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Subject: Draft Irrigated Acreage Comparability Study

1.0 Executive Summary

The purpose of this technical memorandum is to summarize the Draft Irrigated Acreage Comparability Study undertaken as a joint exercise by the GEI and HDR technical teams and to provide a recommendation to Ecology on whether variability between GEI and HDR irrigated area delineations warrants data qualification or updates. This study was conducted at the request of the Ecology team indicated as the recipients of this memo. The Ecology team requested we undertake this study as part of on-going quality assurance work associated with development of products for use by the Watershed Restoration and Enhancement (WRE) committees. The need for this specific study was identified because of perceived differences in specific draft, interim results from the two firms related to the analysis of outdoor irrigation area of existing homes served by permit-exempt (PE) wells. The goals of this study were to: 1) to determine if there was a difference in the mean irrigated areas between the HDR and GEI delineations, 2) to identify the reasons for those differences, and 3) to determine the implications, if any, of these differences for the work of the WRE committees. This memorandum details the reasons for the differences and ultimately concludes that the differences will not have an impact on the work of the WRE committees and the WRE committees may accept the irrigated area results completed by the GEI and HDR without qualification. The results of the comparability study, and subsequent review with Ecology, indicate the following:

- It is our recommendation that Ecology and the WRE committees should accept the irrigated area results completed by the GEI and HDR teams. The differences will have no impact on the work of the WRE committees. Furthermore, our analysis and comparability results indicate there is no need for a systematic reevaluation of the primary data sets or methodologies. The GEI and HDR teams have confidence in their completed work and, notably, in each other's work for their respective WRIAs.
- The outdoor irrigation method is conservative because it assigns outdoor watering rates equivalent to those for crops described in the Washington Irrigation Guide such as to produce commercial pasture/turf grass.
- There is inherent subjectivity and variability associated with estimating irrigated areas from manual aerial photo interpretation.
- There are a continuum of possibilities between slightly watered areas and those have been watered at rates similar to those presented in the Washington Irrigation Guide, and because

of this range there are also ranges of “correct” answers to the question of which outdoor watering areas should be counted.

- While it can be relatively straight-forward to delineate the irrigated footprints for parcels on the extreme – either brown lawns or lush, golf-course green lawns- it can be much harder to make delineations for the rest of the parcels.

2.0 Introduction

GeoEngineers, Inc. (GEI) and HDR, Inc., (HDR) are providing technical support to the Washington State Department of Ecology (Ecology) and the Watershed Restoration and Enhancement (WRE) committees. GEI is providing support for Water Resource Inventory Areas (WRIAs) 7, 8, and 9, while HDR is supporting WRIAs 10, 12, 13, 14, and 15.

Under RCW 90.94, consumptive water use by new permit-exempt (PE) domestic wells must be estimated to establish the water use that watershed restoration and enhancement (WRE) plans are required to address and offset. Consumptive use is water that evaporates, transpires, is consumed by humans, or otherwise removed from an immediate water environment. Appendix A in the *Final Guidance for Determining Net Ecological Benefit* (July 2019) recommends using more than one method for calculating consumptive water use: a method based on analysis of outdoor irrigation; and a method based on location-specific small- to medium-sized water system data. GEI and HDR are developing results for both methods in each of the WRIAs. This memo only addresses a quality review for the outdoor irrigation method. The outdoor irrigation method is based, in part, on an estimate of the average irrigated area anticipated for new PE wells. This average irrigated area is estimated by delineating the apparent irrigated area of existing homes served by PE domestic wells.

Both HDR and GEI drew from the recent building permit or well databases in selecting parcels for irrigated area delineations. HDR delineated the irrigated area for 80 parcels in each of its assigned five WRIAs, and GEI delineated 393, 153 and 221 parcels in WRIAs 7, 8 and 9, respectively. One analyst from each firm conducted the delineations for consistency, and each analyst followed the prescribed methodology outlined in their respective consumptive use methodology memoranda (excerpts included in Attachments A and B). Following the delineation for each parcel, the irrigated area was calculated, then the mean irrigated area for each subbasin was calculated. The results of this work for all the WRE WRIAs are summarized in Table 1.

