
To: Stephanie Potts, Washington State Department of Ecology
From: Bridget August, LG, LHG and John Monahan, FP-C (GeoEngineers, Inc.)
Date: February 21, 2020
File: 00504-161-00
Subject: WRIA 9 Growth Projections – Final Draft

INTRODUCTION

GeoEngineers, Inc. (GeoEngineers) is providing technical support to the Washington State Department of Ecology (Ecology) and the Watershed Restoration and Enhancement (WRE) Committees for Water Resource Inventory Areas (WRIAs) 7, 8 and 9. This memorandum provides a summary of the deliverable for Work Assignment GEO102, Task 3, WRIA 9 Growth Projections.

BACKGROUND AND CONTEXT

The Streamflow Restoration Act (SRA, Chapter 90.94 Revised Code of Washington) specifies that by June 30, 2021, Ecology must establish a WRE Committee and adopt a WRE Plan in the Duwamish-Green Watershed (WRIA 9). The WRE Plan needs to address impacts on streamflows from consumptive use caused by new domestic permit-exempt wells anticipated between January 19, 2018 and January 18, 2038.

The WRE Plan must estimate growth projections for the watershed for January 2018 through January 2038 (at a minimum). Based on the projected growth, the plan will estimate the amount of rural growth and associated water use from new permit exempt well connections.

Ultimately, WRE Plan growth projections need to address the following two primary questions:

1. How many new permit-exempt domestic well connections (PE wells¹) could be installed throughout the watershed over the next 20 years?
2. Where could the PE sourced growth occur at the subbasin level?

WRIA 9 includes parts of unincorporated King County and 15 incorporated cities. The methods used to estimate the number and location of new wells in unincorporated and incorporated areas in WRIA 9 are summarized below.

¹ "PE wells" is used to refer to new homes associated with new permit-exempt wells and also new homes added to existing wells, including homes on group systems relying on permit-exempt wells.

GROWTH PROJECTION METHODS

GeoEngineers worked with the WRIA 9 – Duwamish-Green WRE Committee to define growth projection methods and growth projections for WRIA 9. The WRIA 9 growth projection methods included using King County historical building permit data to predict potential PE well growth over the 20-year planning horizon. This methodology assumes that the rate and location of past growth will continue over the 20-year planning horizon. Using past building permits to predict future growth is one of Ecology’s recommended methods (Ecology 2019). Projecting future PE well growth involves accounting for populations that will be served by community water systems and municipalities (Ecology 2019). Due to data availability, King County considered rates of connection to water service within water service area boundaries.² King County completed the analysis in-house and the methods and assumptions are described in detail in Attachment A and summarized below.

GeoEngineers also completed an analysis of potential PE well growth within the incorporated and unincorporated Urban Growth Areas (UGAs) using Ecology’s Well Report Viewer database. The methods and assumptions are also described below and GeoEngineers data tables are included in Attachment B.

In addition, King County also completed a PE Well Potential Assessment which identified potential parcels where growth could occur within rural King County. The PE Well Potential Assessment results were used to assess whether a subbasin (as identified by the WRE Committee) has the capacity to handle the number of PE wells in the 20-year growth projection. In those areas where the number of projected PE wells exceeded the potential parcels available, the wells were reallocated to the nearest subbasin with similar growth patterns and parcel capacity. The King County PE Well Potential methods and assumptions are described in Attachment A and summarized below.

King County Unincorporated Area Past Trends Analysis

King County does not have a growth target for the unincorporated rural area and therefore decided to use building permit data as its chosen method to assess future growth potential. King County elected to complete the WRIA 9 historic growth analysis in-house using 2000 to 2017 building permit data for new residential structures from the King County Assessor’s office. The analysis estimated the number of recently built homes that relied on PE wells as their water source in unincorporated King County, both inside and outside of water service areas. King County used historic rates of connection to water service because the County does not have county-wide information on the location of water lines.

King County used the time period 2000 through 2017 because those data were available. The building permit data for 2000 through 2017 includes both periods of high growth and periods of low growth. King County compared these data with information from Vision 2040 and population data and is confident in using the average of this time period to project into the future.

King County used the results from the historic growth analysis to determine the projected number of PE wells per year and over the 20-year planning horizon for unincorporated King County. GeoEngineers then used the King County historic growth results to estimate the number of potential new PE wells per subbasin over the 20-year planning horizon. King County historic growth and PE well projection methods and data tables are provided

² Water service area boundaries include areas currently served by existing water lines and may also include areas not yet served by water lines.

in Attachment A for reference. This methodology assumes that the rate and location of past growth will continue over the 20-year planning horizon. This method is referred to as the King County Past Trends Analysis and the general methodology used was as follows:

King County:

- Obtain available King County building permit and parcel data for new residential structures (2000 to 2017).
- Use centroid of parcel to determine location relative to other boundaries (e.g. WRIA, inside or outside water district service areas, King County stream basin, WRIA 9 subbasin, etc.).
- Assess the total number of permits and average number of permits per year for the WRIA.
- Link building permits and parcel data layers to determine water source for each building permit/parcel. The parcel database indicates the water source as “public” (pub) for buildings connected to water service, “private” (pvt) for buildings relying on a permit-exempt well, and “other” (unknown/null). The “other” category includes parcels listing their water source as “unknown,” referring to parcels with no assigned water source (likely vacant land or unoccupied structure) or “null,” referring to building permits that did not link to existing parcels. King County used the “other” category to calculate an error of 6 percent (of the total number of building permits).³
- Determine the number of building permits/parcels inside and outside the water service areas that have a water source as:
 - Public water (pub)
 - Private water (PE wells) (pvt)
 - Other (unknown/null)
- Calculate the percentage of building permits for each type of water source (pub, pvt or other) by subbasin and the WRIA overall.
- Use the annual average number of permits per year multiplied by the percentage of permits/parcels on private water (pvt) to determine the projected number of PE wells per year.
- Multiply the number of PE wells per year by 20 to calculate the total PE wells projected over the 20-year planning horizon for unincorporated rural King County.

GeoEngineers:

- Use the annual average number of permits per year multiplied by the past percentage of growth per subbasin and percentage of building permits using a private water source (well) per subbasin to determine a projected number of PE wells per year for each subbasin.

³ King County’s percent error uses the number of unknown water use type parcels (unknown) plus those permit records that don’t match parcel information (null), divided by the total number of permits for that area. The null data type, based on selected assessment of un-joined data, appears to be related to development that is not fully completed/sold. These developments are typically on public water.

- Multiply the number of PE wells per year per subbasin by 20 to calculate the estimated total of PE wells projected over the 20-year planning horizon for each subbasin.
- Add 6 percent error to projected number of PE wells per year per subbasin (error is based on the “other and null” categories as described above).
- Tabulate the total growth projected over the 20-year planning horizon, including the 6% error, for each subbasin and sum to get the total of PE wells projected over the 20-year planning horizon in rural unincorporated King County

GeoEngineers UGA Well Log Spot Check

As described above, the King County Past Trends Analysis focused on the potential for PE wells to be installed within rural, unincorporated King County. The King County method does not account for potential PE wells in cities or UGAs. However, early in the growth projection planning process, the WRIA 9 WRE Committee recommended looking at the potential for PE well growth within UGAs. GeoEngineers completed an analysis of potential PE well growth within the incorporated and unincorporated UGAs using Ecology’s Well Report Viewer database. UGA well log spot check data tables are included in Attachment C. The general methodology used was as follows:

- Obtain tabular and spatial data from Ecology’s Well Report Viewer database (1998 through 2018). Ecology’s complete Well Report Viewer database was filtered for water wells 6 to 8 inches in diameter and greater than 30 feet deep, which are typical dimensions and depths for domestic wells. PE wells greater than 8 inches in diameter are cost prohibitive and uncommon. Similarly, wells shallower than 30 feet are more susceptible to contamination and are also uncommon, especially in urban areas. Ecology does not have the ability to filter for permit-exempt domestic wells. Information in the database is based on records submitted by the well driller.
- Filter database for wells located within UGAs. Note that well locations were estimated to the nearest ¼-¼ section.
- Review randomly selected water well reports and note the well type (e.g. domestic, industrial, municipal, irrigation, test well, or other), and well location (physical address and/or parcel number).
- Determine the number of wells that were:
 - Domestic (assumed to be PE wells)
 - Irrigation
 - Other (test, municipal, dewatering, industrial, mitigation, UIC, deepened or refurbished wells)
 - Incorrect (location, date, etc.)
- Calculate the percentage of each type of well (domestic, irrigation, other and incorrect).
- Multiply the percentage of domestic wells (assumed to be PE wells) by the total number of wells located within UGAs to estimate the number of domestic wells installed over the past 20-year period.
- Cross-check the physical address of the wells with the UGA boundary to determine in which subbasin the domestic wells were located.
- Tabulate the total number of domestic wells per subbasin.

- Multiply the total number of domestic wells per subbasin by 20 to calculate the estimated number of PE wells located within the UGA projected over a 20-year period for each WRIA 9 subbasin.

King County PE Well Potential Assessment

King County also completed a PE Well Potential Assessment which evaluated the parcels available for future growth in unincorporated King County. The purpose of the PE Well Potential Assessment was to determine if there would be enough parcels to accommodate the 20-year growth projection at the WRIA and subbasin level. In those areas where the number of projected PE wells exceeded the potential parcels available, GeoEngineers reallocated those wells to the nearest subbasin with parcel capacity and similar growth patterns. King County used historic rates of connection to water service because the County does not have county-wide information on the location of water lines. King County PE well potential data tables are included in Attachment A. The general methodology used was as follows:

King County:

- Use assumptions and screening criteria to identify parcels with potential for future growth by subbasin. A list of assumptions made by King County is provided in Attachment A.
- Use centroid of parcel to determine location information (e.g. WRIA, inside or outside water district service areas, WRIA 9 subbasin, etc.).
- Use King County parcel attribute data to determine total number of parcels and dwelling units per subbasin. A dwelling unit (DU) is a rough estimate of subdivision potential based on parcel size and zoning (e.g. a 22-acre parcel zoned RA-5 is assumed to have 4 dwelling units).
- Determine the number of parcels and dwelling units that would be inside or outside water district service boundaries.
- Calculate water source projections for public connections and PE sourced parcels:
 - Public connection parcels would be those located within water district service boundaries and were calculated based on historic rates of connection to public water within each subbasin.
 - The remaining number of parcels located within water district service boundaries that exceeded the historic rate of public water connection were assigned to be PE sourced (e.g. served by a PE well).
 - PE sourced parcels were calculated based on the number of parcels located outside water district service boundaries plus the remaining parcels from “inside” water district boundaries, as described above.
- Calculate the shortfall or surplus of available parcels to be sourced by PE wells by taking the total PE sourced DUs minus the 20-year growth projection from the King County past trends analysis.

GeoEngineers:

- If the projected PE well growth exceeds the total number of available PE sourced parcels, reallocate shortfall to adjacent subbasin with parcel capacity and similar growth patterns.

GROWTH PROJECTION RESULTS

The King County Past Trends Analysis and GeoEngineers UGA Well Log Spot Check results were combined to determine the total number of projected PE wells per subbasin within WRIA 9. Using the King County PE Well Potential Assessment, GeoEngineers compared the total available PE sourced parcels (i.e. DUs and HUs) per subbasin with the projected growth per subbasin. In those areas where the number of projected PE wells exceeded the potential parcels available, GeoEngineers reallocated those wells to the nearest subbasin with parcel capacity and similar growth patterns. The results are summarized in Table 1 and shown on Figure 1. GeoEngineers estimates 632 new permit-exempt domestic well connections in WRIA 9 over the 20-year planning horizon. The following is a brief summary of the calculations used to complete the WRIA 9 growth projection analysis:

- King County used the average number of building permits per year (79) for the 18-year period from 2000 to 2017, multiplied by the historic percentage of homes using PE wells (36.4 percent) to determine a projected number of new PE wells per year (29) in the WRIA 9 portion of rural unincorporated King County. The number of PE wells per year (29) was then multiplied by 20 to determine the estimated total of PE wells projected over the 20-year planning horizon (578) for rural unincorporated King County. (Note that due to rounding, the total number is 578 vs. 580).
- To estimate the 20-year PE well projection per subbasin, GeoEngineers used the average number of building permits per year (79), multiplied by the historic distribution of growth per subbasin. The average building permits per subbasin was then multiplied by the historic percentage of homes using PE wells to estimate the average number of PE wells per year per subbasin. The number of PE wells per year per subbasin was then multiplied by 20 to calculate the estimated total of PE wells over a 20-year period per subbasin. A 6 percent error was then added to each subbasin total. The total number of estimated PE wells, including the 6 percent error, is 612. See Attachment A for detailed results.
- GeoEngineers also completed a UGA Well Spot Check for wells from the Ecology Well Report Viewer database that plot within the Urban Growth Area. Of the wells that plotted in WRIA 9, 93 wells were located within the UGA for 1998 through 2018. GeoEngineers checked about 70 percent of the wells by looking at the well logs and noting whether the wells were identified as being for domestic, irrigation, or other purposes (e.g. test, industrial, errors, etc.). According to the well logs, about 23 percent of the wells were for domestic use.
- GeoEngineers took the number and distribution of wells from the 1998-2018 data and projected the same rate and distribution per subbasin for the 20-year planning horizon. The estimated number of PE wells within the UGA over the 20-year period is 20. (Note that due to rounding, the total number is 20 vs. 21). See Attachment B for detailed results.
- King County also completed a PE Well Potential Assessment to determine whether a subbasin has capacity for the number of wells in the 20-year projection.
- The PE Well Potential Assessment shows a capacity shortfall of 20 wells in the Newaukum subbasin. Those 20 wells were reallocated to the Middle Middle Green subbasin because it has parcel capacity, is adjacent and has similar growth patterns.

**TABLE 1. GROWTH PROJECTIONS FOR NEW PE WELLS IN WRIA 9 – DUWAMISH-GREEN
2018 TO 2038**

Subbasins¹	King County Past Trends²	UGA Well Log Spot Check³	Total PE Wells⁴ per Subbasin⁵
Central Puget Sound	0	0	0
Duwamish River	0	0	0
Lower Green River	0	4	4
Soos Creek	72	11	83
Jenkins Creek	44	1	45
Covington Creek	41	0	41
Lower Middle Green River	81	3	84
Middle Middle Green River	100	0	100
Newaukum Creek	102	1	103
Upper Middle Green River	110	0	110
Coal Deep Creek	62	0	62
Upper Green River	0	0	0
Totals	612	20	632

Notes:

1 = Subbasins from proposal approved at July 23, 2019 WRE Committee meeting.

2 = Based on 20-year estimate of potential new PE wells in unincorporated King County, plus 6% error.

3 = Based on spot-check of Ecology Well Report Viewer database. Accounts for potential wells within the incorporated and unincorporated Urban Growth Areas (UGAs) over the 20-year planning period.

