Public Services

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VERN M. REDIFER, P.E., Director

August 8, 2017

David Bowen
Department of Ecology, Central Region Office
1250 West Alder Street
Union Gap, WA 98903

Re: **Lower Yakima Valley GWMA - 2017 Second Quarter Report (IAA No. C 1200235)**

Dear David:

Enclosed please find one (1) copy of Yakima County's second-quarter report as required under Attachment A, Statement of Work, Agreement No. C 1200235 between the State of Washington Department of Ecology and Yakima County.

This report addresses deliverables 1.1 and 2.2 as required under the agreement.

Deliverable 2.1, invoices, to be sent separately.

If you have any questions, please let me know.

Thank you.

Lisa H. Freund, Administrative Manager
Yakima County Public Services

enclosure

IAA No. C 1200235 – Second Quarter 2017 Report
Lower Yakima Valley GWMA
June 30, 2017

TASK 1 - ADMINISTRATIVE FUNCTIONS
DELIVERABLES

1.1 Meeting Records

For each meeting of the GWAC, submit a copy of the agenda, minutes, attendance and public meeting notice at the end of each quarter.

Attachment [A] includes the final GWAC meeting summaries of February 16, April 20, May 18, and June 29, 2017; the Residential, Commercial, Industrial, and Municipal (RCIM) Working Group summaries of April 10 and June 12, 2017; the Data Collection, Characterization and Monitoring Working Group summary of May 11, 2017; the Regulatory Framework Working Group summaries of May 10 and June 14, 2017; the Livestock/CAFO Working Group summary of May 4, 2017; the Education and Public Outreach (EPO) Working Group summaries of April 5 and June 7, 2017; the Funding Working Group meeting summary of June 14, 2017; and the Joint NLA (hereafter referred to as the 'NAA') Working Group summary of April 13, 2017. The Irrigated Ag Working Group (IAWG) did not hold a meeting in this quarter.

TASK 2 - PROGRAM FUNCTIONS
DELIVERABLES

2.2 Status Report

Submit written quarterly status reports summarizing GWAC plans, activities and work products, and describing any interlocal agreements or other contracts by the end of each quarter.

GWMA Program Development. The GWAC held three meetings in the second quarter. At the April 20 meeting, a tentative schedule for GWMA Program completion was distributed. The document called for the draft GWMA Program to be completed by mid-September, with the GWAC's work completed by December 2017. Accordingly, at its third meeting on June 29, the GWAC agreed to begin meeting biweekly until mid-September to complete the draft GWMA Program within deadline.

The working groups, meanwhile, drafted and/or completed their reports to the GWAC as required under the GWAC's Work Program. Two working groups (Irrigated Ag and RCIM) completed their work and held no further meetings. Livestock/CAFO also completed its report to the GWAC. Meanwhile, the Funding Working Group held its first meeting on June 14 to begin identifying funding sources for the GWAC's proposed alternatives. Public Services Director Vern Redifer was chosen to chair the group.

Nitrogen Availability Assessment. GWAC members had their first look at the draft Nitrogen Loading Assessment at a joint working group meeting on April 13. Authors from Washington State Department of Agriculture (WSDA) and Yakima County described their work and entertained questions from the audience. The assessment suggested that on an overall acreage basis, irrigated agriculture was the largest contributor of nitrogen available for transport in the GWMA, followed by CAFO lagoons and CAFO pens. On a per acre basis, however, the largest contributors of nitrogen available for transport were CAFO pens, lagoons and on-site sewage systems (ROSS, LOSS, and COSS) due to the concentrated nature of these operations. Meeting participants were invited to submit comments on the draft NAA by Friday, April 28. This date was later extended to accommodate GWAC working group comments. The WSDA completed its review of the forthcoming comments in June.

Alternative Land and Water Use Management Strategies for Reaching Program Goals and Objectives (WAC 173 100-100(4)). A draft alternatives section, outlining various land and water use management strategies for reaching the program's goals and objectives, was compiled and released to the GWAC in June. The 240-plus list reflected a compilation of recommendations by the working groups and included a separate literature review. The list, organized by category, was briefly reviewed at the June GWAC meeting. Further work on this section was slated for the third quarter.

A GWAC Member's Alternative Management Strategy Presentation. Independent of the committee's work, GWAC member Jean Mendoza requested time on the May 18 GWAC agenda to present additional alternatives. She suggested options including new technological solutions, conservation solutions, ways to promote behavioral change, and changes to local ordinances and programs.

Attachment [B] includes the GWAC's Tentative Schedule for Completion, the June 29 compiled list of Alternative Strategies, the draft Nitrogen Availability Assessment (NAA) and Attachments and Jean Mendoza's May 18 Alternatives Presentation.

Other Work Plans and Products

Ambient Groundwater Monitoring Network (AMN)

The USGS acquired permission to test 151 wells with associated well logs in the second quarter. All had been tested with quality data returned on 120 tests. Tests ranged from zero to about 45 mg/L with most at less than 10 mg/L. The average was 7.72 mg/L; the median was 6.13 mg/L. 24 drains predetermined by PGG were also tested – one tested high. This preliminary data was shared with the GWAC at its May meeting. Nine additional wells were being sought. Yakima County worked with Pacific Groundwater Group (PGG) to finalize its contract so the purpose-built wells could be installed and testing begin.

Education and Public Outreach

The "Test Your Well" billboard campaign, initiated in late 2016, concluded on June 30.

What You Can Do to Protect Well Water. Local flooding in Outlook in March prompted the EPO to create and carry out the "What You Can Do to Protect Well Water" campaign (see First Quarter 2017 Report to Ecology). Early in the second quarter the campaign concluded with participation in a Spanish-language Radio KDNA news show on the topic (April 4) and a flyer distribution at the Sunnyside Walmart on Saturday, April 29. The flyer is included as Attachment [C].

Working Group Activities

Education and Public Outreach (Lisa Freund, Chair)

The EPO met on April 5 and June 7. At the April meeting the group debriefed the "What You Can Do to Protect Well Water" campaign launched in March and completed the first week of April (See Q1 2017 for details). It was agreed the *Daily Sun News* and *El Sol* newspaper inserts were a cost-effective and efficient way to reach targeted audiences. The cost to distribute 22,700 flyers via these two publications was $4,013.90. The ability to target specific communities through the *Daily Sun News* (and exclude communities not in the GWMA) was very valuable. The group also continued its discussion of the EPO Questionnaire results. The group agreed that without specific direction from the GWAC, it was impossible to move forward with this initiative. The group directed Chair Lisa Freund to seek more specific direction from the GWAC at its April meeting.

At the June meeting, Data Chair Melanie Redding joined the EPO to talk more specifically about what messages and outcomes the Data Collections working group would like distributed. It was agreed that Melanie would provide the EPO with narrative summaries (approximately 75 words, three paragraphs, 25 words each) of all the monitoring efforts, what each effort covered, the intent of each, and where supplemental information could be found.

Education and Public Outreach Alternatives. Jim Davenport presented the draft EPO alternatives and asked the members to suggest additional alternatives by June 23. This list would be incorporated in the master list of proposed alternatives and presented to the GWAC at its June meeting.

Data Collection (Melanie Redding, Chair)

The Data Collection working group met on May 11. The group was briefed on the status of the Ambient Groundwater Monitoring, Drinking Water Monitoring, Drain Monitoring, and Nitrogen Availability Assessment (NAA) and Data Analysis. Vern Redifer summarized the work, reporting that as of April 20, 89 homeowners had agreed to participate in the well testing. The goal was to attain another 50 or 60. USGS had begun gathering samples; Vern was working on providing comments to PGG's proposed QAPP. There was one change to the ambient monitoring network scope of work: delete the $10,000-$15,000 charge to assist with data and analysis. The expertise to conduct the analysis exists within the data working group membership.

Nitrogen Availability Assessment (NAA). Lengthy comments were received on the NAA and were reviewed by its authors. EPO messages were discussed, with Vern suggesting that an important short-term message was:

1. Monitoring efforts have been started; monitoring with oversight will push us in the right direction
2. The intention is for the monitoring efforts to continue
3. Here is what we hope to accomplish through these monitoring efforts and
4. Any reactions to the data from the monitoring efforts will be based on what we learn and success or failure will be monitored over time

Long-term data reporting. Vern advised that the lead entity would be the responsible agency. For the first year USGS would conduct the data analysis of seasonal variations and report to the GWMA via the website. Thereafter it would likely be on the Department of Ecology's website under water quality, although the Yakima Health District has also been discussed as a possible entity.

Irrigated Ag (IAWG) (Troy Peters, Chair)

The IAWG completed its recommendations to the GWAC in March. No further meetings were scheduled.

Residential, Commercial, Industrial, and Municipal (RCIM) (Dan DeGroot, Chair)

The group met on April 10 and June 12 (final meeting). The group completed its investigations of Residential, Commercial, Industrial and Municipal items for the GWAC, reviewed and responded to the draft NAA, and submitted its final report to the GWAC for review and recommendation.

NAA Comments. The RCIM recommended that extreme care is necessary when comparing On-Site Sewage Systems (OSS) discharges with discharges from a cropping system. The group emphasized the effect of density on how discharges from OSS can affect an aquifer. The group also noted that in regards to section 2.3 1(e) of the Work Plan, if no action is taken with present OSS regulations, the nitrogen loading and nitrate contamination will increase, especially in high density areas.

RCIM cautioned that comparing an OSS to an agricultural system is dangerous, and recommended that care is necessary when comparing OSS discharges with discharges from a cropping system. Members wanted to emphasize that the density of OSS can affect an aquifer. The group agreed that when a monitoring system is installed at least two wells be devoted to the Urban Growth Area (UGA) where high density OSS exists.

RCIM Final Report to the GWAC is included as Attachment [D]

Regulatory Framework (Jean Mendoza, Chair)
The Regulatory Working Group met on May 10 and June 14. In May the group reviewed and approved corrected versions of five documents: Groundwater Quality Regulation in Washington; Yakima County's Role in Groundwater Quality Protection; Irrigated Agriculture and Groundwater Quality Regulation; Residential, Commercial, Industrial and Municipal Groundwater Quality Regulation; and Livestock/CAFO and Groundwater Quality Regulation. The documents were incorporated into a single document, "Groundwater Quality Regulation in Washington," with the intent to forward it to the GWAC.

Groundwater Quality Regulation in Washington is included as Attachment [E].

The group further agreed that it had no short-term messages for the EPO.

The group held its final meeting on June 14. The purpose of the meeting was to discuss potential alternative regulatory strategies under the authority of the Yakima County Code.

Analysis of Yakima County Ordinances That Address Nitrates in Groundwater from Agricultural Sources. The group reviewed the state's Growth Management Act (GMA) relative to groundwater, and discussed the designation of critical areas, what they are and how they are regulated. The Voluntary Stewardship Program (VSP) was also discussed as a means to enforce actions that may impact nitrate in groundwater. Two CAFO conditional use permits were also reviewed and discussed, followed by the process of dairy nutrient management plans (DN MP). The group agreed that permit writers at Yakima County should visit a dairy facility. A member expressed concern that the chair appeared to be going down the path towards regulating dairy manure, and reminded everyone that synthetic fertilizers also played a big role in nitrogen availability.

At the conclusion of the meeting the group agreed this would be the last meeting of the working group. Jim Davenport confirmed that he had captured the additions to the alternatives list and they would be incorporated in the list presented to the GWAC [on June 29].

Livestock/CAFO (David Bowen, Chair)

The Livestock/CAFO Working Group met on May 4. The group reviewed the Nitrogen Availability Assessment (NAA), the EPO outreach spreadsheet, and draft comments on two reports: Jim Davenport's "Draft Livestock/CAFO's Final Working Group Report to the GWAC" and David Bowen's "Lower Yakima Valley (LYV) GWMA Groundwater Management Plan-Livestock/CAFO." Both reports were accepted by the group.

The Draft Livestock/CAFO Working Group Report to the GWAC and the LYV GWMA Groundwater Management Plan - Livestock/CAFO are included as Attachment [F]

Funding Working Group (Vern Redifer, Chair)

The Funding Working Group held its first meeting on June 14. Vern Redifer chaired the meeting, and the group agreed that he should continue in this role.

Excerpt from the GWAC Work Plan is included as Attachment [G]

GWMA Website

The GWMA website continued to be updated in real time.

Contracts and Interlocal Agreements

No contracts were executed in the second quarter.

Attachment A

- Final GWAC meeting summary of February 16, 2017.
- Final GWAC meeting summary of April 20, 2017.
- Final GWAC meeting summary of May 18, 2017.
- Final GWAC meeting summary of June 29, 2017.
- GWAC agenda and public meeting notice for April 20, 2017.
- GWAC agenda and public meeting notice for May 18, 2017.
- GWAC agenda and public meeting notice for June 29, 2017.
- GWAC attendance roster record for April 20, May 18 and June 29, 2017.
- Irrigated Ag Working Group (IAWG) – there were no working group meetings during the second quarter.
- Residential, Commercial, Industrial and Municipal (RCIM) Working Group summaries of April 10, 2017 and June 12, 2017.
- Data Collection, Characterization and Monitoring Working Group summary of May 11, 2017.
- Regulatory Framework Working Group summaries of May 10, 2017 and June 14, 2017.
- Livestock/CAFO Working Group summary of May 4, 2017.
- Education and Public Outreach (EPO) Working Group summaries of April 5, 2017 and June 7, 2017.
- NLA Joint Working Group Meeting summary of April 13, 2017.
- Funding Working Group Meeting summary of June 14, 2017.

YAKIMA VALLEY GROUNDWATER MANAGEMENT AREA ADVISORY COMMITTEE (GWAC)

MEETING SUMMARY

Thursday, February 16, 2017 – 5:00 p.m. – 7:00 p.m.

Denny Blaine Board Room
810 East Custer Avenue, Sunnyside, WA

Note: This document is only a summary of issues and actions of this meeting. It is not intended to be a transcription of the meeting, but an overview of points raised and responses from Yakima County and Groundwater Advisory Committee members. It may not fully represent the ideas discussed or opinions given. Examination of this document cannot equal or replace attendance.

I. Call to Order: This meeting was called to order at 5:04 PM by Vern Redifer, Facilitator.

Member	Seat	Present	Absent
Stuart Turner	Agronomist, Turner and Co.,	✓	
Chelsea Durfey			✓
Bud Rogers	Lower Valley Community Representative Position 1	✓	
Kathleen Rogers	Lower Valley Community Representative Position 1 (alternate)	✓	
Patricia Newhouse	Lower Valley Community Representative Position 2		✓
Sue Wedam	Lower Valley Community Representative Position 2 (alternate)	✓	
Doug Simpson	Irrigated Crop Producer	✓	
Jean Mendoza	Friends of Toppenish Creek	✓	
Eric Anderson	Friends of Toppenish Creek (alternate)		✓
Jan Whitefoot	Concerned Citizens of the Yakama Reservation		✓
Jim Dyjak	Concerned Citizens of the Yakama Reservation (alternate)	✓	
Steve George	Yakima County Farm Bureau		✓
Frank Lyall	Yakima County Farm Bureau (alternate)	✓	
Jason Sheehan	Yakima Dairy Federation	✓	
Dan DeGroot	Yakima Dairy Federation (alternate)	✓	
Ron Cowin	Roza-Sunnyside Joint Board of Control	✓	
	Roza-Sunnyside Joint Board of Control (alternate)		
Laurie Crowe	South Yakima Conservation District	✓	

Jim Newhouse	South Yakima Conservation District (alternate)		✓
Robert Farrell	Port of Sunnyside	✓	
John Van Wingerden	Port of Sunnyside (alternate)		✓
Rand Elliott	Yakima County Board of Commissioners		✓
Vern Redifer	Yakima County Board of Commissioners (alternate)	✓	
Dave Cole	Yakima Health District	✓	
Ryan Ibach	Yakima Health District (alternate)		✓
Dr. Troy Peters	WSU Irrigated Agriculture Research and Extension Center		✓
Lucy Edmondson	U.S. Environmental Protection Agency		✓
Peter Contreras	U.S. Environmental Protection Agency (alternate)		✓
Elizabeth Sanchey	Yakama Nation		✓
Stuart Crane	Yakama Nation (alternate)	✓	
Virginia "Ginny" Prest	WA Department of Agriculture		✓
Jaclyn Hancock	WA Department of Agriculture (alternate)		✓
Andy Cervantes	WA Department of Health		✓
Ginny Stern	WA Department of Health (alternate)	✓	
David Bowen	WA Department of Ecology		✓
Sage Park	WA Department of Ecology	✓	
Lino Guerra	Hispanic Community Representative		✓
Rick Perez	Hispanic Community Representative (alternate)		✓
Jessica Black	Heritage University		✓
Matt Bachmann	USGS	✓	

II. Welcome, Meeting Overview and Introductions: Everyone introduced themselves. Vern noted that Commissioner Elliott was absent because of a prior commitment in Olympia. Vern asked everyone to pause for a moment of silence to prepare for the meeting. He then reviewed the agenda. A member asked that the group discuss the last quarter of deep soil sampling and the group agreed to add this item to the agenda.

III. Don Stuart Presentation: Melanie reminded the group that she had heard Don Stuart speak at a seminar and believed his presentation would be beneficial to the group as they were deciding how to move forward and thinking about how to work together. She again summarized his background and how she believed the GWAC could benefit. A member asked if the presentation would be made during the GWAC meeting or prior to it as others had done in the past. Vern indicated that would depend on Don's schedule and the group's interest. After a great deal of discussion the group agreed to invite him to speak before or after a meeting which would give everyone a choice to attend and not distract from the business the group needed to accomplish in the next year. Another member suggested that it would be good to ask other experts to speak in order to help the members better understand some of the more technical sides of the decisions they would be making. Vern passed around a sign-up sheet so members could suggest topics and speakers. Suggestions were made as follows: farming systems common to the Valley; soil science – agronomy/horticulture – the tech side of farming; hydrogeology (Matt Bachman USGS); regulatory agency function/water quality (Melanie Redding/Ecology); irrigation technology/management, manure management plans and implementation; basic statistics; the nitrogen cycle; dairy nutrient management plans; irrigation water management/soil moisture sensors (Troy Peters); how to develop a nutrient management plan soil nitrate fate long term – what kind of studies are needed; and, according to current studies what is the cause of methemoglobinemia? What health effects does excess nitrate cause people? Who is the most susceptible? At what levels? These informational meetings would also be held outside of the GWAC time. It was suggested that Vern be given the authority to decide *which topics and what speakers were a priority and the group agreed.*

IV. Working Group Reports:

Data Collection: Melanie thanked the group for budgeting funding for groundwater projects. She reported that PGG is putting together documentation and working on a contract with Yakima County for installation of the purpose built wells. There will be an "x" on the ground before any drilling. PGG is also working on the Quality Assurance Project Plan for the drain samples. Matt Bachmann (USGS) is working on a contract for the drinking water program to begin testing private domestic wells. Melanie asked Matt to elaborate on his progress. Matt said that his group had identified a number of possible wells for testing. He brought a map so that the group could see the potential locations and marked it with red and green dots. The red dots on the map indicated the wells that had been tested by Yakima County – of those 35 well logs had been found. The green dots are 289 sites previously used by USGS - ID and well logs for these sites have already been acquired. Matt believed given the number of these sites the group wouldn't have a problem finding 160 wells to pick from. In summary, Melanie said she asked PGG and USGS to compile one report so that anyone looking at the program in the future would know exactly what had been done. A member asked who would have oversight of this program after 2017. Vern said he had spoken with the Yakima Health District (YHD) and they had indicated a willingness to take the testing program on after 2017. It was Vern's desire to integrate YHD into the testing this year so that there would be a seamless transition but there were still a number of details to be worked out. Vern said that the plan had been to test intensively for two years and then less frequently and that the group could determine how often YHD would report back to the County. Vern added that he was waiting for a contract proposal and a technical requirement list for drilling the purpose built wells from PGG so that Yakima County could put this into a bid package. Vern thought at the earliest holes would be in the ground by April. The wells would be established in numerical priority and based on the money allocated by the GWAC in its budget for this purpose. Melanie added that the Nitrogen Loading Assessment (NLA) would most likely be delivered to a joint working group meeting by Vern and Gary Bahr (Department of Ag) in March. There would be a time for questions and revisions by the working groups. The goal was to present the NLA at the GWAC's April meeting. ***(NOTE: As this summary was being drafted Melanie received a revision regarding the timeframe for review of the Nitrogen Loading Assessment. It will be presented at a Joint Working Group meeting on April 13 – it will not be presented at the April 20 GWAC meeting).***

Livestock/CAFO: In David Bowen's absence, alternate Sage Park reported that the group is finalizing the collection of information and is in the first stage of reviewing draft language for their portion of the Groundwater Management Plan with a goal of delivering the product to Yakima County in April or May. A member said the group completed an extensive look at BMP's and NRCS standards and practices in November and December.

