

January 18, 2019

To: Mike Hermanson – Spokane County Environmental Services, Lead Agency
WRIA 55 Planning Unit Members

From: Carl Einberger, LHG, Aspect Consulting, LLC
Dan Haller, PE, Aspect Consulting, LLC

Re: **Evaluation of Future Exempt Well Demand
ESSB 6091/RCW 90.94 Watershed Plan Update**

Background

The passage of Engrossed Substitute Senate Bill (ESSB) 6091, as codified by RCW 90.94, requires that an update to the existing Watershed Plan for Water Resource Inventory Area (WRIA) 55, the Little Spokane Watershed, be approved by the Washington Department of Ecology (Ecology) by February 1, 2021. Spokane County Environmental Services is serving as the lead agency for this process. The WRIA 55 Initiating Governments for the watershed planning process are Spokane County, Stevens County, Pend Oreille County, the City of Spokane, and Whitworth Water District. The process is supported by convening the WRIA 55 Planning Unit to review technical tasks and memorandums, policy decisions, and the pending watershed plan update. Aspect Consulting, LLC (Aspect) has been contracted by Spokane County to facilitate planning unit meetings, conduct supporting technical tasks and prepare the watershed plan update.

Section 202 of ESSB 6091, which is applicable to WRIA 55, contains several provisions regarding how watershed restoration and enhancement plans, and updated watershed plans are to offset or account for projected water use.

Specifically, Section 202(4)(b) states, in part:

At a minimum, the [watershed] plan must include those actions that the planning units determine to be necessary to offset potential impacts to instream flows associated with permit exempt domestic water use. The highest priority recommendations must include replacing the quantity of consumptive water use during the same time as the impact and in the same basin or tributary.

Ecology issued Recommendations for Water Use Estimates¹ for ESSB 6091 in March 2018, that provides guidance on evaluation of future exempt well demand. Key excerpts from this document include:

- **Timeframe:** To evaluate and offset potential consumptive impacts from permit-exempt domestic wells, a timeframe over which new domestic use will be considered must be designated. Since a “subsequent twenty years” is referenced throughout other sections of ESSB 6091 (such as sections 202(4)(c), Ecology interprets the timeframe for 202(4)(b)

¹ <https://fortress.wa.gov/ecy/publications/documents/1811007.pdf>



... to be the next twenty years. In its *Interim Guidance for Determining Net Ecological Benefit*², Ecology further clarified that this 20-year planning horizon begins on the date ESSB 6091 was signed into law – January 19, 2018.

- **Scope of “water use”:** Ecology interprets all projected water use referenced in sections 202(4)(c)...to refer to only consumptive permit-exempt domestic groundwater water use (as opposed to water use associated with municipalities, for example).
- **Consumptive use:** Water Resources Program Policy 1020 (1991) states, “Consumptive water use causes diminishment of the source at the point of appropriation,” and that, “Diminishment is defined as to make smaller or less in quantity, quality, rate of flow, or availability.” This guidance document is focused on estimating only quantity diminishment, so for the purposes described here, consumptive water use is considered water that is evaporated, transpired, consumed by humans, or otherwise removed from an immediate water environment due to the use of permit-exempt domestic wells.
- **Subbasins:** ESSB 6091 is written in the context of WRIA-wide mitigation, so Ecology interprets the words “same basin or tributary” to refer to subareas or subbasins as opposed to entire WRIAs. For the purposes of this document, the term “subbasin” is equivalent to the words “same basin or tributary” as used in sections 202(4)(b).

This memorandum presents an evaluation of future exempt well demand on a subbasin level and on a 20-year horizon within WRIA 55 that is intended to meet the requirements of ESSB 6091. Figure 1 presents a map of WRIA 55 delineating the subbasins used in the evaluation, which are the Washington Department of Natural Resources Watershed Administrative Units and are consistent with subbasin boundaries used in previous watershed planning and management.

WRIA 55 extends into Spokane, Stevens, and Pend Oreille Counties. All three counties have conducted analysis and worked cooperatively together to develop estimates of future residential permits in WRIA 55 outside of public water districts to support the development of the exempt well demand estimates.