4 = “PE Wells” is used to refer to new homes associated with new permit-exempt wells and also new homes added to existing wells on group systems relying on permit-exempt wells.

5 = Includes redistribution of 20 wells from Newaukum Creek subbasin to Middle Middle Green River subbasin.

NEXT STEPS

- The WRIA 9 WRE Committee agreed to move forward with the WRIA planning process using 632 as the WRIA 9 20-year PE well growth projection to develop consumptive use estimates.

REFERENCES

Department of Ecology, 2019. Final Guidance for Determining Net Ecological Benefit, GUID-2094 Water Resources Program Guidance. Washington State, Department of Ecology, Publication 19-11-079, p. 131.

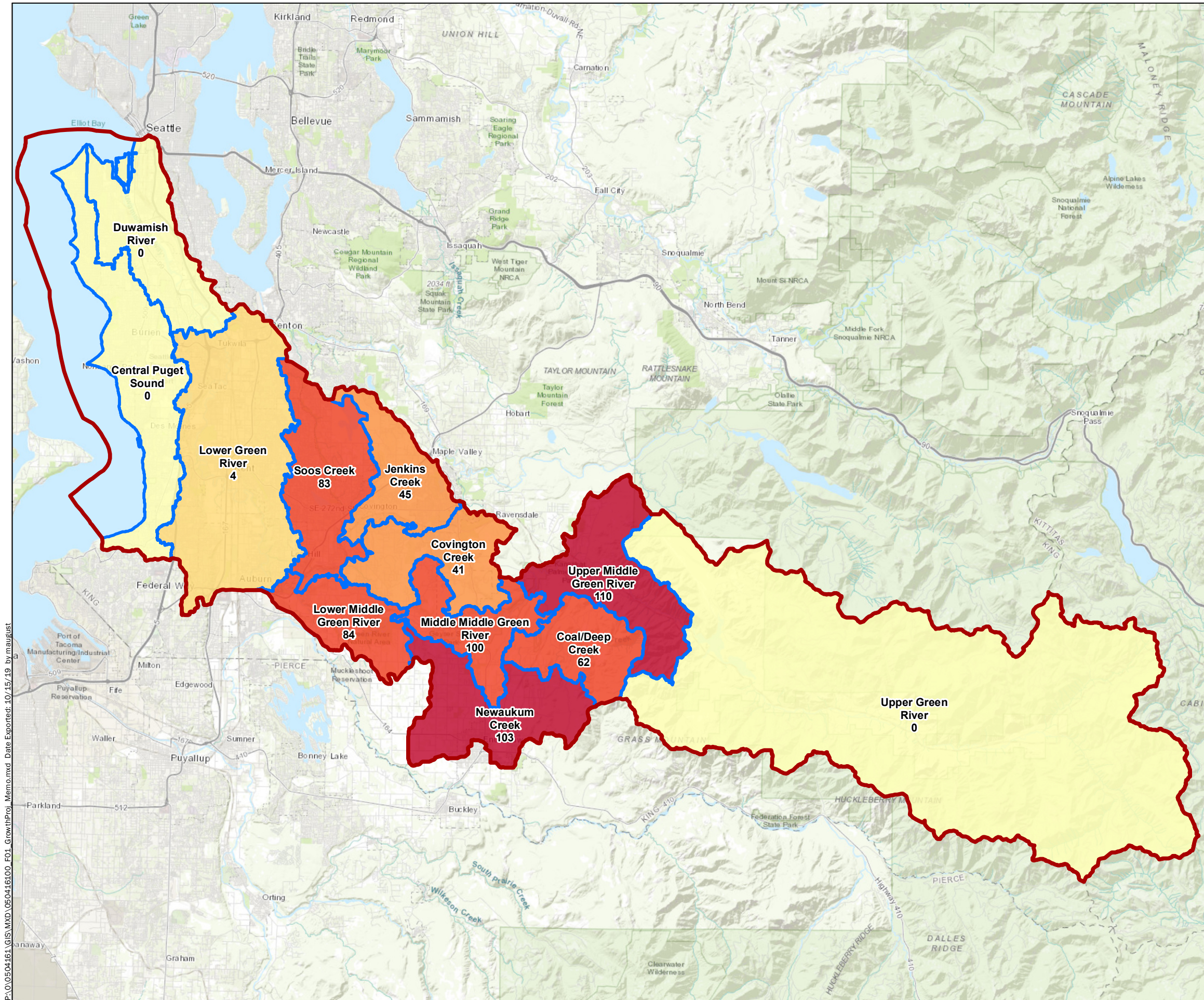
Attachments:

Figure 1. WRIA 9 Distribution of Projected Permit-Exempt Wells 2018-2038

Attachment A. King County Growth Projections and Permit Exempt Well Potential Methods, Assumptions Data Tables

Attachment B. GeoEngineers UGA Well Log Spot Check Data Tables

Disclaimer: Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.



