in mind that, although this work is to be conducted during dry weather, stormwater may continue to run off the landscape for days after a storm, thus carrying bacteria from the land surface to the sampling point; it will be important to recognize that this might be the case, and that a single high EC result does not in most cases indicate a failing OSS.

Although this work is timed to maximize chances of finding failing OSS, other likely sources of fecal bacteria, such as domestic animals, will also be noted during this work. If high fecal bacteria levels found in the MS4 are not accompanied by detection of the human biomarker, possible domestic animal sources will be investigated.

Finally, data loggers measuring water level and/or conductivity may be employed in this work, especially in areas served by sanitary sewers (e.g., southeast Jovita Creek basin, Stuck Junction) during dry weather. This may take place in the dry season or wet season. Best professional judgment will be used to determine whether it is appropriate to deploy these data loggers and any particular location; typically this will be in response to observations or measurements suggesting an illicit discharge, where more investigation is needed.

5.0 SAMPLING AND ANALYSIS

The principal water quality parameters to be measured for this project are summarized in Table 2. Of these, the fecal indicator bacteria *Escherichia coli* is the most important, and will be measured most frequently. Genetic markers such as Hu-2-Bac and/or Rum-2-Bac will be measured at sites with repeatedly high *Escherichia coli* readings. Water temperature, specific conductance and pH will generally not be measured in the wet season, and will only be measured in the dry season where flowing water is found in the MS4. Fluoride will be measured in those portions of the TMDL area where the domestic water supply is fluoridated, namely the Jovita Creek drainage basin and the Stuck Junction neighborhood. In these geographic areas, fluoride will be measured wherever flowing water is found in the MS4 in the dry season, and also in the wet season at specific sites of interest, typically in discharges from private pipes to the MS4.

Specifically with regard to in-house measurement of *Escherichia coli* with Coliscan Easygels, Stormwater Services will use Easygels in accordance with the manufacturer's instructions. All samples will be plated the same day and analyzed after 24-30 hours of incubation. Ambiguous colonies will be considered to be *Escherichia coli*. All plates will be photographed after incubation and prior to disposal.

With regard to the measurement of pH, specific conductance, water temperature, and fluoride, all field meters will be calibrated and maintained in accordance with the manufacturer's instructions.

More information about the measurement of these various parameters can be found in Stormwater Services IC/IDDE SOP (King County 2020).

5.1 Documentation and deliverables

King County SWS will summarize the work performed for this project in each annual report provided to Ecology (as it already does, according to the terms of its municipal NPDES permit). The summary found in the annual report will be limited to a brief, high-level recap, including the following:

- A description of any confirmed illicit discharges, and SWS's response to these;
- A map of locations visited/screened, including locations where water quality measurements were taken; and
- Any other observations relevant to understanding and responding to the overall fecal bacteria problem in the TMDL basin.

King County SWS will also document its work internally in a more detailed fashion; this documentation will not be included in the annual reports, but will be available to Ecology or other agencies upon request. This documentation will include:

- All water quality data acquired during screening work; these will be stored in SWS’s stormwater geodatabase;
- A map or description of each wet-season, dry-weather screening module that was visited during the year, with a high-level summary of screening results; and
- Data tables summarizing results from all wet-weather, wet-season “basin characterization” sampling; these data will not be analyzed or synthesized formally until the number of observations is large enough to give the data set statistical significance.

6.0 REFERENCES

King County, 2019. Fecal Coliform Total Maximum Daily Load, Standard Operating Procedures for Field Screening. (FC TMDL SOP). Department of Natural Resources and Parks, Water and Land Resources Division, Stormwater Services, December 2019.

King County, 2020. Illicit Connection and Illicit Discharge Detection & Elimination Standard Operating Procedures (IC/IDDE SOP). Department of Natural Resources and Parks, Water and Land Resources Division, Stormwater Services, April 2020.

Washington State Department of Ecology (“Ecology”), 2011. Puyallup River Watershed Fecal Coliform Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan. Publication No. 11-10-040.