General Approach

Prior to conducting the exempt well demand analysis described in this memorandum, staff from Spokane, Stevens, and Pend Oreille Counties, Aspect, and Ecology discussed potential approaches with consideration of Ecology’s Recommendations for Water Use Estimates for ESSB 6091. The following approach was agreed upon and implemented:

Each county developed growth projections on a subbasin level for single family residential units (SFUs) relying on exempt wells on the mandated 20-year horizon. Each county used professional judgment in developing the forecast based on available county specific information. Specific approaches for each county are summarized below.

Each county then developed the estimates of average lawn size, on a subbasin level, through geographical information system (GIS) analysis of suitable aerial photos for homes relying on exempt wells built between 2001 to 2017. Each county analyzed a sufficient sample size from the

² <https://fortress.wa.gov/ecy/publications/documents/1811009.pdf>

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set of exempt well properties to attain an approximate 95 percent confidence interval with a 5 percent margin of error, within that county's portion of WRIA 55 that is served by exempt wells.

Aspect then used this information to estimate the average amount of consumptive use associated with the growth projections for SFUs relying on exempt wells, using the following methodology:

- Indoor consumptive use estimates were based on examples presented in Ecology's Recommendations for Water Use Estimates for ESSB 6091 and a review of US Census data on average persons per household by county.
- Outdoor consumptive use estimates were made based on average irrigation lawn size determined on a subbasin level and methods described in Ecology Guidance 1210 (*Determining Irrigation Efficiency and Consumptive Use*), using crop demand estimates provided in the Washington Irrigation Guide (WIG) for pasture/turf for the Spokane and Newport stations.

County-specific approaches and the number of estimated new SFUs relying on exempt wells per subbasin are summarized below, followed by estimates of indoor, outdoor, and total consumptive use.

Spokane County Growth Projections and Estimated Lawn Sizes

Projected Residential Units

Spokane County estimated the projected increase over the next 20 years in residential units relying on permit exempt wells within the Spokane County portion of WRIA 55, outside of the area covered by WAC 173-557. The estimate is based on the Spokane Regional Transportation Council (SRTC) Horizon 2040 projected increase in SFUs. The SRTC Horizon 2040 growth projections are derived from and consistent with the Washington Office of Financial Management (OFM) 2017 Growth Management Act population projections for counties in the category: 2010 to 2040 medium growth.

The SRTC projected increase in single family residential units are spatially distributed into Transportation Analysis Zones (TAZs). TAZ boundaries do not conform to subbasin boundaries or areas served by public water supplies versus permit exempt wells. A GIS analysis was completed to allocate the distribution of the projected increase in SFUs and within each TAZ into each subbasin, followed by allocations between areas served by public water supplies and areas served by permit exempt wells in proportion to the distribution of existing SFUs derived from Spokane County Assessor data. Table 1, below provides an example of this approach, using TAZ 487, which has area within the City of Deer Park water service area, the Dragoon Creek subbasin, and the Beaver Creek subbasin (Figure 1).

Table 1. Example of SFU Allocation Approach by TAZ

TAZ 487	Existing		Projected Growth in SFUs (20-Year Planning Horizon)
	Units	% of Total	
Total Residential Units	354		56
Within Public Water Supply	242	68.4	38
Outside Public Water Supply	112	31.6	18
Dragoon Subbasin	54	15.3	9
Beaver Creek Subbasin	58	16.3	9

Based on the allocation methodology described above, Table 2 presents the projected increases in SFUs by subbasin within Spokane County that are estimated to rely on a permit exempt well for domestic water supply in the next 20 years.

Table 2. Projected Growth in SFUs Relying on Exempt Wells in Spokane County (WRIA 55)

Subbasin	Projected increase in SFUs (20-Year Planning Horizon)
Dartford Creek	265
Dragoon Creek	281
Deadman Creek/Peone Creek	319
Beaver Creek	155
Little Spokane/Deer Creek	261
Little Deep Creek	98
West Branch	67
Otter Creek	156
TOTAL	1602

Comparison to Historical Growth Data

Based on Spokane County Assessor data, 1923 new SFUs relying on exempt wells were built between 2001 and 2017. Table 3 presents a comparison by subbasin between SFUs built between 2001 and 2017 and the projected new SFUs 20 years into the future.