Irrigated Ag: Jim Davenport reported in Troy Peters' absence. He said that the group had two central ideas: irrigation and soil/fertilization management and education. A member mentioned that he had been at a recent water resource conference and was impressed by the changes and progress in irrigation management. Others agreed.

RCIM: Chair Dan DeGroot reported that David Bowen met with the group and provided a detailed report on the Department of Ecology's NPDES permits. The group reviewed outreach materials from EPO on their "What You Can Do" campaign. The group also discussed onsite sewage systems with the Department of Health and compiled a list of suggested solutions. The group hoped to review its draft report at its next two meetings and have it to the GWAC at its April meeting. A member asked Dan to explain what he meant when he said "high density areas of OSS are particularly problematic because there is not enough land mass to properly filter the effluent before the next well is encountered." Dan explained and the group discussed solutions for high density areas and the possibility of installing community wells in these locations. Ginny Stern noted that when there is a density of systems less dilution will occur before it reaches the aquifer and the effluent can stay distinctive for 200 feet making this area a poor location for a well. A member claimed it was not worth the effort to pursue two to four percent of the cause of contamination in

OSS. Dan asked her if she was getting this information from the EPA pie chart that actually claimed that OSS was responsible for four percent of the nitrogen produced in the GWMA.

Regulatory Framework: Jean Mendoza reported that the group had not met since November when it primarily summarized costs related to elevated nitrates in groundwater. She noted the discussion would continue at next week's meeting. The group will also discuss composting regulations and abandoned wells and this had not been done previously. Jean had visited every working group and added that if the working groups had additional regulatory questions she would be happy to meet with them.

EPO: Lisa Freund reported the "Test Your Well" billboards were up in the Lower Valley as of January 1. The work group had also created four well protection flyers in English and Spanish as a result of requests from the RCIM and Abandoned Well groups. The flyers were in member meeting packets. In addition, EPO is working with each of the working groups to create a unified message for the GWAC. Questionnaires had been sent out for each group to complete which was delayed because of working group meeting cancellations due to weather. The questionnaires asked each working group's mission, its accomplishments, discoveries, future products/recommendations and audiences. A member thought that the billboards were hard to read and difficult to find. Another member liked the simplicity and thought they were clear and concise. Lisa reminded everyone that it was difficult to get space on billboards in the Lower Valley as most are under contract and it was the group's pilot project which made the member feedback valuable.

V. Fourth Quarter Deep Soil Sampling: A member indicated that in the last quarter of the deep soil sampling (spring 2016) only 28 fields had been sampled and of that 28, 12 fields didn't return the informational questionnaire making it impossible to know what crops were grown and how much fertilizer was applied. The member felt these tests were now worthless and was disappointed that $250,000 had been spent on this project at tax payer's expense. Laurie Crowe from the South Yakima Conservation District responded that she thought more than 28 fields had been tested in the last round and she believed the soil data was still good even though 12 questionnaires had not been returned as the levels and crops grown are pretty much the same in this area. She continued that it would be very difficult to obtain this data now as no one knows what fields were tested since anonymity had been part of the project plan because of the litigious climate. A member pointed out that the group had to have known this would happen because testing was done on a strictly voluntary basis and another member said that it would be unrealistic to expect anything else. Laurie indicated that the goal was a good background data base. Another member felt that the group still had a good representative set. Matt Bachmann added that the information would be useful, not useless. Another member asked how much sampling was done – Laurie said four rounds - the first spring and the last fall were low, the others went well. 160 tests had been done; the goal had been 200. 90 percent of the information had been turned back in from the testing sites. Matt indicated that often field programs go awry. Another member indicated that the group had been dealing with volunteers where the level of commitment can be variable. The first member remained disappointed as she felt people were paid to be here and saw it as an example of stone-walling. Later the group agreed to have Troy Peters analyze the data which was already in spreadsheet format.

VI. **Committee Business:** The December 15, 2016 summary was approved as presented. The group agreed to schedule monthly meetings beginning in April. The 2017 scheduled dates are: April 20, May 18, June 15, July 20, August 17, September 21, October 19, November 16 and December 21. The meetings will be cancelled if they aren't needed.

VII. **Public Comment:** A member of the public had attended the recent RCIM meeting and voiced concern that in order to inspect and pump onsite sewage systems the Yakima Health District would be required to get an easement to access homeowners' land. She wondered if the USGS could inspect septic systems when they were inspecting private wells. Matt Bachmann indicated that it would be problematic to the endeavor to test private wells and estimated he may lose approximately 90 percent of his prospective volunteers. As an aside to this discussion Ginny Stern believed she knew someone who would help analyze the approximately 450 well assessments. Ginny also introduced her replacement at the Department of Health – Sheryl Howe - as she would retire the 1st of April. Another member was also concerned about the money spent on the deep soil sample test results. After some discussion Jim Davenport informed the group that Troy Peters had volunteered to have some of his graduate students analyze the data. The group desired to pursue this solution. Another member reminded the group that in addition to the data and its analysis, the deep soil sampling had educated a lot of producers that had never soil sampled or sampled at this depth. He felt there were many teaching moments for those who had volunteered. Ginny Stern reminded the group that groundwater sampling, not deep soil sampling, will tell the group where to look for problems.

VIII. **Next Meeting:** The group decided to meet again on April 20, 2017.

IX. **Next Steps:** 1) Schedule the Don Stuart presentation and arrange for other suggested topics and speakers; 2) Present the draft Nitrogen Loading Assessment to a joint meeting of the Irrigated Ag, RCIM, Data and Livestock/CAFO Working Groups; and, 3) Pursue analysis by the Department of Health of the County's 450 well assessments; and, 4) Pursue analysis by Troy Peters of the Deep Soil Sampling.

X. **Meeting Summary** approved by the GWAC on April 20, 2017.

YAKIMA VALLEY GROUNDWATER MANAGEMENT AREA ADVISORY COMMITTEE (GWAC)

MEETING SUMMARY

Thursday, April 20, 2017 – 5:00 p.m. – 7:00 p.m.

Denny Blaine Board Room
810 East Custer Avenue, Sunnyside, WA

Note: This document is only a summary of issues and actions of this meeting. It is not intended to be a transcription of the meeting, but an overview of points raised and responses from Yakima County and Groundwater Advisory Committee members. It may not fully represent the ideas discussed or opinions given. Examination of this document cannot equal or replace attendance.

I. Call to Order: This meeting was called to order at 5:04 PM by Vern Redifer, Facilitator.

Member	Seat	Present	Absent
Stuart Turner	Agronomist, Turner and Co.,	✓	
Chelsea Durfey			✓
Bud Rogers	Lower Valley Community Representative Position 1	✓	
Kathleen Rogers	Lower Valley Community Representative Position 1 (alternate)	✓	
Patricia Newhouse	Lower Valley Community Representative Position 2	✓	
Sue Wedam	Lower Valley Community Representative Position 2 (alternate)		✓
Doug Simpson	Irrigated Crop Producer	✓	
Jean Mendoza	Friends of Toppenish Creek	✓	
Eric Anderson	Friends of Toppenish Creek (alternate)		✓
Jan Whitefoot	Concerned Citizens of the Yakama Reservation		✓
Jim Dyjak	Concerned Citizens of the Yakama Reservation (alternate)		✓
Steve George	Yakima County Farm Bureau	✓	
Frank Lyall	Yakima County Farm Bureau (alternate)	✓	
Jason Sheehan	Yakima Dairy Federation	✓	
Dan DeGroot	Yakima Dairy Federation (alternate)	✓	
Ron Cowin	Roza-Sunnyside Joint Board of Control	✓	
	Roza-Sunnyside Joint Board of Control (alternate)		
Laurie Crowe	South Yakima Conservation District		✓

Robert Farrell	Port of Sunnyside		✓
John Van Wingerden	Port of Sunnyside (alternate)	✓	
Rand Elliott	Yakima County Board of Commissioners	✓	
Vern Redifer	Yakima County Board of Commissioners (alternate)	✓	
Dave Cole	Yakima Health District	✓	
Ryan Ibach	Yakima Health District (alternate)		✓
Dr. Troy Peters	WSU Irrigated Agriculture Research and Extension Center	✓	
Lucy Edmondson	U.S. Environmental Protection Agency	✓	
Peter Contreras	U.S. Environmental Protection Agency (alternate)		✓
Elizabeth Sanchey	Yakama Nation		✓
Stuart Crane	Yakama Nation (alternate)	✓	
Virginia "Ginny" Prest	WA Department of Agriculture	✓	
Jaclyn Hancock	WA Department of Agriculture (alternate)		✓
Andy Cervantes	WA Department of Health	✓	
Sheryl Howe	WA Department of Health (alternate)		✓
David Bowen	WA Department of Ecology	✓	
Sage Park	WA Department of Ecology		✓
Lino Guerra	Hispanic Community Representative		✓
Rick Perez	Hispanic Community Representative (alternate)		✓
Jessica Black	Heritage University		✓
Matt Bachmann	USGS	✓	

II. Welcome, Meeting Overview and Introductions: Everyone introduced themselves and paused for a moment of silence to prepare for the meeting. Vern reviewed the agenda and asked to add a discussion about the Funding Working Group after the Working Group reports. He also noted that the members had received a handout entitled "Tentative Schedule for Completion of Groundwater Management Program" for discussion under the agenda item "Where do We go from Here." There were no other items for the agenda.

III. Nitrogen Availability Assessment (NAA – previously called the Nitrogen Loading **Assessment):** Vern indicated that the assessment had been renamed since the study only included nitrogen availability and not loading to groundwater. He reminded everyone that there had been an open Joint Working Group meeting Thursday, April 13 where the Washington State Department of Agriculture and Yakima County (authors) reported their methodology of analysis on potential sources of nitrogen and the results. Everyone now has the opportunity to comment by April 28. All comments should be sent to Bobbie who will compile them and forward them on to WSDA and Yakima County for their response. Vern encouraged the working groups to discuss the assessment. It will then be presented to the GWAC in May (and June, if necessary) in accordance with the process outlined in the Data Working Group. Vern affirmed that he would post the PowerPoint presentations from the meeting on the website. He also stated that when he referred to the GWAC "accepting" the assessment it means that the GWAC agreed the study was complete. A member felt that there would be a great deal of discussion and named several notable topics. Vern didn't feel he could say how long the discussion would last until he better understood the depth of the members' concerns and received their comments. Vern reminded everyone that the assessment was still in draft form until the comment and answer period was completed and the working groups had reviewed the assessment as it may change based on the comments received.

IV. Working Group Reports:

Livestock/CAFO: David Bowen reported that the group had met once and were one-third of the way through the draft report to the GWAC. He had received a set of minor edits from Jim Davenport. David expected the group to be done in May, maybe June and would forward the report to the County. A member asked David about the comments she had sent and he reminded her that they were already a part of the ongoing discussion.

Irrigated Ag: Troy Peters believed that his group had finalized their findings and suggestions as the deep soil sampling had revealed that irrigated agriculture contributed in part to the nitrates in the soil. They can be found in the EPO Summary which was attached to the GWAC agenda packet. Troy added that fertilizer companies potentially had a conflict of interest which is why the group had recommended reaching out to them. Troy said that there were no recommendations for additional regulations because of the makeup of the committee. The GWAC then discussed whether or not regulatory action was the objective of the GWMA. A member indicated he didn't believe it was. Vern stated that neither he nor Commissioner Elliott remembered such an agreement, nor did they have any preconceived notions in this regard. He added that he had had personal discussions with Tom Eaton who had said that the Environmental Protection Agency (EPA) would not participate in the GWMA if regulations were taken off the table. Vern did believe, however, that many members thought non-regulatory strategies were more effective, but there was no advance decision.

He also recalled that EPA, Yakima County and Washington State Departments of Health, Ecology and Agriculture addressed regulatory actions in a document entitled "Vital Elements of a Groundwater Protection Body." A member asked Troy what incentives the group had suggested; Troy said cost shares for irrigation water management and soil sampling data analysis and said that he felt the group had made good decisions that can effect change and come up with good results. Troy added, however, that the group would meet again to talk about the NAA and stated that the preliminary results of the NAA did not come as a surprise to most of the group.

RCIM: Dan DeGroot stated that the group had completed their investigation and had reviewed the second draft of their report at their April meeting. The report had not been approved because the group was awaiting the results of the NAA. The group's May meeting will be cancelled and Dan hoped to review the NAA in June and have the report to the GWAC ready for its June meeting. Dan noted that there was concern that the NAA doesn't emphasize the fact that onsite sewage systems are designed to leach into the aquifer as discussed at the last GWAC meeting but noted this is of greater concern where there are areas of high density. Dan said the group also discussed the two Large Onsite Sewage Systems (LOSS) systems in the GWMA and learned that even though reports are not being submitted in a timely fashion, permits are still being issued. There was also a question as to whether the operation and maintenance plans for each LOSS were being followed correctly. Vern added that Peter Severtsen of the Department of Ecology is preparing a separate analysis of bio-solids for the NAA because none had been included earlier but pointed out that the Port of Sunnyside was moving away from land applying waste to a drain discharge in 2019.

Regulatory Framework: Jean reported that Ecology made a presentation on Total Maximum Daily Loads (TMDL's) since TMDL's had been brought up before the GWMA was formed as a potential format to address nitrates in the groundwater. Several members said that while TMDL's address surface water it would be difficult to follow surface water from its source into the aquifer. Another member added that the ground acts as a filter so this may not be an issue. Jean noted that the group had also reviewed composting operations from a WSDA perspective. Jean said there was lots of support for minimizing regulation of this activity but there was a minority who disagreed. The group had also looked at their remaining assignments and hoped to have a written report ready next month. Jean offered a variety of regulatory assistance to other working groups and said that the group also needed to develop narratives to go with the key messages and recommendations it had submitted to the EPO Working Group.

EPO: Lisa shared that EPO formulated a "What You Can do to Protect Well Water" campaign in response to the recent flooding in the Yakima Valley. Flyers in English and Spanish and test strips were distributed door-to-door in Outlook, 20,000 flyers were inserted into the *Sunnyside Daily News* and *El Sol* at the end of March, two members of the EPO committee participated in a KDNA news show, and Commissioner Rand Elliott was interviewed on KIT. Lisa added that the flyer will also be handed out at the Sunnyside Walmart store on April 29. A member asked if there was an uptake in well testing as a result of these efforts. Dave Cole from the Yakima Health District said yes. Lisa then addressed the EPO Questionnaire Summary in the agenda packet. The working groups had completed questionniares over a period of several months and answered a series of questions posed to them by EPO. The goal was to create a unified messaging for the GWAC, both short-term (through 2017) and post-plan adoption. Lisa continued that EPO was asking the GWAC for assistance to identify specific messages and outreach the group would like conducted. Lisa stated that to-date all outreach had centered on the health risks, "test your well" and letting people know about the GWMA. EPO now wanted the group's short-term recommendations of specific messages for "before plan adoption" and "beyond plan adoption and review" to ensure the public is aware of the plan and their opportunity to review. David Bowen noted that it would be important for EPO to provide information to the public on public hearings. Lisa acknowledged that this was on the committee's radar. Troy asked that EPO develop brochures on water management, nutrient management and soil sampling and indicated that he would be willing to help. Vern asked that all working groups include this in their next month's agenda. He suggested that they specifically review their responses to Question No. 6 and develop ideas for potential messages. Vern reminded everyone that the GWAC has an obligation to inform the public about what the group is doing.

Data Collection: Vern reported for Melanie who had been ill. Regarding the Ambient Monitoring Network, PGG has updated their Quality Assurance Project Plan (QAPP) and the Board of Yakima County Commissioners will be considering a contract PGG just submitted to install purpose built wells. USGS has submitted a QAPP for common water supply aquifers, which will be reviewed by the Data Collection Working Group. Matt Bachmann noted that 89 samples of the first round had already been completed (USGS will conduct six rounds of sampling). The remaining first-round sampling will be done in the next week. Sampling reports will be available at the next GWAC meeting. Matt also brought a map of the first 60 sites for people to look at. A member asked if it could be put into a GIS layer – Matt said yes. Matt said that 24 of the 25 surface water wells had been approved and the Granger drain site was moved 40 feet. Another member mentioned that when the purpose built wells had been located he wanted to be advised so he could look at their sites. Vern said the process had been delayed due to bad weather, but that the County survey crew would head out shortly. Vern continued that the Data group planned to delineate how data from all the GWMA efforts will be analyzed. Melanie reported that she was trying to set up the Don Stuart presentation and that Andrew Bary of WSU had already presented information on the nitrogen cycle and compost as part of the Data group's education efforts. Vern said that they would try to get other speakers scheduled which would include experts from this group like Troy Peters on water management.

Funding: Vern indicated that it was time for the funding working group to meet and proposed a June 14 initial meeting date to list generic funding alternatives and determine the scope of funding needs. The group would continue to meet through September to consider funding alternatives for recommendations chosen by GWAC and funding for the ongoing water monitoring program. Vern will send out a blanket invitation to everyone.

V. Where We're Going From Here: Vern referred everyone to the Tentative Schedule for Completion of Groundwater Management Program passed out earlier. He reviewed the timeline for the GWAC and working group meetings and agreed that some of the agenda items may take longer than currently scheduled. Jim Davenport pointed out that most working groups wouldn't meet after June or July so that if the GWAC needs to meet more frequently it could. A member stated that she found the tentative schedule very helpful and asked for some clarification about the final product. Vern noted that the SEPA process will lead to clarifications. Once that is done the plan will be presented to the Department of Ecology. They will then hold public hearings which are typically done jointly with the County Commissioners although this is not a requirement. As lead agency Yakima County must then compile comments where clarification is required and the GWAC may need to come back together in 2018 to respond. When the Department of Ecology finally approves the plan it will go to the affected jurisdictions who have a role in enacting the plan. The member asked if there was a timeline for this. David Bowen indicated it will move forward at a good rate. Vern also added that it will come out just before the legislative session which will be timely to get financial requests in.

Another member asked when the group would talk about alternative management strategies. Vern asked the member for her definition of what this meant. The member stated that she asked for an opportunity to present to the GWAC but had been put off continuously. Several members indicated that the member had many opportunities over the past five years. A great deal of discussion ensued including a discussion on the effectiveness of BMP's. The member asked for 30 minutes in a GWAC meeting to present alternative strategies. The group agreed and the member was asked to prepare a short synopsis of her presentation to go out with the agenda one week prior to the May meeting. A member wanted to see the presentation be solution oriented—her version of the best course of action. The member agreed.

VI. **Committee Business:** The February 16, 2017 meeting summary was approved as presented.

VII. **Public Comment:** Several people spoke up. One who was disappointed with the attitude in the meeting as she had come wanting something positive after being at a Yakima Regional Clean Air Agency (YRCAA) meeting that turned down air sensors for ammonia. She was excited, however, that her neighbor was cleaning up his dairy. Another person commented on the Irrigated Ag portion of the WSDA presentation. He felt the data, methodology, assumptions and conclusions were flawed. He felt that nitrogen was overstated and thought it was a problem that in the three years he had participated in the GWAC there hadn't been participation by an agriculture economist. A discussion ensued on the economic incentive to apply commercial fertilizer as opposed to animal waste product. Another person asked if Melanie Redding had scheduled the Don Stuart presentation yet and suggested that it may be good to do this at the next meeting prior to the presentation on alternative management strategies. The meeting was adjourned at 7:23 PM.

VIII. **Next Meeting:** May 18, 2017.

IX. **Next Steps:** 1) Vern to schedule Funding Working Group Meeting in June. A blanket invitation will be sent to everyone. 2) Member Jean Mendoza to present her suggested alternative management strategies at the next GWAC meeting. Jean will provide a short synopsis of her presentation to go out with the agenda one week prior to the May 18 meeting.

X. **Meeting Summary** approved by the GWAC on May 18, 2017.

YAKIMA VALLEY GROUNDWATER MANAGEMENT AREA ADVISORY COMMITTEE (GWAC)

MEETING SUMMARY

Thursday, May 18, 2017 – 5:00 p.m. – 7:00 p.m.

Denny Blaine Board Room
810 East Custer Avenue, Sunnyside, WA

Note: This document is only a summary of issues and actions of this meeting. It is not intended to be a transcription of the meeting, but an overview of points raised and responses from Yakima County and Groundwater Advisory Committee members. It may not fully represent the ideas discussed or opinions given. Examination of this document cannot equal or replace attendance.