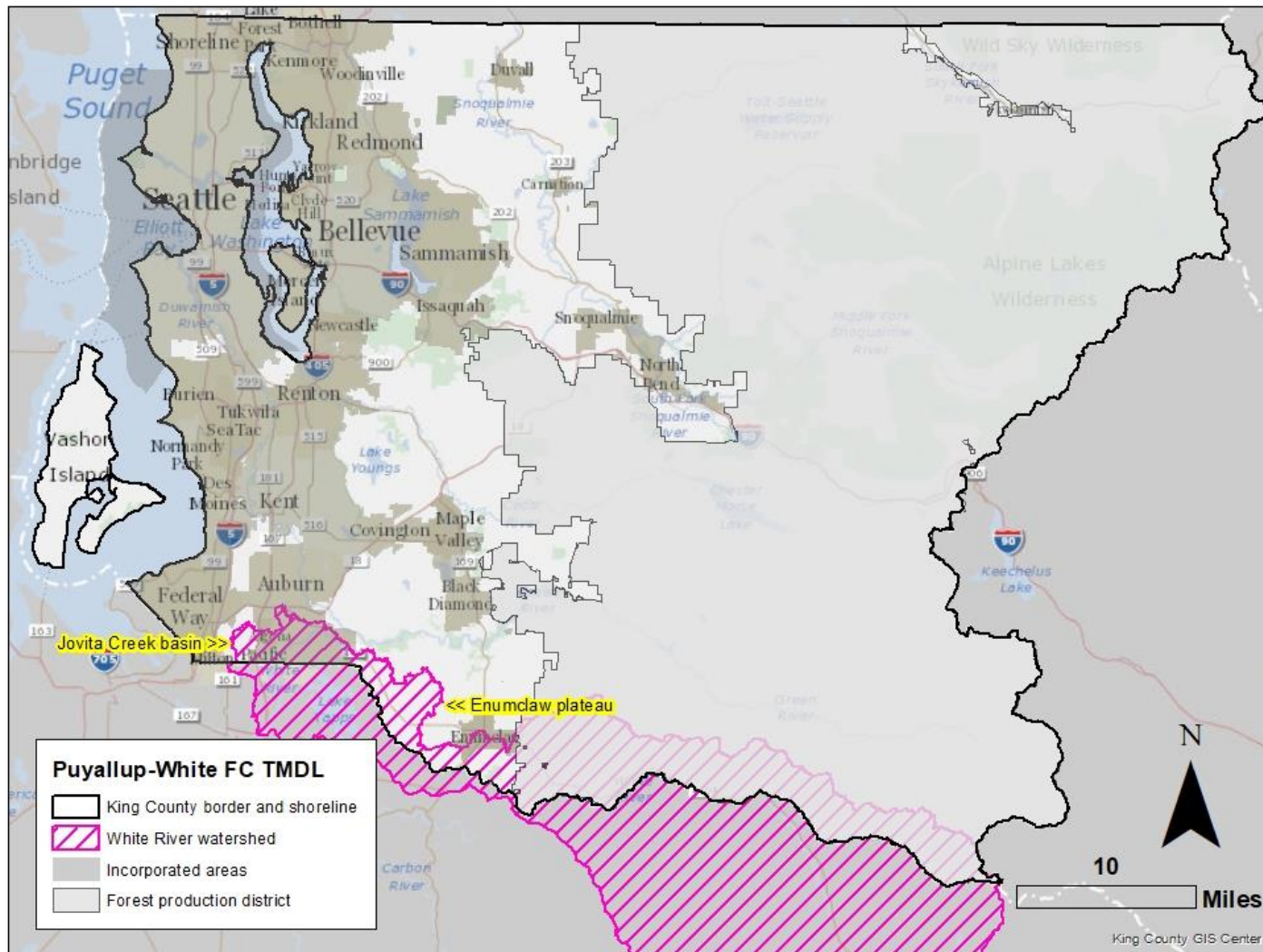


Figure 1. Overview map of Puyallup-White FC TMDL area

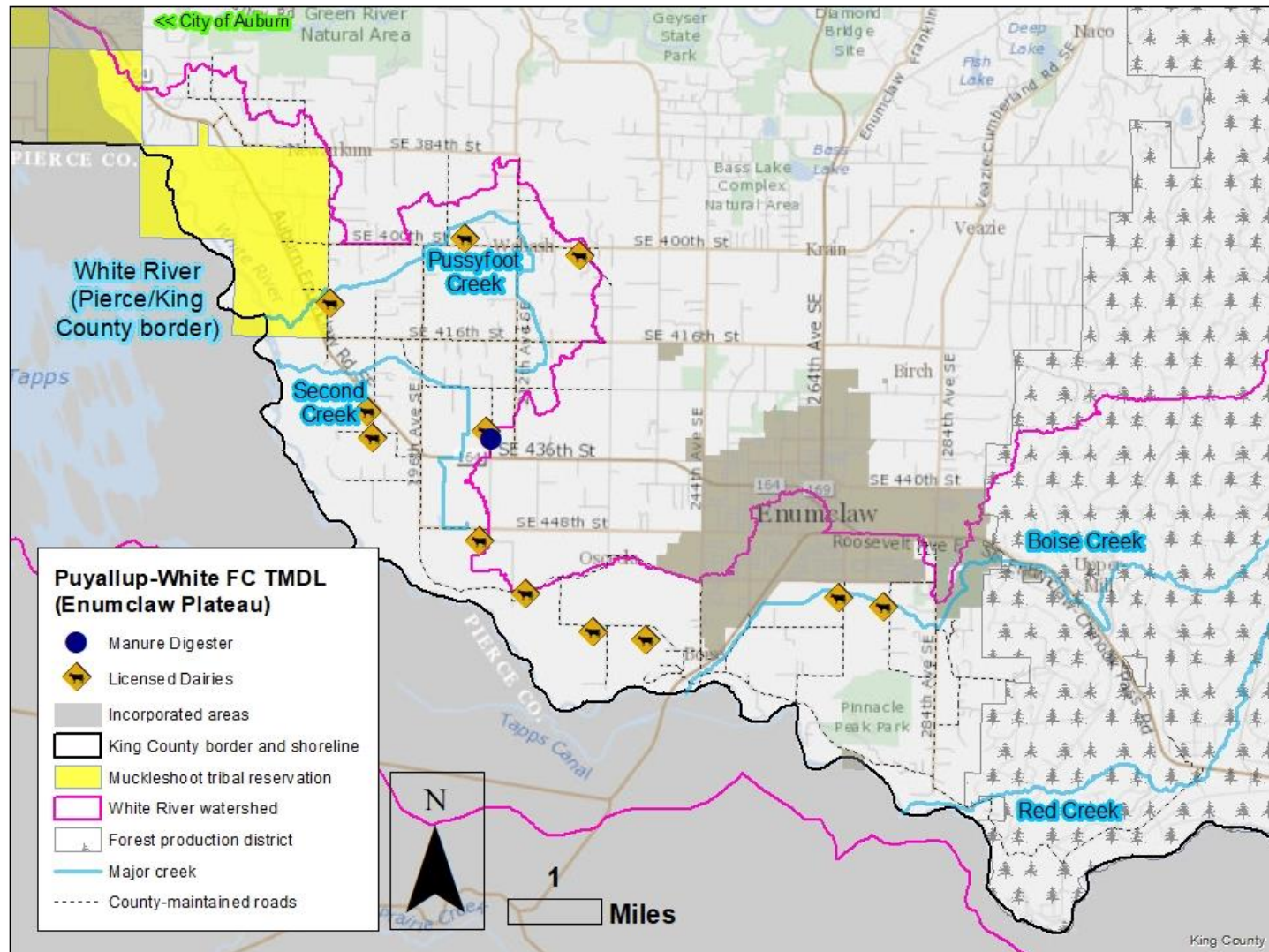


Figure 2. Enumclaw Plateau

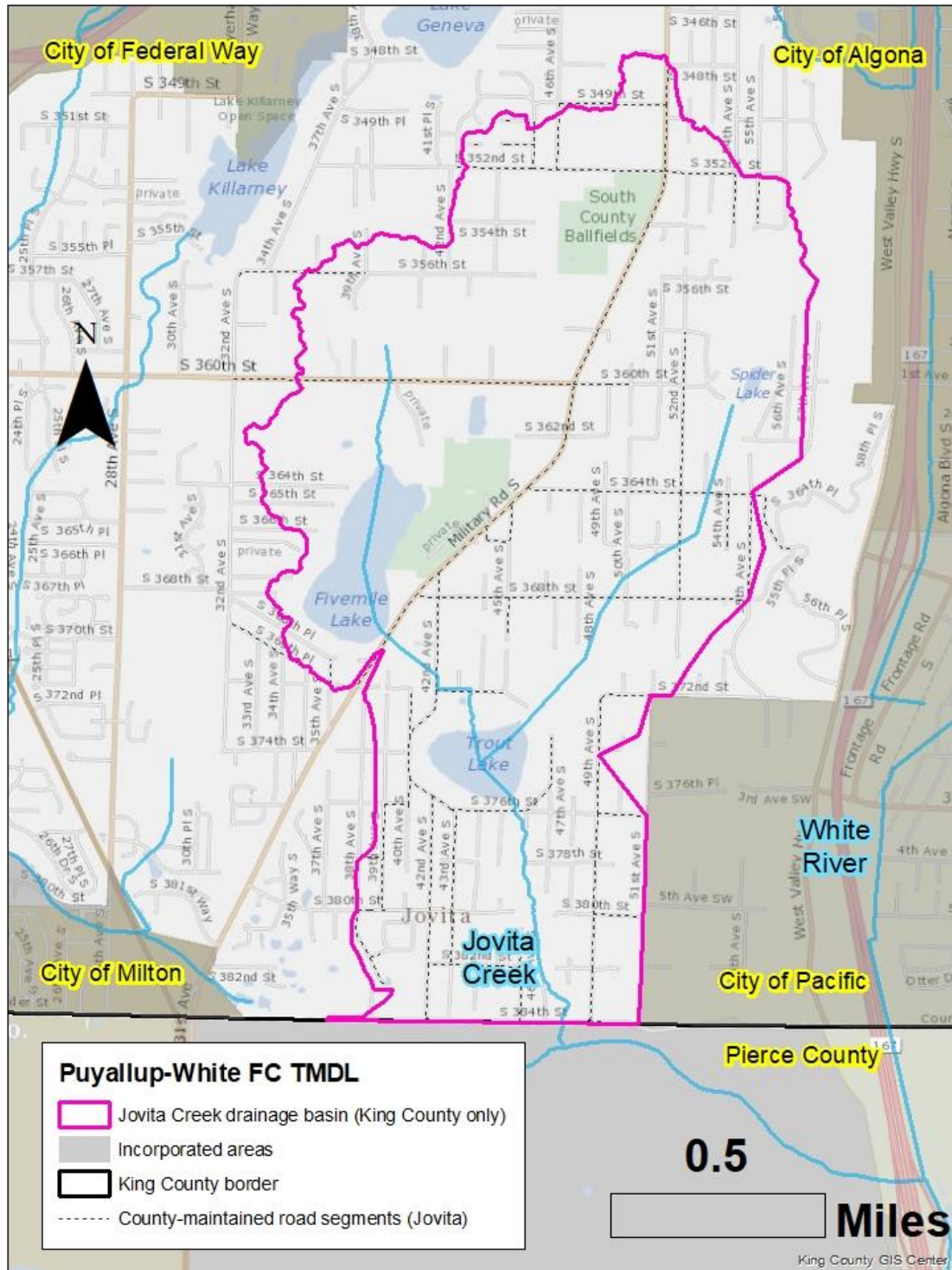


Figure 3. Jovita Creek drainage basin

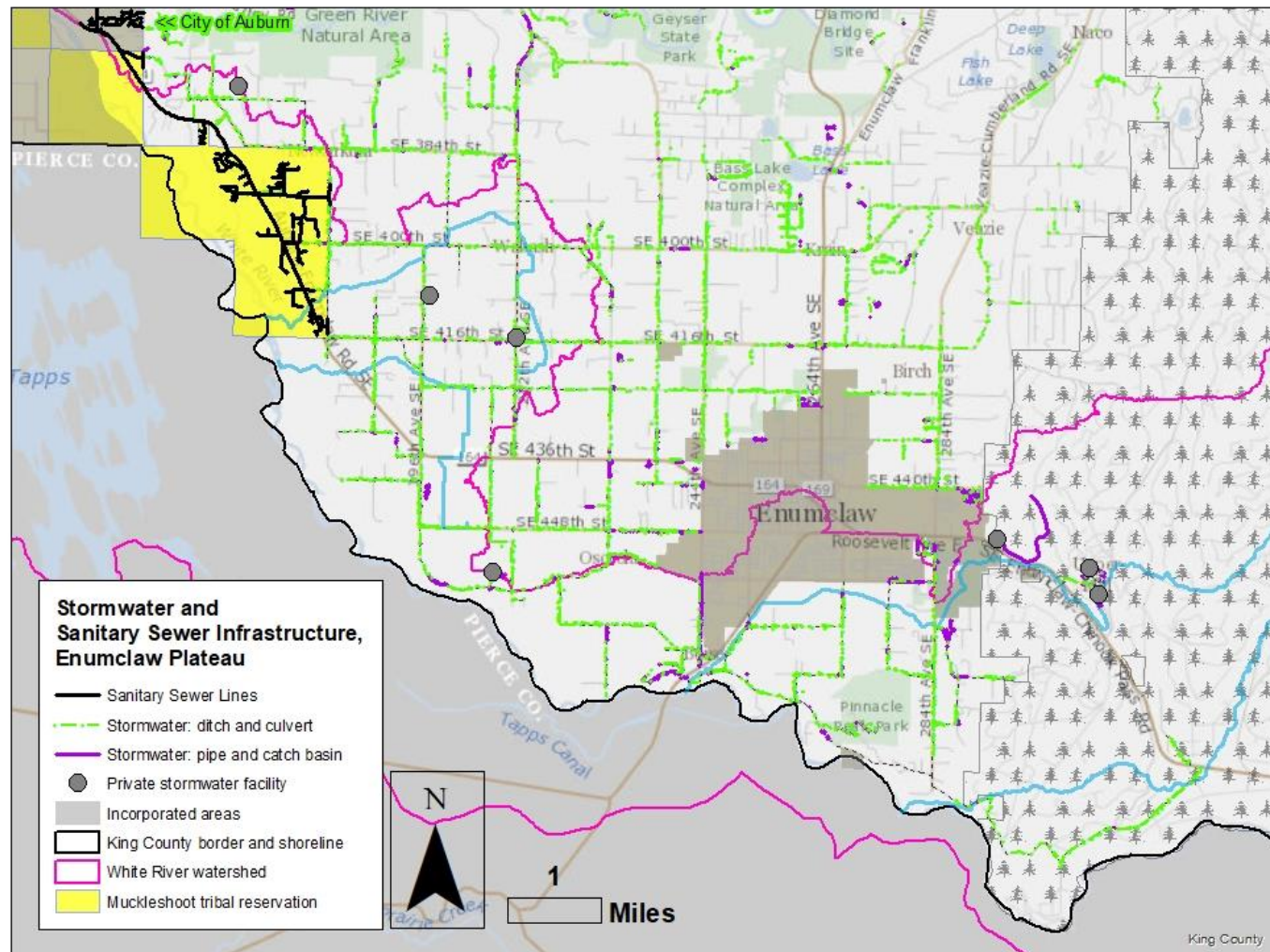


Figure 4. Sewer and stormwater infrastructure, Enumclaw Plateau

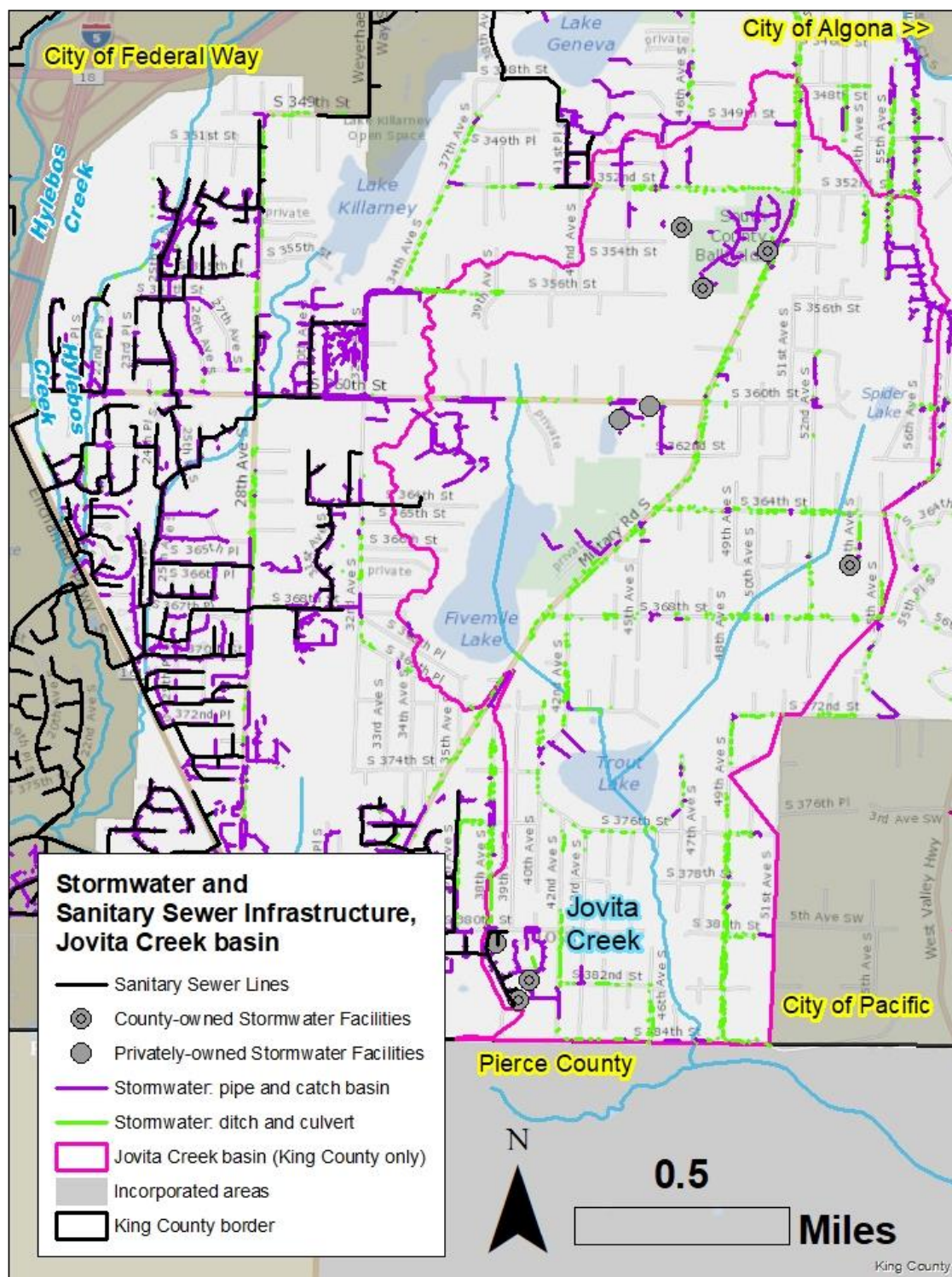


Figure 5. Sewer and stormwater infrastructure, Jovita Creek drainage basin

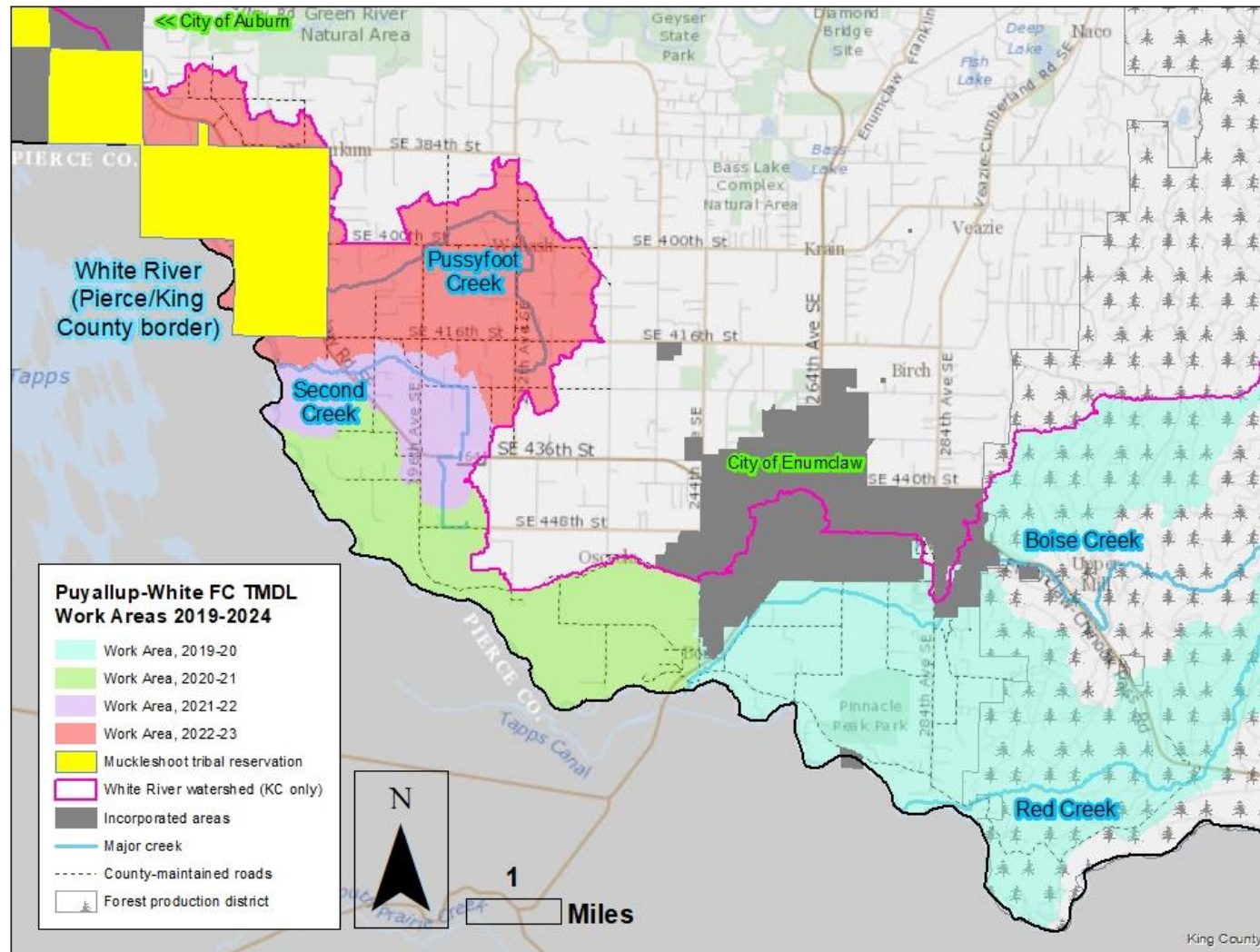


Figure 6. Puyallup-White FC TMDL work areas by year, 2019-2024 permit cycle

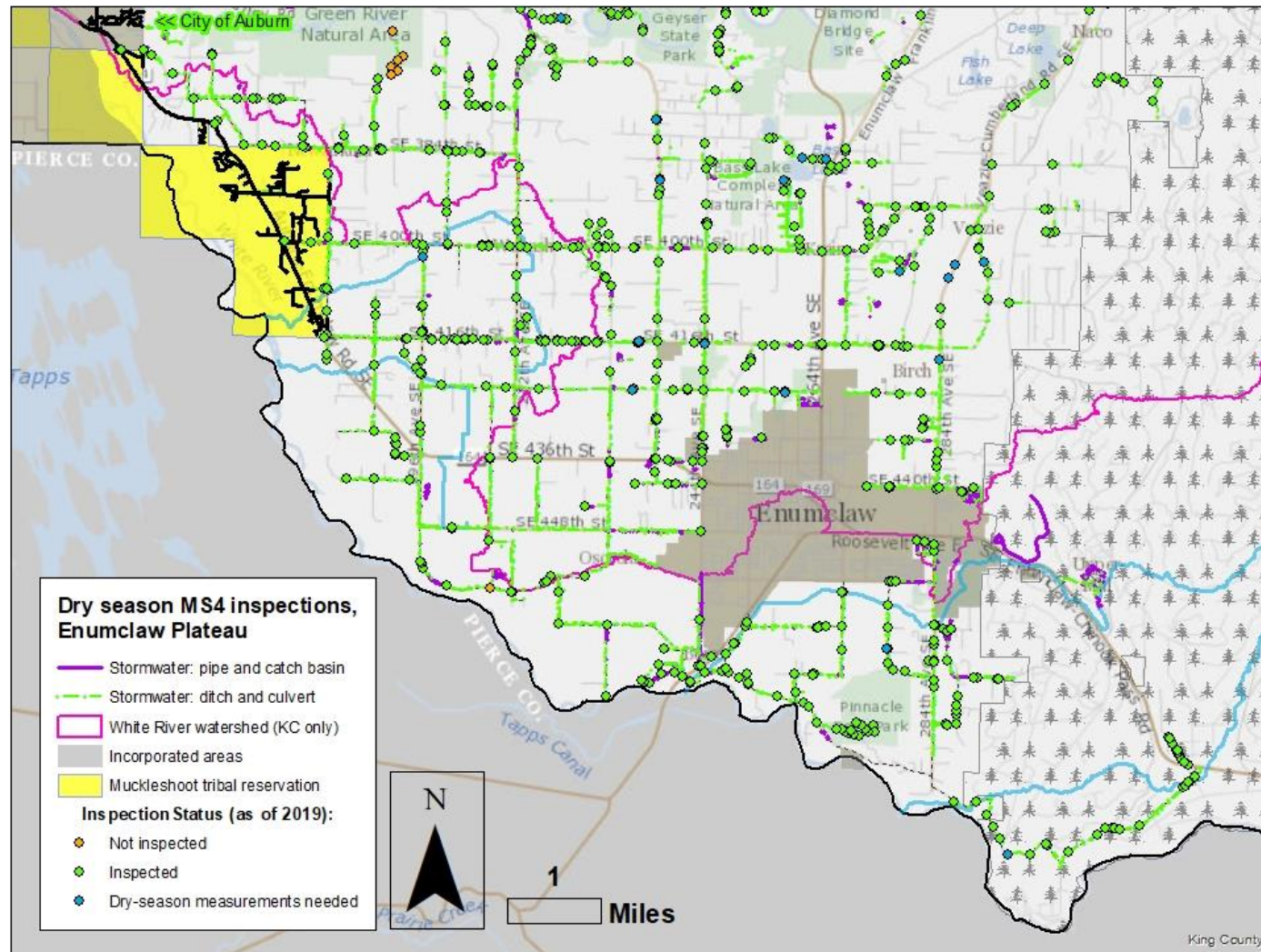


Figure 7. Locations of dry-season MS4 inspections, Enumclaw Plateau

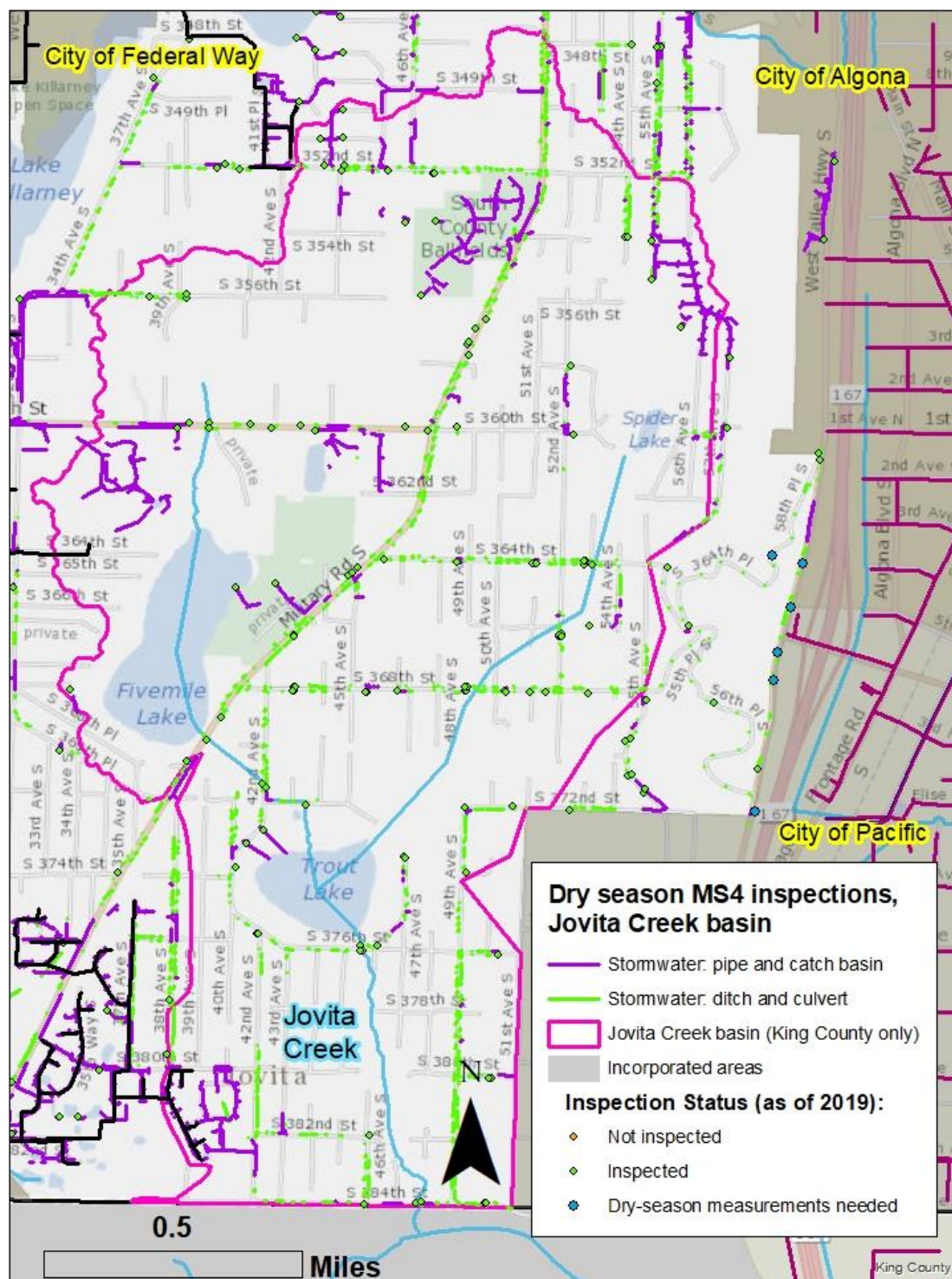


Figure 8. Locations of dry-season MS4 inspections, Jovita Creek drainage basin

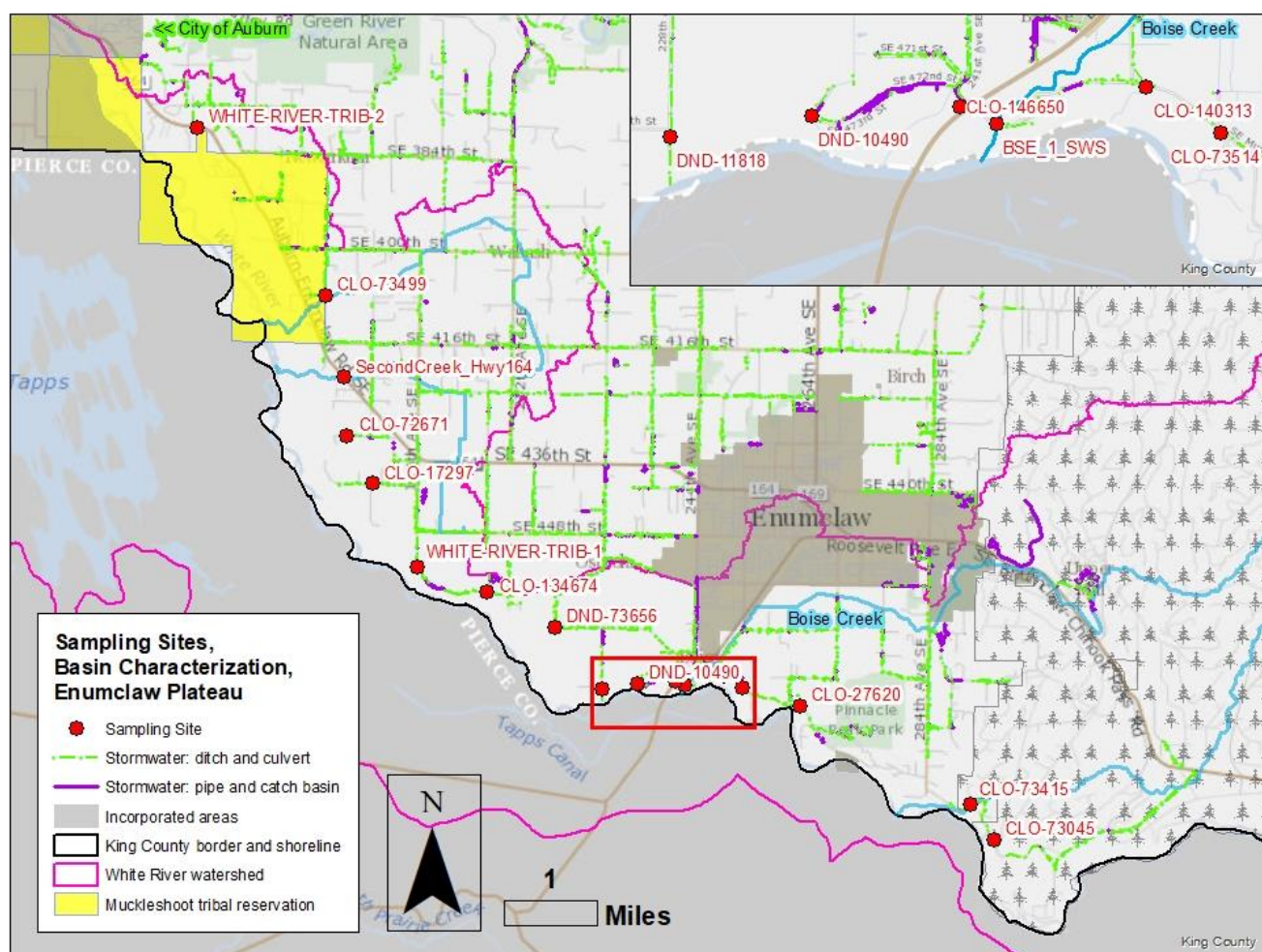


Figure 9. Wet-weather sampling sites, Enumclaw Plateau

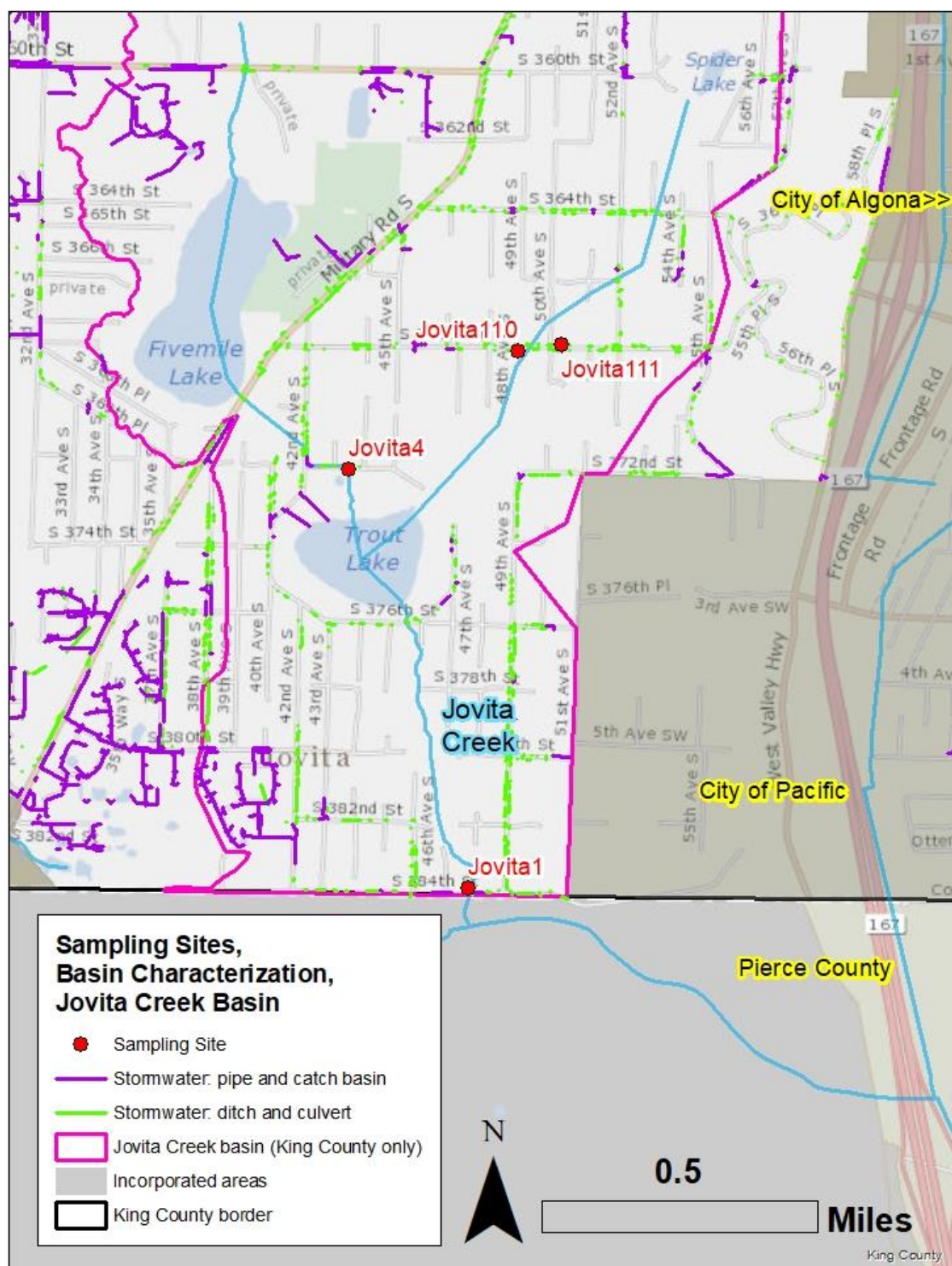


Table 1. Wet-season, wet-weather screening sites

Site name	X	Y	Description
BSE_1_SWS	1345650	66506	AKA BSE_1MUDMTNRD. Boise Creek, near mouth, at crossing of SE Mud Mountain Road.
CLO-134674	1334454	71801	Inlet to 60-inch HDPE tightline, south side of SE Mud Mountain Road, via structure SNS-46122.
CLO-140313	1347827	67034	Outlet of twenty-four inch concrete culvert passing under SE Mud Mountain Road.
CLO-146650	1345121	66761	Outlet of 36-inch concrete pipe, just west of intersection of Hwy 410 and 241st Ave SE.
CLO-17297	1327970	77898	Outlet of 12-inch concrete pipe discharging to the north, north side 18900 block SE 440th St
CLO-27620	1352117	65334	Inlet to 48-inch CMP passing under SE Mud Mountain Road.
CLO-72671	1326555	80600	Inlet to 24-inch concrete pipe, north side of 18700 block SE 432nd St.
CLO-73045	1363080	57766	Inlet to thirty-six inch CMP passing under SE Mud Mountain Road.
CLO-73415	1361756	59789	Red Creek. Sample from large box culvert using telescoping pole, downstream side of SE Mud Mountain Road.
CLO-73499	1325343	88532	Pussyfoot Creek. Inlet to box culvert underneath 180th Ave SE, at intersection with SE 408th St, access trail on east side of road, twenty feet south of fire hydrant.
CLO-73514	1348904	66373	Outlet of twenty-four inch concrete culvert passing under SE Mud Mountain Road.
DND-10490	1342977	66624	Ditch just west of intersection of 235th Ave SE and SE 473rd St, prior to entry to 18" culvert.
DND-11818	1340931	66320	Stormwater ditch just south of driveway to 47402 228th Ave SE, and south of pipe entering from east.
DND-73656	1338286	69777	Sample flow from ditch at SW corner of SE 464th St and 220th Ave SE, as water is leaving ROW, flowing to west. Water arrives at location from north, east and northeast. Sample combined flow.
SECONDCREEK_HWY164	1326354	83900	Second Creek, inlet to culvert under WSDOT Hwy 164.
WHITE-RIVER-TRIB-1	1330486	73195	West side of road, 45300 block 196th Ave SE, down steep embankment, combined flow from ditches and 60-inch culvert.
WHITE-RIVER-TRIB-2	1318100	98017	Outlet of box culvert, south side of Hwy 164, 900 feet west of SE 380th Place, just west of driveway to 37961.
JOVITA1	1282337	97272	Inlet to thirty-six inch CMP passing under S 384th St. Approach from north side of road, down slope.
JOVITA4	1281193	101277	Outlet of thirty-six-inch concrete culvert, just east of driveway to 4317 S 372ND ST.
JOVITA110	1282816	102423	Outlet of 12-inch concrete pipe discharging to the south, south side 4800 block S 368th St. Will only be sampled if flow rate is greater than that at JOVITA111.
JOVITA111	1283238	102476	Inlet of 12-inch concrete pipe discharging to the south, north side 5000 block S 368th St. Will only be sampled if flow rate is greater than that at JOVITA110.

Table 2. Parameters measured for MS4 screening, Puyallup-White FC TMDL

Parameter	Analyzed by (method):	Dry season		Wet season	
		Dry weather	Wet weather	Dry weather	Wet weather
Water temperature	SWS (Hydrolab MS5)	Yes	NA	No	No
Specific conductance	SWS (Hydrolab MS5)	Yes	NA	No	No
pH	SWS (Hydrolab MS5)	Yes	NA	No	No
Fluoride	SWS (ExStik II FL700)	Yes*	NA	Yes*	No
<i>Escherichia coli</i>	SWS (Coliscan Easygel) or KCEL (SM 9213D)	Yes	NA	Yes	Yes**
qPCR (various markers)	KCEL	Maybe***	NA	Maybe***	Yes**

NA = not applicable; SWS generally will not perform TMDL screening during summer storms. Larger summer storms that generate widespread runoff and cause a significant water level rise in the receiving water body may be sampled for purposes of basin characterization.

* Fluoride will only be measured in areas where the domestic water supply is fluoridated. Within the unincorporated, King County portion of the White River watershed, this applies only to the Jovita Creek drainage basin and Stuck Junction areas. In the wet season, fluoride will only be measured at key locations in these areas, such as where EC levels from a private pipe have been elevated.

** Sampling in wet weather in the wet season is generally only done for purposes of basin characterization, and not for source tracking.

***Maybe = in general, will only be measured in response to high EC results. Principal qPCR analytes will be Hu-2-Bacteroidales and Rum-2-Bacteroidales.

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Appendix A: work area 2019-2020

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Appendix A: work area 2019-2020

As mentioned in the main body of this document, the geographic focus of Stormwater Services' FC TMDL work in water year 2019-2020 (October 2019 - September 2020, inclusive) will be the uppermost portion of the White River watershed (where King County has MS4 assets), including the Boise Creek basin. This area is depicted in Figure A1.