The average irrigated footprint results for WRIAs 7, 8, and 9 were generally higher than those for WRIAs 10, 12, 13, 14, and 15. Because of this difference, Ecology asked GEI and HDR to conduct a blind comparability study on a subset of common parcels. The objectives of the comparison were to determine if there was a difference in the mean irrigated areas between the HDR and GEI delineations and to identify the reasons for those differences, if they occurred. This memo further describes the methods and results of the comparison study and provides a recommendation on how Ecology and the WRE Committees can move forward.

Table 1. Irrigated acreage statistical summary.

WRIA	GEI			HDR				
	7	8	9	10	12	13	14	15
Sample Size (PE Parcels)	393	153	221	80	80	80	80	80
Mean Irrigated Area per Parcel	0.21	0.32	0.30	0.17	0.15	0.06	0.07	0.08

3.0 Methods

All irrigated area delineations were done on the Google Earth platform. HDR and GEI each provided a Google Earth spatial data file (KMZ file) containing a randomly selected subset of 10 PE parcels from one WRIA that had been delineated as part of the original irrigated area analysis. GEI provided HDR a KMZ file with 10 parcels from WRIA 9, and HDR provided GEI a KMZ file with 10 parcels from WRIA 10. Only parcel numbers and boundaries were provided in the KMZ file; the results of the original irrigated area delineations from each analyst were not provided to the other consultant.

Each consultant delineated irrigated areas for the 10 parcels provided by the other consultant, using the same analyst and methods as was used for the original WRIA analyses (Attachments A and B). In general, the irrigated areas included turf (residential lawn or pasture), gardens, and landscaping. Unirrigated lawns go dormant in the dry summer months and turn brown. Consultants used summer and winter imagery publically available in Google Earth to determine which areas of the parcel were dormant in the summer. Two or more years of aerial imagery was used when available. Consultants compared winter imagery, when precipitation turns lawns green naturally, to summer imagery, when the study areas receive little to no precipitation and lawns that are not irrigated typically go brown. Areas that remained green in the summer imagery were considered irrigated. Those areas that did not change color from winter to summer, or moderately changed color but remained green through the summer months, were considered irrigated. Consultants also compared each subject parcel to surrounding parcels with managed turf to differentiate the irrigated versus non-irrigated color signatures. Each analyst took notes detailing the rationale for inclusion or exclusion of an area for each delineation and documented the date(s) of the aerial photography utilized to make that determination.

After the analysts completed the additional delineations, HDR and GEI provided their delineated areas (KMZ files and tabular data) and notes to the other consultant to compare results. A conference call with a shared screen was held with Ecology on November 12, 2019, to discuss the delineated areas on Google Earth and calculated acreage results on a parcel by parcel basis. The rationale for inclusion or exclusion of an area from an irrigated footprint delineation was discussed.

After this initial conference call, analysts from HDR and GEI were each asked to re-delineate all 20 parcels a second time to determine if the delineated acreage from each consultant would be closer in value following this reconciliation of differences in methodology by parcel. A conference call was held with Ecology after this second delineation on November 26, 2019, to compare the new mean irrigated acreage between HDR and GEI.

4.0 Results

On average, GEI delineated larger irrigated areas than HDR during both rounds of comparative analyses. The first round had the largest differences. GEI's irrigated areas were estimated to be 0.27 and 0.14 acre larger than HDR's estimates for WRIAs 10 and 9, respectively (Table 2). While most of the delineated areas were similar (i.e., within 0.10 acre) between analysts, there were large differences (i.e., greater than 0.10 acre difference) in five parcels in WRIA 10 and three parcels in WRIA 9. The complete results table with notes is included in Attachment C. During the November 12, 2019 meeting, the following differences in evaluation accounted for most of these differences in irrigated acreages:

- Per GEI’s methods (Attachment A), landscaping outside of but adjacent to irrigated lawn areas were included within irrigated acreage. HDR excluded these areas per their methods (Attachment B).
- GEI was more inclusive of additional acreage under the tree canopy within the irrigated footprint.
- HDR did not identify some gardens that should have been included within the irrigated footprint.
- HDR utilized a more restrictive seasonal range of aerial photography to determine irrigated versus dormant turf (residential lawn and pasture) color signatures. For some parcels, GEI used more recent June and early July imagery, if available, to determine if an area was irrigated. HDR only used imagery from late July to early September to differentiate dormant versus irrigated turf. The different aerial imagery being evaluated by GEI and HDR resulted in some different interpretations of irrigated acreage.
- In some cases, there was a difference in analyst interpretation of areas that would plausibly be managed as irrigated turf (i.e., based off of fence lines and apparent uses).
- In some cases, there was a difference in analyst interpretation of whether or not the turf in the subject parcel was “greener” than turf in the surrounding parcels that was also managed (i.e. as residential yards or pastures) but was not irrigated (assuming that at least some people do not irrigate their lawns and pastures). For example, if the subject parcel had green grass in their yard, but other yards in the area had brown grass (indicating dormancy from no irrigation), the green area in the subject parcel would be delineated. These comparisons and decisions can be subjective.

Following the discussion on November 12, 2019, outlining these differences in methodology and subsequent re-delineation of the 20 parcels, the average irrigated acreages calculated by HDR and GEI were much closer in value, with a difference on average of 0.05 and 0.06 acre in WRIA 9 and 10 respectively (Table 2). GEI reduced the irrigated area, particularly under tree canopies, while HDR slightly expanded irrigated areas for gardens and turf. The GEI mean irrigated areas were reduced by 0.2 and 0.03 acre for WRIAs 10 and 9, respectively. The HDR mean irrigated areas were increased by 0.02 and 0.05 acre for WRIAs 10 and 9, respectively.

Table 2. GEI and HDR irrigated area comparability study results.

Parcel No.	WRIA	Delineated Irrigated Acreage Initial Comparison Analysis			Delineated Irrigated Acreage following Methodology Reconciliation		
		GEI	HDR	Difference	GEI	HDR	Difference
A	10	0.50	0.09	0.41	0.09	0.09	0.00
B	10	0.00	0.00	0.00	0.00	0.00	0.00
C	10	0.00	0.00	0.00	0.00	0.00	0.00
D	10	0.82	0.13	0.68	0.38	0.22	0.16
E	10	0.29	0.31	-0.02	0.23	0.36	-0.13
F	10	0.15	0.15	0.01	0.15	0.15	0.01
G	10	0.10	0.00	0.10	0.10	0.05	0.06
H	10	0.25	0.00	0.25	0.25	0.01	0.24
I	10	0.31	0.00	0.31	0.02	0.01	0.01
J	10	0.91	0	0.91	0.12	0.00	0.12

Parcel No.	WRIA	Delineated Irrigated Acreage Initial Comparison Analysis			Delineated Irrigated Acreage following Methodology Reconciliation		
		GEI	HDR	Difference	GEI	HDR	Difference
K	9	0.23	0.21	0.02	0.23	0.21	0.01
L	9	0.42	0.44	-0.02	0.42	0.54	-0.13
M	9	0.46	0.37	0.09	0.46	0.38	0.09
N	9	0.00	0.00	0.00	0.00	0.00	0.00
O	9	0.65	0.00	0.65	0.48	0.00	0.48
P	9	2.28	1.92	0.36	2.28	1.95	0.34
Q	9	0.18	0.09	0.09	0.18	0.09	0.09
R	9	0.34	0.22	0.12	0.25	0.23	0.02
S	9	0.00	0.00	0.00	0.00	0.00	0.00
T	9	0.11	0.05	0.05	0.11	0.06	0.05
WRIA 10 Average		0.33	0.07	0.27	0.13	0.09	0.05
WRIA 9 Average		0.47	0.33	0.14	0.44	0.38	0.06

5.0 Discussion

What became evident during this exercise is that while it can be relatively straight-forward to delineate the irrigated footprints for parcels on the extreme – either brown lawns or lush, golf-course green lawns- it can be much harder to make delineations for the rest of the parcels. Studies from municipal water suppliers around North America have shown that many homeowners apply outdoor water sparingly, with just enough to prevent landscaping from dying or at least far short of what is needed for maximum growth (DeOreo, et al., 2016. Residential End Uses of Water, Version 2)..