I. Call to Order: This meeting was called to order at 5:04 PM by Vern Redifer, Facilitator.

Member	Seat	Present	Absent
Stuart Turner	Agronomist, Turner and Co.,		✓
Chelsea Durfey		✓	
Bud Rogers	Lower Valley Community Representative Position 1	✓	
Kathleen Rogers	Lower Valley Community Representative Position 1 (alternate)		✓
Patricia Newhouse	Lower Valley Community Representative Position 2	✓	
Sue Wedam	Lower Valley Community Representative Position 2 (alternate)		✓
Doug Simpson	Irrigated Crop Producer	✓	
Jean Mendoza	Friends of Toppenish Creek	✓	
Eric Anderson	Friends of Toppenish Creek (alternate)		✓
Jan Whitefoot	Concerned Citizens of the Yakama Reservation		✓
Jim Dyjak	Concerned Citizens of the Yakama Reservation (alternate)	✓	
Steve George	Yakima County Farm Bureau	✓	
Frank Lyall	Yakima County Farm Bureau (alternate)	✓	
Jason Sheehan	Yakima Dairy Federation	✓	
Dan DeGroot	Yakima Dairy Federation (alternate)		✓
Ron Cowin	Roza-Sunnyside Joint Board of Control	✓	
	Roza-Sunnyside Joint Board of Control (alternate)		
Laurie Crowe	South Yakima Conservation District	✓	

Robert Farrell	Port of Sunnyside		✓
John Van Wingerden	Port of Sunnyside (alternate)	✓	
Rand Elliott	Yakima County Board of Commissioners	✓	
Vern Redifer	Yakima County Board of Commissioners (alternate)	✓	
Dave Cole	Yakima Health District	✓	
Ryan Ibach	Yakima Health District (alternate)		✓
Dr. Troy Peters	WSU Irrigated Agriculture Research and Extension Center	✓	
Lucy Edmondson	U.S. Environmental Protection Agency	✓	
Nick Peak	U.S. Environmental Protection Agency (alternate)		✓
Elizabeth Sanchey	Yakama Nation		✓
Stuart Crane	Yakama Nation (alternate)	✓	
Virginia "Ginny" Prest	WA Department of Agriculture		✓
Jaclyn Hancock	WA Department of Agriculture (alternate)		✓
Andy Cervantes	WA Department of Health	✓	
Sheryl Howe	WA Department of Health (alternate)	✓	
David Bowen	WA Department of Ecology	✓	
Sage Park	WA Department of Ecology		✓
Lino Guerra	Hispanic Community Representative		✓
Rick Perez	Hispanic Community Representative (alternate)		✓
Jessica Black	Heritage University		✓
Matt Bachmann	USGS	✓	

II. Welcome, Meeting Overview and Introductions: Everyone introduced themselves and paused for a moment of silence to prepare for the meeting. Vern reviewed the agenda and asked if there were additions - there were none.

III. Working Group Reports:

Data Collection: Melanie Redding reported the group met on May 11 and was pleased with the projects that were beginning to compile data. The County is working with Pacific Groundwater Group (PGG) to finalize its contract so that the purpose built wells could be installed and testing could begin. USGS has begun the drinking water and drain testing. The working group is now looking at how data will be analyzed, stored and evaluated and will work to establish consistent methods. The group also wants data to be accessible on a website as quickly as possible and for the data to be assessed annually. All work will be in line with the objectives PGG put together and the GWAC voted on and approved. The group had learned through the comments made by members that biosolids and land application of wastewater (that has nitrogen loading) had not been included in the Nitrogen Availability Assessment (NAA). The Department of Ecology is working on a biosolid piece and the Port of Sunnyside is working on land application of wastewater piece for inclusion in the NAA. The Data group also discussed long-term and short-term messages for the EPO. The group recommended that EPO inform the public about the monitoring initiatives and the long-term commitment to the monitoring effort. It was also suggested that a member of the Data Working Group attend the EPO Working Group to help with this project. There were no questions.

Livestock/CAFO: David Bowen reported his group had met in May and discussed the EPO request for short and long-term messages; the group suggested that there be education on the application of nutrients at agronomic rates. The group also commented on the NAA. David thanked the working group for their extra effort to work through their comments on the reports which had been completed and forwarded to Yakima County. One report documents the story of where the group started and the other follows the work plan highlighting a couple of areas where the group could not reach a consensus. There were no questions.

Irrigated Ag: Troy Peters indicated that his group's meeting had been postponed to Tuesday, May 30, 1:30 to 3:30 PM.

RCIM: Dan DeGroot was not present. RCIM did not meet in May but will meet on June 12.

Regulatory Framework: Jean stated that she had been unable to attend the May Regulatory Working Group meeting because of a conflict. Instead, Jim Davenport acted as the meeting chair. He and the group worked through and completed the report he had drafted. Jean indicated that her group would not meet again unless the GWAC or another working group requested that they examine other regulations and/or ordinances. Jean suggested that if the group desired they could examine and research Aquifer Protection Areas. There were no questions for Jean.

EPO: Lisa shared that her group had not met in May because they were waiting for direction from each working group. EPO will meet in June to work on refining messages.

Funding: Vern stated that Yakima County Support staff would send a notice inviting GWAC members and their alternates to the first Funding Working Group meeting scheduled for Wednesday, June 14 at the Yakima County Courthouse, 10:00 AM to Noon. Vern suggested he chair the first meeting; the group could then select a chair from its members. Everyone agreed. Vern stressed the importance of providing a response to the meeting invitation as it would allow staff to plan appropriately. He said the group will focus on determining the funding needs from the working group recommendations and identify possible sources for funding.

IV. Well and Drain Monitoring Progress Report: Matt Bachmann (USGS) reported that the USGS had acquired permission to test 151 wells with associated well logs indicating known depths; all have been tested. USGS is looking for nine more wells (plus a few additional for backup). Matt received water quality data on 120 of the tests. Tests ranged from zero to about 45 mg/L but most were less than 10 mg/L. The average was 7.72 mg/L and median 6.13 mg/L. There were two tests at 42 and 45 respectively (these are being re-tested for accuracy); the next nearest tested at 20. Matt explained that most of the wells they are testing are 100 to 200 feet deep – one is over 800 feet and most likely will be removed from the program. Matt said that he had just received the data and not a lot of analysis had been done yet. Twenty-four drains predetermined by PGG were also tested – one tested high. A member of audience asked what drain had tested high. Matt couldn't remember for sure but said it was number 31 or 34 near Mabton. He reminded everyone that no QAQC had been done yet, so he was presenting preliminary data.

V. Nitrogen Availability Assessment: Vern indicated that three sets of comments had been received. The authors completed a cursory review of the comments. Every comment will be answered and published for further review. Vern reminded the group that he was not asking them to accept the assessment but was open to questions and/or comments. A member stated that she understood the NAA was to be a living document and wondered how that would happen. Vern said that where assumptions were made updates would be generated as better data became available. The member inquired what would happen to the document at the end of the year. Vern said it would be passed on to the entity taking over the program. An alternate member stated that he thought April 28 had been the cutoff date for questions; he was confused because the working groups were allowed to ask questions and the opportunity was being given again tonight. Vern indicated that his desire was to ultimately get to a point where the GWAC could accept the study as complete and if the document has a role. His vision was for the working groups to discuss whether or not the information provided in the assessment makes them want to rethink what's been done in the past and if the assessment provides information they should consider. A member stated that in order to evaluate the NAA each member needed the Irrigated Crops N Mass Balance Table that Perry Beale had distributed at the joint NAA working group meeting. Vern said he would have it emailed to the group and posted with the other NAA reference documents tomorrow. The member encouraged others to look at the contribution of apples on the Irrigated N Mass Balance Table, pencil it out and see what happens. Another member repeated concerns raised in his written comments to the authors of the irrigated ag piece. Melanie Redding felt that if the group was going to have a discussion on the NAA they must consider first the goals, what the assessment was designed to do and not to do. She felt that if someone was looking for specific numbers they would be disappointed, but if they were looking for generalities the assessment could be beneficial. Vern reminded everyone that the goal of questions and answers at this evening's meeting was more as a generality – basic general information for the group. He had not intended the group to get into specifics. He also noted that if members had additional written comments to please submit them sooner rather than later because the GWAC needed to move to a place where it could determine if the assessment was acceptable.

VI. Alternative Management Strategy Presentation by Jean Mendoza: *Jean reviewed how* decisions are made and noted that WAC 173-100-100 required alternatives. Jean stated that alternatives could include new technological solutions, conservation solutions, ways to promote behavioral change, and local ordinances and programs. She also believed it was important to ask "what are acceptable losses?" Jean went on to say that people in the community had suggested various technological solutions and gave bio-char as an example. She added that Yakima County looked into bio-char in 2003, Heritage University had a grant to study it and USDA produced a document on its benefits. Jean also suggested that the group ask NRCS to require data sharing as part of the federal Environmental Quality Incentives Program (EQIP). A member said that EQIP is already doing this as it requires a number of years of soil sampling and the data is shared with NRCS. Jean suggested asking NRCS to share this information with the GWMA and its successor agency. Jean added the following suggestions: 1) encourage the use of soil moisture sensors with data sharing; 2) impose a government tax on the synthetic fertilizer industry in order to provide a vehicle to collect data; 3) place a sticker on fertilizer bags to encourage people to apply it at agronomic rates; 4) improve composting regulations (Jean proposed that the GWAC look at this and make proposals); 5) implement a bonding requirement for operations that pose a higher risk to groundwater in order to assure the public that it will be protected by providing funds for cleanup; 6) tap into the checkoff dollars available through commodity checkoff programs for research and development (Jean recommended Steve George as an expert on the topic); and, 7) Jean looked at several hypothetical models of a dairy in order to focus on their potential to pollute. She named several routes that other states or counties had implemented to address this including both health and zoning ordinances.

The group was invited to comment or ask questions on the presentation. One member stated that the Irrigated Ag group had a discussion on taxing commercial fertilizer but had concluded that nothing prevented a farmer from bringing in fertilizer from a neighboring county or state. He also stated that most vendors supply a spreader and written information on how to apply at an agronomic rate. Jean said that she had been thinking more of the average buyer. Another member indicated that while he thought the idea of soil moisture management was good the group would be better served by going after the conversion of rill irrigation to other types and thought perhaps this could be coupled with a soil moisture sensor requirement. Troy Peters agreed that this would be a good effort and noted it is impossible to use rill irrigation and not leach. The member stated that funding assistance was now focused elsewhere and believed the GWMA should push for its return. Laurie Crowe agreed and stated it was the biggest issue for SYCD last year. Vern recalled that Irrigated Ag had discussed that some crops grow better with rill irrigation. Troy agreed that mint and sometimes corn do, but great yields can also be attained with pivots. A member said the biggest resistance comes from the organic farming community because weed distribution tends to follow the rill making it easier to stay away from chemical weed killers. Troy emphasized that there is a great need for funding for the equipment. A member agreed that this should be included in the GWMA's suggestions.

A member asked Vern if the County had found anything good when it looked at the possibility of bio-char. Jean thought one of the determinations had been that it might not be cost effective. Troy Peters stated that while bio-char is good for the soil, the amount one would need would be so big it would be very expensive to be effective. Vern believed that the County had investigated bio-char as a way to get rid of organics and burnable material which would result in reduced deposits to the landfill. He also remembered that it would burn up to 50 to 60 percent of the moisture which would be helpful as it relates to manure but he didn't remember all of the details. He did not remember whether it was economically viable and would have to look into it. A member indicated that Dr. Black of Heritage College had looked into it. Another member asked if the furnaces would be portable which he thought would be important. Jean thought so and said that WSDA had a handout on it. Vern thanked Jean and the group for their input and thought there may or may not be other great ideas out there that the group had not yet talked about.

VII. Working Group Reports to the GWAC: Vern asked Jim Davenport to update the group. Jim stated that when the reports are received from the working groups groups they will be combined. He has looked at two – RCIM is almost done and Livestock/CAFO has been completed and was forwarded to him. Between the two there were approximately 30 to 40 recommendations; more were anticipated from Irrigated Ag. Once the reports and recommendations are combined they will be brought to this group to ask – "are all of the good ideas here or are there others, what is the feasibility and can they be implemented (including cost)." He hoped to have everything to the GWAC in June or July. Vern believed that additional recommendations might arise in this process. He asked if the group had any questions or comments. A member asked if a small group needed to talk about local ordinances and a great deal of discussion ensued. Some members thought that it was important to identify recommendations before discussing implementation. Vern pointed out, however, that the working groups had already looked at management strategies and made their recommendations so he believed implementation was an appropriate topic to discuss. Other members returned to the member's question and thought that voluntary programs had been highly successful and regulatory measures were not needed. They felt that the goal should be to change attitudes/practices through positive incentives and that ordinances would only increase the need for a policing effort. Another member suggested that it would be most appropriate for the Regulatory Working Group to look at what ordinances are already in effect in Yakima County, if they could be tweaked and those in effect in other counties. Other members agreed.

VIII. Committee Business: The April 20, 2017 meeting summary was approved as presented.

IX. Public Comment: There were no public comments. The meeting adjourned at 6:55 PM.

X. Next Meeting: June 15, 2017.

XI. Next Steps: 1) Yakima County Support staff will send a notice inviting GWAC members and their alternates to the first Funding Working Group meeting scheduled for Wednesday, June 14 at the Yakima County Courthouse, 10:00 AM to Noon. Members should RSVP to the invitation. 2) Vern will have the Irrigated Crops N Mass Balance Table that Perry Beale distributed at the joint NAA working group meeting emailed to the group and posted with the other NAA reference documents.

XII. Meeting Summary approved by the GWAC on June 29, 2017.

YAKIMA VALLEY GROUNDWATER MANAGEMENT AREA ADVISORY COMMITTEE (GWAC)

MEETING SUMMARY

Thursday, June 29, 2017 – 5:00 p.m. – 7:00 p.m.

Radio KDNA Conference Rooms 1-2
121 Sunnyside Avenue, Granger, WA 98932

Note: This document is only a summary of issues and actions of this meeting. It is not intended to be a transcription of the meeting, but an overview of points raised and responses from Yakima County and Groundwater Advisory Committee members. It may not fully represent the ideas discussed or opinions given. Examination of this document cannot equal or replace attendance.

I. Call to Order: This meeting was called to order at 5:01 PM by Vern Redifer, Facilitator.

Member	Seat	Present	Absent
Stuart Turner	Agronomist, Turner and Co.,	✓	
Chelsea Durfey			✓
Bud Rogers	Lower Valley Community Representative Position 1	✓	
Kathleen Rogers	Lower Valley Community Representative Position 1 (alternate)	✓	
Patricia Newhouse	Lower Valley Community Representative Position 2		✓
Sue Wedam	Lower Valley Community Representative Position 2 (alternate)	✓	
Doug Simpson	Irrigated Crop Producer		✓
Jean Mendoza	Friends of Toppenish Creek	✓	
Eric Anderson	Friends of Toppenish Creek (alternate)		✓
Jan Whitefoot	Concerned Citizens of the Yakama Reservation		✓
Jim Dyjak	Concerned Citizens of the Yakama Reservation (alternate)	✓	
Steve George	Yakima County Farm Bureau	✓	
Frank Lyall	Yakima County Farm Bureau (alternate)	✓	
Jason Sheehan	Yakima Dairy Federation	✓	
Dan DeGroot	Yakima Dairy Federation (alternate)	✓	
Ron Cowin	Roza-Sunnyside Joint Board of Control	✓	
	Roza-Sunnyside Joint Board of Control (alternate)		
Laurie Crowe	South Yakima Conservation District		✓

Robert Farrell	Port of Sunnyside		✓
John Van Wingerden	Port of Sunnyside (alternate)	✓	
Rand Elliott	Yakima County Board of Commissioners	✓	
Vern Redifer	Yakima County Board of Commissioners (alternate)	✓	
Dave Cole	Yakima Health District		✓
Ryan Ibach	Yakima Health District (alternate)	✓	
Dr. Troy Peters	WSU Irrigated Agriculture Research and Extension Center	✓	
Lucy Edmondson	U.S. Environmental Protection Agency	✓	
Nick Peak	U.S. Environmental Protection Agency (alternate)		✓
Elizabeth Sanchey	Yakama Nation		✓
Stuart Crane	Yakama Nation (alternate)	✓	
Virginia "Ginny" Prest	WA Department of Agriculture	✓	
Jaclyn Hancock	WA Department of Agriculture (alternate)		✓
Andy Cervantes	WA Department of Health	✓	
Sheryl Howe	WA Department of Health (alternate)		✓
David Bowen	WA Department of Ecology		✓
Sage Park	WA Department of Ecology	✓	
Lino Guerra	Hispanic Community Representative		✓
Rick Perez	Hispanic Community Representative (alternate)		✓
Jessica Black	Heritage University		✓
Matt Bachmann	USGS	✓	

II. Welcome, Meeting Overview and Introductions: Everyone introduced themselves. Vern reviewed the agenda – there were no additions. The group paused for a moment of silence.

III. Working Group Reports:

Data Collection: Melanie stated her group had worked through their assignments and she had nothing to report. Vern asked about data analysis. Melanie said that would be coming to the group soon.

Livestock/CAFO: Sage Park reported for David Bowen. The group's final report had been submitted to Jim Davenport.

Irrigated Ag: Troy indicated that the group was in a holding pattern.

RCIM: Dan DeGroot said his group met June 12. As a result of the recommendation made in the Nitrogen Availability Assessment (NAA) that extreme care is necessary when comparing onsite sewage system (OSS) discharges with discharges from a cropping system, RCIM Working Group members wanted to emphasize the impact of future increased density of OSS on the aquifer and pointed out that if no action is taken with present OSS regulations, the nitrogen load and nitrate contamination will increase, especially in high-density areas connected to residential onsite sewage systems. The group recommended that when the monitoring system is installed at least two wells should be devoted to the UGA (where high density OSS exists). One well should be placed in a shallow aquifer and one in a deeper aquifer for comparison to surrounding land uses. Dan added that the report and recommendations from RCIM was finalized subject to comments from the GWAC; therefore, no further working group meetings were anticipated at this time. A member stated that he had yet to see proof that a high density of OSS increase nitrates in the groundwater especially since the amount leaked was far less than any dairy. He was also concerned that any laymen reading the report would think OSS were contaminating their drinking water. Several members responded and Vern summarized the RCIM comments by stating that if building increased in the Lower Valley thus increasing the number of OSS, the amount of nitrogen from OSS would increase if nothing was done about its contribution (which is designed to leach to the aquifer). Another member added that engineers have confirmed this. A member asked if the NAA addresses this – Vern said yes.

Regulatory Framework: Jean reported that her group met last month and reviewed an analysis of Yakima County ordinances that address nitrates in groundwater from agricultural sources, the Growth Management Act and the County's involvement in the Voluntary Stewardship Program (VSP). Jean provided an overview of what the VSP would mean to the County. In addition the group reviewed Yakima County's Conditional Use permitting process and looked specifically at two CAFO permits. Jean stated that the group found areas that could be improved, noting that Yakima County was not allowed to see the CAFO's Dairy Nutrient Management Plan. Jean stated that the group more or less agreed upon Yakima County and the South Yakima Conservation District (SYCD) working more closely on this. Jean added that the group agreed that the majority of manure regulations are directed at dairies and that there was much less regulation of synthetic fertilizer. The group had learned that Maryland does have regulations on synthetic fertilizers. A member said the Regulatory meeting summary stated that SYCD would set up a tour of a dairy for the Yakima County Planning Department and stated that he hoped they would be visiting a "dirty" dairy not one that was being showcased.

EPO: Lisa Freund said Melanie Redding attended the group's June meeting in order to communicate her committee's needs for short and long-term messaging. Lisa noted that any messaging for the Data Collections group on matters like the NAA would be approved by the GWAC first. Lisa added that it was important for EPO to receive specific messages from the GWAC and that EPO was fully aware of the work they would be doing as the program moved to completion. A member complimented Lisa and the EPO Working Group. He felt that their efforts to get the message out to everyone went above and beyond expectation and wondered if the billboards would come down when the contract ended. Lisa affirmed that the billboards were only under contract for the length of the GWAC and acknowledged the volunteer efforts of many members of her working group. Another member said that in her opinion a huge amount of work was left to be done to reach Spanish speaking people and those less educated in the Lower Valley.