Table 3. Comparison of Historical and Projected Growth in SFUs Relying on Exempt Wells in Spokane County (WRIA 55)

Subbasin	Actual 2001-2017		Projected 20-Year Growth	
	SFUs	% of total	SFUs	% of total
Dartford Creek	259	13%	265	17%
Dragoon Creek	371	19%	281	18%
Deadman-Peone Creek	345	18%	319	20%
Beaver Creek	178	9%	155	10%
Otter Creek	220	11%	156	10%
West Branch	104	5%	67	4%
Little Spokane/Deer Creek	373	19%	261	16%
Little Deep Creek	73	4%	98	6%
TOTAL	1923		1602	
Yearly Average	113		80	

The projected reduction in yearly average new SFUs is consistent with the smaller growth rate projected by OFM for Spokane County population for 2020-2040 of 0.74 percent in comparison to 2001-2017 actual annual growth rate of 1.06 percent.

Irrigated Area Estimate by Subbasin

A random sample of the 1923 SFUs built between 2001-2017 were analyzed with aerial photos from 2006, 2009, 2014, 2016, and 2018. GIS methods were used to delineate the size of apparent area of lawn irrigation. A sample size of 321 was selected to achieve a 5 percent margin of error with a 95 percent confidence interval. Table 4 presents the results of this analysis.

Table 4. Estimated Irrigated Area by Subbasin in Spokane County (WRIA 55)

Subbasin	Number of Household Lawns Analyzed	Average Irrigated Lawn Size (sq. ft.)
Dartford Creek	47	15,290
Dragoon Creek	50	15,211
Deadman-Peone Creek	52	17,334
Beaver Creek	44	14,753
Otter Creek	42	14,282
West Branch	14	8,948
Little Spokane/Deer Creek	53	10,433
Little Deep Creek	19	7,769
WRIA 55 Average	321	13,880

Stevens County Growth Projections and Estimated Lawn Sizes

Projected Residential Units

Stevens County estimated the projected increase over the next 20 years in SFUs relying on permit exempt wells within the Stevens County portion of WRIA 55. The County reviewed the number of building permits issued from 2001 - 2017 for new homes using a private water supply. GIS

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methods were used to filter the data to include only parcels within both WRIA 55 and Stevens County.

The average number of new homes built annually from 2001 – 2017 was used to predict the number of new homes for the 20-year planning horizon. Between 2001 and 2017 there were 209 new residences that rely on permit exempt wells in Stevens County’s portion of WRIA 55. This equates to an average growth rate of 12.3 homes per year. This rate was used to extrapolate growth over the next 20 years. Based on this rate, there will be an estimated 246 new homes relying on permit exempt wells built within WRIA 55 in Stevens County in the next 20 years (Table 5). That total will include an estimated 65 homes in the Beaver Creek subbasin, 179 homes in the Dragoon Creek subbasin, and 2 homes in the West Branch subbasin.

Table 5. Historical and Projected Growth in SFUs Relying on Exempt Wells in Stevens County (WRIA 55)

Year	Beaver Creek	Dragoon Creek	West Branch	Total
2001	4	12	1	17
2002	6	13		19
2003	6	16		22
2004	6	16		22
2005	6	16		22
2006	3	12		15
2007	6	10		16
2008	2	9		11
2009		8		8
2010	3	8		11
2011	3	3		6
2012	2	4		6
2013	2	3		5
2014	1	8		9
2015	1	4	1	6
2016		6		6
2017	4	4		8
Total	55	152	2	209
Projected SFUs 20-Year Horizon	65	179	2	246

Average Irrigated Area Estimate by Subbasin

Average lawn size was estimated by choosing a random sample of the building permits and using aerial imagery (2015, 2017) to make a digitally-measured estimate of irrigated lawn and garden area. The sample for the lawn size analysis was chosen randomly to obtain a 95 percent confidence level with a 5 percent margin of error. Lawns were digitally measured for a randomly selected sample of 136 out of the 209 new residences in WRIA 55, providing a 95 percent confidence level with a 5 percent margin of error. The sample’s average lawn size was 6,316 sq. ft. (0.1450 acres), with 97 out of 136 parcels having any identifiable irrigated lawn.