Another important conclusion that can be made from this work is that in many cases using remote sensing to delineate outdoor water areas will not resolve all questions about what outdoor areas were irrigated. This is because that answer depends on how much outdoor watering needs to have occurred in order to be counted. For example, if a lawn has been watered just once during a dry season or just 5 times, and it is not dormant but far from green, is that sufficient to call that area an outdoor watered area? And, if so, is it reasonable to expect a technician to be able to delineate that area using aerial images? In reality, there are a continuum of possibilities between slightly watered areas and those have been watered at rates similar to those presented in the Washington Irrigation Guide (WAIG). Because of this range in watering, there are also ranges of “correct” answers to the question of which outdoor watering areas should be counted.

One important implication of variable watering rates is that the outdoor irrigation method described in Appendix A of the *Final Guidance for Determining Net Ecological Benefit* and the method used by both GEI and HDR for calculating consumptive use is conservative. This is because it assigns outdoor watering rates equivalent to those for crops described in the WAIG, such as for the production of commercial pasture/turf grass. Many of the lawns that are delineated as “irrigated” may not apply water at these rates, resulting in conservatively high consumptive use estimates. At the subbasin and WRIA scale, we are confident that our estimate of the water used for outdoor watering is larger than what is actually being used by permit-exempt domestic well owners. This assumption was corroborated with a comparison of irrigated areas in specific parcels that had metered water use data (HDR 2019).

Based on the above considerations and the results of this comparison exercise, there is inherent subjectivity and variability associated with estimating irrigated areas from manual aerial photo interpretation. Although these results indicate that additional training (or cross-training) may have reduced this variability between analysts, differences are still to be expected. Furthermore, the original differences in mean irrigated areas are generally within the 95 percent confidence interval for the primary data sets. Therefore, these comparability results do not indicate a need for a systematic reevaluation of the primary data sets. The GEI and HDR teams have confidence in their completed work and in each other's work for their respective WRIs. It is GEI's and HDR's opinion that Ecology and the WRE committees may accept the irrigated area results completed by the GEI and HDR teams without qualification. The WRE committees may consider investigating the sensitivity of consumptive use based on mean irrigated areas for each WRIA and/or at upper or lower 95 percent confidence limits.

Attachment A

GEI Irrigated Footprint Analysis Methods

Irrigated Footprint Analysis Methods

The GEI team conducted an aerial photo-based analysis of irrigated lawn and garden area for 393 parcels in the 16 WRIA 7 subbasins, 153 parcels in seven of the WRIA 8 subbasins, and 211 parcels in eight of the WRIA 9 subbasins. Parcels used for the irrigated footprint analysis were selected based on recent (2006–2017) building permits for new single-family residential homes not served by public water. Permits for accessory dwelling units (ADUs) or reconstruction/remodel were excluded. All new home building permit sites in WRIA 9 were included in the analysis, however, a subset of building permits were selected for WRIsAs 7 and 8. The target sample size for WRIsAs 7 and 8 was set to provide a 95 percent confidence level (i.e., 95 percent certainty of the sample capturing the true mean of the population). Sample parcels were selected by assigning a random number to each building permit, and then evaluating sites in rank order up to the target sample size. Using a random selection from the permit list avoids the bias that could be introduced if selecting from the imagery.