Funding: Vern stated that the group had met in June and he was appointed chairman. The purpose of the first meeting was to brainstorm, organize and to discuss the group's purpose and goal which was to look at the suggested alternative programs in order to determine their costs so that funding sources could be sought. The group also discussed an effort to continue the work of the GWMA at the local level, a forum to evaluate progress and a forum to collect and monitor data. One thought was that the lead entity could be Yakima County – Vern had agreed to attempt to determine this cost. Discussion also included an additional concerned citizens group or steering, executive or listening committee, but these decisions would be dependent on understanding the GWAC's recommendations of alternatives. Finally, Vern stated the group changed its meeting schedule and would now meet on the 2nd Wednesday of each month from 5:00-7:30 PM at the Department of Ecology (next meeting date is July 12). A member asked Vern to explain what an aquifer protection area was. Vern stated that the Revised Code of Washington allowed for a geographic area to be defined as an aquifer protection area and an additional property tax to be levied to provide funding for the protection of that area. He noted that the Commissioners cannot create this tax by themselves, the people in that area must approve it by a majority vote. Vern said that this was a tool for funding that the group could consider.

IV. Sources of Nitrogen – Consolidated Report: Jim stated that the report had been provided to the group for their review prior to its inclusion in the program and noted that the RCIM and Livestock/CAFO Working Groups had reviewed their portion of this report; Irrigated Ag had not. Jim stated that if members wanted to edit or change any portions of the report the comments or edits needed to be turned in to him in the next two weeks (by July 13).

Lucy Edmondson (EPA) asked if the group would be discussing the Nitrogen Availability Assessment. Vern said no; but he hoped to have the discussion in a July meeting. Vern went on to say that the Department of Agriculture (WSDA) had finished their review of comments, but he had not completed the review of comments made to the RCIM piece as he had been on vacation. A member wanted to know how many hours a week the WSDA and Yakima County were spending reviewing member comments. Several members of the WSDA related that a number of staff were involved and it would be hard to estimate the number of hours. All parties acknowledged the review had not been put on the back burner. Lucy noted that EPA had some concerns with how the document will continue to develop as they have more data. Vern stated that he had participated in a demonstration of the GIS application and it was ready to go. He directed Lucy to provide the EPA data to the Department of Agriculture. Lucy added that she appreciated the document was designed to be living and could be updated. She said that it was unclear what kind of QAPP had been used and thought WSDA could look to Ecology or EPA for an example. Lucy added that she thought the group should look at the additional data on dairies available on the EPA website. She also thought it would be good to look at post-harvest deep soil samples and she encouraged WSDA also to look at some interesting research on soil organic matter which was going on at the University of Idaho – Ralph Fisher is the contact person. Another member was concerned that the Irrigated Ag Working Group had not had an opportunity to address the NAA as other working groups had. After some discussion it was agreed to schedule a meeting of this working group.

V. Alternative Land and Water Use Management Strategies for Reaching Program Goals and Objectives per WAC 173-100-100(4): Jim Davenport asked the group to look at this spreadsheet and explained that WAC 173-100-100(4) required that the group compile a list of alternative management strategies and consider them in light of the criteria found in the WAC, e.g., feasibility, effectiveness, cost, proposed funding, time difficulty to implement and degree of consistency with local comprehensive plans and water management programs) in order to cut the list down. Jim explained that the list included recommendations made by working groups (noted by specific working group), suggestions made during working group discussions that had not been decided upon ("WGD") and from literature reviews done by Jim ("literature") then organized by category. Jim's goal was for the group to review and reduce the list by 25 to 50 percent by the next meeting. Sage asked what criteria determines "good." Jim stated that the criteria outlined in the WAC appeared in the top line across the chart, but acknowledged that individuals might have their own criteria as well – for example, a member may not desire to see regulatory alternatives or criteria may be based on cost effectiveness. Jim said that some criteria will be subjective and some will be objective and also stated that the group might decide to change the language of suggested alternatives. Sage also asked if the group should first look at the list without looking at the criteria. Jim said yes, but if a member had information that fit into a criteria category it would be helpful. Vern believed the review of the alternatives should be intuitive – some ideas aren't practical, or some just seem good. Another member pointed out that some of the alternatives could be consolidated and that some of the groups represented at the table (like the Health District or WSDA) would be able to indicate if the alternative was already covered based on their knowledge. A member asked that the list of BMPs the Irrigated Ag and Livestock/CAFO group reviewed be sent out to the group.

After a great deal of discussion on how the group could best proceed with its evaluation of the list it was agreed that Ginny Prest would create a survey monkey poll for primary members (or their alternates but only one response could be made from each group), where they could enter "yes", "no" (and comment why) or "maybe" for each alternative. Each member was encouraged to work their way through the list prior to the availability of the survey monkey poll in order to accommodate for the short turn around as the group desired that the results of the poll be available for its next meeting on July 13. Ginny will rank the responses by category.

A member stated that some objectives focused on health issues and not the purpose of the GWMA to reduce nitrate contamination concentration in groundwater below state drinking water standards. He wondered if those should be eliminated because they don't address the goal. Vern thought that the group should go through the list without regard to the goal; then the revised list could be categorized at a later date. A member thought that if the program addressed both goals it would be appropriate for the the alternatives to do so as well. Another member wondered when the group would see area characterization. Jim Davenport said that the document had come to the GWAC several months ago and included everything he could find from the EPA, the Department of Ecology and USGS. The goal now was to have Matt Bachmann refine it before finalizing its placement in the program. Another member asked if it would include the history Laurie Crowe had put together. Vern said that it was his goal to give the group portions of the program in the ensuing months as it must be completed by September.

VI. Committee Business: The May 18, 2017 meeting summary was approved as presented. The group also reviewed the meeting schedule which had been updated because of the amount of work the group had to do.

VII. Public Comment: A member stated that he opposed regulation of agriculture because he feared the inevitable result would be a choice for large corporate farms over small farms because the tendency of people determining policy was to pay more attention to businesses with money. A member thanked Yakima County Support Staff for their work and another member acknowledged those who were lending their expertise to the group and thanked them for their time on this huge effort. The meeting adjourned at 6:55 PM.

VIII. Next Meeting: July 13, 2017.

IX. Next Steps: 1) Member edits, comments or changes to the Sources of Nitrogen – Consolidated Report need to be to Jim Davenport in the next two weeks (by July 13). 2) A member asked that the list of BMPs the Irrigated Ag and Livestock/CAFO group reviewed be sent out to the group. 3) Ginny Prest will create a survey monkey poll for primary members (or their alternates but only one representative from each group) where they could enter "yes", "no (and comment why)" or "maybe" for each alternative. The results of the poll will be available for its next meeting on July 13. Ginny will rank the responses by category.

X. Meeting Summary approved by the GWAC on ______________________________.

LOWER YAKIMA VALLEY

GROUNDWATER
ADVISORY
COMMITTEE

Groundwater Management Area (GWMA):
The purpose of the GWMA is to reduce nitrate contamination concentrations in groundwater below state drinking water standards

Meeting Time and Location

Thursday, April 20, 2017 5:00 p.m. – 7:00 p.m.

Denny Blaine Board Room
810 East Custer Avenue
Sunnyside, WA 98944

Agenda

Time	Topic	
5:00 – 5:10 p.m.	Welcome, Meeting Overview and Introductions: • Committee members • Others attending the meeting	Vern Redifer, Facilitator
5:10 – 5:30 p.m.	Nitrogen Loading Assessment • Review of Joint Meeting • Comment due date: April 28	Vern
5:30 – 6:20 p.m.	Working Group Reports • Data Collection • Livestock/CAFO • IAWG • RCIM • Regulatory Framework • EPO	 Melanie Redding David Bowen Troy Peters Dan DeGroot Jean Mendoza Lisa Freund
6:20 – 6:45 p.m.	Where We're Going from Here	Vern, Jim Davenport
6:45 – 6:50 p.m.	Approve the February 16, 2017 GWAC Meeting Summary	Vern

6:50 – 6:55 p.m.	Public Comment
7:00 p.m.	Adjourn

Committee Members

Stuart Turner, agronomist, Chelsea Durfey (alternate)	Turner and Co.
Bud Rogers, Kathleen Rogers (alternate)	Lower Valley Community Representative Position 1
Patricia Newhouse, Sue Wedam (alternate)	Lower Valley Community Representative Position 2
Doug Simpson	Irrigated Crop Producer
Dr. Jessica Black	Heritage University
Jean Mendoza, Eric Anderson (alternate)	Friends of Toppenish Creek
Jan Whitefoot, Jim Dyjak (alternate)	Concerned Citizens of the Yakama Reservation
Steve George, Frank Lyall (alternate)	Yakima County Farm Bureau
Jason Sheehan, Dan DeGroot (alternate)	Yakima Dairy Federation
Ron Cowin	Sunnyside-Roza Joint Board of Control
Laurie Crowe	South Yakima Conservation District
Robert Farrell, John Van Wingerden (alternate)	Port of Sunnyside
Rand Elliott, Vern Redifer (alternate)	Yakima County Commission
Dave Cole, Ryan Ibach (alternate)	Yakima Health District
Dr. Troy Peters	WSU Irrigated Agriculture Research and Extension Center
Lucy Edmondson, Peter Contreras (alternate)	U.S. Environmental Protection Agency
Elizabeth Sanchey, Stuart Crane (alternate)	Yakama Nation
Virginia "Ginny" Prest Jaclyn Hancock (alternate)	Washington Department of Agriculture
Andy Cervantes, Sheryl Howe (alternate)	Washington Department of Health
David Bowen, Sage Park (alternate)	Washington Department of Ecology
Lino Guerra, Rick Perez (alternate)	Hispanic Community Representative
Matt Bachmann	U.S. Geological Survey

Committee Ground Rules:

- Come to committee meetings prepared
- Treat one another with civility
- Respect each other's perspectives
- Listen actively
- Participate actively
- Honor time frames
- Silence electronic devices during meetings
- Speak from interests, not positions.

2017 Meeting Dates:

February 16	July 20	October 19
April 20	August 17	November 16
May 18	September 21	December 21
June 15		

Meeting Materials:

Name	Date Provided	From
2017_02_16 GWAC Meeting Draft Summary	2/23/2017 & 4/14/2017	lisa.freund@co.yakima.wa.us
Meeting Agenda	4/14/2017	lisa.freund@co.yakima.wa.us
EPO Working Group Meeting Summaries of March 15 and April 5, 2017	4/14/2017	lisa.freund@co.yakima.wa.us
Data Collection Working Group Meeting Summary of February 22, 2017	4/14/2017	lisa.freund@co.yakima.wa.us
Livestock/CAFO Working Group Meeting Summary of March 2, 2017	4/14/2017	lisa.freund@co.yakima.wa.us
IAWG Working Group Meeting Summary of February 21, 2017	4/14/2017	lisa.freund@co.yakima.wa.us
Regulatory Framework Working Group Meeting Summary of February 23, 2017	4/14/2017	lisa.freund@co.yakima.wa.us
RCIM Working Group Meeting Summaries of February 13 and March 13, 2017	4/14/2017	lisa.freund@co.yakima.wa.us
EPO Questionnaire Summary	4/14/2017	lisa.freund@co.yakima.wa.us

Affidavit of Publication

Yakima County
Notice of Public Meeting
Lower Yakima Valley
Groundwater Advisory
Committee
NOTICE IS HEREBY GIVEN that Yakima County is holding a public meeting of the Lower Yakima Valley Groundwater Advisory Committee on **Thursday, April 20, 2017, at 5:00 PM at Denny Blaine Boardroom, Sunnyside School District No. 201, 810 E. Custer, Sunnyside, WA 98944** pursuant to Chapter 173-100-080 WAC Ground Water Management Areas and Programs.

For Additional Information
To learn more about the Lower Yakima Valley Groundwater Management Area, the Groundwater Advisory Committee, and its goals and objectives, please see the Lower Yakima Valley Groundwater Management Area on the County webpage at: http://www.yakimacounty.us/gwma/

For more information about the meeting, please contact Lisa Freund, Yakima County Public Services Administrative Manager at 574-2300.

If you are a person with a disability who needs any accommodation in order to participate in this program, you may be entitled to receive certain assistance at no cost to you. Please contact the ADA Coordinator at Yakima County no later than forty-eight (48) hours prior to the date service is needed.
Yakima County ADA Coordinator
128 N. 2nd Street, Room B27
Yakima, WA 98901
(509) 574-2210
7-1-1 or 1-800-833-6384 (Washington Relay Services for deaf and hard of hearing)
Dated this **Thursday, April 6, 2017**
PUBLISH: DAILY SUN NEWS
April 12, 2017.

STATE OF WASHINGTON
ss.
County of Yakima

Roger Harnack, being first duly sworn on oath deposes and says that he is the Publisher of the DAILY SUN NEWS, a daily newspaper.

That said newspaper is a legal newspaper and it is now and has been for more than six months prior to the date of publications hereinafter referred to, published in the English language continually as a daily newspaper in the city of Sunnyside, YAKIMA County, Washington, and it is now and during all of said time printed in an office maintained at the afforesaid place of publication of said newspaper, and that the said Daily Sun News was on the 4th Day of April, 1969 approved as a legal newspaper by the Superior Court of said Yakima County.

That the annexed is a true copy of a LEGAL PUBLICATION - Yakima Co. Public Services
FC3463-100-120

published in regular issues (and not in supplemental forms) of said newspaper once each week for a period of 1 consecutive issue(s) commencing 04/12/17 and ending on 04/12/17, both dates inclusive, and that such newspaper was regularly distributed to its subscribers during all of said period. That the full amount of the fee charged for the foregoing publication is the sum of $52.50, amount has been paid in full, at the rate of $7.50 per column inch per insertion.

Subscribed and sworn to before me 04/12/17

Notary Public in and for the State of Washington

041206-00000

DEBBIE GUERRERO
COMMISSION EXPIRES
NOTARY
PUBLIC
JUNE 17, 2020
STATE OF WASHINGTON

YAKIMA HERALD REPUBLIC

Affidavit of Publication

STATE OF WASHINGTON,)
)
COUNTY OF YAKIMA)

Danielle Rogers, being first duly sworn on oath deposes and says that she/he is the Accounting clerk of Yakima Herald-Republic, Inc., a daily newspaper. Said newspaper is a legal newspaper approved by the Superior Court of the State of Washington for Yakima County under an order made and entered on the 13th day of February, 1968, and it is now and has been for more than six months prior to the date of publication hereinafter referred to, published in the English language continually as a daily newspaper in Yakima, Yakima County, Washington. Said newspaper is now and has been during all of said time printed in an office maintained at the aforesaid place of publication of said newspaper.

That the annexed is a true copy of a:
Yakima County Notice of Public Meeti

it was published in regular issues (and not in supplement form) of said newspaper once each day and for a period of 1 times, the first insertion being on 04/12/2017 and the last insertion being on 04/12/2017

Yakima Herald-Republic 04/12/17
YakimaHerald.com 04/12/17

and the such newspaper was regularly distributed to its subscribers during all of the said period. That the full amount of the fee charged for the foregoing publication is the sum of $116.16

Danielle Re

Accounting Clerk

LISA M DRIPPS NOTARY My Comm. Expires April 05, 2021 PUBLIC STATE OF WASHINGTON

Sworn to before me this 12th day of, April 2017

Lisa M. Dripps

Notary Public in and for the
State of Washington,
residing at Yakima

Yakima County

**Notice of Public Meeting
Lower Yakima Valley
Groundwater Advisory
Committee**

NOTICE IS HEREBY GIVEN that Yakima County is holding a public meeting of the Lower Yakima Valley Groundwater Advisory Committee on **Thursday, April 20, 2017, at 5:00 PM at Denny Blaine Boardroom, Sunnyside School District No. 201, 810 E. Custer, Sunnyside, WA 98944** pursuant to Chapter 173-100-080 WAC Ground Water Management Areas and Programs.

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Yakima, WA 98901
(509) 574-2210
7-1-1 or 1-800-833-6384
(Washington Relay Services for deaf and hard of hearing)

Dated this **Thursday, April 6, 2017**

(724683) April 12, 2017

LOWER YAKIMA VALLEY

GROUNDWATER
ADVISORY
COMMITTEE

Groundwater Management Area (GWMA):
The purpose of the GWMA is to reduce nitrate contamination concentrations in groundwater below state drinking water standards

Meeting Time and Location

Thursday, May 18, 2017 5:00 p.m. – 7:00 p.m.

Denny Blaine Board Room
810 East Custer Avenue
Sunnyside, WA 98944

Agenda

Time	Topic	
5:00 – 5:10 p.m.	Welcome, Meeting Overview and Introductions: • Committee members • Others attending the meeting	Vern Redifer, Facilitator
5:10 – 5:30 p.m.	Working Group Reports • Data Collection • Livestock/CAFO • IAWG • RCIM • Regulatory Framework • EPO	 Melanie Redding David Bowen Troy Peters Dan DeGroot Jean Mendoza Lisa Freund
5:30 – 5:40 p.m.	Well Monitoring Progress Report	Matt Bachmann
5:40 – 6:15 p.m.	Discuss the Nitrogen Availability Asssessment	Vern Redifer
6:15 – 6:45 p.m.	Alternative Management Strategies	Jean Mendoza
6:45 – 6:50 p.m.	Approve the April 20, 2017 GWAC Meeting Summary	Vern

6:50 – 6:55 p.m.	Public Comment
7:00 p.m.	Adjourn

Committee Members

Stuart Turner, agronomist, Chelsea Durfey (alternate)	Turner and Co.
Bud Rogers, Kathleen Rogers (alternate)	Lower Valley Community Representative Position 1
Patricia Newhouse, Sue Wedam (alternate)	Lower Valley Community Representative Position 2
Doug Simpson	Irrigated Crop Producer
Dr. Jessica Black	Heritage University
Jean Mendoza, Eric Anderson (alternate)	Friends of Toppenish Creek
Jan Whitefoot, Jim Dyjak (alternate)	Concerned Citizens of the Yakama Reservation
Steve George, Frank Lyall (alternate)	Yakima County Farm Bureau
Jason Sheehan, Dan DeGroot (alternate)	Yakima Dairy Federation
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Robert Farrell, John Van Wingerden (alternate)	Port of Sunnyside
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2017 Meeting Dates:

February 16	July 20	October 19
April 20	August 17	November 16
May 18	September 21	December 21
June 15		

Meeting Materials:

Name	Date Provided	From
2017_04_20 GWAC Meeting Draft Summary	4/25/2017 & 5/11/2017	lisa.freund@co.yakima.wa.us
Meeting Agenda	5/11/2017	lisa.freund@co.yakima.wa.us
Joint Nitrogen Loading Assessment Working Group Meeting Summary of April 13, 2017	5/11/2017	lisa.freund@co.yakima.wa.us
Data Collection Working Group Meeting Summary of May 11, 2017 (still in draft)	N/A	lisa.freund@co.yakima.wa.us
Livestock/CAFO Working Group Meeting Summary of May 4, 2017	5/11/2017	lisa.freund@co.yakima.wa.us
IAWG Working Group Meeting Summary of March 21, 2017	5/11/2017	lisa.freund@co.yakima.wa.us
Regulatory Framework Working Group Meeting Summary of March 22, 2017 Regulatory Framework Working Group Meeting Summary of May 10, 2017	5/11/2017 At Table	lisa.freund@co.yakima.wa.us
RCIM and EPO did not meet in May	N/A	lisa.freund@co.yakima.wa.us
Alternative Management Strategies to Reduce Nitrate in Groundwater (PowerPoint Presentation)	5/11/2017	lisa.freund@co.yakima.wa.us

Yakima County
Notice of Public Meeting
Lower Yakima Valley
Groundwater Advisory
Committee
NOTICE IS HEREBY GIVEN that Yakima County is holding a public meeting of the Lower Yakima Valley Groundwater Advisory Committee on Thursday, May 18, 2017, at 5:00 PM at Denny Blaine Boardroom, Sunnyside School District No. 201, 810 E. Custer, Sunnyside, WA 98944 pursuant to Chapter 173-100-080 WAC Ground Water Management Areas and Programs. **For Additional Information**
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128 N. 2nd Street, Room B27
Yakima, WA 98901
(509) 574-2210
7-1-1 or 1-800-833-6384
(Washington Relay Services for deaf and hard of hearing)
Dated this Thursday, May 4, 2017
PUBLISH: DAILY SUN NEWS
May 10, 2017

Affidavit of Publication

STATE OF WASHINGTON
ss.
County of Yakima

Roger Harnack, being first duly sworn on oath deposes and says that he is the Publisher of the DAILY SUN NEWS, a daily newspaper.

That said newspaper is a legal newspaper and it is now and has been for more than six months prior to the date of publications hereinafter referred to, published in the English language continually as a daily newspaper in the city of Sunnyside, YAKIMA County, Washington, and it is now and during all of said time printed in an office maintained at the afforesaid place of publication of said newspaper, and that the said Daily Sun News was on the 4th Day of April, 1969 approved as a legal newspaper by the Superior Court of said Yakima County.