Table 6: Average Estimated Lawn Size in Stevens County for New Homes on Private Water Supply (WRIA 55)

Sub-basin	Lawns Sampled	Average Lawn Size (sq. ft.)
Beaver Creek	33	3,944
Dragoon Creek	102	7,145
West Branch	1	-
Total	136	6,316

Pend Oreille County Growth Projections and Estimated Lawn Sizes

Projected Residential Units

Pend Oreille County estimated the projected increase over the next 20 years in SFUs relying on permit exempt wells within the Pend Oreille County portion of WRIA 55. GIS methods were used to filter residential building permit data for the period 2011- 2017 to include only permits that were in WRIA 55, but outside public water districts, indicating use of an exempt well. Between the years of 2011-2017 there were 116 new residential permits that are or will be relying on permit exempt wells in Pend Oreille County’s portion of WRIA 55 (Table 7). The average annual growth rate of 16.6 homes was used to extrapolate growth on a 20-year horizon. Based on this rate, there will be an estimated 332 new homes relying on permit exempt wells built within WRIA 55 in Pend Oreille County in the next 20 years (Table 8). That total will include an estimated 138 homes in the West Branch subbasin and 194 homes in the Otter Creek subbasin (Table 8).

Table 7: Pend Oreille County Residential Permits Issued Outside of Public Water Districts, 2011-2017 (WRIA 55)

YEAR	NUMBER	PERCENTAGE OF TOTAL
2011	15	12.9%
2012	13	11.2%
2013	9	7.8%
2014	21	18.1%
2015	20	17.2%
2016	22	19.0%
2017	16	13.8%
TOTAL	116	100.0%
Average of 16.6 New Residential Permits a Year		

Table 8. Project SFUs Relying on Exempt Wells in Pend Oreille County (WRIA 55)

Sub Basins	Projected SFU Growth 20-Year Planning Horizon
West Branch	138
Otter Creek	194
WRIA 55 Total	332

Average Irrigated Area Estimate by Subbasin

An average lawn size was determined by choosing a random sample of the building permits, with a 95 percent confidence interval to achieve a 5 percent margin of error, and digitizing their irrigated lawn based off aerial photography (2011, 2015, 2017), NDVI imagery, and the Pend Oreille County Assessor photos from the field. All indefinable agricultural activity was excluded. 89 out of the 116 newly permitted residence that rely on permit exempt wells and are within WRIA 55 had their lawns digitized, providing a 95 percent confidence level with a 5 percent margin of error. The sample’s average lawn size was 9,648 sq. ft, with 53 out of 89 having any identifiable irrigated lawn (Table 9).

Table 9. Estimated Irrigated Area by Subbasin in Pend Oreille County (WRIA 55)

Sub Basins	Average Irrigated Lawn Size (ft²)
West Branch	5355
Otter Creek	12564
WRIA 55 Average	9648

Analysis of Consumptive Use by Subbasin

Aspect used the information provide by each County to estimate the average amount of consumptive use associated with the growth projections for SFUs relying on exempt wells, as described below:

Indoor Consumptive Use

Indoor consumptive use estimates were developed based on examples presented in Ecology’s Recommendations for Water Use Estimates for ESSB 6091 and a review of US Census data on average persons per household by county. Key assumptions incorporated into the analysis include:

- The number of new exempt wells in the next 20 years in each subbasin is based on the analyses conducted by Spokane, Stevens, and Pend Oreille Counties discussed in this memorandum.
- US Census Data³ tabulating the persons per household from 2013-2017 were used combined with the per capita water use noted below. The US Census Data indicates that the average number of people per household is 2.43 in Spokane County, 2.48 in Stevens County, and 2.3 in Pend Oreille County.
- Per capita water use is 60 gallons per day (gpd), based on the analysis provided in Ecology’s Recommendations for Water Use Estimates for ESSB 6091:
 - *To estimate the impacts of indoor water use, the population to be served by future permit-exempt domestic wells can be multiplied by assumed water use. A 2016 study by the Water Research Foundation (DeOreo, et al., 2016) determined an average per capita water use of 59 gallons per day (gpd) in homes provided municipal water in 23 areas across the U.S. and Canada. This result is based on actual flow monitoring and survey responses from 737 homes. The 59 gpd average*

³ <https://www.census.gov/quickfacts>

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is down 15.4 percent from results found during a 1999 American Water Works Association Research Foundation study (Mayer and DeOreo, 1999). Some homes supplied by Tacoma Water were monitored for the 2016 report, producing an average 51 gpd per capita indoor water use. Bearing in mind that homes supplied municipal water are more likely to be fitted with water saving appliances, an assumption of 60 gpd per capita seems reasonable when estimating water use for permit exempt wells.

- Indoor consumptive is equal to 10 percent of total use, based on the analysis provided in Ecology's Recommendations for Water Use Estimates for ESSB 6091:
 - A reasonable assumption for much of Washington is that about 10 percent of indoor domestic water use is consumed, and about 80 percent of outdoor domestic water use is consumed (Culhane and Nazy, 2015). A consumptive use rate of 10 percent for indoor domestic use is in keeping with recent groundwater models constructed by the U.S. Geological Survey (USGS) for the Kitsap peninsula (Frans and Olsen, 2016) and the Chamokane Creek basin (Ely and Kahle, 2012).

Table 10 presents the 20-year projected consumptive indoor use associated with exempt wells in WRIA 55. Estimated consumptive indoor use within the subbasins ranges from 7.51 afy in the Dragoon Creek subbasin to 1.60 afy in the Little Deep Creek subbasin. The total indoor consumptive use with WRIA 55 is estimated to be 35.60 afy on the 20-year planning horizon.

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Table 10. Projected Consumptive Indoor Use Associated with Exempt Wells in WRIA 55, 20-Year Planning Horizon

	Spokane County		Stevens County		Pend Oreille County		All Counties		
	SFUs	Projected Consumptive Indoor Use (afy)	SFUs	Projected Consumptive Indoor Use (afy)	SFUs	Projected Consumptive Indoor Use (afy)	Totals SFUs	Projected Consumptive Indoor Use (afy)	Projected Consumptive Indoor Use (cfs)
WRIA 55 Subbasins	Spokane County		Stevens County		Pend Oreille County				
Dartford Creek	265	4.33					265	4.33	0.006
Dragoon Creek	281	4.59	179	2.92			460	7.51	0.010
Deadman-Peone Creek	319	5.21					319	5.21	0.007
Beaver Creek	155	2.53	65	1.06			220	3.59	0.005
Otter Creek	156	2.55			194	3.17	350	5.72	0.008
West Branch	67	1.09	2	0.03	138	2.25	207	3.38	0.005
Little Spokane/Deer Creek	261	4.26					261	4.26	0.006
Little Deep Creek	98	1.60					98	1.60	0.002
TOTAL	1,602	26.16	246	4.02	332	5.42	2,180	35.60	0.049

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Outdoor Consumptive Use

Outdoor consumptive use estimates were developed based on average irrigation lawn size determined on a subbasin level and methods described in Ecology Guidance 1210 (Determining Irrigation Efficiency and Consumptive Use). Key assumptions incorporated into the analysis include:

- The number of new exempt wells in the next 20 years in each subbasin is based on the analyses conducted by Spokane, Stevens, and Pend Oreille Counties discussed in this memorandum.
- Average irrigation lawn sizes in each subbasin are based on the analyses conducted by Spokane, Stevens, and Pend Oreille Counties discussed in this memorandum.
- The seasonal net irrigation requirement was taken from Washington Irrigation Guide (WIG) for pasture/turf for the Spokane station (29.81 inches) for all subbasins, with the exception of the West Branch and Otter Creek subbasins, for which the Newport station (24.11 inches) was used. Data from a relatively new (2015) AgriMet station at Deer Park was also reviewed but not used in the analysis, as it was generally consistent with Spokane WIG values, ranging between 27.08 and 30.66 inches of lawn evapotranspiration between 2015 and 2018.
- An irrigation efficiency of 75 percent was used, which is applicable to sprinkler methods typically used for lawn irrigation, such as pop-up impact or handline methods referenced in Table 1 of Ecology Guidance 1210.
- Consumptive irrigation quantities are calculated from the number of new exempt wells in each subbasin, average irrigation lawn size, net irrigation demand from the WIG, and irrigation efficiency.
- For subbasins that have land in multiple counties, the analysis was aggregated using the average lawn size and estimated number of new exempt wells for each county within that subbasin.

Table 11 presents the 20-year projected consumptive outdoor use associated with exempt wells in WRIA 55. Estimated consumptive outdoor use within the subbasins ranges from 340.38 afy in the Dragoon Creek subbasin to 46.67 afy in the Little Deep Creek subbasin. The total outdoor consumptive use with WRIA 55 is estimated to be 1,611.38 afy on the 20-year planning horizon.

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Table 11. Projected Consumptive Outdoor Use Associated with Exempt Wells in WRIA 55, 20-Year Planning Horizon

	Spokane County				Stevens County				Pend Oreille County				All Counties	
	SFUs	Average Irrigated Lawn Size (ft ²)	Average Irrigated Lawn Size (acres)	Projected Consumptive Outdoor Use (afy)	SFUs	Average Irrigated Lawn Size (ft ²)	Average Irrigated Lawn Size (acres)	Projected Consumptive Outdoor Use (afy)	SFUs	Average Irrigated Lawn Size (ft ²)	Average Irrigated Lawn Size (acres)	Projected Consumptive Outdoor Use (afy)	Projected Consumptive Outdoor Use (afy)	Projected Consumptive Outdoor Use (cfs)
WRIA 55 Subbasins	Spokane County				Stevens County				Pend Oreille County				Total	
Dartford Creek	265	15,290	0.35	248.36									248.36	0.343
Dragoon Creek	281	15,211	0.35	261.99	179	7,145	0.16	78.39					340.38	0.470
Deadman-Peone Creek	319	17,334	0.40	338.93									338.93	0.468
Beaver Creek	155	14,753	0.34	140.16	65	3,944	0.09	15.71					155.88	0.215
Otter Creek	156	14,282	0.33	116.62					194	12,564	0.29	127.58	244.19	0.337
West Branch	67	8,948	0.21	31.38	2	0	0	0	138	5,355	0.12	38.68	70.06	0.097
Little Spokane/Deer Creek	261	10,433	0.24	166.91									166.91	0.230
Little Deep Creek	98	7,769	0.18	46.67									46.67	0.064
TOTAL	1,602	-	-	1,351	246	-	-	94	332	-	-	166	1,611.38	2.224

Total Consumptive Use by New Exempt Wells in WRIA 55, 20-Year Planning Horizon

Total consumptive use estimates were developed by combining the results for indoor and outdoor consumptive use discussed above. Table 12 presents the 20-year projected total consumptive use associated with exempt wells. Estimated total consumptive use within the subbasins ranges from 347.90 afy in the Dragoon Creek subbasin to 48.27 afy in the Little Deep Creek subbasin. The total outdoor consumptive use with WRIA 55 is estimated to be 1,646.98 afy on the 20-year planning horizon.

Table 12. Total Projected Combined Indoor/Outdoor Consumptive Use in WRIA 55, 20-Year Planning Horizon

	Projected Consumptive Use (afy)	Projected Consumptive Use (cfs)
WRIA 55 Subbasins		
Dartford Creek	252.69	0.349
Dragoon Creek	347.90	0.480
Deadman-Peone Creek	344.14	0.475
Beaver Creek	159.47	0.220
Otter Creek	249.91	0.345
West Branch	73.44	0.101
Little Spokane/Deer Creek	171.17	0.236
Little Deep Creek	48.27	0.067
TOTAL	1,646.98	2.273

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