Legend

- WRIA 9 Boundary
- WRIA 9 Subbasins

Projected Permit-Exempt Wells 2018-2038

- 0
- 1 - 5
- 6 - 25
- 26 - 50
- 51 - 100
- >100

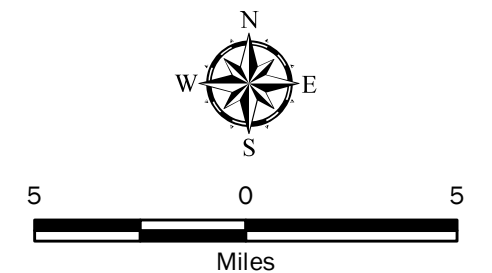
Projected WRIA 9 PE Well Total = 632

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI Topographic Map Base

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet



WRIA 9 Distribution of Projected Permit-Exempt Wells 2018-2038	
Watershed Restoration and Enhancement Plan King County, Washington	
	Figure 1

ATTACHMENT A

King County Growth Projections and Permit Exempt Well Potential Methods, Assumptions and Data Tables



King County

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TECHNICAL MEMORANDUM

December 12, 2019

TO: Stephanie Potts, Ingria Jones, Rebecca Brown, and Stacy Vynne McKinstry, Streamflow Restoration Implementation leads, Water Resources Program, Washington State Department of Ecology

FM: Eric Ferguson, LHG, Science and Technical Support Section, Water and Land Resources Division, Department of Natural Resources and Parks

RE: King County Growth Projections for all Watershed Restorations and Enhancement Committees – WRIAs 7, 8, 9, 10, and 15

This memorandum summarizes the work that King County did in support of generating 20-year growth projections in the rural areas of the county for Watershed Restoration and Enhancement committee (WREC) work. This effort will be incorporated into another technical memorandum that is area specific for each Watershed Resource Inventory Area (WRIA). The additional memorandum will be authored by consultants working for the Washington State Department of Ecology.

Introduction

King County is participating in five WRECs, one for each of the WRIA within its boundary. King County is providing growth projections for each area that assesses a two-part question:

- A. How much potential growth could occur during the 20-year (2018-2038) planning period?
- B. Where could that growth occur at a sub-basin/watershed scale within each WRIA?

Principles

King County does not have growth targets for unincorporated rural areas in the county. All growth targets are for the urban growth area (UGA). No changes to the UGA boundary are intended during the 20-year planning period.

The following are highlights from planning policies:

- Accommodate most recent 20-year population forecast from OFM, and 20-year jobs forecast from Puget Sound Regional Council.
- Plan for growth consistent with Regional Growth Strategy
 - Focus growth in cities with major centers, and in other large cities
 - Limit development in Rural Areas, protect Resource Lands

Source: Policy DP-11 in Countywide Planning Policies, 2012

Population growth in the unincorporated rural area is estimated to be about 20,000 people or ~3% of overall population from Vision2040, Figure 1.

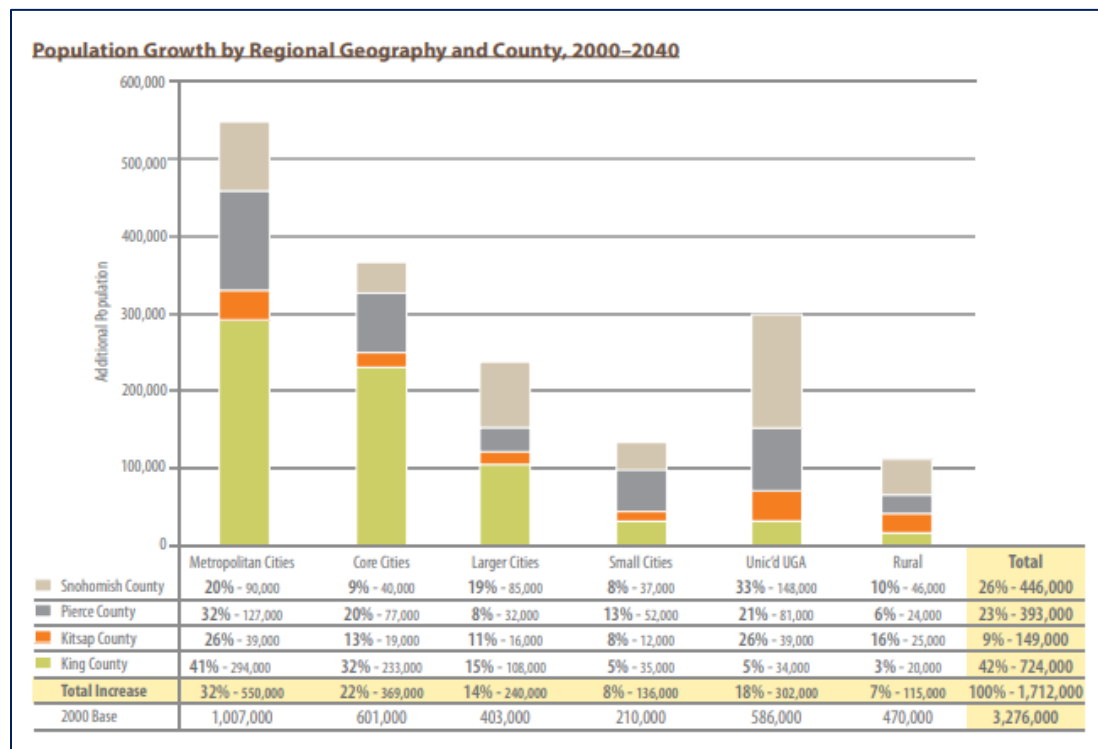


Figure 1. Estimated population growth for rural King County from 2000-2040 is 20,000, King County, Vision 2040.