The County's MS4 in the 2019-2020 work area is entirely contained within those road right-of-ways maintained by the County (Figure A1). The eastern portion of the 2019-2020 work area is a forest production district (FPD)—very few houses are present, and very few human activities besides forest management take place in this area. The only County-maintained roads in the FPD, and thus the only locations where County MS4 is located, are 323rd Avenue SE (north of Highway 410) and SE Mud Mountain Road. Outside of the FPD, the rest of the focus area for 2019-2020 is a mix of agricultural and rural-residential land uses. Houses in the unincorporated area are more densely clustered where there is topographic relief above the flat, agricultural plateau—for instance, in the Fairway Hills neighborhood and along 288th Avenue SE. Even here, housing is much less dense than in the City of Enumclaw. All residential properties in the unincorporated portion of this area are served by on-site sewage systems. Figure A2 illustrates the locations of residential structures in the vicinity.

The unincorporated area between the City of Enumclaw and Pinnacle Peak contains some houses, but most of the area is dedicated to livestock grazing. This area contains two dairies (Ritter, at the 276th Avenue SE crossing of Boise Creek, and Boise Creek Farms at the 268th Avenue SE crossing of Boise Creek) and several other properties housing many animals, principally cattle and horses. Figure A3 illustrates the approximate locations of livestock in the work area for 2019-2020, including locations of known manure lagoons and also suspected locations of animal access to Boise Creek or other watercourses. These features have been mapped based on field observations, aerial photography, and data available from King County GIS. It should be noted that the land use on any given parcel may change from year to year. SWS will endeavor to confirm and update the information contained in Figure A3 during the course of its FC TMDL field work.

The King County Water and Land Resources Division (WLRD) works with the King Conservation District (KCD) to provide technical assistance to agricultural landowners in the White River basin. Stormwater Services carries out stormwater (source control) business inspections County-wide, but it generally does not visit agricultural/livestock businesses, leaving this to KCD and other groups in WLRD. Stormwater Services has, in the last few years, performed the following work visiting businesses and responding to water quality complaints in the work area for 2019-2020 (see Figure A4):

- Visited two alpaca farms, Mt Peak Alpacas (47921 284th Avenue SE) and Back at the Ranch Alpacas (46424 276th Avenue SE);

- Responded to a citizen complaint regarding a manure dumping in a County ditch on 248th Way SE; a King County Road crew removed the material from the ditch;
- Identified four failing OSS or illicit sewage/septage discharges to the MS4;
- Identified a fifth failing OSS; the Department of Public Health Seattle-King County is currently working with the property owner to eliminate the problem.

Stormwater Services also, during the 2013-2018 permit cycle, identified numerous properties in the Boise Creek drainage basin suspected of contributing animal fecal waste to the County's MS4. A list of these properties was shared with KCD and the Department of Ecology in early 2018. These properties will not be specified here, but this list will be added to, as appropriate, over the course of 2019-2020, as additional field work in the Boise Creek basin takes place.

For purposes of MS4 conveyance screening, and according to the rationale and methods referenced in the main body of this document, the County's MS4 in the 2019-2020 work area was broken up into areas or segments—these are delineated in Figure A5. The boundaries of these “screening modules” are not meant to represent hydrologic catchments. They are intended to show which sections of MS4 will be included in screening; beyond this, their boundaries are somewhat arbitrary. Due to the lack of topographic relief on the Enumclaw Plateau, it is difficult to discern the direction of surface drainage in many locations. If the boundaries shown in Figure A5 can be edited to better reflect actual drainage patterns, SWS will do so in the course of field work in 2019-2020.

Information about each screening module can be found in Table A1, including the name of each module, the (expected) number of inspection sites, and the approximate length of conveyance within each module's boundaries.

A sample map depicting screening sites in the Boise Creek/Fairway Hills screening module is provided in Figure A6.

Some work will take place in 2019-2020 outside of the area depicted in Figures A1 through A5. Specifically, the following:

- **Stuck Junction:** This neighborhood, a small unincorporated area completely surrounded by the City of Auburn, is shown in Figure A7. It will be the subject of both dry-season and wet-season screening activities in 2019-2020.
- **Watershed delineation:** There is some uncertainty as to the actual boundary between the White River watershed and the Green River watershed (Newaukum Creek), due to the lack of topographic relief at the watershed divide. In year 2019-2020, SWS will attempt to verify that

the flow directions depicted in its MS4 conveyance map are accurate. This will allow SWS to more accurately depict its FC TMDL work area for the 2019-2024 permit cycle.