That the annexed is a true copy of a LEGAL PUBLICATION
Yakima County Public Services
FC3463-100-120 yAK COUNT

published in regular issues (and not in supplemental forms) of said newspaper once each week for a period of 1 consecutive issue(s) commencing 05/10/17 and ending on 05/10/17, both dates inclusive, and that such newspaper was regularly distributed to its subscribers during all of said period. That the full amount of the fee charged for the foregoing publication is the sum of $52.50, amount has been paid in full, at the rate of $7.50 per column inch per insertion.

Subscribed and sworn to before me 05/10/17

Notary Public in and for the State of Washington

030110-00000

DEBBIE GUERRERO
COMMISSION EXPIRES
NOTARY PUBLIC
JUNE 17, 2020
STATE OF WASHINGTON

YAKIMA HERALD REPUBLIC

Affidavit of Publication

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)
COUNTY OF YAKIMA)

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Yakima Herald-Republic 05/10/17
YakimaHerald.com 05/10/17

and the such newspaper was regularly distributed to its subscribers during all of the said period. That the full amount of the fee charged for the foregoing publication is the sum of $116.16

Accounting Clerk

LISA M DRIPPS
NOTARY
My Comm. Expires
April 05, 2021
PUBLIC
STATE OF WASHINGTON

Sworn to before me this 10th day of, May 2017

Lisa M Dripps

Notary Public in and for the
State of Washington,
residing at Yakima

Yakima County

Notice of Public Meeting Lower Yakima Valley Groundwater Advisory Committee

NOTICE IS HEREBY GIVEN that Yakima County is holding a public meeting of the Lower Yakima Valley Groundwater Advisory Committee on **Thursday, May 18, 2017, at 5:00 PM at Denny Blaine Boardroom, Sunnyside School District No. 201, 810 E. Custer, Sunnyside, WA 98944** pursuant to Chapter 173-100-080 WAC Ground Water Management Areas and Programs.

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Yakima, WA 98901
(509) 574-2210
7-1-1 or 1-800-833-6384
(Washington Relay Services for deaf and hard of hearing)

Dated this **Thursday, May 4, 2017**

(731309) May 10, 2017

LOWER YAKIMA VALLEY

GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA):
The purpose of the GWMA is to reduce nitrate contamination concentrations in groundwater below state drinking water standards

Meeting Time and Location

Thursday, June 29, 2017 5:00 p.m. – 7:00 p.m.

Radio KDNA Conference Rooms 1-2
121 Sunnyside Avenue
Granger, WA 98932

Agenda

Time	*Topic*	
5:00 – 5:10 p.m.	Welcome, Meeting Overview and Introductions: • Committee members • Others attending the meeting	Vern Redifer, Facilitator
5:10 – 5:30 p.m.	Working Group Reports • Data Collection • Livestock/CAFO • IAWG • RCIM • Regulatory Framework • EPO • Funding	 Melanie Redding David Bowen Troy Peters Dan DeGroot Jean Mendoza Lisa Freund Vern Redifer
5:30 – 5:50 p.m.	Sources of Nitrogen – Consolidated Report	Jim Davenport
5:50 – 5:55 p.m.	Break	
5:55 – 6:45 p.m.	Alternative Land and Water Use Management Strategies for Reaching Program Goals and Objectives per WAC 173-100-100(4) • Review • Discuss	Jim Davenport
6:45 – 6:50 p.m.	• Approve the May 18, 2017 GWAC Meeting Summary	Vern

Time	Topic
	• Review the updated GWAC Meeting Schedule and Locations
6:50 – 6:55 p.m.	Public Comment
7:00 p.m.	Adjourn

Committee Members

Stuart Turner, agronomist, Chelsea Durfey (alternate)	Turner and Co.
Bud Rogers, Kathleen Rogers (alternate)	Lower Valley Community Representative Position 1
Patricia Newhouse, Sue Wedam (alternate)	Lower Valley Community Representative Position 2
Doug Simpson	Irrigated Crop Producer
Dr. Jessica Black	Heritage University
Jean Mendoza, Eric Anderson (alternate)	Friends of Toppenish Creek
Jan Whitefoot, Jim Dyjak (alternate)	Concerned Citizens of the Yakama Reservation
Steve George, Frank Lyall (alternate)	Yakima County Farm Bureau
Jason Sheehan, Dan DeGroot (alternate)	Yakima Dairy Federation
Ron Cowin	Sunnyside-Roza Joint Board of Control
Laurie Crowe	South Yakima Conservation District
Robert Farrell, John Van Wingerden (alternate)	Port of Sunnyside
Rand Elliott, Vern Redifer (alternate)	Yakima County Commission
Dave Cole, Ryan Ibach (alternate)	Yakima Health District
Dr. Troy Peters	WSU Irrigated Agriculture Research and Extension Center
Lucy Edmondson, Nick Peak (alternate)	U.S. Environmental Protection Agency
Elizabeth Sanchey, Stuart Crane (alternate)	Yakama Nation
Virginia "Ginny" Prest Jaclyn Hancock (alternate)	Washington Department of Agriculture
Andy Cervantes, Sheryl Howe (alternate)	Washington Department of Health
David Bowen, Sage Park (alternate)	Washington Department of Ecology
Lino Guerra, Rick Perez (alternate)	Hispanic Community Representative

Matt Bachmann	U.S. Geological Survey

Committee Ground Rules:

- Come to committee meetings prepared
- Treat one another with civility
- Respect each other's perspectives
- Listen actively
- Participate actively
- Honor time frames
- Silence electronic devices during meetings
- Speak from interests, not positions.

2017 Meeting Dates:

(Red text reflects new meeting dates)

February 16
April 20
May 18
~~June 15~~
June 29

July 13
~~July 20~~
July 27
August 10
~~August 17~~
August 24

September 7
September 21
October 19
November 16
December 21

Meeting Materials:

Name	Date Provided	From
2017_05_18 GWAC Meeting Draft Summary	5/24/2017 & 6/22/2017	lisa.freund@co.yakima.wa.us
Meeting Agenda	6/22/2017	lisa.freund@co.yakima.wa.us
EPO Working Group Meeting Summary of June 7, 2017	6/22/2017	lisa.freund@co.yakima.wa.us
Data Collection Working Group Meeting Summary of May 11, 2017	6/22/2017	lisa.freund@co.yakima.wa.us
RCIM Working Group Meeting Summary of June 12, 2017	6/22/2017	lisa.freund@co.yakima.wa.us
Regulatory Framework Working Group Meeting Summary of June 14, 2017	6/22/2017	lisa.freund@co.yakima.wa.us
Funding Working Group Meeting Summary of June 14, 2017	6/22/2017	lisa.freund@co.yakima.wa.us
The IAWG and Livestock/CAFO Working Groups did not meet	N/A	N/A
Sources of Nitrogen – Consolidated Report	6/22/2017	lisa.freund@co.yakima.wa.us
Alternative land and water use management strategies for reaching program goals and objectives per WAC 173-100-100(4)	6/22/2017	lisa.freund@co.yakima.wa.us
Jean Mendoza - recommendations for outreach: Español – 1) Cuales son Agronomic Rates; 2) Sobre Nitratos; 3)Cual es al diferencia EPA y Ecologia; and 4) Research (Long List) of Health Problems Related to Nitrates	6/22/2017	lisa.freund@co.yakima.wa.us

Affidavit of Publication

Yakima County
Notice of Public Meeting
Lower Yakima Valley Groundwater Advisory Committee
NOTICE IS HEREBY GIVEN that Yakima County is holding a public meeting of the Lower Yakima Valley Groundwater Advisory Committee on Thursday, June 29, 2017, at 5:00 PM at Radio KDNA, 121 Sunnyside Avenue, Granger, WA 98932 pursuant to Chapter 173-100-080 WAC Ground Water Management Areas and Programs.
For Additional Information
To learn more about the Lower Yakima Valley Groundwater Management Area, the Groundwater Advisory Committee, and its goals and objectives, please see the Lower Yakima Valley Groundwater Management Area on the County webpage at: http://www.yakimacounty.us/gwma/
For more information about the meeting, please contact Lisa Freund, Yakima County Public Services Administrative Manager at 574-2300.
If you are a person with a disability who needs any accommodation in order to participate in this program, you may be entitled to receive certain assistance at no cost to you. Please contact the ADA Coordinator at Yakima County no later than forty-eight (48) hours prior to the date service is needed.
Yakima County ADA Coordinator
128 N. 2nd Street, Room B27
Yakima, WA 98901
(509) 574-2210
7-1-1 or 1-800-833-6384
(Washington Relay Services for deaf and hard of hearing)
Dated this Thursday, June 15, 2017
PUBLISH: DAILY SUN NEWS
JUNE 21, 2017

STATE OF WASHINGTON
ss.
County of Yakima

Roger Harnack, being first duly sworn on oath deposes and says that he is the Publisher of the DAILY SUN NEWS, a daily newspaper.

That said newspaper is a legal newspaper and it is now and has been for more than six months prior to the date of publications hereinafter referred to, published in the English language continually as a daily newspaper in the city of Sunnyside, YAKIMA County, Washington, and it is now and during all of said time printed in an office maintained at the afforesaid place of publication of said newspaper, and that the said Daily Sun News was on the 4th Day of April, 1969 approved as a legal newspaper by the Superior Court of said Yakima County.

That the annexed is a true copy of a LEGAL PUBLICATION -
Yakima County Public Services
FC3463-100-120

published in regular issues (and not in supplemental forms) of said newspaper once each week for a period of 1 consecutive issue(s) commencing 06/21/17 and ending on 06/21/17, both dates inclusive, and that such newspaper was regularly distributed to its subscribers during all of said period. That the full amount of the fee charged for the foregoing publication is the sum of $52.50, amount has been paid in full, at the rate of $7.50 per column inch per insertion.

Subscribed and sworn to before me 06/21/17

Debbie Guerrero

Notary Public in and for the State of Washington

030110-00000

DEBBIE GUERRERO
COMMISSION EXPIRES
NOTARY PUBLIC
JUNE 17, 2020
STATE OF WASHINGTON

YAKIMA HERALD REPUBLIC

Affidavit of Publication

STATE OF WASHINGTON,)
)
COUNTY OF YAKIMA)

Danielle Rogers, being first duly sworn on oath deposes and says that she/he is the Accounting clerk of Yakima Herald-Republic, Inc., a daily newspaper. Said newspaper is a legal newspaper approved by the Superior Court of the State of Washington for Yakima County under an order made and entered on the 13th day of February, 1968, and it is now and has been for more than six months prior to the date of publication hereinafter referred to, published in the English language continually as a daily newspaper in Yakima, Yakima County, Washington. Said newspaper is now and has been during all of said time printed in an office maintained at the aforesaid place of publication of said newspaper.

That the annexed is a true copy of a:
Yakima County Notice of Public Meeti

it was published in regular issues (and not in supplement form) of said newspaper once each day and for a period of 1 times, the first insertion being on 06/21/2017 and the last insertion being on 06/21/2017

Yakima Herald-Republic 06/21/17
YakimaHerald.com 06/21/17

and the such newspaper was regularly distributed to its subscribers during all of the said period. That the full amount of the fee charged for the foregoing publication is the sum of $112.64

Danielle Rogers

Accounting Clerk

LISA M DRIPPS NOTARY My Comm. Expires April 05, 2021 PUBLIC STATE OF WASHINGTON

Sworn to before me this 21st day of, June 2017

Lisa M. Dripps

Notary Public in and for the
State of Washington,
residing at Yakima

Yakima County

Notice of Public Meeting Lower Yakima Valley Groundwater Advisory Committee

NOTICE IS HEREBY GIVEN that Yakima County is holding a public meeting of the Lower Yakima Valley Groundwater Advisory Committee on **Thursday, June 29, 2017, at 5:00 PM at Radio KDNA, 121 Sunnyside Avenue, Granger, WA 98932** pursuant to Chapter 173-100-080 WAC Ground Water Management Areas and Programs.

For Additional Information
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Dated this Thursday, June 15, 2017

(740649) June 21, 2017

Courtesy of Yakima Herald-Republic

GWAC Attendance Roster

Member	20-Apr-2017	18-May-2017	29-Jun-2017
Stuart Turner	Present	Absent	Present
Chelsea Durfey	Absent	Present	Absent
Bud Rogers	Present	Present	Present
Kathleen Rogers	Present	Absent	Present
Patricia Newhouse	Present	Present	Absent
Sue Wedam	Absent	Absent	Present
Doug Simpson	Present	Present	Absent
Jean Mendoza	Present	Present	Present
Eric Anderson	Absent	Absent	Absent
Jan Whitefoot	Absent	Absent	Absent
Jim Dyjak	Absent	Present	Present
Steve George	Present	Present	Present
Frank Lyall	Present	Present	Present
Jason Sheehan	Present	Present	Present
Dan DeGroot	Present	Absent	Present
Ron Cowin	Present	Present	Present
Laurie Crowe	Absent	Present	Absent
Robert Farrell	Absent	Absent	Absent
John Van Wingerden	Present	Present	Present
Rand Elliott	Present	Present	Present
Vern Redifer	Present	Present	Present
Ryan Ibach	Absent	Absent	Present
David Cole	Present	Present	Absent
Dr. Troy Peters	Present	Present	Present
Lucy Edmondson	Present	Present	Present
Peter Contreras/Nick Peak	Absent	Absent	Absent
Elizabeth Sanchey	Absent	Absent	Absent
Stuart Crane	Present	Present	Present
Virginia "Ginny" Prest	Present	Absent	Present
Jaclyn Hancock	Absent	Absent	Absent
Andy Cervantes	Present	Present	Present
Sheryl Howe	Absent	Present	Absent
David Bowen	Present	Present	Absent
Sage Park	Absent	Absent	Present
Lino Guerra	Absent	Absent	Absent
Rick Perez	Absent	Absent	Absent
Jessica Black	Absent	Absent	Absent
Matt Bachmann	Present	Present	Present

Residential, Commercial, Industrial, Municipal (RCIM) Work Group

Charge from Groundwater Management Area Advisory Committee

Working Group Members

Dan DeGroot, Chair (Yakima Dairy Federation), Dave Cole (Yakima Health District), Elizabeth Sanchey (Yakama Nation), Jan Whitefoot (Concerned Citizens of Yakama Reservation), John Van Wingerden (Port of Sunnyside), Stuart Turner (Turner & Co.), Tom Ring (Yakama Nation), Kathleen Rogers (Citizen Rep), Sanjay Barik (Ecology)

Meetings/Calls Dates

Meeting Date: April 10, 2017
Sunnyside School District Administration Building, 1110 S. 6th Street, Conference Room 23, Sunnyside, WA 98944
Call in: 509-574-2353 (pin 2353#)

Participants

Present: Dan DeGroot (Chair), Steve George, Vern Redifer, Jim Davenport and Bobbie Brady (Yakima County Support Staff). No one was present by phone.

Key Discussion Points

The meeting was called to order by Chair Dan DeGroot at 2:06 PM. Dan asked if the group had any comments about the draft RCIM report for the GWAC. Jim Davenport reported that Steve had sent him a document to consider including, but Steve had decided to hold off the discussion until after the presentation of the Nitrogen Loading Assessment. Dan pointed out that two numbers appear in the first sentence of the last paragraph of page 1 as the group agreed to discuss the actual number of residential households within the GWMA that discharge wastewater to an onsite sewage system. The discrepancy comes from the report Steve George contracted with Kevin Lindsay of EA Engineering to prepare (referred to above). The group agreed to discuss the report at its May meeting which Steve will forward to Bobbie for distribution to the group.

Vern asked about a sentence in the third paragraph on page 2 which reads: "Within the GWMA, moderate denitrification occurs about 3 months a year and poor denitrification occurs about 3 months (soil saturated and no warmth)." Vern wanted to know where this statistic originated. Dan indicated that since rainy season typically lasts for about three months a year and since denitrification can't occur when the soil is saturated he concluded that denitrification is lower during that time frame. Vern added that most people water their grass over their drain fields during the summer which may affect denitrification as well. He agreed with the range of 10 to 13 percent and said that in the Nitrogen Loading Assessment he used 10 to 20 percent. The EPA had said up to 40 percent but the Department of Health said he shouldn't go that high.

Jim noted that on page 2 the conventional ROSS technology information from Dan had been added. Dan said he added it to the report because it will effect recommendations. Vern agreed. On page 3, under Commercial Onsite Sewer Systems (COSS) Dan stated that a significant number of systems had been added to the list (the Nitrogen Loading Assessment had only one according to Jim). Dan pointed out that on page 4 under Discharges to Surface Water the paragraph now included a list of NPDES permits issued in the GWMA, but noted the date so that it was understood this list would change over time.

Recommendations: Dan had received the reports requested from Frank Baird and Ginny Stern of the Department of Health on the LOSS systems in the GWMA. He sent a copy of the information to Jim for his review as well. It was Dan's opinion that the reporting was sketchy and he was concerned. As a result Dan added a paragraph to the first recommendation (bottom of page 5, last paragraph) as follows: "This recommendation also applies to the LOSS in Zillah which is close to the Zillah Middle School. This would remove this LOSS from operation and the need to file timely reports." After some discussion about specific enforcement, the group agreed to delete this additional sentence and reword the original sentence as follows: "Encourage municipalities within the GWMA to extend municipal sewer systems within urban growth areas and retire on-site septic systems including large onsite septic systems." Vern was going to check to make sure that the LOSS in Zillah was inside the UGA.

On page 6 Jim pointed out that that paragraphs 2 and 3 beginning "Request Yakima County Public Services to perform an engineering study of locations outside urban growth areas" will help obtain state and federal grants. In addition, he felt paragraph 4, "Request that the Yakima Health District prepare a plan" will do this as well.

The group agreed to delete paragraph 5 (which begins "Request the Department of Ecology") as it was better addressed in paragraph 7. Jim noted that it would be hard to tell people which onsite septic system they would need to buy without having a criteria to act as guideline, e.g., you live in a zone with a need or a housing density component. Vern felt that paragraph 7 began to consider the density element Dan was talking about. Jim added that he was not asking this committee to develop a standard, but was suggesting it will cause someone to have to do this. Dan thought the group could look at the EA Engineering report next month and suggested perhaps the group could ask for his methodology. Vern said this would be like the septic density map in the Nitrogen Loading Assessment and the land use in zoning component too and added it would be important to know the smallest lot size in the GWMA.

Dan added a new paragraph (8) which the group revised as follows: "Request State Department of Health to not reissue a LOSS permit until ALL reports are turned in from existing LOSS and request that employee numbers are regularly reported so that the system continues to run as designed. Strongly consider not adding additional LOSS or require an upgraded effective nitrate removal."

Dan added another recommendation as follows: "Request that the Department of Ecology develop a plan for finding and decommissioning with incentives abandoned wells in the next 12 months. The Lower Yakima Valley GWMA could be used as a pilot project." The group added the words "with incentives" to the recommendation to help encourage people to report and brand wells as abandoned since it can be very expensive to close them.

On page 7 Jim noted that he thought the first paragraph was important particularly where property was being redeveloped. Vern agreed with the second paragraph and Dan felt like the third paragraph was important because Hobby Farms change their layout on a regular basis.

The group agreed to meet again on May 8, 2017 to discuss any issues that arise as a result of the release of the Nitrogen Loading Assessment and to discuss the report Steve George obtained from Kevin Lindsay of EA Engineering. The meeting was adjourned.

Resources Requested

Recommendations for GWAC

Deliverables/Products Status

Proposed Next Steps

Steve will forward a copy of Kevin Lindsay's report (EA Engineering) to Bobbie for distribution to the group prior to the May meeting.12

Vern was going to check to make sure that the LOSS in Zillah was inside the UGA.

Residential, Commercial, Industrial, Municipal (RCIM) Work Group

Charge from Groundwater Management Area Advisory Committee

Working Group Members

Dan DeGroot, Chair (Yakima Dairy Federation), Dave Cole (Yakima Health District), Elizabeth Sanchey (Yakama Nation), Jan Whitefoot (Concerned Citizens of Yakama Reservation), John Van Wingerden (Port of Sunnyside), Stuart Turner (Turner & Co.), Tom Ring (Yakama Nation), Kathleen Rogers (Citizen Rep), Sanjay Barik (Ecology)

Meetings/Calls Dates

Meeting: June 12, 2017
Sunnyside School District Administration Building, 1110 S. 6th Street, Conference Room 20, Sunnyside, WA 98944
Call in: 509-574-2353 (pin 2353#)

Participants

Present: Dan DeGroot (Chair), Steve George, Stuart Crane, Kathleen Rogers*, Chris Saunders (Support Staff) *via phone

Key Discussion Points

The meeting began at 2:06 pm.