Note: the updated Vision (2050) document is due to be adopted in May 2020. The updated growth for rural King County is planned to be about 1% during 2017–2050 period (or ~6,000 people).

Methods

The first part of the growth projection assessment was performed in order to respond to the question: “How many new single-family permit-exempt well connections will be installed throughout each watershed over the next 20 years?” King County does not have a growth target

for the unincorporated rural area (as noted above) and therefore decided to use building permit data (for new residential structures) as its chosen method to assess future growth potential.

The following is the methodology used to assess the potential growth:

1. Compiled 18 years (2000–2017) of building permit data for new residential structures;
 - a. This data was subdivided into two periods: 2000–2009 and 2010–2017, Table 1; each period has a range of low to high growth.

Table 1. Building permits from 2000-2017; new residential structures only

Building permits (unincorporated rural KC)	
2000-2009	4595
2010-2017	1252
Total	5847

2. Used GIS to provide location based information about building permits
 - a. Use centroid of the building permit/parcel to assess location relative to other boundaries such as WRIA boundaries, stream basins, water district service areas, sub-basin delineations.
 - b. Assess the number of permits per each WRIA, Table 2

Table 2. Building permits by WRIA

WRIA*	Total permits	Permits per year	Percentage of total
7	1864	104	32%
8	1836	102	31%
9	1430	79	24%
10	100	6	2%
15	617	34	11%

* = WRIA boundaries are delineated by Ecology coverage

3. Linked building permits and parcel data layers to assess percentage of parcels using public versus private water with parcel attribute data.
4. Determined the number of building permits/parcels that have a water source as:
 - a. Public (pub) water
 - b. Private (pvt) water (Permit-Exempt wells)
 - c. Other (unknown/null)
 - i. “unknown” refers to parcels with no assigned water source (likely unoccupied structure)
 - ii. “null” refers to those building permits that did not link to existing parcels.

- iii. This category can be used as an “error” since it refers to the amount of information that is undetermined and could potentially be private sourced.
5. Calculated the percentage of building permits for each type of water source (i.e. public, private or other) for entirety of King County as shown in Table 3 below as well as by WRIA and its sub-basin delineations.

Table 3. Water source by parcel/permit

Type of water use	Total permits	Percentage of total
Public	3113	53%
Private	2369	40%
Other -unknown	73	1%
Other - null	292	5%

6. Used the annual average number of permits per year multiplied by the percentage of permits/parcels on private water to determine a projected number of Permit Exempt (PE) wells per year, Table 4.

Multiplied the number of PE wells per year by 20 to calculate the estimated total of PE wells projected over a 20-year period for unincorporated rural King County, Table 4.

Table 4. Average number of permit exempt well users by WRIA for the planning period.

WRIA*	Permit-exempt well/year^	20-year estimate	Error®
7	46	926	6%
8	35	698	6%
9	29	578	6%
10	4	81	2%
15	18	368	4%

* = WRIA boundaries are delineated by Ecology coverage

^ = WRIA specific percentage of private well users

® = Error calculated from percentage of building permits with “other” water service

Projected number of permit-exempt wells for time period (01/18/2018 to 01/18/2038) for all of King County is 2650. Each WRIA has a series of tables of this specific information, see Tables.

The second part of the growth projection assessment was performed in order to respond to the question: “Where will the well connections be installed?” The PE potential assessment is a GIS assessment of current (2019) parcel data. This work used a series of assumptions to assess potential area of growth within the county, specifically at the sub-basin scale as defined by the WREC for each WRIA.

The following are the assumptions used to refine the parcels:

- Outside Urban Growth Boundary
 - Outside Forest Production District
 - Outside Agriculture Production District
 - Not Encumbered by K`C Parks or TDR conservation easements
 - Not enrolled in Farmland Preservation Program
 - Not Owned by Public Agencies
 - Vacant land (with appraised improvements <\$10,000)
 - Have at least 1 acres of land outside 100 year Floodway and Severe River Channel Migration Hazard Areas.
 - Parcel size – 1 acre or greater.
 - Zoning – no exclusion and maximum density allowed by current zoning
7. Used centroid of the refined parcel data to determine location information, similar to step 2 (above).
 8. Linked parcel and assessor attribute data to determine total number of parcels and dwelling units per sub-basin. A dwelling unit (DU) is a rough estimate of subdivision potential based on parcel size and zoning (e.g., a 22-acre parcel zoned RA-5 is assumed to have 4 dwelling units).
 9. Determined the number of parcels and DUs that are inside or outside water district service boundaries.
 10. Calculated water use projections for public connections and PE sourced parcels:
 - a. Public connection parcels are located within water district service boundaries and are calculated based on historic rates of connection to public water within each sub-basin, assessed in step 5 (above).
 - b. Any remaining number of parcels located within water district service boundaries are assigned to be PE sourced.
 - c. PE sourced parcels were calculated based on the number of parcels located outside water district service boundaries plus the remaining parcels from “inside” water district boundaries, as described above, Table 5.