- As time allows: Jovita Creek basin; start screening work in year 2020-2021 area (see Figure A6).

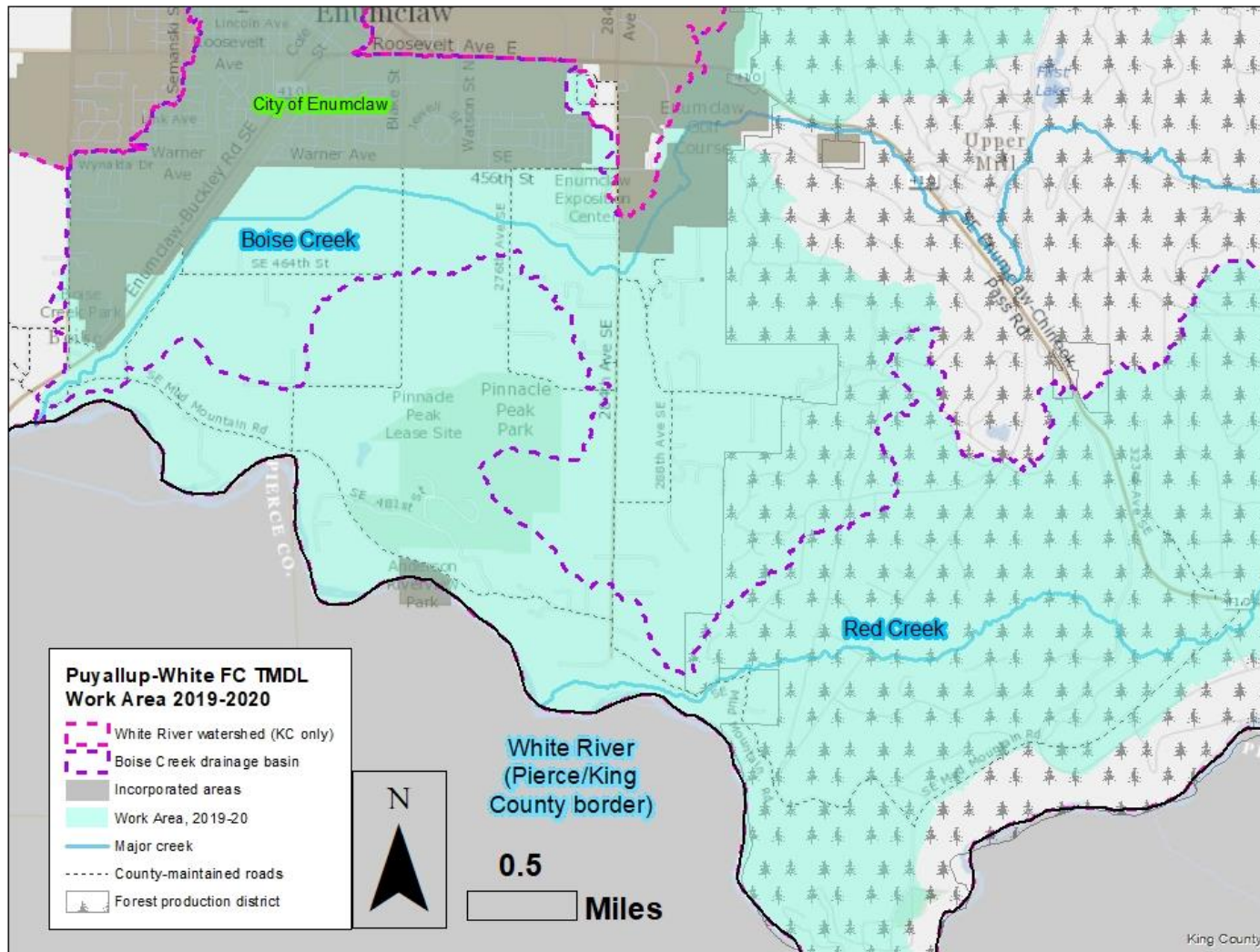


Figure A1. Stormwater Services' FC TMDL work area for 2019-2020

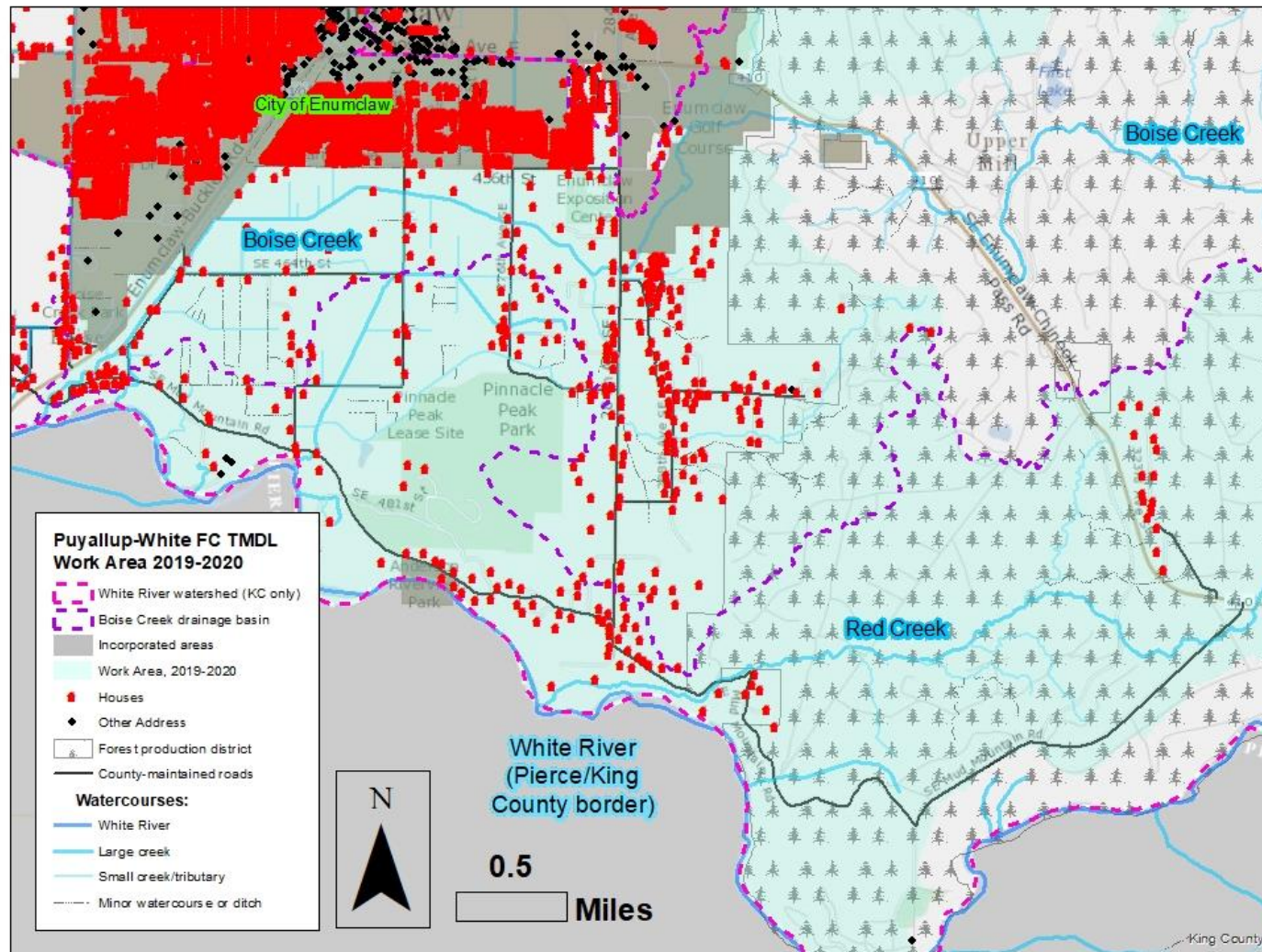


Figure A2. FC TMDL work area for 2019-2020, houses and streams

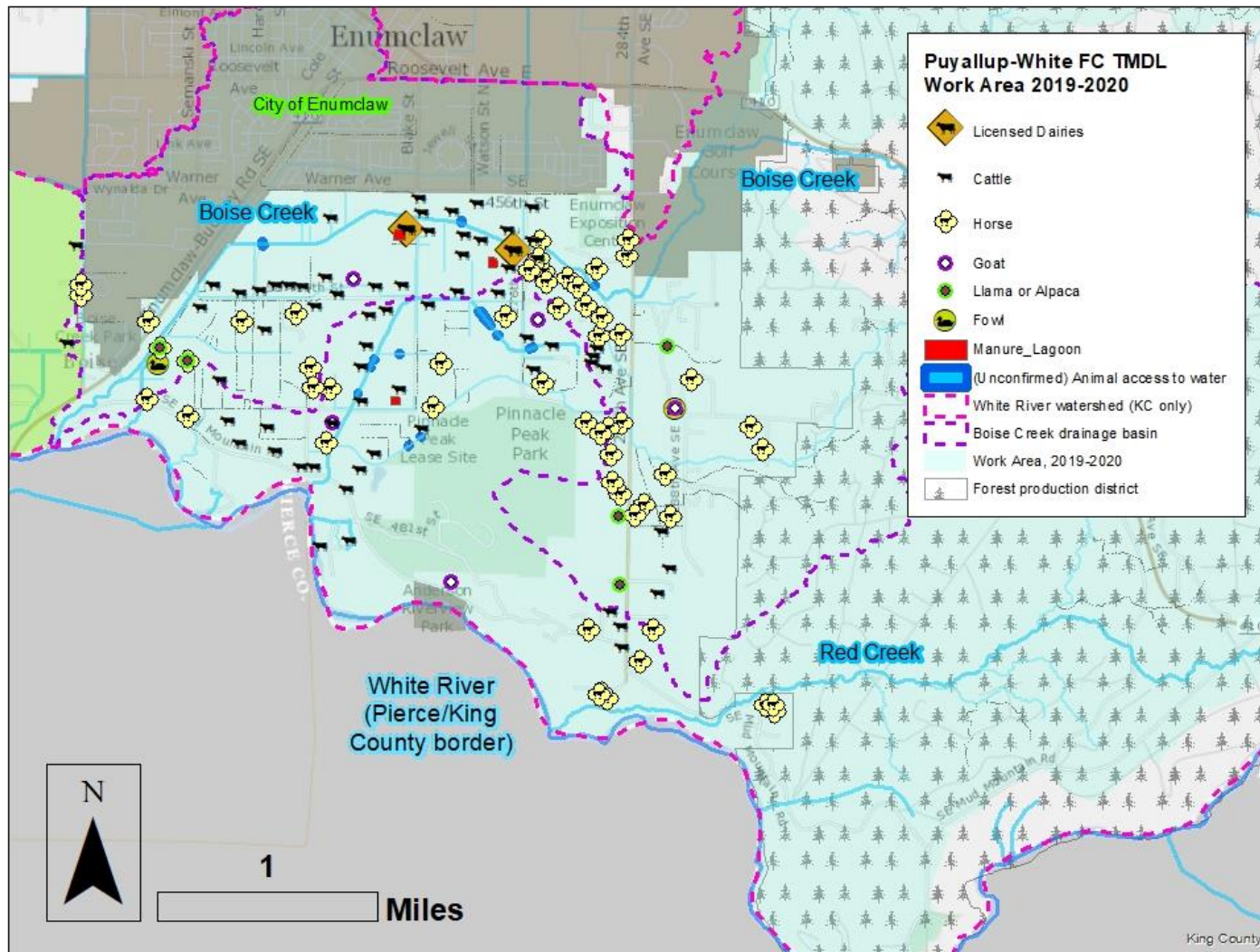


Figure A3. FC TMDL work area for 2019-2020, dairies and domestic animals

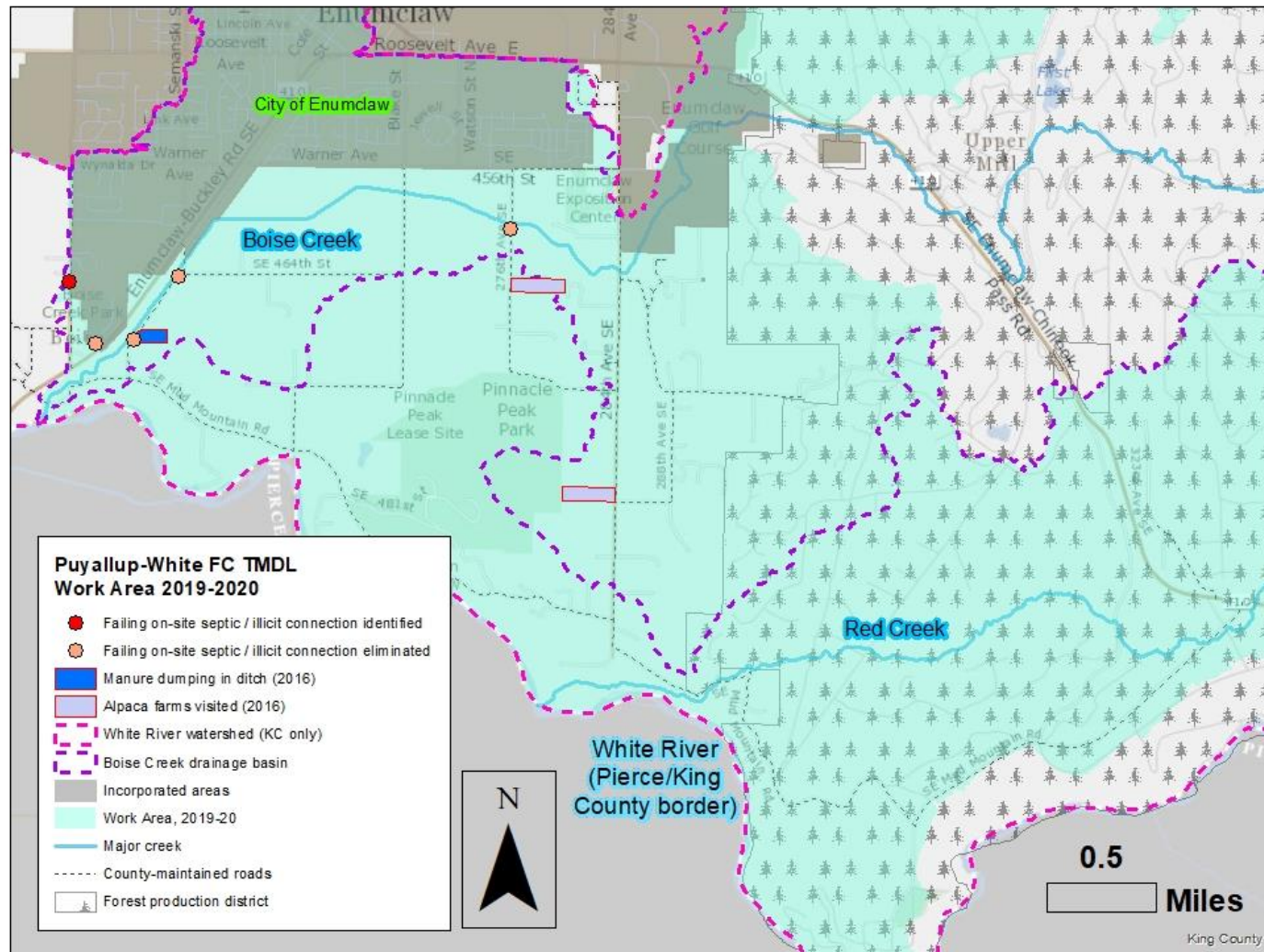


Figure A4. FC TMDL work area for 2019-2020, past water quality complaints and business visits