NAA Review: Dan opened the meeting on the question of whether the final Nitrogen Availability Assessment (NAA) should place a greater emphasis on the risks of comparing a cropping system to a leaching system. There was agreement that it should.

Dan also wanted the NAA to put a greater emphasis on the risks posed by high-density residential onsite sewage systems. As referenced on page 2 of the draft RCIM report, residential septic systems are designed to leach into the groundwater. With high-density residential development occurring and projected to continue to occur in areas of the GWMA, Dan felt the threat of increased nitrate contamination from this source deserved to be mentioned in the final draft of the NAA. Members agreed that it should.

YHD OSS Plan: Dave Cole was unable to attend the meeting due to a work-related emergency. Attending members reaffirmed their support for the recommendation on page 6 of the RCIM draft final report, that the Yakima Health District (YHD) prepare an on-site sewage system (OSS) plan, but with no representative from the YHD present, the subject was not explored further.

GWMA Work Plan: Dan felt that section 2.3.1(e) of the GWMA Work Plan, predicting the likelihood of future problems if no action is taken, should contain a statement along the lines of, "If no action is taken, the nitrogen load and nitrate contamination will increase, especially in high-density areas connected to residential onsite sewage systems." The group agreed.

A member felt that section 2.3.2 should contain a goal of monitoring groundwater in high-density residential drain fields. He felt the placement of future monitoring wells should include at least two such locations, preferably one with a shallow water table, and one with a deep table. Data gathered from these wells could be compared with data near cropland and CAFOs. Members agreed that it was preferable to have more data in this area.

RCIM Final Report: Dan asked members if they had any objections to his corrections, or the final recommendation he had inserted in the latest draft RCIM report. There were none.

Dan brought up paragraphs 3 and 4 on page 6 of the final report, and questioned whether a greater emphasis should be placed on one over the other. Paragraph 3 called for a feasibility study of installing community wells in high-density residential septic system areas, and paragraph 4 called for the same type of study regarding community sewage systems. A member stated that community wells were much faster and less expensive to put in place, which might lead residents in affected areas to choose this as their preferred option over being connected to municipal sewer lines. Members decided that residents should be educated in equal measure on the costs and benefits of both scenarios so they could make a fully-informed decision.

Dan asked whether the opening paragraph of the report should contain a brief history of the YHD and the reason for its founding. A member felt it wasn't pertinent. The subject was not added.

Returning to the subjects discussed earlier, the group agreed to include a new recommendation that monitoring wells should be placed under at least two high-density residential drain fields, one with a shallow water table, and one with a deep table. The last page should also include a final statement of purpose mirroring its proposed GWMA Work Plan warning that the nitrate load in drinking water aquifers will have a strong potential to increase in high-density rural residential areas if no action is taken.

Future Meetings: Dan did not anticipate holding any future meetings, but requested that the meeting room reservations be kept in place in case anything arose in the future. He foresaw two potential causes of future meetings: 1) If members of the GWAC object to the RCIM Final Report and ask for revisions; and 2) If the agencies that drafted the NAA respond to RCIM-related comments in a way group members wish to discuss. He did not foresee a YHD OSS Plan being a subject of future meetings, unless it was paired with another subject.

The meeting adjourned at 2:59 pm.

Resources Requested

Recommendations for GWAC

Deliverables/Products Status

Proposed Next Steps

A final report containing the discussed changes will be submitted to the GWAC's next meeting.

Data Collection, Characterization, Monitoring

Charge from Groundwater Management Area Advisory Committee

Working Group Members

Melanie Redding (Chair); Andres Cervantes; Bob Stevens; Charles (Pony) Ellingson; David Bowen; Chelsea Durfey; Dave Cowan; Doug Simpson; Elizabeth Sanchey; Frank Lyall; Ginny Stern; Jaclyn Hancock; Jan Whitefoot; Jean Mendoza, John Van Wingerden, Kevin Lindsey; Laurie Crowe; Lino Guerra; Mike Shuttleworth; Ralph Fisher; Robert Farrell; Ron Cowin; Scott Stephen; Steve Swope; Stuart Turner; Dr. Troy Peters

Meetings/Calls Dates

Meeting: Wednesday, May 11, 2017, 10:30 AM to 12:30 PM
Call Number: 509-574-2353 pin: 2353#

Participants

Present: Melanie Redding (Chair)*, Steve George, Jean Mendoza, David Bowen, Vern Redifer, Bobbie Brady (County Support Staff) *via phone

Key Discussion Points

Meeting Overview: The meeting got underway at 10:33 PM and everyone introduced themselves.

Where are we at on the Ambient Groundwater Monitoring, Drinking Water Monitoring, Drain Monitoring, Nitrogen Availability Assessment and Data Analysis: Melanie asked Vern to update everyone on these projects. Vern had no updates from Matt Bachmann (USGS) since he reported at the last GWAC meeting (April 20). Vern reminded everyone Matt reported then that 89 homeowners had agreed to participate in the well testing and he were hopeful for another 50 or 60. USGS had already begun gathering samples. Vern was also working to provide comments on the QAPP USGS had proposed. With regard to the ambient monitoring network the scope of work proposed by PGG was reviewed and there are some suggested changes. One change was to delete the $10-15,000 charge to assist with data analysis as both Melanie and Vern felt that the group had the expertise to do this (other members agreed as well). PGG is installing the purpose built shallow wells and will sample them because their initial tests go beyond nitrates in order to establish a standard. Once that is done USGS will take over the sampling of the purpose built wells as well. All USGS test results will go through their lab in the Midwest so there may be a two week turn around time. Vern assumes that Matt will update the GWAC next week as part of the Data Working Group report. A member asked when the first set of data would be available. Vern thought next month. Vern went on to say that when the data is available and passed on to the County it would be put in the USGS data center where everyone can see it.

A member asked what the objectives were. Vern said they are spelled out in the QAPP developed by the USGS. Melanie added they were as the group had discussed. The member stated that she would like to see the information in writing. Melanie said that Matt will make the data available as quickly as possible. The member wanted to know what criteria will help determine the water quality. Melanie stated that the topic of data analysis was an agenda item and the group will need to determine what to do with the data and who will do long-term data collection and analysis in the future. Melanie wants to make sure whoever takes this over knows what to do with the data. The member agreed the expertise was in the room. Melanie added that the group had had a lot to work on and the first priority was to get the monitoring going.

The member was also bothered that there was no testing for chloride as this was a tracer test and there was no plan for analysis prior to proceeding. Vern agreed but felt they had made a pragmatic decision because of the time crunch to proceed without a plan for analysis in order to get samples with seasonal variation. Melanie agreed but pointed out that PGG does have a level of detail for analysis in the QAPP and that there was a small subset of statistical data to look at trends. Melanie stated that there was a need to talk about how to capture a trend and not overestimate the trend. Further discussion ensued.

Vern continued his update and stated that there were lengthy comments on the Nitrogen Availability Assessment (NAA) which were under review by the authors, but a response won't be ready for the May 18 GWAC meeting because they were substantive. He thought the GWAC discussion on the NAA would be more of a question and answer session. Vern added that three individuals (Jean, Kevin Lindsey (EA Engineering) and Frank Lyall) had all made submittals, Jean's comments were very comprehensive. There was no real duplicity or themes that Vern saw. Jean asked how the authors would respond. Vern said he thought in writing and all comments will be shared with the GWAC. The GWAC will not "accept" the NAA on May 18, but he will see if an overview could be prepared. He hadn't talked with Gary Bahr, but Kevin Lindsey pointed out a few things in RCIM. Vern added that the RCIM report will be updated to include biosolids and the Port of Sunnyside waste field.

Melanie was pleased with the group's efforts and the resulting data being accumulated which would result in science based decisions. She was proud too that USGS was out sampling.

<u>EPO Message</u>: Melanie reminded everyone that EPO was looking for long and short-term messages from each working group. Vern thought an important short term message was:

1. Monitoring efforts have been started; monitoring with oversight will push us in the right direction.
2. The intention is for the monitoring efforts to continue.
3. Here's what we hope to accomplish through these monitoring efforts.
4. Any reactions to the data from the monitoring efforts will be based on what we learn and success or failure will be monitored over time.

Another member thought this message should go to a wide audience not just homeowners because of health concerns, but also the ag industry because it would provide them with another reason to convert to a better technology.

A member wanted to know if there was a commitment from agencies to monitor domestic wells.

Other members agreed there was a commitment. Vern added that there will be a meeting of the Funding Working Group in June and it would be their job to help determine funding sources. The group will need know what will need to be funded, how much funding will be required and when it is needed. Vern thought that the funding group should discuss an aquifer protection area as a funding source. He explained that property owners would be assessed a fee on their taxes to create funding. However an aquifer protection area must be voted on by the residents of Yakima County; it cannot be approved by the County Commissioners. David thought it would be appropriate to use public money for the monitoring effort. Jean thought it was as important as having safe highways as this is infrastructure.

Melanie stated that she is optimistic that entities like the Department of Ecology and State Legislature will step up and she believed that as there is a broader involvement from the community additional funding sources would become available. Vern said that the goal is to vigorously pursue funding sources but he had learned that because the GWMA is talking about domestic wells, Department of Health funding is not available. Another member thought chances were good funding would be available from the legislature if both the Department of Ecology and Yakima County were making these requests.

The member was concerned that testing of domestic wells would be dropped. David said that wouldn't happen unless private homeowners decided to withdraw their well from the program. He did think that if some of the wells continued to test low those may potentially be dropped but added that he didn't foresee the Department of Ecology dropping the well testing until the issues are resolved. Melanie added that Whatcom County had been testing now for 15 years. Originally the testing occurred more frequently to get a good baseline, but then the frequency was dropped back to annual testing. Vern thought that the monitoring program was one recommendation out of the whole program that needed to continue and that it was a common goal everyone in the group agrees on. Melanie agreed. Vern added that monitoring is the only real scientific unbiased data – a true report card – that will reveal on an annual basis whether everything is getting better, staying the same or getting worse.

The member wanted to know if well testing was in with the ambient monitoring network plan. Melanie said that they were two projects with different goals that were complimentary so the funding could be tied together. Another member wanted to make sure the drain testing was tied into the same request as well. The member added that she thought the program should be written up with a scheduled reevaluation.

Long Term Messages:

The primary concern was a way for people to look at the collected data and conclusions (which will be updated every year). A member wanted to know what USGS protocol was. Vern said USGS will do a summary. A member asked who is going to do the data reporting. Vern said the lead entity. Another member asked if the analysis would be done by the GWMA. Vern said for the first year USGS will do the data analysis of seasonal variations and report to the GWMA on the website, but he doesn't expect any trends to be established that soon. In the future Vern thought it could be on the Department of Ecology website under water quality, but there had also been a discussion with Yakima Health District to do it.

David wanted to know how the EPO will consolidate all of the messages for the working Groups. Vern was going to recommend that members of each group join the EPO Working Group as the current membership of EPO is not involved in the working groups. He thought this would bolster the EPO Working Group as it tries to accomplish this task.

Nitrogen Management Strategies: Melanie pointed out that this group had not discussed nitrogen management strategies (e.g., soil moisture sensors) thus far. A member noted that most of the working groups had this discussion and will be making recommendations. Melanie verified with David Bowen that this was already happening in his group (Livestock/CAFO). He said recommendations had been made with the caveat that as we go forward and learn more adaptations would be made.

Other Issues: Melanie asked if there were any other issues the group should address. A member said that she had tried to get the Regulatory group to come up with a list of costs related to elevated nitrates in groundwater, but met resistance and the group suggested that perhaps it should be something the Data Working Group should take on. The member believed that an economist should do a study. After a great deal of discussion Melanie asked the member to email her the specific questions she would like answered through undertaking this project and the purpose for getting these answers. Melanie felt the member's explanation would help the group's discussion on the topic and determine if the project was part of the goals of the GWMA. Another member suggested that Jean send Melanie a copy of the cost analysis (Costs Related to Elevated Nitrates in Groundwater) she prepared for the Regulatory Working Group. David explained that part of the Regulatory group's issue with it was that it included expenses to communities to improve infrastructure in their entirety. Many members of the group felt that the entire cost shouldn't be attributed to nitrates in the groundwater as the projects were done for a variety of different reasons and needs. Debate over these issues in the Regulatory group made it difficult to move forward. The member believed that an economist should do a study and also mentioned that this was something that Frank Lyall had been vocal about - the need for an agricultural economist as he had said that economics motivate agriculture to make decisions (an opinion Jean agreed with).

The member also wanted to know if the group was going to talk about the NAA as a group or leave it to the GWAC. Vern and David thought the group had discussed it already. The meeting was adjourned at 12:20 PM.

Resources Requested

Deliverables/Products Status

Proposed Next Steps

Jean will email Melanie the specific questions she would like answered through undertaking this project and the purpose for getting these answers. She will also send Melanie a copy of the costs analysis (Costs Related to Elevated Nitrates in Groundwater) she prepared for the Regulatory Working Group.

Regulatory Framework Working Group

Charge from Groundwater Management Area Advisory Committee

[Insert Charge]

Working Group Members

Jean Mendoza, Chair (Friends of Toppenish Creek), Andres Cervantes (Department of Health), David Bowen (Department of Ecology), Chelsea Durfey (Turner and Co.), Dan DeGroot (Yakima Dairy Federation), David Newhouse (interested party), Ginny Prest (WSDA), Jason Sheehan (Yakima Dairy Federation), Jim Dyjak (Concerned Citizen of Yakama Reservation), Larry Fendell (interested party), Laurie Crowe (South Yakima Conservation District), Nick Peak (EPA), Patricia Newhouse (Lower Valley Community Representative), Steve George (Yakima County Farm Bureau), Stuart Crane (Yakama Nation), Sue Wedam (Lower Valley Community Representative), Vern Redifer (Yakima County Public Services), Jim Davenport (Yakima County Public Services)

Meetings/Calls Dates

Meeting: May 10, 2017, 5:00-7:30 PM

Call Number: 360 407-3780 PIN Code: 306589#

Participants

Present: Jim Davenport (Acting Chair), David Bowen, Larry Fendell, Steve George, Pat Newhouse, Kathleen Rogers, Bud Rogers, Sandy Braden, Stuart Crane, Ginny Prest and Bobbie Brady (Yakima County Public Services). No one was on the phone.

Key Discussion Points

Jim Davenport opened the meeting at 5:08 PM and welcomed everyone. He explained that Jean Mendoza had called him ten days prior explaining she had another commitment for this evening and asking him to chair the meeting. She sent him a number of documents that he had originally written for discussion at the meeting. Subsequently, Jean suggested Jim create a second version toning down the language to a 5th or 6th grade reading level so it was better understood by the average reader. Jim explained he had done his best and those revised documents had been sent to the group earlier in the week for review and approval at this meeting. Jim reviewed the five documents: 1) Groundwater Quality Regulation in Washington, 2) Yakima County's Role in Groundwater Quality Protection, 3) Irrigated Agriculture and Groundwater Quality Regulation, 4) Livestock/CAFOs and Groundwater Quality Regulation, and, 5) Residential, Commercial, Industrial and Municipal Groundwater Quality Regulation and explained the group would discuss them in that order. Jim reminded the group that they were scheduled to meet tonight and again in June and their last task as he perceived it was to provide to the GWAC in essence a pertinent inventory of the regulations the group had reviewed for inclusion in the program. Jim also indicated that he thought the readers of this document would be the general public, irrigated agriculture, livestock, and residential, commercial, industrial and municipal entities. Ginny asked if this information would be presented to the GWAC as part of the proposed plan. Jim verified this and reminded everyone it would give them another chance to review the information and provide input.

Response to EPO: Jim asked the group if any of the six responses the group provided in response to EPO Questionnaire No. 6 would be appropriate for presentation to the public. A member thought No. 1 was probably true but didn't think the public would care. Another member added that she thought it should state that the current regulatory structure doesn't work and then list the things that need to be done. Another member thought it should state what agencies are under-resourced, explain why they needed additional funding and what for. Jim thought this would be appropriate for program recommendations.

A member also thought that No. 5 should be reworded because the words "paradigm/perception of enforcement" were awkward. A member was concerned about chronic violators. After some discussion it was agreed Ginny would provide Jim with a paragraph of additional detail about technical assistance as a first step and what regulatory backstop is available should volunteer action be unsuccessful. The member added they also needed the manpower to follow up.

David reminded everyone that EPO was looking for short term messages; he didn't believe this working group had a message to get out and Jim agreed. The group also agreed that it had no short-term message for EPO.

Groundwater Quality Regulation in Washington: After a review of the document and brief discussion about the portion written on RCRA it was the consensus of the group to accept the document as written move the document on to the GWAC.

Yakima County's Role in Groundwater Quality Protection: After a review of the document and brief discussion about the Growth Management Act it was the unanimous consensus of the group to accept the document as written and move the document on to the GWAC.

Irrigated Agriculture and Groundwater Quality Regulation: There was concern about the statement "there are no federal, state or local regulations that specifically address the application of irrigation water to agricultural crops," but after some discussion the group agreed that the word "specifically" took care of any issue. The group also discussed the phrase "State water law prohibits wasting water." Jim said his thinking had been that since water could only be used for beneficial use it was implied the use must be efficient and not wasteful. Ginny asked if Jim was referring to the "use it or lose it" concept. Jim said yes. He added that he wasn't aware of any regulation that relates to irrigation practices. A member asked Jim if he had asked Ron Cowin from SVID this question. Jim said yes and that Ron had stated that SVID doesn't tell farmers how to use irrigation water once it's on their property. Jim agreed to rewrite the sentence and include the term "beneficial use." A member added that there was a County "Right to Farm" ordinance too. Jim agreed to check and add it.

Residential, Commercial, Industrial and Municipal Groundwater Quality Regulation. There was a discussion about the words "sewer," "septic" or "sewage." Dan DeGroot, chair of the RCIM working group said that onsite sewage system is correct (as it is referred to by the Department of Health that way). Jim will confirm and add an explanation that sewage and septic are the same.

Jim also noted that some of this was duplicative of the RCIM report. Ginny asked where Table X came from; Jim responded it was from the WAC. It was also noted that Table V should appear on the same page. The group agreed to the document with the revisions as noted and to move this document on to the GWAC.

Livestock/CAFOs and Groundwater Quality Regulation: A member asked what soft enforcement was. Ginny responded: technical assistance first with enforcement tools available only if people don't cooperate. Ginny will prepare a paragraph for Jim clarifying this and take out the term "soft enforcement." Ginny agreed there were plenty of chances to adapt. There were no other comments and the group agreed to the document with the revisions as noted and to move this document on to the GWAC.

In summary, Jim confirmed that the group approved the five documents with the corrections noted above and to move all five revised documents on to the GWAC. He then asked the group if they saw a need for another meeting and if so, what else the group needed to accomplish at that meeting. The group reached a consensus that there was no need for another meeting and therefore nothing more for the group to do. The meeting was adjourned at 6:00 PM.

Resources Requested: None.

Recommendations for GWAC: None.

Deliverables/Products Status: None.

Proposed Next Steps

-Documents corrected per discussion and moved on to the GWAC for their consideration.

Regulatory Framework Working Group

Charge from Groundwater Management Area Advisory Committee

[Insert Charge]

Working Group Members

Jean Mendoza, Chair (Friends of Toppenish Creek), Andres Cervantes (Department of Health), David Bowen (Department of Ecology), Chelsea Durfey (Turner and Co.), Dan DeGroot (Yakima Dairy Federation), David Newhouse (interested party), Ginny Prest (WSDA), Jason Sheehan (Yakima Dairy Federation), Jim Dyjak (Concerned Citizen of Yakama Reservation), Larry Fendell (interested party), Laurie Crowe (South Yakima Conservation District), Nick Peak (EPA), Patricia Newhouse (Lower Valley Community Representative), Steve George (Yakima County Farm Bureau), Stuart Crane (Yakama Nation), Sue Wedam (Lower Valley Community Representative), Vern Redifer (Yakima County Public Services), Jim Davenport (Yakima County Public Services)

Meetings/Calls Dates

Meeting: June 14, 2017, 5:00-7:30 PM

Call Number: 360 407-3780 PIN Code: 306589#

Participants

Present: Jean Mendoza (Chair), David Bowen, Larry Fendell, Steve George, Sandy Braden, Jim Davenport, Stuart Crane, Ginny Prest, Vern Redifer, Dan DeGroot, Laurie Crowe and Bobbie Brady (Yakima County Public Services). No one was on the phone.