Table 5. Permit exempt (PE) estimate along with PE potential assessment data.

WRIA*	PE 20yr estimate^	Parcel^	DU
7	926	1175	1901
8	698	819	1070
9	578	746	1077
10	81	72	82
15	368	788	888

* = WRIA boundaries are delineated by Ecology coverage

^ = WRIA specific percentage of private well users

DU = Dwelling unit as noted in step 9.

WRIA specific data along with sub-basin assessments can be found in the Tables.

References

King County Countywide Planning Policies

<https://www.kingcounty.gov/depts/executive/performance-strategy-budget/regional-planning/CPPs.aspx>

<https://www.kingcounty.gov/~media/depts/executive/performance-strategy-budget/regional-planning/CPPs/2012-CPPsAmended062516withMaps.ashx?la=en>

Vision 2040 link:

https://www.kingcounty.gov/~media/depts/executive/performance-strategy-budget/regional-planning/Comp%20Plan/VISION_2040_-_2008.ashx?la=en

**King County Growth Projection data tables
by WRIA (Watershed Resource Inventory Area)**

WRIA 9 - Green-Duwamish

Draft 9/23/19

WRIA (Ecology Coverage) 9	(KC building permitting data)			permits per year
	2000-2009	2010-2017	total	
	1152	278	1430	79

% of county-wide total
24%

WRIA 9 Future Permit- Exempt wells	PE/yr 29	20 yr est 578
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District info	2000-2009	2010-2017	total
total	1152	278	1430
wtr dst (inside water district)	831	219	1050
no dst (outside water district)	321	59	380

Ag PD	permits	% of WRIA total
WRIA 9	125	9%
Forest PD	permits	% of WRIA total
WRIA 9	43	3%

Historic Percentages	pub	0.576
	pvt	0.364

Water service info	(derived from KC parcel attribute data)		
pub (water service)	708	115	823
pvt (well)	436	84	520
other	8	79	87
total	1152	278	1430

Existing PE wells	2000-2009	2010-2017	Total
	436	84	520

error	1%	28%	6%
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WRIA 9 - Green-Duwamish - Historic Growth and Water Use by Subbasin

WRIA 9 - 20 year PE Well Projection by Subbasin

Sub-basin delineations v. 9/23/19

Sub-basin w/ permits	Number of permits	Distribution of growth
Central Puget Sound	Urban	0%
Duwamish	Urban	0%
Lower Green	3	0%
Soos subbasin	167	12%
Jenkins subbasin	154	11%
Covington subbasin	235	16%
Lower Middle Green	250	17%
Middle Middle Green	256	18%
Newaukum subbasin	172	12%
Upper Middle Green	121	8%
CoalDeep	72	5%
Upper Green Subbasin	0	0%

Water use by basin

pub	pvt	oth	%pub	%pvt
0	0	0	0%	0%
0	0	0	0%	0%
3	0	0	100%	0%
96	61	10	57%	37%
109	37	8	71%	24%
189	35	11	80%	15%
168	69	13	67%	28%
157	68	31	61%	27%
60	104	8	35%	60%
26	93	2	21%	77%
15	53	4	21%	74%
0	0	0	0%	0%

total 1430 100% 823 520 87 total 1430

permits/year	79	Added by GeoEngineers:			Sub-basins	Distribution of PE
Average bldg. permits per year	Average wells per year (pvt)	Total wells in 20 years	Total wells in 20 years + 6% error	Total Rounded		
0.0	0.0	0.0	0.0	0	Central Puget Sound	0%
0.0	0.0	0.0	0.0	0	Duwamish	0%
0.2	0.0	0.0	0.0	0	Lower Green	0%
9.3	3.4	67.8	4.1	72	Soos subbasin	12%
8.6	2.1	41.1	2.5	44	Jenkins subbasin	7%
13.1	1.9	38.9	2.3	41	Covington subbasin	7%
13.9	3.8	76.7	4.6	81	Lower Middle Green	13%
14.2	3.8	75.6	4.5	80	Middle Middle Green	13%
9.6	5.8	115.5	6.9	122	Newaukum subbasin	20%
6.7	5.2	103.3	6.2	110	Upper Middle Green	18%
4.0	2.9	58.9	3.5	62	CoalDeep	10%
0.0	0.0	0.0	0.0	0	Upper Green Subbasin	0%
79.4	28.9	577.7	34.7	612		