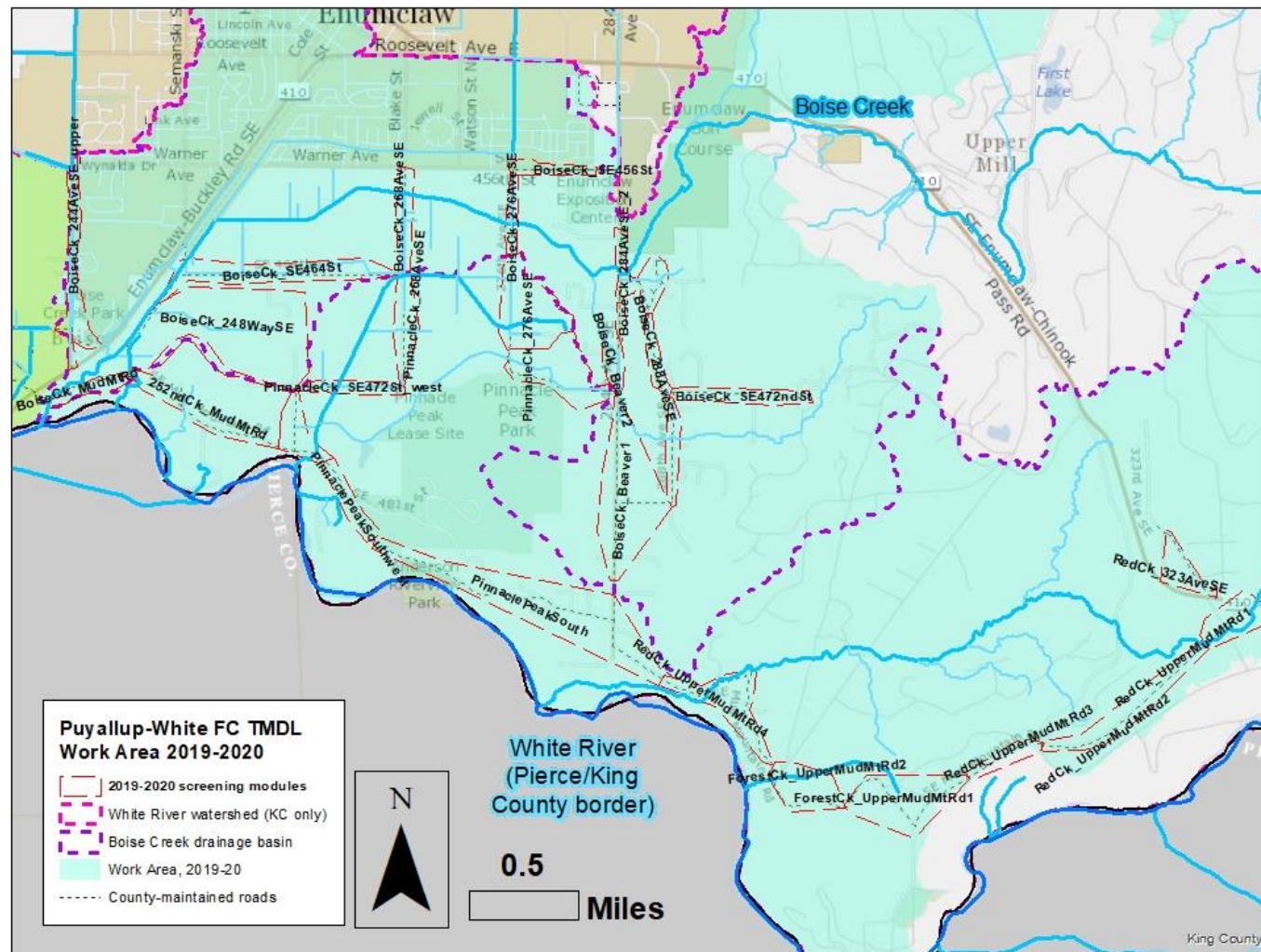


Figure A5. FC TMDL work area for 2019-2020, screening modules

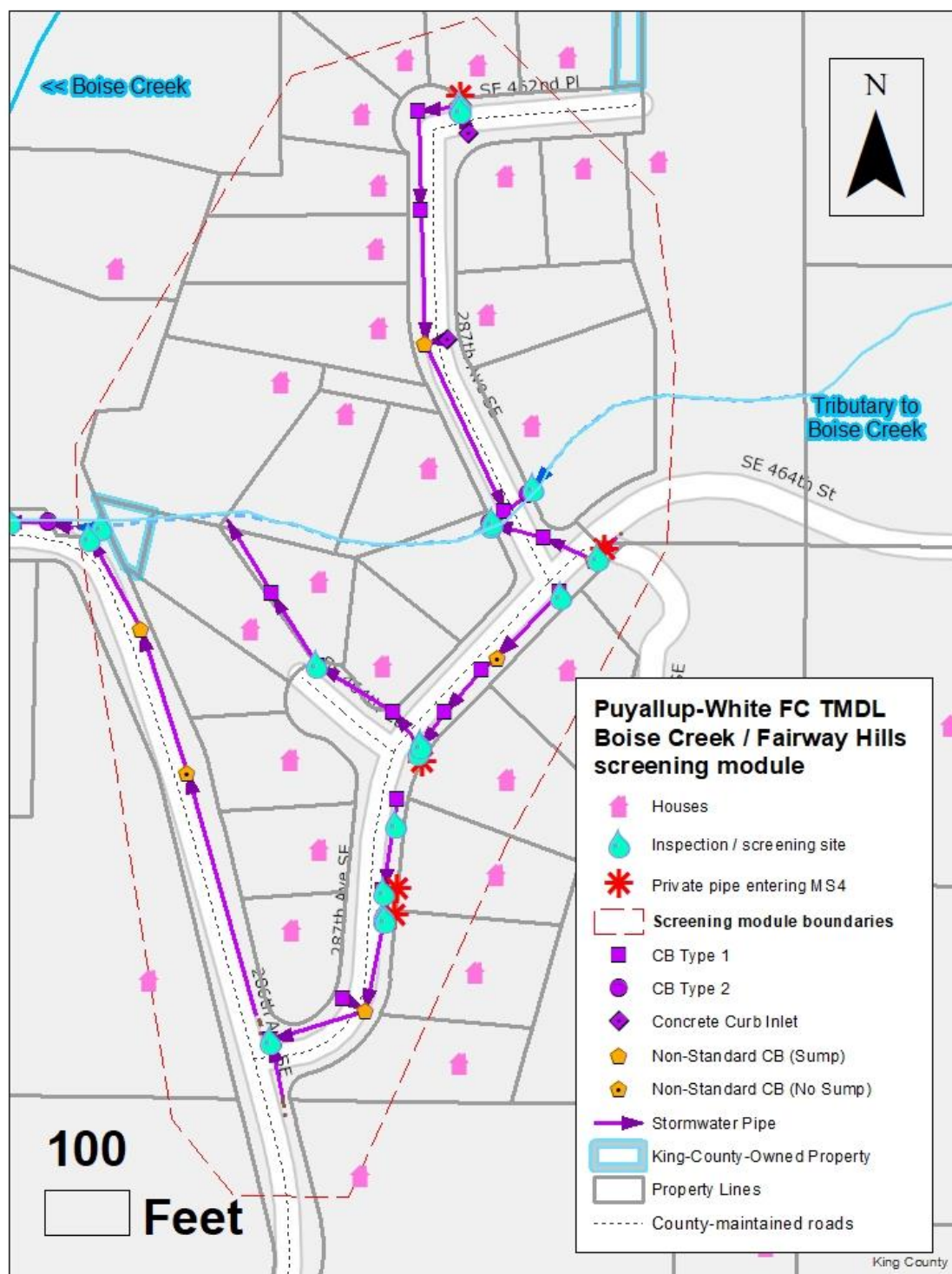


Figure A6. FC TMDL work area for 2019-2020, screening modules

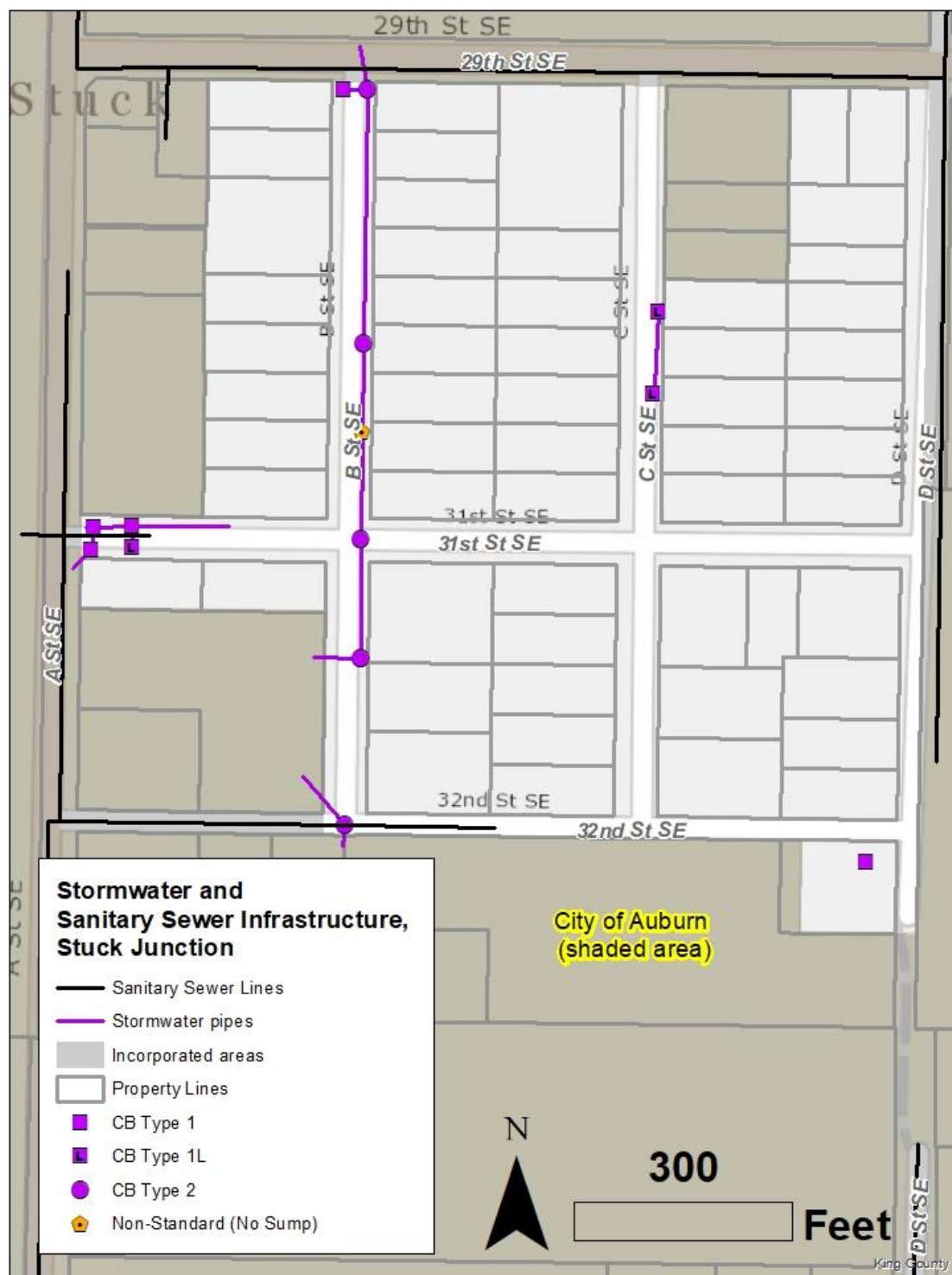


Figure A7. Sewer and stormwater infrastructure, Stuck Junction

Table A-1 2019-2020 screening module attributes

Screening Module Name	Type of conveyance	Length of roadway, feet	Length of conveyance, feet	# of catch basins	# of mapped, private pipes entering KC MS4	Anticipated # of screening sites	Notes
BoiseCk_244AveSE_lower-east	Ditch and culvert	2800	3400	5	1	10	
BoiseCk_244AveSE_lower-west	Mix	3000	4400	12	27	37	
BoiseCk_244AveSE_upper	Ditch and culvert	2100	2900	2	15	17	Conveyance on west side of road only
BoiseCk_248WaySE	Ditch and culvert	1800	2450	1	1	7	
BoiseCk_268AveSE	Ditch and culvert	2300	4250	2	5	9	Water from Boise Creek backs up into MS4
BoiseCk_276AveSE	Ditch and culvert	2000	920	1	0	4	
BoiseCk_284AveSE_1	Ditch and culvert	1200	1700	1	0	6	
BoiseCk_284AveSE_2	Ditch and culvert	1100	1840	0	0	2	
BoiseCk_286AveSE	Ditch and culvert	2321	1629	1	4	6	Completed module in 2018-2019
BoiseCk_288AveSE	Ditch and culvert	2640	3545	2	5	17	Completed module in 2018-2019
BoiseCk_Beaver1	Ditch and culvert	5000	10200	0	4	21	Unmapped private ditches entering MS4?
BoiseCk_Beaver2	Ditch and culvert	1800	3000	0	7	11	
BoiseCk_Beaver3	Ditch and culvert	850	1760	0	0	5	
BoiseCk_FairwayHills	Pipe and CB	4700	2850	29	5	28	Completed module in 2018-2019
BoiseCk_MudMtRd	Ditch and culvert	2300	1900	2	2	8	
BoiseCk_SE456St	Mix	2000	3340	10	1	8	
BoiseCk_SE464St	Ditch and culvert	6400	8700	4	7	16	
BoiseCk_SE472ndSt	Ditch and culvert	3164	3912	9	4	12	Completed module in 2018-2019
ForestCk_UpperMudMtRd1	Ditch and culvert	4300	10080	0	2	10	No houses in contributing area
ForestCk_UpperMudMtRd2	Ditch and culvert	2400	1620	0	0	3	No houses in contributing area
PinnacleCk_260AveSE	Ditch and culvert	2700	3720	0	4	10	
PinnacleCk_268AveSE	Ditch and culvert	4600	6300	1	1	9	
PinnacleCk_276AveSE	Ditch and culvert	2300	3260	1	2	7	
PinnacleCk_SE472St_east	Ditch and culvert	2900	4480	0	0	8	
PinnacleCk_SE472St_west	Ditch and culvert	2500	4150	2	6	12	
PinnaclePeakSouth	NA	8800	0	0	0	0	No mapped MS4 in this area
PinnaclePeakSouthwest	Mix	2200	2600	7	0	3	No houses in contributing area, apparently
RedCk_323AveSE	Ditch and culvert	2100	3300	0	0	13	No houses in contributing area, apparently
RedCk_UpperMudMtRd1	Ditch and culvert	1300	1930	0	2	6	No houses in contributing area
RedCk_UpperMudMtRd2	Ditch and culvert	4800	9250	0	0	9	No houses in contributing area
RedCk_UpperMudMtRd3	Ditch and culvert	2000	3400	0	0	6	No houses in contributing area
RedCk_UpperMudMtRd4	Ditch and culvert	4900	3100	2	0	7	
252ndCk_MudMtRd	Ditch and culvert	3900	3900	0	0	7	

Appendix B: work area 2020-2021

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Appendix B: work area 2020-2021

As mentioned in the main body of this document, the geographic focus of Stormwater Services' FC TMDL work in water year 2020-2021 (October 2020 - September 2021, inclusive) will be the portion of the watershed draining to the right bank of the White River downriver of Boise Creek and upriver from the mouth of Second Creek. This area is depicted in light green in Figure B1.

The County's MS4 in the 2020-2021 work area is entirely contained within those road right-of-ways maintained by the County, and largely consists of ditch-and-culvert drainage. There are several unnamed, intermittent watercourses that drain the area. There are many properties from which surface runoff drains directly to the White River (or to a watercourse draining to the river), without the water ever passing through the County's MS4 (Figure B1).

Land use and locations of homes. The area is a mix of agricultural and rural-residential land uses. Houses in the work area are widely scattered and are most densely clustered in the Glacier Vista neighborhood (located in the southeast part of the work area near the Highway 410 crossing of the White River), and along 244th Ave SE near the City of Enumclaw. All residential properties in the unincorporated portion of the work area are served by on-site sewage systems. Figure B2 illustrates the locations of residential structures in the vicinity.

Domestic animals. In the 2020-2021 work area, there are more large domestic animals than humans, as most of the area is dedicated to livestock grazing. This area contains six dairies (Providence Farm, Osceola Jerseys, Van Hoof, Lanting, De Jong, Van Dam) and several other properties housing many animals, principally cattle and horses. Figure B3 illustrates the approximate locations of livestock in the work area for 2020-2021, including locations of known manure lagoons and manure application. These features have been mapped based on field observations, aerial photography and data available from King County GIS. Figure B3 most likely is not comprehensive in regard to livestock locations; however, it provides a general idea of livestock presence. It should also be noted that land use activities on any given parcel may change from year to year or even month to month. SWS will endeavor to confirm and update the information contained in Figure B3 during the course of its FC TMDL field work in 2021.

Business inspections and citizen complaints. No graphic is provided here illustrating the locations of recent business source-control visits or water quality complaints (as was provided in Appendix A). In summary, there are very few active businesses that SWS has identified in the work area for 2020-2021 (beyond the dairies just mentioned), and those that were identified have been visited at least once by SWS source control specialists in the last five years. SWS will endeavor to identify any active businesses where source control inspections have not yet taken place (besides dairies, which are regulated by the Washington State Department of Agriculture) in the work area for 2020-2021.

With regard to water quality complaints in the area, the only recent call came in late 2018, when SWS received a report from a citizen regarding possible agricultural waste in a County ditch on 235th Ave SE. SWS followed up with the complainant, but he decided to wait to see if the discharge occurred again, and if so, he said he would take photos and contact SWS.

MS4 screening sites, 2020-2021. For purposes of MS4 conveyance screening, and according to the rationale and methods referenced in the main body of this document, the County's MS4 in the 2020-

2021 work area was broken up into areas or segments – these are delineated in Figure B4. The boundaries of these “screening modules” are not meant to represent hydrologic catchments. They are intended to show which sections of MS4 will be included in screening on a given day; beyond this their boundaries are somewhat arbitrary. In the course of reviewing King County’s MS4 data for the purposes of delineating these screening modules, it became apparent that the County’s GIS data regarding the White River watershed’s boundary was not completely accurate: it appears that parts of the MS4 *outside* of the green area shown in Figure B4 drain *into* the green area. This means that the area draining to the White River in King County’s jurisdiction is slightly larger than that shown by the watershed boundary, which is drawn using LIDAR data. For this reason, the dashed-red lines in Figure B4 extend somewhat outside of the (green) work area for 2020-2021.

As just evidenced here, due to the lack of topographic relief on the Enumclaw Plateau, it is difficult to discern the direction of surface drainage in many locations. If the watershed boundary and the County’s MS4 data can be edited to better reflect actual drainage patterns, SWS will do so in the course of field work in 2020-2021.

Information about each screening module can be found in Table B1, including the expected number of inspection sites in each module, and the approximate length of conveyance within each module’s boundaries.