Each parcel was evaluated visually in Google Earth for irrigated lawn areas. Google Earth's historical imagery collection allowed for clearer identification of irrigated areas than available orthophotos because it was possible to compare aerial photos spanning multiple seasons and years. Late summer imagery was particularly helpful in determining boundaries of irrigated (green) vs. non-irrigated (brown) grass areas. Often, the parcels did not demonstrate such a clear-cut distinction between green and brown spaces. It appears that many homeowners irrigate enough to keep lawns alive but not lush (or comparable to commercial turf grass/golf course green). Delineating these irrigated spaces is subjective and the GEI team minimized potential for additional bias to the results by having one GIS analyst evaluate all of the permit parcels in the WRIA. The irrigated area was delineated for each parcel based on several key assumptions:

- Landscaped shrub/flower bed areas were included in the irrigated footprint (not just lawn areas).
- Homes that did not show visible signs of irrigation were tracked as zero irrigated footprint, and this was included in the calculated results.
- Homes or landscaping still under construction in the most recent Google Earth imagery were excluded.
- Native forest or unmaintained grass/pasture were not included in the irrigated footprint.
- Pre-existing agricultural land use was not considered part of the residential irrigation footprint.

The following examples illustrate selected delineations.

Figure 1 shows examples of irrigated area delineation for two representative parcels in the Patterson (left) and Upper Skykomish (right) subbasins in WRIA 7. On each photo, the parcel boundary is shown in yellow and the area identified as irrigated in white. Large homes and extensive irrigated lawn and garden areas were much more common in the Patterson, Pilchuck, and Raging subbasins compared to the rest of the WRIA.



Figure 1. Example Irrigated Area Delineations, Patterson subbasin (left) and Upper Skykomish subbasin (right), WRIA 7

Figure 2 shows examples of irrigated area delineation for two parcels in the Bear/Evans subbasin in WRIA 8. On each photo, the parcel boundary is shown in light blue and the area identified as irrigated in white. For the example on the left, photos at different times of year showed a clear break between irrigated and non-irrigated grass.



Figure 2. Example Irrigated Area Delineations, Bear/Evans subbasin, WRIA 8

Figure 3 shows examples of irrigated area delineation for two parcels in the Covington Creek subbasin in WRIA 9. On each photo, the parcel boundary is shown in orange and the area identified as irrigated in white. For the example on the left, photos at different times of year showed a clear break between irrigated and non-irrigated grass.



Figure 3. Example Irrigated Area Delineations, Covington Creek Subbasin, WRIA 9

Attachment B

HDR Irrigated Area Analysis Methods

Irrigated Area Analysis Methods

1. The GIS technician selected four sample parcels from the WRIA 13 parcel selection pool to draft preliminary delineations. Parcels that displayed a range of potential irrigation situations (e.g., unirrigated lawns, lawns requiring tree/shadow interpolations, minimally irrigated area) were selected for the preliminary analysis.
2. Polygons were created in Google Earth representing the irrigated area within a given tax parcel. The GIS technician made several judgments and assumptions:
 - a. Landscaped shrub/flower bed areas within a larger irrigated footprint were included. Shrub and flower bed areas outside of the irrigated footprint were excluded.
 - b. If the irrigated area extends beyond the parcel boundary, those areas were included.
 - c. Parcels with no visible signs of irrigation were tracked as zero irrigated footprint.
 - d. Areas that appeared to be native forest or unmaintained grass were not included in the irrigated footprint.
 - e. Parcels with homes under construction in the most recent Google Earth imagery were excluded from the analysis.
 - f. New construction due to additional dwelling units (ADUs) were not counted.

The following examples illustrate example delineations.