WRIA 9 - Permit-Exempt Well Potential Assessment

Assessment of potential parcels for future growth

Sub-basins	Number of parcels	Number of Dwelling Units (DU)
Central Puget Sound	Urban	Urban
Duwamish	Urban	Urban
Lower Green	3	3
Soos subbasin	197	232
Jenkins subbasin	176	234
Covington subbasin	207	316
Lower Middle Green	152	237
Middle Middle Green	212	451
Newaukum subbasin	106	123
Upper Middle Green	161	208
CoalDeep	122	170
Upper Green Subbasin	0	0

total 1336 1974

Water district boundaries				subbasin	Water Use Projection						
Inside		Outside			public connection		PE sourced				
parcels	DU	parcels	DU		parcels	DU	parcels	DU	20 year well projection (incl error)	Shortfall (red if present) in 20 year well projection	Redistribution - 20 year well projection
0	0	0	0	Central Puget Sound	0	0	0	0	0	0	
0	0	0	0	Duwamish	0	0	0	0	0	0	
3	3	0	0	Lower Green	3	3	0	0	0	0	
196	231	1	1	Soos subbasin	113	133	84	99	72	27	72
175	233	1	1	Jenkins subbasin	124	165	52	69	44	25	44
207	316	0	0	Covington subbasin	166	254	41	62	41	21	41
127	210	25	27	Lower Middle Green	85	141	67	96	81	15	81
130	294	82	157	Middle Middle Green	80	180	132	271	80	191	100
53	60	53	63	Newaukum subbasin	18	21	88	102	122	-20	102
0	0	161	208	Upper Middle Green	0	0	161	208	110	98	110
0	0	122	170	CoalDeep	0	0	122	170	62	108	62
0	0	0	0	Upper Green Subbasin	0	0	0	0	0	0	0
891	1347	445	627		590	897	746	1077	612	-----	612

total parcels	1336	total parcels	1974
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total parcels	1336	total parcels	1974
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20 year Permit Exempt well total
612

Notes:
The King County 20 year PE well projections are revised because of a correction to the historic growth by subbasin data. Number of permits in Covington subbasin revised from 237 in WRIA9-GrowthProjectionSummary_082319.xls to 235 in this version, which changes total building permits for 18 year period to 1430.
The Permit-Exempt Well Potential Assessment is outlined in red
Columns in yellow include redistribution of wells in the 20 year growth projection, based on the permit-exempt well potential assessment done by King County.
Red numbers indicate a shortfall (more projected PE wells than parcels/DU)
Blue numbers indicate redistribution of PE projected numbers

ATTACHMENT B
GeoEngineers UGA Well Log Spot Check Data Tables

GeoEngineers - Incorporated (UGA) WRIA 9 Growth Projections

Developed 8/21/19

GeoEngineers - UGA Well Log Spot Check						
Period	Total Wells	Total Wells Spot Checked	Domestic wells (includes Group B wells)	Irrigation wells	Other (Test, Municipal, Dewatering, Industrial, Mitigation, UIC, Deepened or Refurbished)	Incorrect (Location, Date, etc.)
1998-2007	58	41	7	19	11	4
2008-2018	35	24	8	10	1	5
Totals	93	65	15	29	12	9
Percent of Total		70%	23%	45%	18%	14%
<i>Potential number of new wells based on percentage of past 20 year total (93)</i>						
WRIA 9			21	41	17	13

Notes:

Total domestic well numbers have been revised after cross-checking well address with the UGA boundary.

Wells located outside of the UGA have been removed from the domestic well total.

The remaining domestic wells that have been spot checked are located in the following UGAs: King County (2), Kent (3), Auburn (5), Covington (3), Maple Valley (1) and Enumclaw (1).

Service Area/City Policy Notes:

Covington WD - incentivizes hookups, only 1 PE well in last 4 years in service area

Tacoma Water (Cumberland) - allows wells until service reaches new homes

Auburn - Allows PE wells until water service reaches new homes. Short plats must hookup.

only 1 new well in last 5 years

Tukwila - PE wells not allowed. No known wells in use.

GeoEngineers - Incorporated (UGA) WRIA 9 Growth Projections

Subbasins	Spot Checked 1998-2007	Spot Checked 2008-2018	Total	Total Potential Wells in UGA in 20 years	Total Rounded	City UGA
Central Puget Sound	0	0	0	0.00	0	
Duwamish		0	0	0.00	0	
Lower Green	1	2	3	4.20	4	King Co, Kent and Auburn UGAs
Soos subbasin	5	3	8	11.20	11	Kent, Covington, King Co, and Auburn UGAs
Jenkins subbasin	0	1	1	1.40	1	Maple Valley UGA
Covington subbasin	0	0	0	0.00	0	
Lower Middle Green	1	1	2	2.80	3	Auburn UGA
Middle Middle Green	0	0	0	0.00	0	
Newaukum subbasin	0	1	1	1.40	1	Enumclaw UGA
Upper Middle Green	0	0	0	0.00	0	
Coal Deep	0	0	0	0.00	0	
Upper Green Subbasin	0	0	0	0.00	0	
Totals	7	8	15	21.00	20	

Note: This tables includes data for wells in Ecology's Well Report database, filtered for a depth greater than 30 feet and diameter 6-8 inches. Ecology does not have the ability to filter for permit-exempt domestic wells. Information in the database is based on records submitted by the driller. Well Report Data and Images released from the Department of Ecology are provided on an "AS IS" basis, without warranty of any kind.