Some work may take place in 2020-2021 outside of the area depicted in Figures B1 through B4. Specifically, as time allows, some screening work may take place in the Jovita Creek basin (see Figures 1 and 3 in the main body of this document). All locations where surface water leaves the County’s MS4 in the Jovita Creek basin have already been visited in the dry season. As time allows, some wet-season screening work (performed during dry weather period) may take place in this basin in 2020-2021.

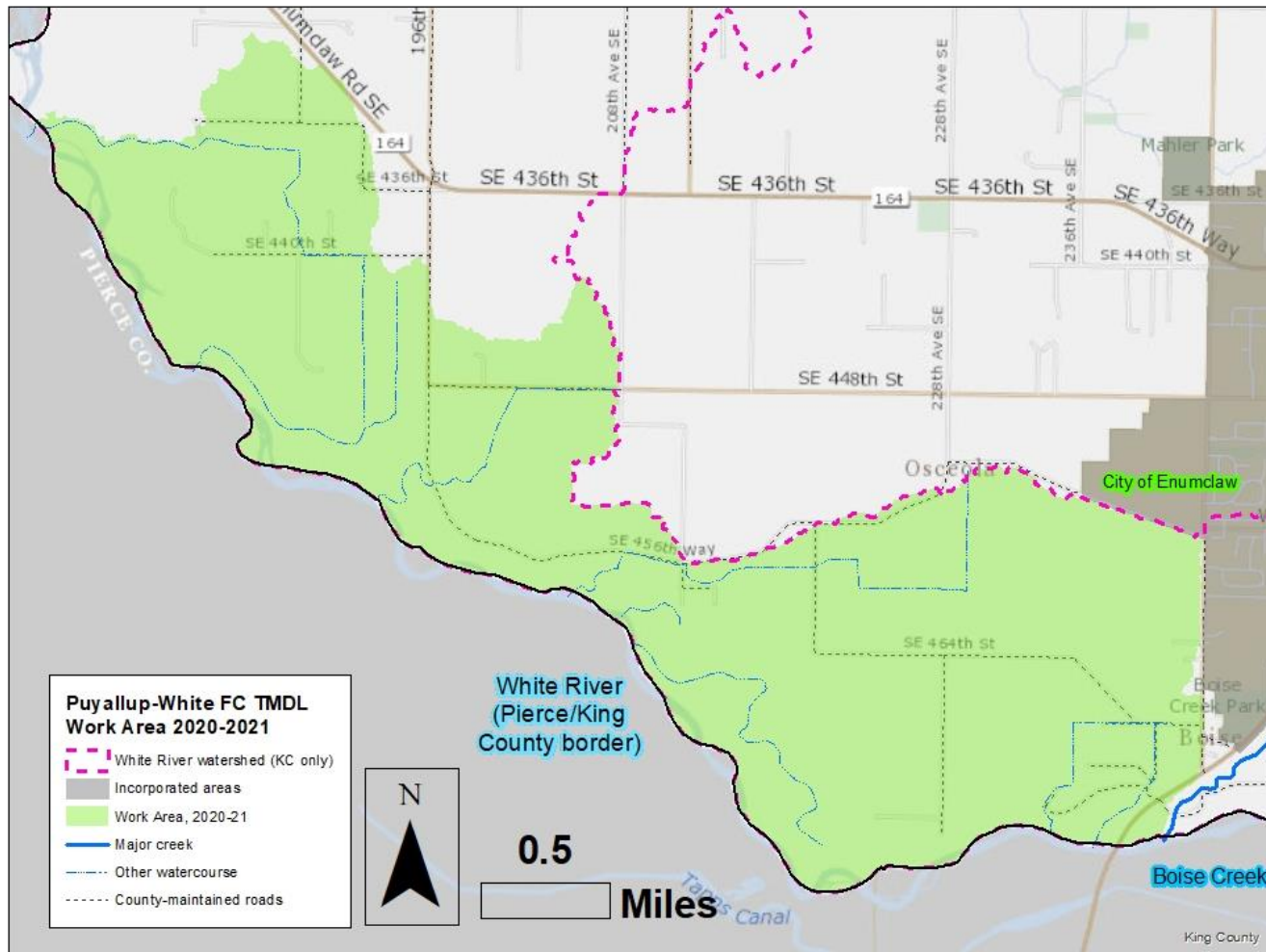


Figure B1. Stormwater Services' FC TMDL work area for 2020-2021

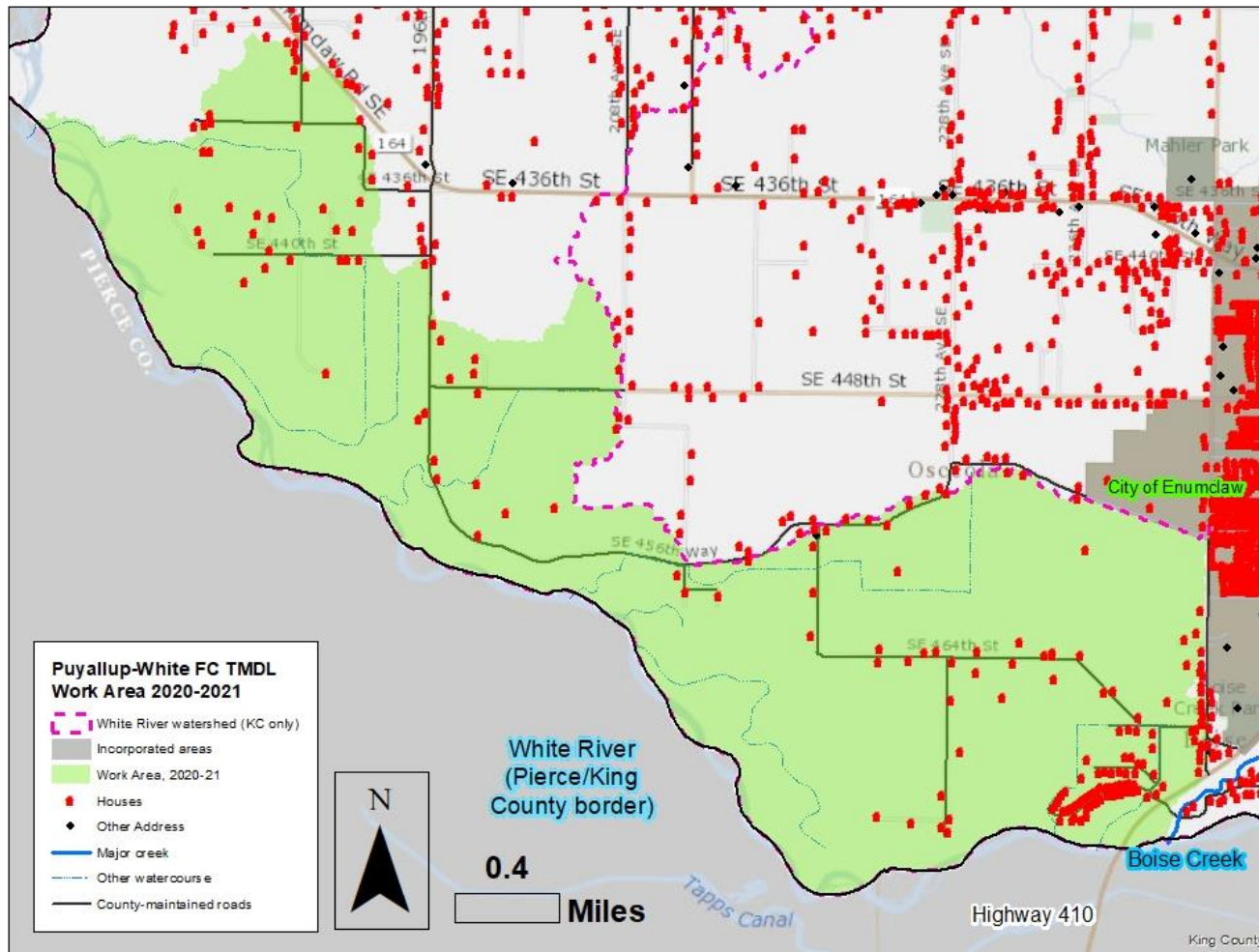


Figure B2. FC TMDL work area for 2020-2021, houses

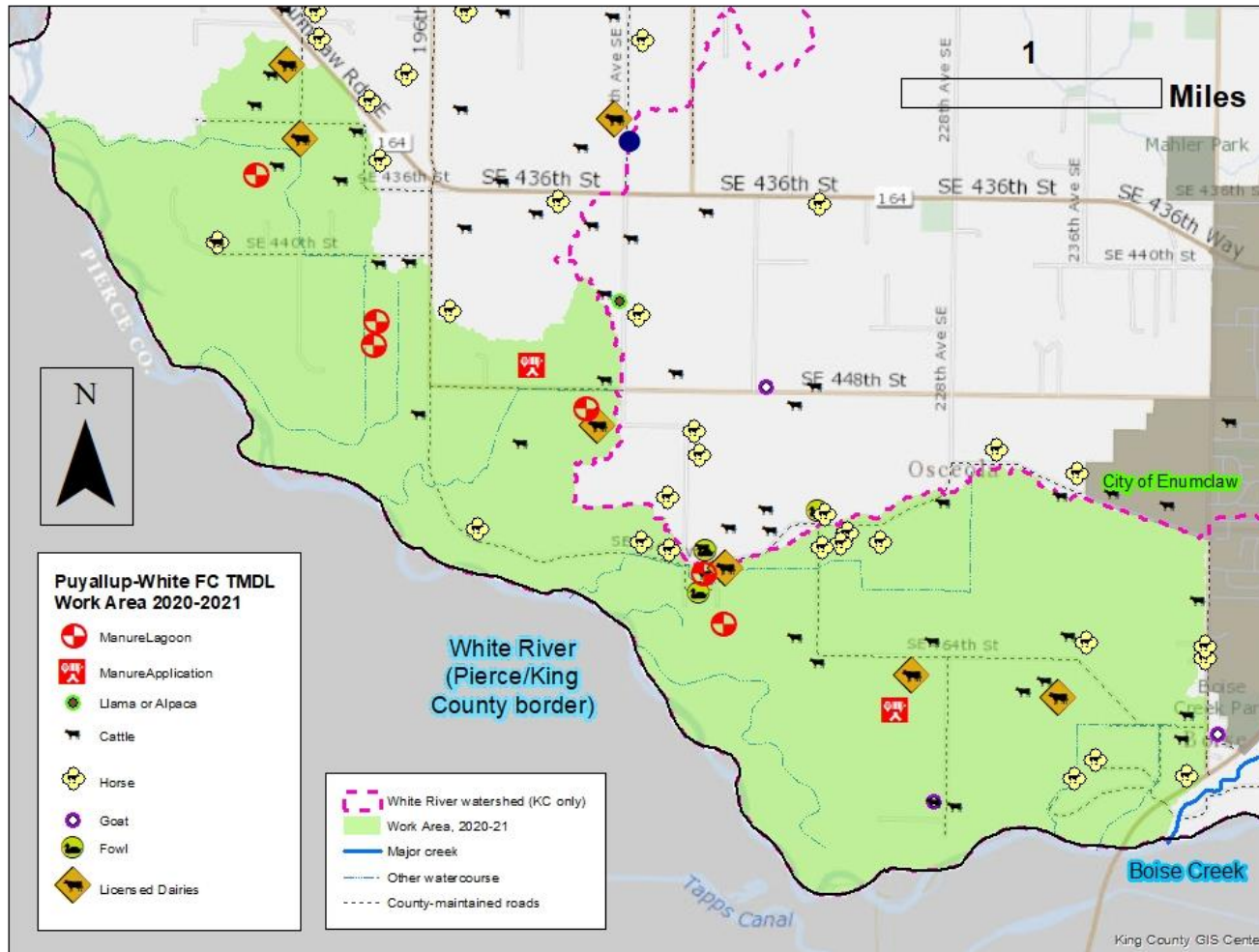


Figure B3. FC TMDL work area for 2020-2021, dairies and domestic animals

Screening module name	Type of conveyance	Length of roadway, feet	Length of conveyance, feet	# of catch basins	# of mapped, private pipes entering KC MS4	Anticipated # of screening sites	Notes
GlacierVista1	Mix	1800	3900	13	6	18	
GlacierVista2	Mix	6900	10500	18	9	28	
228thAveSE	Ditch-culvert	2700	3000	0	2	8	
Osceola_464	Ditch-culvert	8300	14000	6	6	17	
Osceola_220	Ditch-culvert	4100	5700	0	2	13	
Osceola_460	Ditch-culvert	2400	4000	4	0	10	
Osceola_196A	Mix	4100	7000	13	7	13	
DeJongDairy_440	Ditch-culvert	2800	4900	1	1	11	
DeJongDairy_432	Ditch-culvert	3800	5200	2	3	10	
DeJongDairy_192	Ditch-culvert	3000	1600	5	2	8	
Osceola_196B	Ditch-culvert	6100	12000	15	2	16	
Osceola_450	Ditch-culvert	6700	14000	10	8	30	Back Forte Riding Facility
Osceola_448A	Ditch-culvert	6600	10000	0	1	17	
Osceola_456	Ditch-culvert	1300	1900	3	0	5	
Osceola_452	Ditch-culvert	4700	9000	3	4	15	
Osceola_448B	Ditch-culvert	3800	8000	4	24	36	
Note: all values in table are estimates and are only intended for planning purposes.							

Table B-1 2020-2021 screening module attributes (wet season, dry weather)

Appendix C: work area 2021-2022

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Appendix C: work area 2021-2022

As mentioned in the main body of this document, the geographic focus of Stormwater Services' FC TMDL work in water year 2021-2022 (October 2021 - September 2022, inclusive) will be the portion of unincorporated King County that drains to Second Creek. This area is depicted in light purple in Figure C1. Second Creek drains to the White River just upriver from Pussyfoot Creek. Both of these creeks flow through Muckleshoot tribal properties just prior to entering the White River.

The County's MS4 in the 2021-2022 work area is entirely contained within those road right-of-ways maintained by the County, and consists almost entirely of ditch-and-culvert drainage. There are many properties from which surface water (rainwater) runoff drains directly to Second Creek (or the White River), without the water ever passing through the County's MS4 (Figure C1).

Second Creek typically is dry from June until October, and the MS4 discharging to Second Creek is almost completely dry during this time period as well. There are almost no locations in the White River watershed (on the Enumclaw plateau) where flowing water has been found during Stormwater Services' dry-season screening of its MS4.

Residential land use. The area is a mix of agricultural and rural-residential land uses. There are about 100 residences in the work area, which are widely scattered and mostly clustered along State Route 164 (Auburn-Enumclaw Road) or 196th Ave SE. All residential properties in the work area are served by on-site sewage systems, few of which are less than 40 years old. Figure C2 illustrates the locations of residential structures in the vicinity.

Domestic animals. Like most other parts of the Enumclaw plateau, the 2021-2022 work area is rural, and large domestic animals are found on many properties. This area contains at least one dairy (De Groot), and another dairy (Ritter) owns several large parcels near Second Creek. A third dairy (van Dam) is on the edge of the subbasin but appears to drain away from Second Creek. There are many other properties with domestic animals, principally cattle and horses. Figure C3 illustrates the approximate locations of livestock in the work area for 2021-2022, including locations of known manure lagoons. These features have been mapped based on field observations, aerial photography, and data available from the King County GIS. A horse or cow shown in Figure C3 does not necessarily indicate the presence of only one individual animal, but rather indicates a tax parcel where one, a few, or many animals are housed. It should be noted that grazing or other agricultural land use on any given parcel may change from year to year or even month to month. SWS will endeavor to confirm, update, and add to the information contained in Figure C3 during the course of its FC TMDL field work in 2021-2022.

Business inspections and citizen complaints. King County Water and Land Resources Division (WLRD) works with the King Conservation District (KCD) to provide voluntarily accepted technical assistance to agricultural landowners in the White River basin. Stormwater Services (SWS) carries out stormwater (source control) business inspections County-wide, but it generally does not visit agricultural/livestock businesses, leaving this to other groups in WLRD, as well as to KCD.

Recently, Stormwater Services' source control program began visiting more businesses engaged in horse training and boarding county-wide, as these often are not inspected by other County programs. Two such businesses are located in the work area for 2021-2022 and are shown in Figure C4: Chateau Rodeo

Farm and Fox Ridge Stables. SWS source control specialists visited these businesses and provided technical assistance regarding manure management practices. These businesses will be visited again in the near future. SWS also endeavors to identify any other active businesses in the area where source control inspections have not yet taken place (not including registered dairies, which are regulated by the Washington State Department of Agriculture and therefore not visited by SWS source control specialists).

MS4 screening sites, 2021-2022. For purposes of MS4 conveyance screening, and according to the rationale and methods referenced in the main body of this document, the County's MS4 in the 2021-2022 work area was demarcated into areas or segments – these are delineated in Figure C5. The boundaries of these “screening modules” do not represent hydrologic catchments. They are intended to show which sections of MS4 will be included in screening on a given day; beyond this their boundaries are somewhat arbitrary. By visiting all of the screening modules, all of the County's MS4 in the year's work area will be screened. An example of one such screening module – along SE 424th Street -- is illustrated in Figure C6.