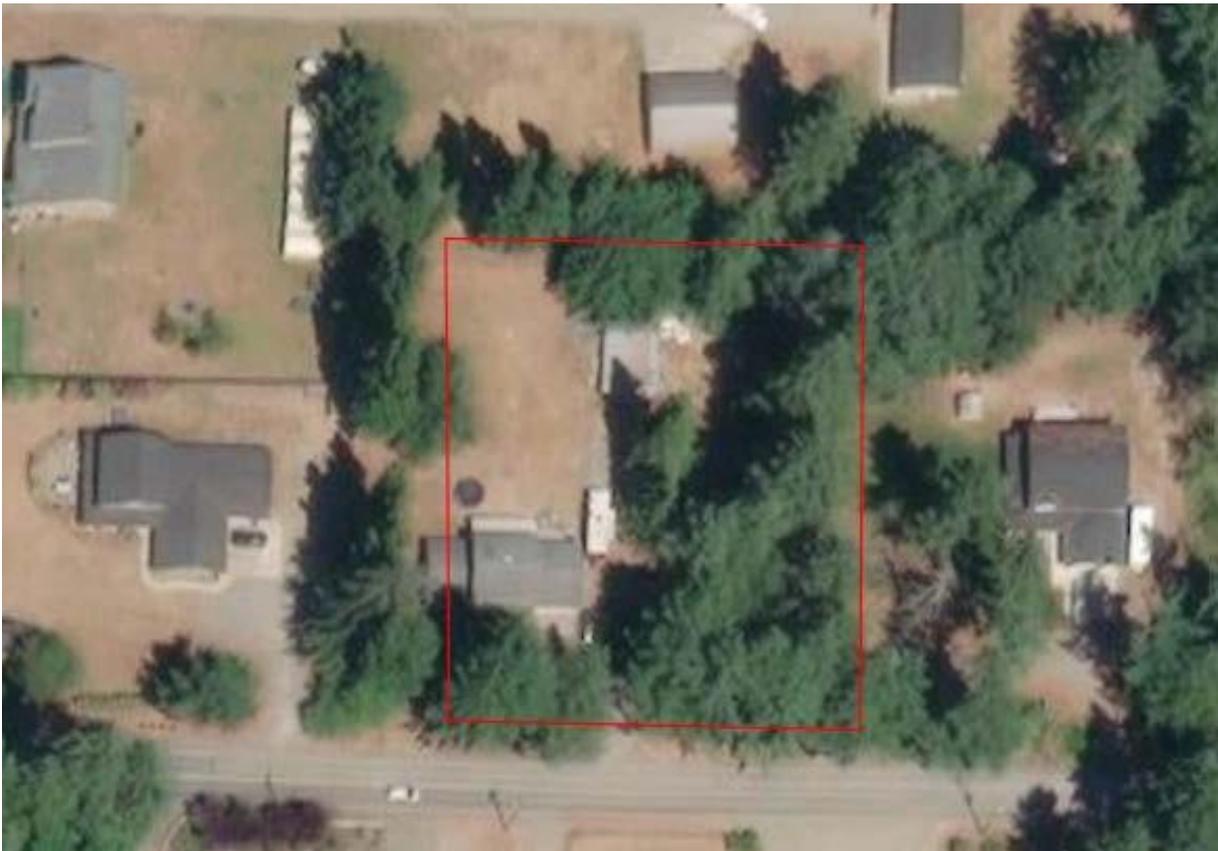


Figure 1. No irrigated areas visible in most recent google earth aerial imagery.