Key Discussion Points

Jean began the meeting at 5:02 PM and everyone introduced themselves. Jean stated that the purpose of the meeting was to discuss potential alternative regulatory strategies by looking at ways the County codes could be tweaked or improved. Jean prepared a power point presentation to provide background for the discussion and two redacted Conditional Use Permits for CAFO dairies so that the group could determine how well they allow for the process to protect groundwater from nitrates.

<u>Analysis of Yakima County Ordinances that Address Nitrates in Groundwater from Agricultural Sources</u>: Jean reviewed Yakima County local ordinances to address nitrates in groundwater from CAFO's. She noted that several local ordinances are based on the Growth Management Act (GMA) and summarized what the GMA requires. Vern said that the GMA required Yakima County to have a comprehensive plan since 2007 and that the plan was currently being updated (Horizon 2040) and should be finalized this month. Jean stated that the GMA also required counties to designate critical areas and that there are different classifications of critical areas – what they are and how they are to be regulated. The group also discussed Yakima County's

involvement in the Voluntary Stewardship Program (VSP) which is designed to treat watersheds holistically and addresses protecting critical areas (including addressing agriculture) through a collaborative effort. Jean drew specific attention to GOAL NS 9 and pointed out that some of the requirements overlap with the GWMA efforts and provide lofty goals for Yakima County including the policy that it would ensure abandoned wells are closed properly. Jean perceived that this was a heavy load that would require serious evaluation. Vern said that an alternative could be to require abandoned wells be dealt with properly as a condition before issuing any new building permits. Jim thought this was a section that pertained to surface water and not groundwater and another member wondered how this related to CAFO dairies because they couldn't be located in this area. Jean wanted to know how the VSP would handle this. Steve responded that it had to do with artificial wetlands and natural wetlands. The current law doesn't allow disturbance of natural wetlands. He went on to say that the critical issue was natural streams and river protection. Jean felt this was an example of how the County Code could be tweaked because there was no good definition for natural or artificial wetlands. Vern stated the County had adopted the State definition and David Bowen said that the County Code does indeed refer back to the Revised Code of Washington.

Jean also said that a goal in NS 9 states that the County will protect water quality standards and asked the group to start to think about whether there are adequate performance standards for CAFO's in Yakima County. Vern noted that as part of the County's quest to work through the recent issues concerning domestic wells they had in fact learned a lot more about the County's groundwater system and its vulnerability to contamination. The group discussed this endeavor at length before moving on. Jean wondered if it would be a requirement for the GWMA to include this information in the program. Vern said it really was more of a quantity issue not a quality issue. Jim thought that perhaps a paragraph or two could address the water quantity issue which he pointed out would also be addressed by the Yakima Basin Integrated Plan (YBIP). He would add a sentence or two on the Plan as well.

A member asked what the definition of "traditional rural lifestyles" was. Jim stated that this language came from the GMA. Vern said these sorts of statements are up for definition by the County Commissioners and added that they were meant to preclude high density development in rural areas because a major goal of the GMA is to protect farmland. As a result it is very difficult to rezone from AG to anything else. Vern did acknowledge that a traditional rural lifestyle in Yakima County might not look like other counties.

Jean presented a GIS picture of three large CAFO's referred to as the "Dairy Cluster." She stated that these CAFOs represented 24,000 animals on 2,300 acres and wondered if that was reasonable and if the County permitting process could keep that from happening. Vern noted that there was a characterization entitled ELD – extremely limited development. Jean also drew attention to the regulation of CAFO's, particularly the "Dairy Cluster" and expressed concern with the risks associated at the site because of their proximity. Jean provided an explanation of the types of review that would be required and the permit forms for CAFO Conditional Use Permits.

<u>Review of Two CAFO Conditional Use Permits</u>: Jean had four questions for the group: 1) Does the permitting staff have the ability to deny a permit based on the concentration of animals? 2) Does the permitting staff have the ability to impose restrictions based on site conditions? 3) Does

the permitting staff have the ability to impose water monitoring? 4) Does the permitting staff have the ability to review nutrient management plans and history of compliance?

Jean had marked several statements on each conditional use permit to guide the group's discussion and had the following concerns.

Jean was concerned that the Yakima County planning department can't look at a Dairy Nutrient Management Plan to verify the number of cows on the dairy. Several members pointed out that 1) the definition of a CAFO has changed over time. The number of mature animals used to define a CAFO has was lowered and the distinction of medium or large was removed, so an dairy animal feeding operation that has 200 or more mature animals is considered a CAFO (in the past 200-699 mature animals would be considered a "medium" CAFO and above 700 mature animals was considered a "large" CAFO); and, 2) the dairies in the sample permits appeared to be older and would have been grandfathered into zoning regulations that had not existed at the dairies' inception. Vern referred to that as legally non-conforming uses which in essence means "this entity existed prior to the rules but they were okay to be there. He added that when landowners begin to add structures they are required to permit them. He thought both of the examples Jean had referred to most likely fell into this category and the groups were now adding structures which under the law they were required to seek a permit (new structures at an existing "grandfathered" entity do trigger the permitting process).

Jean was concerned about the proximity of larger dairies and felt they should be required to separate. David pointed out that they were accepted because of compatible neighbor land uses. A member stated that feed lots have a much greater density of cows. He said that cattle feed lots can have 50-100,000 animals in order to be economically feasible. Others didn't think feed lots this size existed in Yakima County. Another member stated that we would see an increase in sizes because the United States just opened up the export of beef to China.

Jean wanted to know if the South Yakima Conservation District had a process when reviewing a DNMP for determining the number of cows per acre and the manure produced. Laurie said yes there were forms that she completed during the process that would calculate this and at times owners were told they will either have to sell cows or export manure to non-dairy uses through a transfer agreement to ensure that the nutrient management plan balanced for land application to available crop land under the control of the dairy.

Jean wondered if it was reasonable for Yakima County to reference terms like "agronomic rates" and if that was a measurable number. Ginny stated that a dairy's use of agronomic rates was confirmed through soil testing and land application records. Ginny also noted that a goal to not exceed 30 ppm nitrate in post-harvest soil test was currently the standard and the dairy would be expected to "adaptively manage" to reduce residual soil nitrate if soil test levels consistently exceed 45 ppm or an enforcement action would be taken by the WSDA. She believed the conditional use permit referred back to the Dairy Nutrient Management Plan made by Laurie (South Yakima Conservation District) and the plan was based on agronomic rates. A member added that the County's job was to permit the structure, not the farming practices, for which the County has no jurisdiction.

Jean was concerned that the DNMP describes manure and wastewater in detail and that this wasn't sufficient for permitting. Vern stated that the County's job was to focus on the actual permitting request. The County does not permit the dairy to be a CAFO. Vern noted that the County relies on an approved DNMP and the County can ask the entity when it was approved or updated. The County can also contact various agencies to draw from their areas of expertise during the permitting process.

Jean was concerned that a permit referred to lagoons being lined and approved. Jean felt this was asking permit writers to be experts on this topic. Vern said the lining was approved by NRCS according to their specifications. Vern indicated that permit writers will contact the agency with expertise. David agreed. A member stated that if someone is following NRCS standards for ponds it will be signed off by an engineer. Jean asked if the group saw a way for those who wrote the DNMP plan and NRCS to interact with the County better. Vern didn't see a problem, but said it was some time since someone applied to put in a new CAFO. Ginny suggested that a strategy could be for the State, Districts and County agencies to work better together. Steve didn't think there was a lack of communication. Vern agreed, but said perhaps a good suggestion would be for there to be better documentation of the interaction. For instance, the County could note that it emailed Laurie to verify that something was up to the NRCS standards without including the actual plan. Laurie agreed.

Laurie suggested that the permit writers at Yakima County tour a dairy facility with her so they would see what they were approving and better understand the process. Vern asked Laurie to email him the invitation so that he could make it happen.

A member felt both applications by the dairies were very detailed. Another member thought it would have been important for the group to also review a non-dairy Conditional Use Permit application.

Ginny expressed a concern that Jean only seemed to be going down the path towards regulating dairy manure and reminded everyone that if manure is applied to land only 50 percent of the nutrients will be utilized this year while the rest will process itself over the next few years. In contrast, if a grower applies a synthetic fertilizer 100 percent of the nutrients are released into the ground immediately. She believed it was extremely short-sighted to focus on the dairy industry without applying that same scrutiny to the fertilizer industry. Ginny pointed out that the dairy industry had participated in the GWMA efforts to get the job done to improve nitrates in the groundwater, but in contrast the fertilizer industry was absent. It was her opinion that in response Jean was suggesting additional regulatory efforts applicable to the dairy industry while there were no regulations monitoring the use of synthetic fertilizers. Others agreed.

Jean asked how the group could address synthetic fertilizer. Jim noted that among the alternatives being suggested was a discussion in the Irrigated Ag Working Group about nutrient management plans for everyone – growers and dairies in order to look at both manure and synthetic fertilizer applications. Ginny stated that through WSDA the fertilizer industry does pay a registration fee and a fee for tonnage sold in the State but these figures are not broken down by County. Vern added that Jean had suggested a small tax in Yakima County on fertilizer sold in order to begin tracking efforts for its sale and use but agreed there were issues with this method because it could be circumvented by purchasing fertilizer in other counties or states and still be applied within Yakima County.

Dan pointed out that if the group was going to make a statement he thought it would be important to say that there are volumes of dairy regulations and nothing on synthetic fertilizers. Ginny agreed and said that the playing field in terms of regulatory requirements wasn't even and said she thought it was very important for Regulatory Framework to say there are more regulations regarding dairies but very little regulations for others. Vern said that this could be added to the list of alternatives for the GWAC to discuss. David indicated that a paragraph in the Livestock/CAFO report references this. Ginny added that she thought there was a program in Maryland that includes commercial fertilizer oversight. Steve said that there were a couple of places in other states that require a prescription by a certified agronomist.

The meeting concluded at 7:38 PM. The group agreed that this would be the last meeting of the working group. Jim confirmed that he had captured the additions to the alternatives list to be included in the list presented to the GWAC.

Resources Requested: None.

Recommendations for GWAC: None.

Deliverables/Products Status: None.

Proposed Next Steps

Laurie suggested that the permit writers at Yakima County tour a dairy facility with her so they would see what they were approving and better understand the process. Vern asked Laurie to email him the invitation so that he could make it happen.

The group agreed that this would be the last meeting of the working group. Jim confirmed that he had captured the additions to the alternatives list to be included in the list presented to the GWAC.

Livestock/CAFO Working Group

Charge from Groundwater Management Area Advisory Committee

Discussion of data sources and remaining Work Plan Items

Working Group Members

David Bowen, Chair (Department of Ecology), Gary Bahr (Department of Agriculture), Elizabeth Sanchey (Yakama Nation), Jason Sheehan (Dairy Federation), Jim Newhouse (South Yakima Conservation District), Laurie Crowe (South Yakima Conservation District), Sue Wedam (LV Community Rep.), Patricia Newhouse (Community Rep Position #2), Steve George (Yakima County Farm Bureau), Stuart Turner (Turner & Co., Inc.), Jean Mendoza (Friends of Toppenish Creek), Jim Dyjak (Concerned Citizens of the Yakama reservation)

Meetings/Calls Dates

Meeting: Thursday, May 4, 2017, 5:00 – 7:00 PM

Participants

David Bowen, Jean Mendoza, Larry Fendell, Stuart Crane, Kathleen Rogers, Bud Rogers, Steve George, Jason Sheehan, Ginny Prest, Sandy Braden, Jim Davenport and Bobbie Brady (Yakima County Support Services).

Key Discussion Points

David Bowen opened the meeting at 5:05 PM, welcomed everyone and reviewed the agenda.

<u>Nitrogen Availability Assessment</u>: David passed out pages 71 and 72 which he believed summed up the assessment and reminded everyone the assessment wasn't meant to direct, but to inform. David added that it stated "the large contribution to available nitrogen from irrigated agriculture is largely due to the high acreage of irrigated agriculture." David felt it was important to instead look at the estimated nitrogen available per acre which had been highlighted in the assessment at Table 32, Page 71. According to the chart, lagoons had the most concentrated potential, pens were next and then residential onsite septage systems especially where the density of systems was larger. David added the exactness of the numbers wasn't important to him; instead he felt the assessment clearly indicated where the group should focus and get the most bang for their buck. Ginny stated that Ecology's new CAFO permit allowed her group to take a closer look at lagoons and rate them on a risk scale when inspected. A three on the risk scale would require corrective actions. Failure to correct would result in discontinued use until corrected. Four on the risk scale would immediately discontinue use until the issues were corrected. A member asked who would do the inspections. Ginny indicated that WSDA and Ecology would need to work that out but the Conservation District will be involved in the review as well.

A member indicated she thought the NAA was nicely written but she (and others) were bothered that it said that the NPDES permit was effective and could go a long way to solve the problem.

Since a group disagrees with this statement she wondered if those concerns should be a part of this report. David indicated he had spoken with Bill Moore who stated that the permit was protective of the environment. David thought the NPDES permit would go a long way to solve the problem and would collect a lot of information. The member indicated she had spoken with Bill as well and didn't think everyone would sign up. David thought some would sign up right away, others would roll over and visits would be made to those who didn't volunteer. He added that NPDES permits are issued for five years in order to make improvements from what has been learned during the previous term. The member said she also thought the NAA was inadequate and faulty as it didn't look at ponds, composting and math for the lagoon or silage. She noted that her comments had been submitted to the authors for review. Another member said the NAA didn't include bio-solids either. Ginny said that the RCIM component was being updated by the Department of Ecology and Yakima County to include bio-solids. Another member asked if the comments made to the NAA were important to the document Livestock/CAFO was discussing today.

Jim thought irrigated agriculture was weighted heavily due to reliance on survey feedback which produced a disproportionate number of acres as it increased some numbers while playing down others. This made him cautious about relying on the pie chart. On the other hand he felt that data was much more precisely gathered in the livestock piece. David noted that he was less concerned about the optical appearance of the pie chart and didn't believe it was worth fighting about. Jim was concerned that the group hadn't yet identified what they were going to do to solve the problem.

<u>EPO Outreach Spreadsheet:</u> David mentioned that he had received feedback from two members adding two items to Question No. 6 on the EPO questionnaire which David passed out to the group. A member was concerned that the recommendations would result in asking the taxpayers for more money. Another member responded and said that the funding could come from grants, industry money or commission funding if an infrastructure was set up to receive it for researchers. Another member said they had spoken with Kirk Robinson about getting check-off dollars from commodity assessments which are typically used for marketing, but could be used for research and development. The member agreed, but stated that it is a big challenge to reallocate funding and that a recommendation from the GWAC might help. Jim Davenport was interested to learn more about this funding source.

A member asked what the group would do with these recommendations if they weren't given to EPO as they must have something to educate with. Another member thought the EPO group needed to understand basic concepts (leeching and the groundwater cycle for example) before they could do anything else. Ginny stated that she had recently discovered a 7th and 8th grade curriculum on growing food which included the nitrogen cycle. She thought the curriculum could be added to schools in the GWMA and suggested EPO get the books for schools before they ran out of funding. The books come from the American Society of Agronomy. A member indicated that Joye Redfield-Wilder had recommended this as well. Another member knew the science teacher in Sunnyside and would mention it to her and provide Ginny's contact information. Jim thought that the concept of agronomic rates was central to the work of the GWMA and was an important part of public education. Ginny indicated that in recent years there had been a great deal of education amongst dairymen and farmers on agronomic rates. Another member thought it was more widely understood by dairy farmers as a result of the GWMA. A member also stated that serious farmers take samples. Steve George indicated that he would be interested in working on school education funding as he had sponsored some in the past. The members eventually concluded that they would be interested in EPO preparing a fact sheet that explains agronomic rates. They would also recommend that EPO look at the school curriculum and explore its use. The additions made by the members in response to EPO's Question No. 6 were accepted as well.

Draft Schedule: David indicated that if the group didn't complete its work tonight he was looking at scheduling another meeting for either May 22 or 23 in order to stay on schedule. The group agreed to complete it.

Draft Comments from Jim Davenport: David explained that he had sent the group the draft Livestock/CAFO Work Group Summary that Jim Davenport had written. There had been one set of comments in response which Jim and David had addressed. The group was invited to comment now as well. A member had the following concerns: on page 2, last sentence in paragraph 1 there was a concern that the following sentence may not be consistent with the NAA: "Losses due to volatilization or denitrification during storage are estimated at 35%." Ginny stated that this came from the NRCS Waste Ag Handbook and she would send Jim/David the citation as the information had already been provided to the authors of the NAA. The next concern was on page 1 in the second paragraph, first sentence "The Livestock/CAFO Working Group defers to the WSDA's Nitrogen Availability Study . . . ." because the member couldn't agree with it. Jim noted that the work group hasn't defined or quantified the available source contributions. A member suggested that perhaps something could be added here that says that dairy nutrient management plans are not publicly available and cannot be verified. In the last sentence of that paragraph there was a concern that the "identification of areas where other sources or forms of contamination primarily bacteria, overlap with or are related to nitrate sources" was being dumped on the Data Working Group. On page 5, first sentence in paragraph 3, the member was concerned that this sentence belonged in the IAWG piece. Ginny thought it was suitable here because it is pertinent and part of the requirements for AFO's and CAFO's. The member was also concerned about the first sentence in paragraph 2 on page 6 ("The distinction between a lagoon, a settling basin, a settling pond, or a pond can be hard to clarify") because she felt that if ponds weren't addressed in the NAA they shouldn't be cited in this report either. Ginny stated that it might be helpful to define the word "pond" as irrigation ponds or settling ponds. Another member wanted to know what this sentence meant. Ginny said it meant clarification was difficult due to different practice standards.

The member was also concerned about the description of pens and composting areas on page 7. Another member responded and said he wasn't willing to say pens and lagoons leak if it wasn't noted that there were safeguards which prevent pens and lagoons from leaking. Other members disagreed with this characterization and there was additional discussion. Ginny suggested that this was not done purposefully and that regulators are taking a closer look at composting to make sure it was meeting the true spirit of solid waste rules as this was addressed in the CAFO permit and NPDES. The member explained that she had attempted to read the report as someone who was new to the topic. She also asked that Jim reference the citations. Jim indicated that he would do that when all of the revisions were complete. Ginny complimented Jim on the job he had done.

Draft Livestock/CAFO Work Group Report: David reminded everyone that they had left off at 2C in their review of the document at the last meeting. He read each comment and the portion of the document each comment referred to. The following is a brief summary of the discussion that ensued on each item: 2C) and 2D) The comments explain the references. 2E) David stated that TMDL's showed that implementation of BMP's can make changes. A member stated that there was a need to improve implementation.

3A) A member had learned from a public disclosure request that the average inspection consisted of 1.6 hours. Ginny explained that additional time was actually spent prior to the visit reviewing the producer's file and reviewing records after the visit. She believes, therefore, that each inspection takes six to seven hours not including drive time. Ginny added that nothing directs a standard time and that when travelling they will schedule inspections every two to three hours. Ginny suggested that the group might recommend the DNMP evaluate their inspection protocols. 3B) There was concern about including a complete dairy nutrient management plan in the document as it could be two to three inches thick in size (rather than the outline of the plan that exists presently). Ginny suggested that she provide a template of the summary document. David and Ginny will team together to see what can be done.

4A) The group discussed the comments at great length. Ultimately Jean (who had made the comment that BMP's have been in place for years and have not succeeded in preventing the high levels of nitrates in LYV groundwater that we see today) agreed to delete her comments on BMP's. 4B) Again, these comments caused a great deal of discussion as RCRA has an agriculture exemption and is federal law not state law even though it has been used to address overapplication to cropland. Ginny suggested that there be a reference to WAC 173-350 solid waste rule. David indicated he would add more clarification and reference.

5A) Comments were accepted as written. 5B) David will reflect on both of the comments. 5C) Both Ginny and David agreed Eastern Washington needs more DNMP inspectors. A member agreed since the percentage of cows are higher in this area than Western Washington. 5D) Jean will send Steve the figures verifying the statistic she quoted. Steve indicated that $900 million was pumped back in to the economy by dairies who are second only to fruit in farmgate in Yakima County and the State. 5E) David indicated that he didn't believe the comments were adding to the document and said he had merely identified organizations that could carry the project forward. 5F) David stated that when people get on the new permit there will be better tracking and thought that end users should provide their own reporting. David added that there was an incentive in the permit to do so. A member didn't think composting was a big part of the CAFO permit. David will look into it.