In the course of reviewing King County's MS4 data for the purposes of delineating these screening modules, it became apparent that the County's GIS data regarding catchment boundaries in the White River watershed were not completely accurate. Specifically, while the purple area shown in Figures C1-C5 is meant to represent the hydrologic catchment of Second Creek, it appears that parts of the MS4 shown *outside* of the purple area in reality drain *into* the purple area. Additionally, a small area shown as draining to the White River via Second Creek instead appears to actually drain to the Green River via Newaukum Creek – this is where a large manure digester (Rainier Biogas) is located (shown as the black dot, right side of Figure C3). Thus, the true area draining to Second Creek is slightly different from that shown in King County's GIS library, which is drawn using LIDAR data. For this reason, the dashed-red lines in Figure C4 do not completely align with the purple area.

Due to the lack of topographic relief on the Enumclaw Plateau, it can be difficult to discern the direction of surface drainage in some locations. If the watershed and catchment boundaries and the County's MS4 data can be edited to better reflect actual drainage patterns, SWS will do so during field work in winter 2021-2022.

Information about each screening module can be found in Table C1, including the name of each module, the (expected) number of screening sites, and the approximate length of stormwater conveyance within each module's boundaries.

Some work may take place in 2021-2022 outside of the purple-shaded area depicted in Figures C1 through C5. Specifically, as time allows, some screening work may take place in the Pussyfoot Creek basin. This is because the total work area of the Second Creek subbasin is smaller than had been anticipated in previous planning; it will be advantageous to start screening the MS4 draining to Pussyfoot Creek with an eye towards completing 2022-2023 planned work. Additionally, some follow-up at sites of concern identified in the last two years will also be revisited during the 2021-2022 screening season.

Previous data. Second Creek is not included in WLRD's monthly streams monitoring program. The Washington State Department of Ecology, as part of a ten-year status-and-trends monitoring program, collected samples in the Second Creek basin from late 2019 through early 2021. The data collected

suggest that Second Creek generally meets the geometric mean *E. coli* bacteria standard, except for the “south fork” which flows south to north, crosses State Route 164 between 188th Ave SE and 196th Ave SE, and combines with the mainstem of Second Creek at 188th Ave SE (see Figure C2). Also, the mainstem of Second Creek between 188th Ave SE and 196th Ave SE appears to violate the exceedance criteria for *E. coli*, although the number of observations is very limited.

Lastly, Stormwater Services also collected samples from Second Creek from late 2019 to early 2021 and submitted these to the King County Environmental Lab for *E. coli* analyses. The results suggest that the reach of Second Creek between 188th Ave. SE and State Route 164 might also be violating state standards, although more data are needed to confirm this. In the winter of 2021-2022, Stormwater Services will add additional sample collection sites on Second Creek for the purposes of determining in which reaches bacteria levels are the highest, and whether any violations are more likely due to human or domestic animal sources. Figure C7 illustrates the locations of stream sampling sites on Second Creek to be visited in the wet season of 2021-2022. Figure C8 shows the locations of other stream sites that will also be visited and sampled on the days when Second Creek is sampled.