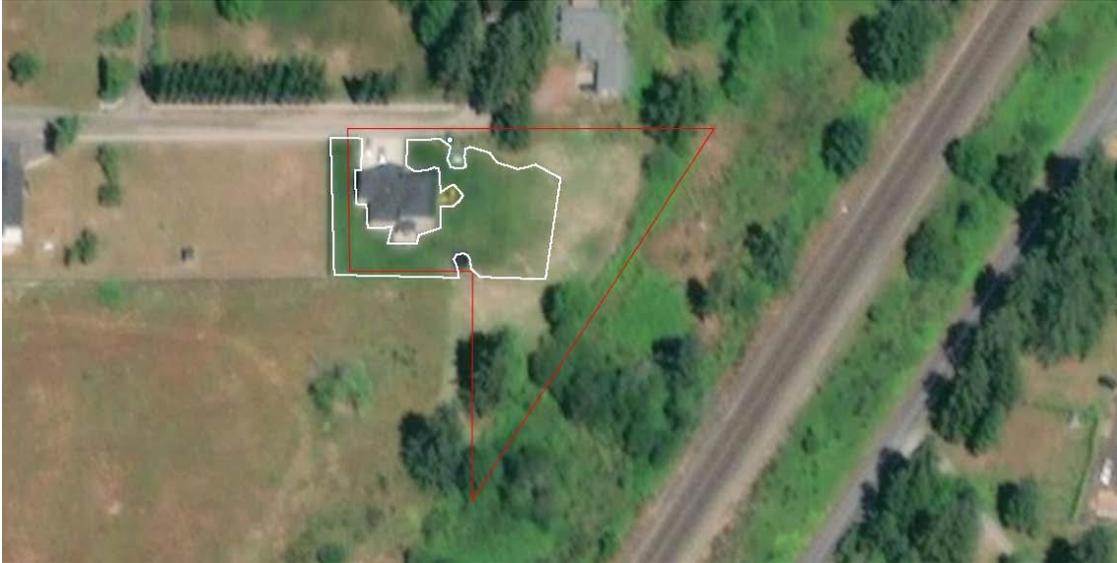


Figure 2. Area in white includes maintained grass. Residence constructed between June 2017 and July 2018. Therefore, historical irrigation of property is unavailable in GoogleEarth imagery.



Figure 3. Irrigated area includes landscaped area in driveway, maintained yard around residence, garden area, and maintained grass near garden area.



Figure 4. No irrigated area. Assumption that green vegetation on southern portion of parcel is due to proximity to Spurgeon Creek since clear delineation of irrigated area is not present on aerial. Green area near residence appears to be tree and shrubs, not maintained landscaping and is excluded.

Attachment C

Results Table

Parcel	WRIA	GEI Notes	HDR Notes	Geo Acres	HDR Acres	Diff	Geo Adj Acres	HDR Adj Acres	Adj Diff	Geo Adjusted Notes	HDR Adjusted Notes
A	10	8/2006 ; 8/2011 - difficult to distinguish if western portion of home area is irrigated	Front yard delineated based on 9/2009 and 8/2011 imagery.	0.50	0.09	0.41	0.09	0.09	0.00	tightened lawn area, omitted truck/boat parking	No change
B	10	No apparent irrigation, landscaping not established yet	zero irrigated footprint	0.00	0.00	0.00	0.00	0.00	0.00	no change	No change
C	10	No apparent irrigation ; 7/2014 ; 7/2012	zero irrigated footprint (9/2009 and 8/2011)	0.00	0.00	0.00	0.00	0.00	0.00	no change	No change
D	10	6/2016 - extensive landscaping and garden area, difficult to discern extent of irrigated lawn ; 7/2014 ; 7/2012	area delineated	0.82	0.13	0.68	0.38	0.22	0.16	tightened lawn area to within fenceline, omitted truck/boat area	Garden area SW of home included
E	10	6/27/2016 - areas outside of the riding ring near the house are landscaped and appear irrigated ; 7/2014 - lawn area - compare to western pasture inside parcel	delineated yard area (8/2006 image)	0.29	0.31	-0.02	0.23	0.36	-0.13	tightened lawn area to within fenceline, omitted area near garage/barn	reduced front yard area
F	10	7/2014 ; 7/2012 - compare to neighboring lawns	Yard area delineated. 7/2018 image	0.15	0.15	0.01	0.15	0.15	0.01	no change	No change
G	10	7/2014 - small hayfield? compare lawn/landscaping (NE of corner of house) area around house to neighbor to the WNW ; 7/2012 - compare to neighbor's lawn to the NW ; 9/2009 - blurry but hayfield area is bright green	zero irrigated footprint. 7/2018 and 7/2006, 9/2009 imagery	0.10	0.00	0.10	0.10	0.05	0.06	no change	Added garden bed northwest
H	10	8/2011 - compare lawn to NW portion of property, lawn areas to the NE, particularly the watered lawn to the NE, SW side of house	zero irrigated area 9/2009	0.25	0.00	0.25	0.25	0.01	0.24	no change	Added garden area between barn and shop
I	10	7/2014 - garden area and lawn tight to house ; 6/2016 - compare to house/lawn to the southeast ; 8/2011 - compare to lawn at home 750ft E	zero irrigated footprint. 8/2011 and 11/2011	0.31	0.00	0.31	0.02	0.01	0.01	only included raised garden bed	Added garden bed northeast of house
J	10	7/2012 - home to the NW across street is brown comparatively	zero irrigated footprint	0.91	0	0.91	0.12	0.00	0.12	hard to discern lawn area, kept tight to house where grass is green compared to house to west 7/2014	no change
K	9	moderate gardening area	maintained lawn areas and garden area delineated.	0.23	0.21	0.02	0.23	0.21	0.01	no change	Addition of garden area on north section of lawn
L	9		area irrigated based on 4/2015 imagery. Although not summer, clear area of irrigation defined.	0.42	0.44	-0.02	0.42	0.54	-0.13	no change	Slightly expanded irrigated in the backyard further east.
M	9	includes golf practice green	area delineated 7/13/2017 imagery. Golf bunkers not included. Vegetation on east side of partial either dormant or unmaintained and well as vegetation between irrigated lawn and golf area.	0.46	0.37	0.09	0.46	0.38	0.09	no change	Slightly expanded area near golf bunkers. No other change.

Parcel	WRIA	GEI Notes	HDR Notes	Geo Acres	HDR Acres	Diff	Geo Adj Acres	HDR Adj Acres	Adj Diff	Geo Adjusted Notes	HDR Adjusted Notes
N	9	No apparent irrigation	zero irrigated footprint. Lawn dormant in 7/30/2006, 8/17/2006, 9/10/2009 photo. Green patches of lawn in 7/13/2017 not clearly defined and could be drain field	0.00	0.00	0.00	0.00		0.00	no change	No change
O	9		zero irrigated footprint. Only early July summer imagery available. In HDR analysis, would've selected new parcel.	0.65	0.00	0.65	0.48	0.00	0.48	removed western portion of property beyond fenceline	No change
P	9	large 2ac+ landscaped home	area delineated 8/2011 imagery. Eastern portion of parcel excluded, not maintained and vegetation dormant. Landscaping outside of footprint not included	2.28	1.92	0.36	2.28	1.95	0.34	no change	Slightly expanded area in backyard to include irrigated area near patio.
Q	9	front half of yard apparently hardscaped	area delineated based on 8/2011 and 5/2018 imagery. Front yard is completely landscaped and not included in irrigated footprint.	0.18	0.09	0.09	0.18	0.09	0.09	no change	No change
R	9		Area delineated. However, early 7/2014 was only summer imagery available. Backyard partially obscured by tree canopy. In HDR analysis, would've selected new parcel to delineate due to lack of summer imagery.	0.34	0.22	0.12	0.25	0.23	0.02	tightened up area along tree line	Expanded eastern boundary of delineation
S	9	No apparent irrigation	zero irrigated footprint. No maintained vegetation. Drainage ditch appears to traverse southern portion of parcel. Vegetation color matches vegetation on undeveloped parcel adjacent to the east.	0.00	0.00	0.00	0.00	0.00	0.00	no change	No Change
T	9		area delineated based on 9/10/2009 imagery showing area of green near front of home and 7/10/2012 imagery of maintained green lawn near home. Area of green south of home looks to be unmaintained.	0.11	0.05	0.05	0.11	0.06	0.05	no change	Slightly expanded area in front yard.
WRIA 10 Total				3.34	0.68	2.66	1.35	0.88	0.47		
WRIA 9 Total				4.66	3.30	1.36	4.41	3.46	0.95		
WRIA 10 Average				0.33	0.07	0.27	0.13	0.09	0.05		
WRIA 9 Average				0.47	0.33	0.14	0.44	0.38	0.06		
				GEI	HDR						
WRIA 10 Change				-0.20	0.02						
WRIA 9 Change				-0.03	0.05						