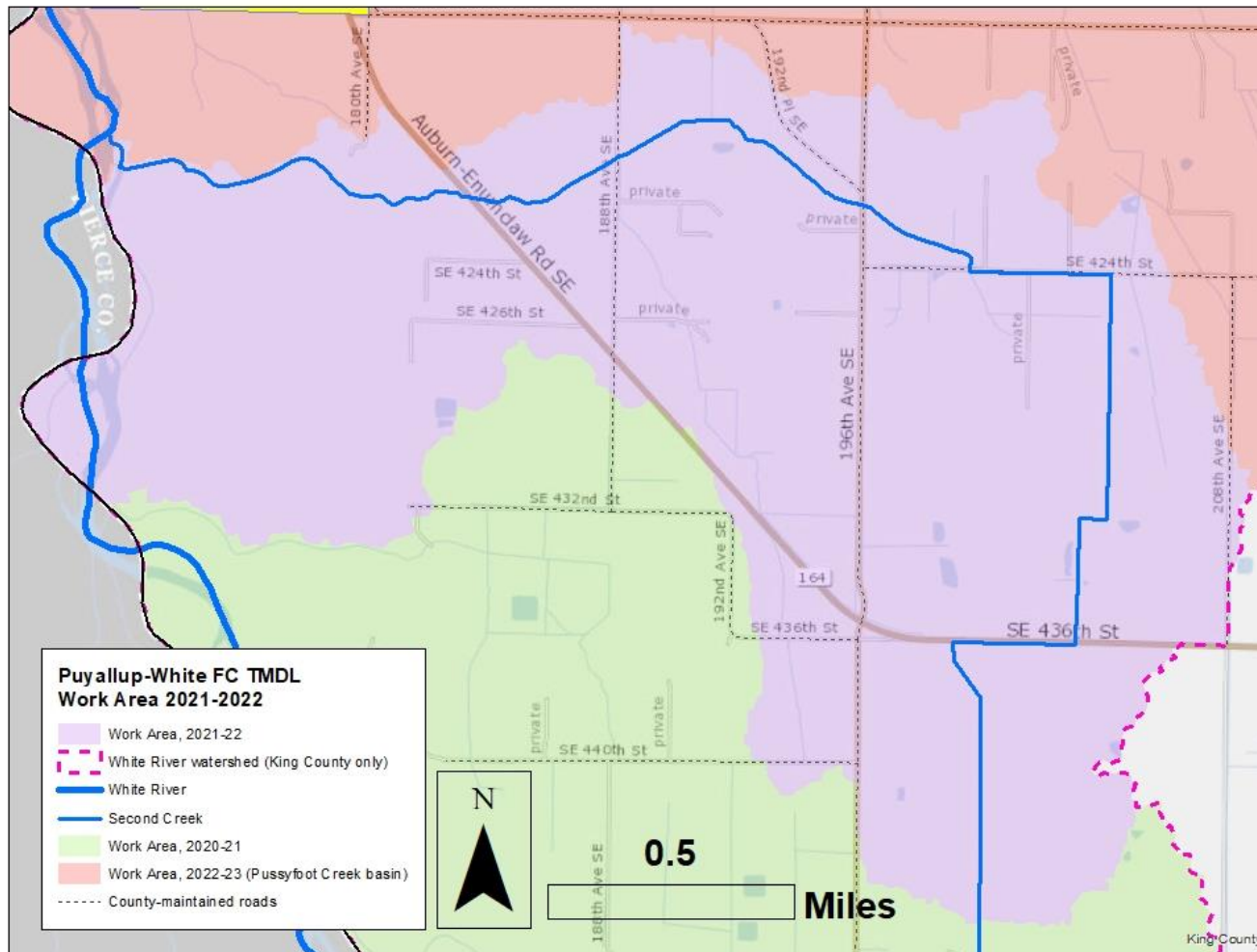


Figure C1. Stormwater Services' FC TMDL work area for 2021-2022

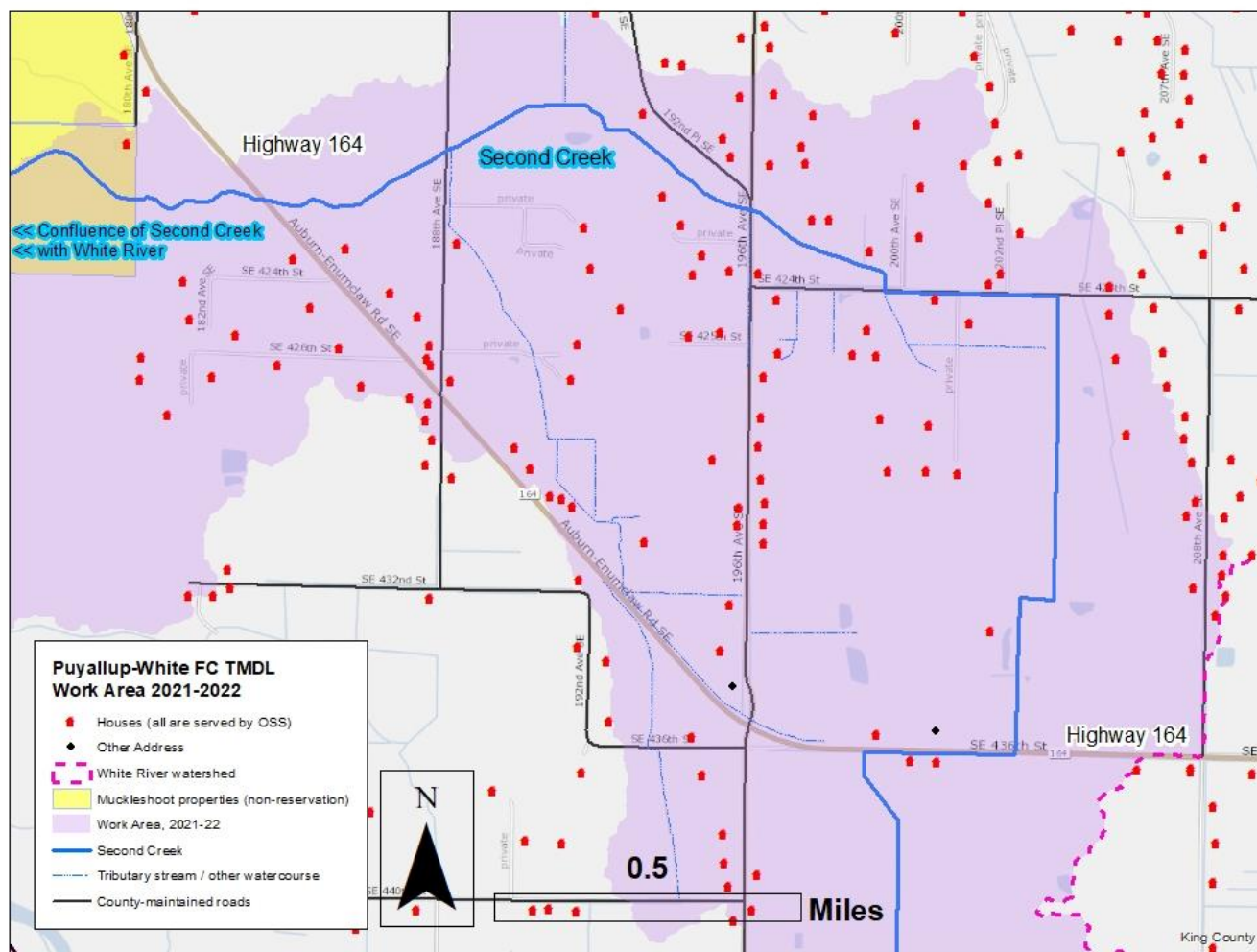


Figure C2. FC TMDL work area for 2021-2022, houses

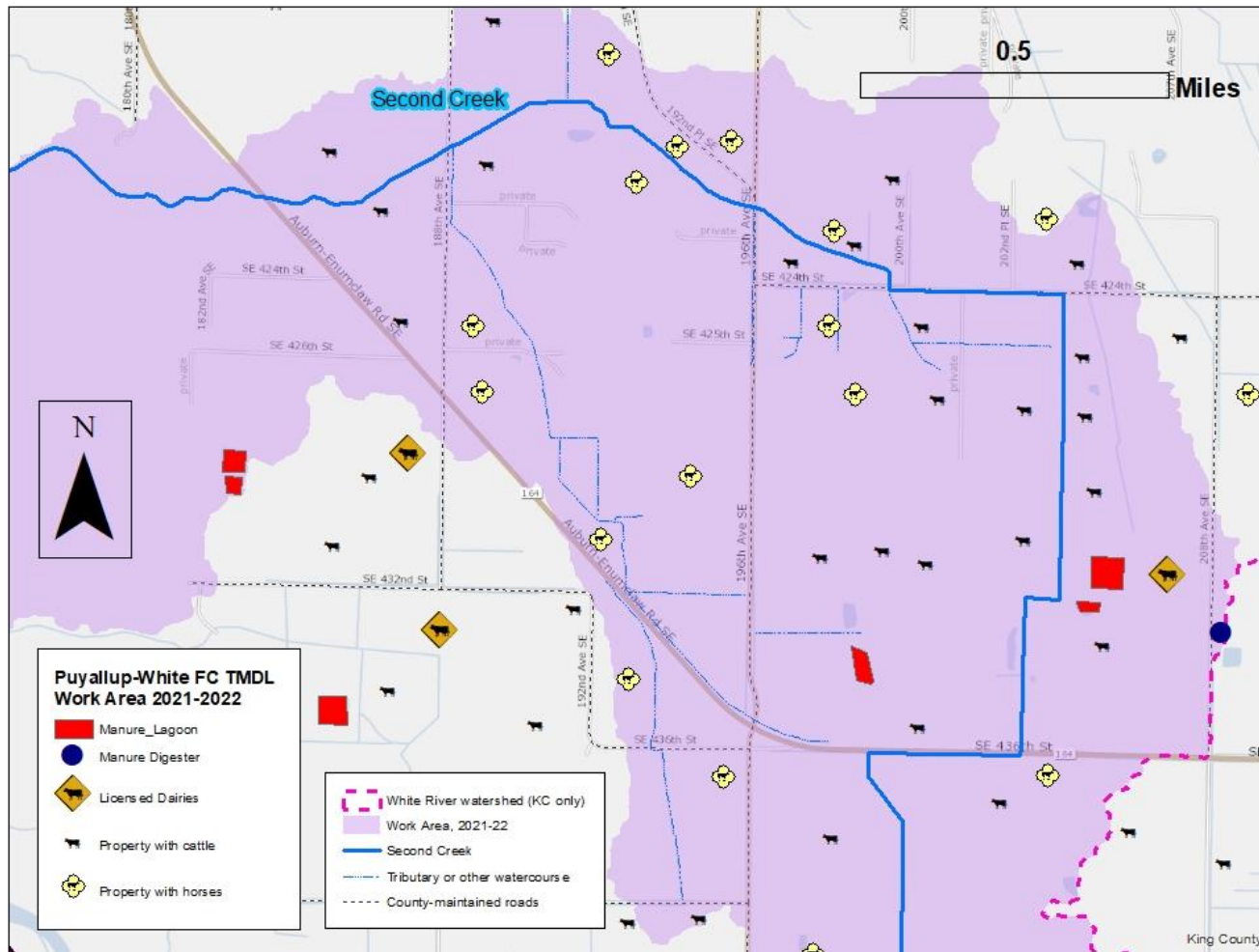


Figure C3. FC TMDL work area for 2021-2022, dairies and domestic animals

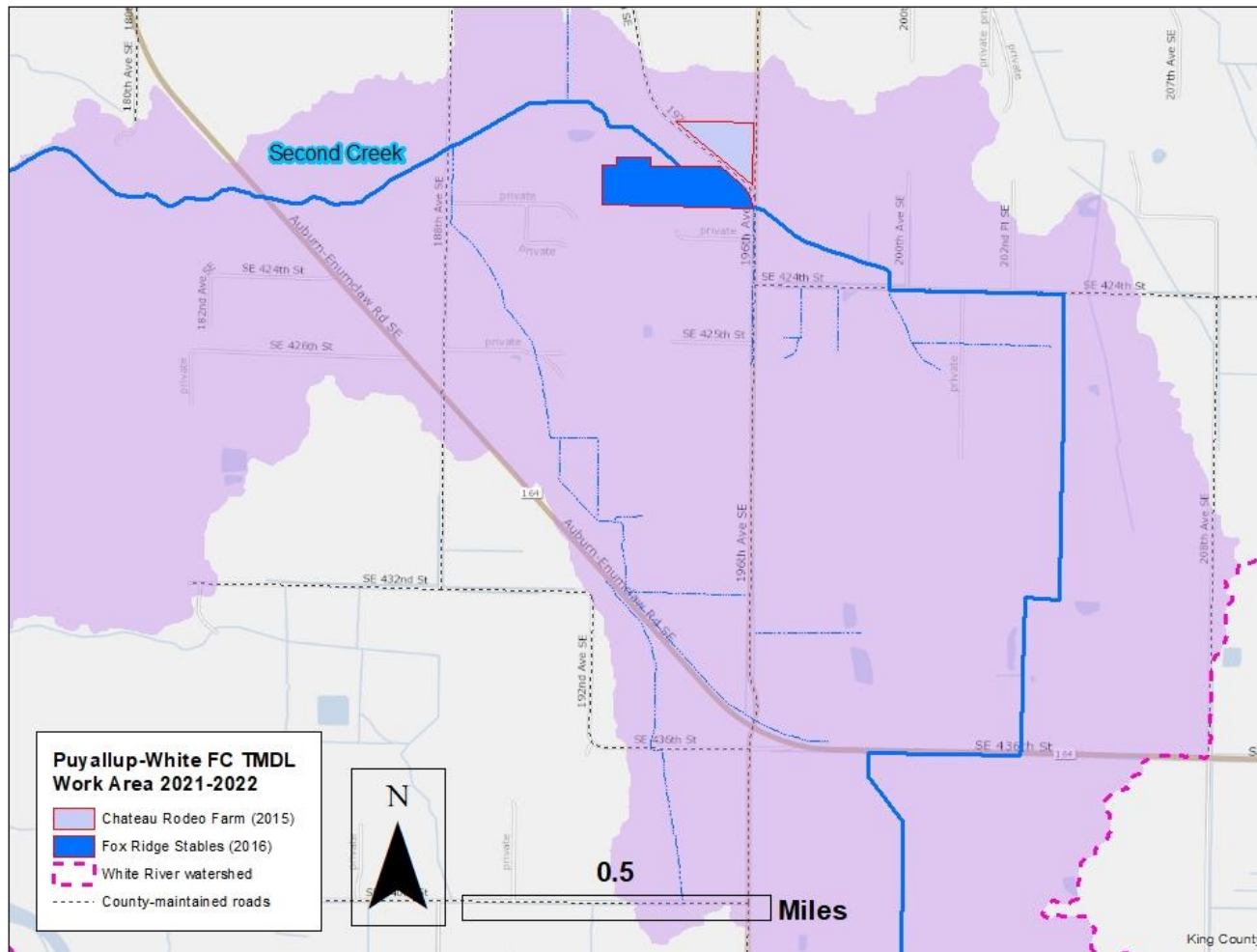


Figure C4. FC TMDL work area for 2021-2022, recent business visits

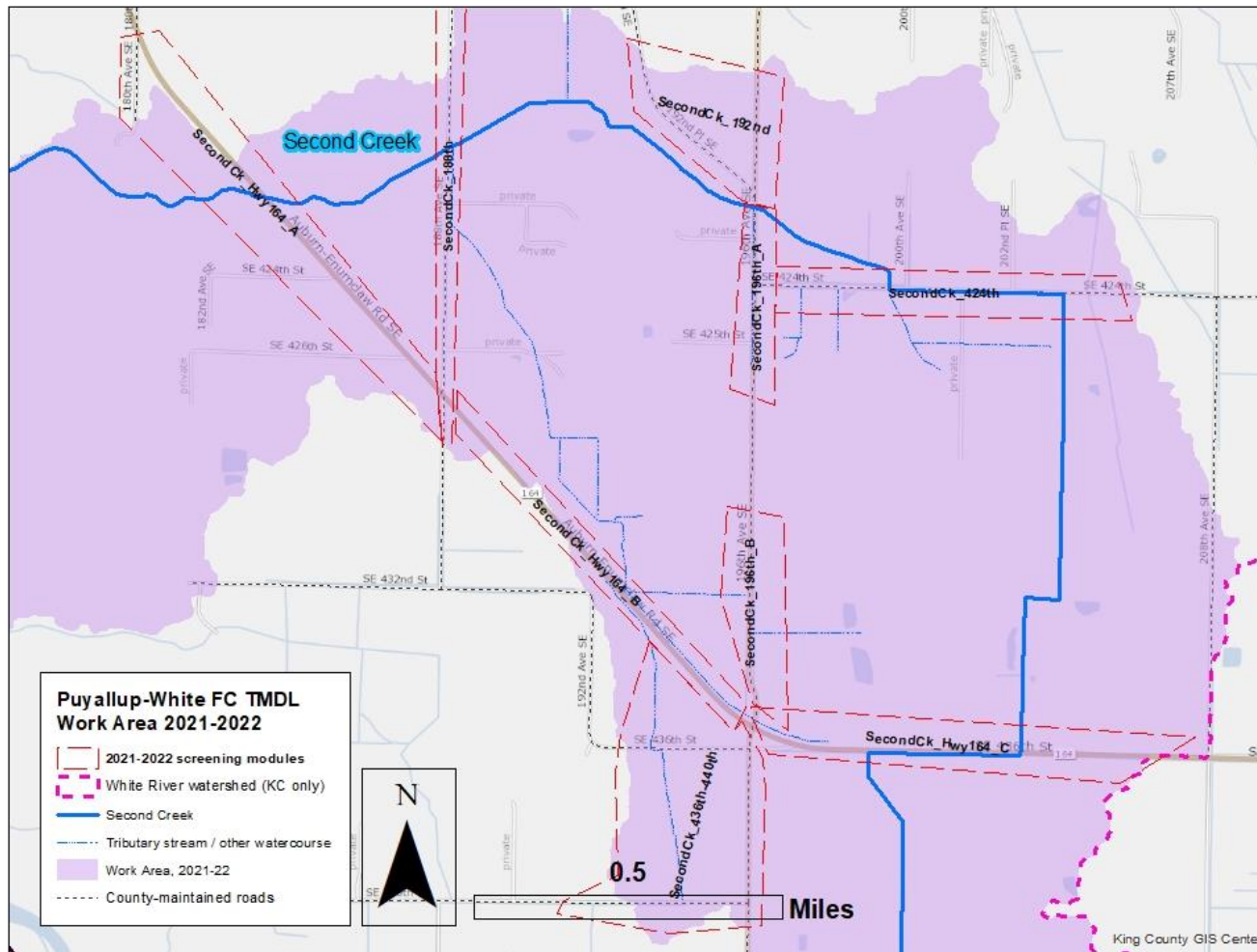


Figure C5. FC TMDL work area for 2021-2022, screening module boundaries

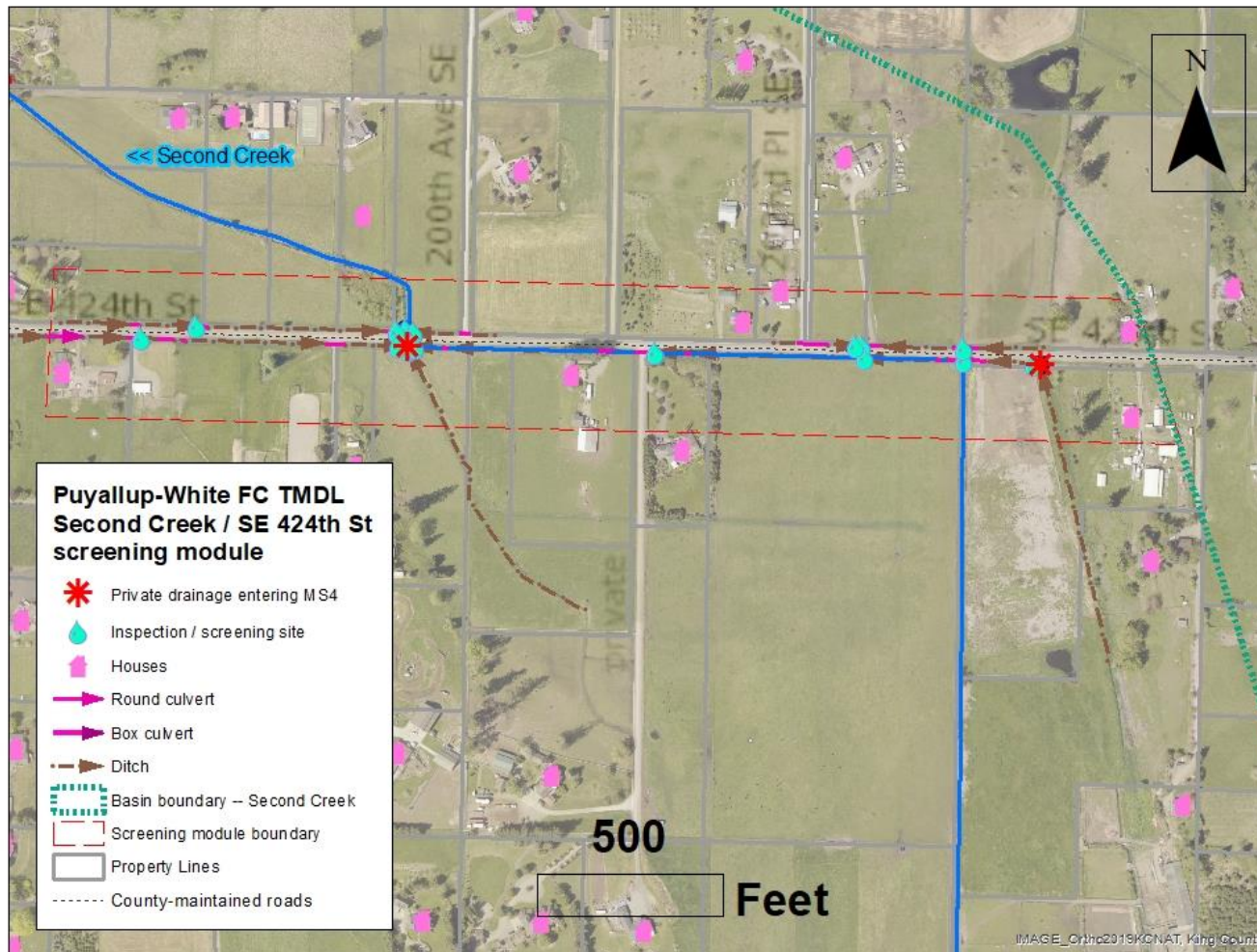


Figure C6. Second Creek / SE 424th St screening module

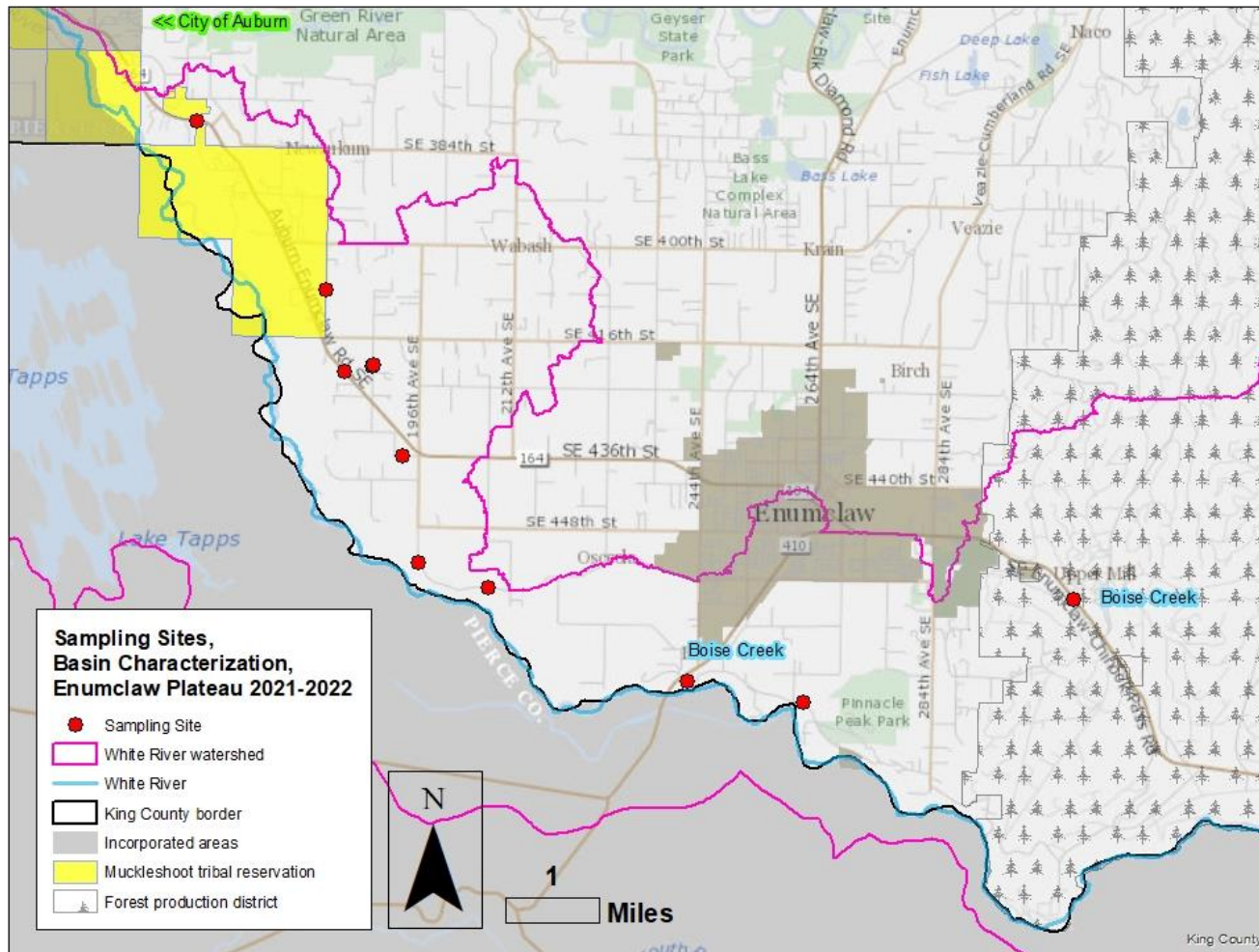


Figure C7. Principal stream sampling sites, Enumclaw plateau, 2021-2022

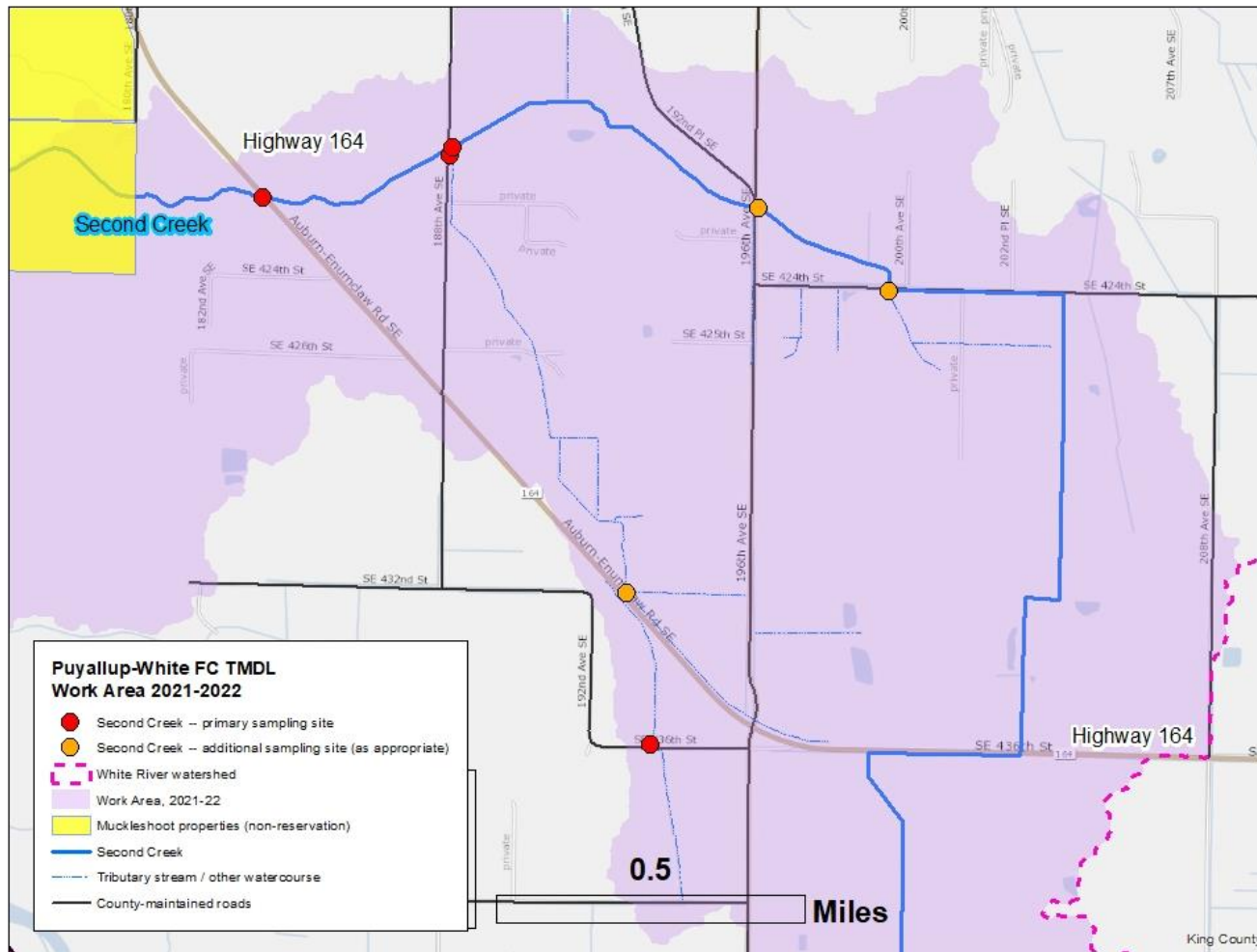


Figure C8. Stream sampling sites, Second Creek subbasin, 2021-2022

Screening module name	Type of conveyance	Length of roadway, feet	Length of conveyance (KC MS4), feet	# of catch basins	# of mapped, private pipes entering KC MS4	Anticipated # of screening sites	Notes
SecondCk_Hwy164_A	Ditch-culvert	4600	300	0	0	10	WSDOT drainage*
SecondCk_188th	Ditch-culvert	3930	6500	0	1	13	
SecondCk_Hwy164_B	Ditch-culvert	3500	0	0	0	12	WSDOT drainage*
SecondCk_436th-440th	Ditch-culvert	4200	4900	0	0	15	
SecondCk_192nd	Ditch-culvert	2700	3200	0	0	7	
SecondCk_196th_A	Ditch-culvert	1630	2100	0	5	11	
SecondCk_424th	Ditch-culvert	3000	4600	0	2	15	
SecondCk_196th_B	Ditch-culvert	1700	3300	0	0	8	
SecondCk_Hwy164_C	Ditch-culvert	3500	130	0	2	10	WSDOT drainage*

Note: all values in table are estimates and are intended only for planning purposes.
 * The area to be screened is served primarily by WSDOT stormwater infrastructure. King County does not have data regarding the locations of WSDOT's pipes and ditches, but will collect relevant information as needed.

Table C-1 2021-2022 wet season screening module attributes

Appendix D: work area 2022-2023 (not completed as of 2021)

Appendix E: work area 2023-2024 (not completed as of 2021)