6A and B) David spoke with Melanie Redding about the adaptive management plan in the permit and noted soil testing took up two-thirds of a page. He added it was normal to put a plan in place before adapting. Jim agreed and believed that the general statement David made was appropriate. His interpretation was that the group was agreeing to use an adaptive management approach which he defined as: the more you learn, the more you adapt and do better. 6C) David stated the group could discuss the new CAFO permit at the group's June meeting if desired. No one responded.
6D and F) David indicated he used the opinion about a County ordinance generally shared by the group and based on his own experience. David added that he didn't think an ordinance could be done in time for this plan so it was his opinion that the group should spend time on what could be done. 6G) No additional comments. 6E) David asked and yes, it is at the discretion of the regulatory agency involved. 6H) Steve once again noted that AKART is not backed up by science.

7A) David looked it up and the topic was discussed at the December meeting and the consensus was that they were short on resources. 7B) David said that there were examples of unfounded complaints. 7C) David doesn't know that the GWMA was asked to do this, but it has already been started and will be a part of the implementation. 8A) David explained he had provided publications everyone was familiar with that could help guide. 8B) David stated that he was trying to expand beyond dairies – the agricultural community can assist a lot as we go forward. Some programs already exist and could use a boost. David will clarify some more but there are a lot of other sources of funding. 8C) David thought the group had a good conversation on this earlier in the meeting. Ginny and David are already communicating in order to understand and coordinate better. 8D) David said his reference to unfounded complaints was not meant to be insulting and added that the new CAFO permit plays a part in this as well.

9A) The lead entity is currently Yakima County but eventually it will be someone else, most likely Yakima Health District or another entity. The ambient monitoring network and well testing by USGS and PGG will monitor and collect data. The member noted that those were GWMA-wide monitoring systems and not specific for Livestock/CAFO's. David said that data from these wells will reflect CAFO's influence. The member added that if the group says BMP's are the solution she wanted to know how those would be monitored. Ginny indicated that they would be monitored through the new CAFO permit, and dairy nutrient management plans. She added that there was more transparency in the CAFO permit, including a manure pollution prevention plan. David said a combination of entities will take this on – the Conservation District, Ecology, WSDA, and the entity that takes on the plan.

Jim said David will now work on finalizing the documents the group reviewed. These documents will be consolidated with all of the working group reports and everyone will have a chance to review them again at a GWAC meeting. The meeting concluded at 8:00 PM.

Resources Requested

Recommendations for GWAC

Deliverables/Products Status

Proposed Next Steps

- Recommend that EPO request a fact sheet that explains agronomic rates.
- Recommend that EPO explore and purchase the 7-8th grade school curriculum Ginny Prest identified on growing food which included the nitrogen cycle.
- Recommend the additional responses to EPO Questionnaire No. 6: 1) Promote on-going research for managing animal nutrients and 2) Promote new products that are found through research. Promote markets for those products.
- Ginny will provide Jim Davenport and David Bowen with the citation from the NRCS Waste Ag Handbook for the statistic found in the sentence "Losses due to volatilization or denitrification during storage are estimated at 35%.

[Education and Public Outreach]

Charge from Groundwater Management Area Advisory Committee

Working Group Members

Andres Cervantes (GWAC-DOH), Jean Mendoza (GWAC-Friends of Toppenish Creek), Elizabeth Torres (Citizen), Gretchen Stewart (EPA), Patricia Newhouse (GWAC-Citizen Rep Position #2), Joye Redfield-Wilder (Ecology), Stuart Turner (GWAC-Turner & Co), Ignacio Marquez (AGR), Jessica Black (GWAC); Lisa Freund (Yakima County-Chair)

Meetings/Calls Dates

Meeting: Wednesday, March 15, 2017 from 1:30 to 3:30 PM.

Participants

Lisa Freund (Chair-Yakima County), Patricia Newhouse (GWAC-Citizen Rep Position #2), Ignacio Marquez (AGR), Joye Redfield-Wilder (Ecology), Andres Cervantes (GWAC-DOH), *Jessica Black (GWAC), and *Gretchen Stewart (EPA). *Via phone

Key Discussion Points

The meeting was called to order at 1:33 PM. Lisa welcomed everyone and reviewed the agenda.

<u>Debrief the "What You Can Do to Protect Well Water" Campaign</u>: Lisa passed out a summary of campaign Outreach and Expenditures for March and April 2017. The Daily Sun News insert went out on a Wednesday with the shopper so it was delivered to both subscribers and in the mail to the general residency. A member had received the insert and found it very colorful. 22,700 inserts had been sent out between the two papers at a cost of $4,013.90 and targeted mainly the Lower Valley GWMA. Lisa said the County had received several calls as a result of the insert. Andy Cervantes agreed to field Spanish-language questions; Lisa will inform Yakima County personnel to send Spanish-speaking inquiries to him. In addition, working group members Andy Cervantes and Ignacio Marquez were interviewed on Radio KDNA and Commissioner Rand Elliott on KIT. Both Andy and Ignacio thought the interview went well. Their message was simple: find your well, fix it, sample it and treat it, if necessary. They also emphasized that they wanted to hear from folks about the challenges they face so that they could convince people who have funds to provide them, but were disappointed at the number of calls into the program. They agreed that Francisco did well asking questions that led into the talking points Lisa had prepared. Lisa said that Rand's interview with KIT lasted 10 minutes and was replayed later in the day. She listened to the interview and said that the interviewer did a remarkable job at hitting every talking point. The group agreed that 22,000 flyers and two radio interviews accomplished the goals set at last month's EPO meeting. The group was also pleased that the outreach had been completed within a month of the flooding in Outlook.

The group also discussed the Walmart flyer distribution that had been postponed due to extenuating circumstances. Walmart agreed to reschedule the distribution to April 29. Ignacio and Andy agreed to check their calendars for availability. Jessica agreed to recruit students to help as well. The new date would allow for the table, tablecloth and banner to be displayed allowing the community to see the GWMA branding. The group agreed that it was good to continue these outreach efforts. Pat had also tried to contact Fiesta Foods twice, but failed to get a response. Ignacio had a contact and was going to see if he could work out a time for this outreach venue as well.

Lisa also reported that she had spoken with Vern about the well assessment sampling survey offer. Vern indicated that since this endeavor would be a continuance of data collection the GWAC must make the decision to spend any additional money. Unfortunately the data collected from the previous two endeavors (460+ surveys) was not as helpful as they had hoped due to some unforeseen circumstances. Andy agreed to look at the data to see what might be learned from it. Lisa will send it to him. Another member suggested that he determine if it could be mapped as she thought this would be helpful. A member added that if the request for additional assessments was going to be presented to the GWAC it would be important to tell them why they should approve it and the benefit to the plan. Another member noted that the just-completed "What You Can Do to Protect Well Water" Campaign only elicited two calls to the County. After lengthy discussion the group agreed that none of the outreach done to date elicited much response and that the efforts to get information out to the community should continue, but well testing could be done at the homeowner's expense. The group also discussed other methods of communication, but felt that the outreach effort had been their best.

"What Can You Do" Flyer Distribution: The group agreed to include the flyers in the next GWAC agenda packet. It was also suggested that they be made available at the Yakima Health District, KDNA reception area, a local veterinarian clinic, Public Services at Yakima County and the Department of Ecology. They are also currently available online at the Yakima County website. Pat reported that she spoke with both the library and post office in Sunnyside, but neither had much space available for display. Another member suggested that a video be filmed of proper well maintenance. Andy indicated that the Department of Health website included a short video on this topic which he will find and send to Lisa. The group agreed that the link could be added to the GWMA page on the brochure. Lisa will also check into putting the video on the County Planning Division and Water Resources Division Facebook pages and determine their ability to provide feedback. Joye will prepare a short clip to go with it.

2017 Outreach - Working Groups: Lisa reminded everyone that at the January EPO meeting Vern explained the expectation under the grant for the GWAC to: 1) report on what had been accomplished; 2) describe the group's audiences; and, 3) explain the group's main talking points. As a result, EPO had asked the Working Groups to complete questionnaires with a series of six questions. Answers to those questionnaires had been summarized and provided to the members prior to this meeting for discussion. Several members stated, however, that they were still confused about what they were expected to do. Lisa rephrased and asked the group how this information could be used to answer the question "what have the working groups accomplished in the last five years." After a great deal of discussion the group agreed that they needed to better understand the purpose of the outreach before they could develop a plan and felt that Lisa should update Question No. 2 on behalf of EPO. The group also made the following points for consideration once the goal was better understood: 1) According to the agreements reached by the GWAC only Vern and/or the Commissioners could act as spokespersons. 2) It was suggested that the questionnaire be given to the GWAC for their direction on what kind of short term and long term recommendations for outreach/messages they would like delivered and that the working groups be reminded that EPO is the marketing arm of the group and ask if they have any messages they want presented to the community in the short term. 3) It would also be helpful to know when the GWAC report would be finalized as some members felt this was a "need to know" before providing a status report to the community.

Next Meeting and Next Steps: The next EPO meeting is scheduled for Wednesday, May 3, 2017 at 1:30 PM, Yakima County Courthouse Room 419. The meeting was adjourned at 3:34 PM.

Resources Requested

Recommendations for GWAC

Requesting clarification on short and long-term recommendations for outreach and messaging.

Deliverables/Products Status

"What You Can Do to Protect Well Water" Campaign was successfully completed.

Proposed Next Steps (Summary of ACTION STEPS)

Ignacio: Determine availability to help at April 29 Walmart outreach and let Lisa know. Check with friend about handing out flyers at Fiesta Foods in Sunnyside.

Andy: Determine availability to help at April 29 Walmart outreach and let Lisa know. Locate the link to the Department of Health video on caring for your well and send it to Lisa. Look at the well assessment data from the last two rounds to see what could be learned from it and map it if possible.

Joye: Provide Facebook Spanish contacts. Prepare a short clip to go with the Department of Health how to care for your well video for the various sites.

Lisa: Email Jessica with details about April 29 outreach at Walmart for recruitment purposes. Add video from DOH to GWMA website and check on posting it to the Planning and Water

Resources Facebook pages and the ability to get feedback once it is posted. Provide the well assessment data from the last two rounds to Andy for study and possible mapping. Place the "What Can You Do" brochures in the GWAC agenda packets for April 20. Update Question No. 2 on the Questionnaire Summary for EPO. Ask Vern to clarify 2017 Outreach goals.

<u>Jessica</u>: Recruit students for April 29 outreach at Walmart.

[Education and Public Outreach]

Charge from Groundwater Management Area Advisory Committee

Working Group Members

Andres Cervantes (GWAC-DOH), Jean Mendoza (GWAC-Friends of Toppenish Creek), Elizabeth Torres (Citizen), Gretchen Stewart (EPA), Patricia Newhouse (GWAC-Citizen Rep Position #2), Joye Redfield-Wilder (Ecology), Stuart Turner (GWAC-Turner & Co), Ignacio Marquez (AGR), Jessica Black (GWAC); Lisa Freund (Yakima County-Chair)

Meetings/Calls Dates

Meeting: Wednesday, June 7, 2017 from 1:30 to 3:30 PM.

Participants

*Lisa Freund (Chair-Yakima County), Ignacio Marquez (AGR), Joye Redfield-Wilder (Ecology), Jim Davenport (Yakima County), and *Melanie Redding (Ecology). *Via phone

Key Discussion Points

The meeting was called to order at 1:31 PM by Jim Davenport who explained that Lisa went home unexpectedly and asked him to chair the meeting. Lisa joined the meeting by phone.

Data Collections Working Group Short and Long-Term Messages: Lisa introduced Melanie Redding, chair of the Data Collections Working Group, and explained Melanie had been invited to communicate her committee's needs for short and long-term messages. Melanie stated we have an opportunity to tell the public about the role of the GWMA, the data that has been collected, explain why it has been collected, communicate the results, provide an explanation of what the results mean and where the information could be found. She added that it would be important to determine where the information should be stored and the need for the information to be as accurate as possible. Melanie asked that the EPO determine strategies not only for "how do we communicate with the public" but also how to tie economic benefit back to positive actions (e.g., save money by using less fertilizer) in addition to protecting the groundwater. Lisa suggested the EPO should work with a summary of each of the Data Working Group's accomplishments in order to determine a public relations plan. For example, EPO could say "here is the data we are gathering which will tell you about the health of the water where you are" and that the data will be updated. Lisa asked Melanie to provide EPO with narrative summaries (approximately 75 words, three paragraphs, 25 words each) on all of the monitoring efforts; what each effort covers, what each is intended to do, and where supplemental information could be found.

As an example Lisa asked Melanie to summarize the Nitrogen Availability Assessment (NAA). Melanie stated the NAA is a living document designed to disclose relative contributions to nitrates in the groundwater from all available sources in the Lower Yakima Valley. She said the NAA was not meant to be precise but will allow the GWAC/GWMA to focus in on the numerous sources that could be impacting people's water quality. She believed it provided a holistic approach to improving numerous sources because the data is in GIS and will allow people to zoom in on potential sources around their homes. A member thought the suggested summaries would provide a tool to give additional direction for outreach as it would allow EPO to determine more accurately who the target audiences would be. Jim did caution that the NAA was in draft form - the working groups had been briefed and the GWAC members were reminded at a recent meeting to submit their written comments. The authors would then consider the comments and ultimately the GWAC will decide whether to accept the assessment but regardless it will likely be published by the authors. Jim anticipated this project would be done in the next few months. Both Lisa and Melanie thought it would be good to get permission to share the NAA once the work was done. A member also mentioned that the EPO Questionnaire may have been an important exercise for the working groups because it required them to identify specific program outcomes and noted that although the outreach may have to wait until September, they really are key messages. Melanie stated that a lot of the spreadsheet ties into ambient monitoring strategies but it was a good exercise with good information noting that the group has to wait for the GWAC to catch up.

The group discussed additional outreach ideas as follows:

A member wondered whose website will permanently house the information produced, who will update it and who will analyze the data? The group thought it would be important to determine and achieve clear web posting of the GWMA Program and data reports; focus sheets and outreach materials – a permanent repository for materials once the GWMA process is complete and the committees disband.

A concern was expressed that the group not reinvent the wheel in its attempt to reach its targeted audience as much of this information is already available through the Department of Ecology, the State Department of Health, the State Department of Agriculture and the Yakima Health District. The member also pointed out that partnering may help to leverage funding. The group also recognized that others were educating a variety of stakeholders, e.g., the South Yakima Conservation District and Washington State University Research and Extension Center. Jim said that many of the working groups had agreed that these agencies were underfunded to accomplish this task and one of the recommendations of the working groups was adequate funding to employ additional personnel for outreach and educational purposes.

Another member felt it was important to inventory and track what the group had already done specifically, i.e., "this information was shared with these people at these events." Jim added that the Livestock/CAFO working group had recommended an evaluation in five years mostly to assess how well behavior modifications are being implemented.

Joye explained Ecology puts together focus groups and asks them "what would it take to make you change ________ behavior?" Based on the responses of the focus group, grant funding is sought and plans made to proceed to change community-based behaviors. Lisa thought focus groups or surveys may be a route the group would want to explore to identify what it would take to change behavior in the GWMA. Lisa added that it would be irresponsible to recommend strategies that EPO had already found ineffective. Focus groups or surveys could help EPO focus GWMA program messaging. A member suggested that the group could elicit feedback from GWAC members, particularly commodity and agricultural stakeholders and conservation districts to determine best approaches to achieving educational goals. This could be done in tandem with other community-based outreach efforts. Jim noted that "incentives" was a subject that had been tangentially discussed in the working groups over several meetings, but there had been no previous suggestions about how to approach behavioral modification. The suggestion could be implemented by EPO within the remaining months of the GWAC, or could be added to the EPO's list of alternatives list, or both.

EPO Proposed Alternatives: Jim presented the group with a list of EPO Proposed Alternatives to consider and explained that the list had been derived from a review of all the working groups' written summaries from the middle of 2015 to present, and contained everything on the subject of education. Jim also provided a handout to help the group winnow down potential solutions at the working group level.

A member suggested that the group add a recommendation for a webpage, website accessibilities, and content and it be housed somewhere as she had outlined previously. Jim thought this was on the Yakima County list. Jim said that there is also a recommendation that someone become the lead agency, and noted that one suggestion was that it be Yakima County. He added that other entities had been suggested: Yakima Health District, South Yakima Conservation District, Department of Ecology, Department of Health and Washington State University, but he thought the lead agency would be Yakima County. The group also discussed the working association between the Yakima Health District and Yakima County.

A member thought the list was great but needs action verbs. Another member thought it was important to build an outreach plan as actual implementation had not been included. She also thought the group should remove education in public schools from the list because she wasn't sure this was feasible but Jim noted that the group's job was just to get the list edited and changed – the other columns, which represented the criteria for the alternatives from the WAC, could be sorted through once the list was complete. The group also discussed various ways to analyze the criteria, e.g., costs could be rated by high, medium and low. Jim added that there was no direction in this regard from the WAC. Lisa said that when the EPO developed its budget four years ago they employed a range system and thought it worked well. Jim said that some things on the master list will require cost numbers like the ambient monitoring network.

A member noted that she saw duplication and thought the list could be winnowed down. Another member thought it was a good starting point and suggested that the list be sent out to the working group for consideration prior to its presentation to the GWAC. Joye agreed to review and edit the list first then return it to Bobbie who would send it out for the entire group's review. It was agreed to give the group until Friday, June 23 to suggest additions or make any other changes.

Joye mentioned Access Washington which hosts web information for free (there is a fee for the set-up). This could be a neutral location and a link to the site could be on the County website. It is cloud based so there lots of storage. EPO could look into it to make sure they wanted to recommend it.

Next Meeting and Next Steps: The group agreed to reschedule the next EPO meeting to Tuesday, July 18, 2017 at 1:30 PM, Yakima County Courthouse Room 418. The group agreed to finish its work on recommended alternatives and what messages can be communicated in the short-term at this meeting and discuss the format of the "Fire Adapted Communities" brochure (located in the kiosk in the foyer of Yakima County Public Services) for use as a model for an EPO publication. Jim liked the how-to's found in this brochure. The meeting was adjourned at 3:25 PM.

Resources Requested

Recommendations for GWAC

Deliverables/Products Status

Proposed Next Steps (Summary of ACTION STEPS)

Melanie: Provide EPO with narrative summaries (approximately 75 words, three paragraphs, 25 words each) on all of the monitoring efforts; what each effort covers, what each is intended to do, and where supplemental information could be found.

Joye: Review and update the Proposed EPO Alternatives and talk to the "community change" person at Ecology to gather information on focus groups.

Everyone: Review and approve Proposed EPO Alternatives; make additional suggestions if appropriate. Return to Bobbie by Friday, June 23. Review the "Fire Adapted Communities" booklet available at the kiosk in the foyer of Yakima County Public Services. Jim thought this was a good model for an EPO publication.

Joint Data, Livestock/CAFO, Irrigated Ag, RCIM and Data Collection and Monitoring Working Group Meeting with Nitrogen Loading Assessment Presentation

Charge from Groundwater Management Area Advisory Committee

None at this time.

Working Group Members

Troy Peters (Chair, Irrigated Ag), Melanie Redding (Chair, Data), David Bowen (Chair, Livestock/CAFO), Dan DeGroot (Chair, Residential, Commercial, Industrial, Municipal)

Meetings/Calls Dates

Location: Yakima County Roads Maintenance Conference Room

Date/Time: Thursday, April 13, 2017 / 10:00 AM – 4:00 PM

Phone Line: (509) 574-2353 – PIN 2353#

Participants

Rand Elliott, Vern Redifer, Jim Davenport, Melanie Redding, Dave Cole, Steve George, Ron Cowin, Sheryl Howe, Stuart Crane, Jean Mendoza, Corina Hayes, Sandy Braden, Bud Rogers, Kathleen Rogers, Dan McCarty, Mark Peterschmidt, Ginny Prest, Laurie Crowe, Rodney Heit, Lisa Freund, Marivet Lombera, Joshua Tsavastewa, Frank Lyall, Larry Fendell, Doug Simpson, Kevin Lindsey, Mike Martian, Gary Bahr, Hector Castro, Margaret Drennan, Perry Beale, Kelly McLean, Laura Butler, Jaclyn Hancock, Andy Bary, Marlene Carpenter and Bobbie Brady (Yakima County Staff Support). Andres Cervantes (participated by telephone).

Key Discussion Points

Melanie Redding opened the meeting at 10:06 AM and welcomed everyone. She explained the logistics for the meeting and had everyone introduce themselves. Melanie reiterated the goal of the GWMA was to reduce nitrates in the groundwater and that the task of the nitrogen loading assessment was to determine how much loading was coming from different sources so that the GWAC could determine how to direct future limited resources and assist with developing strategies.

Nitrogen Cycle/Nitrogen Fate and Transport (Andy Bary): Melanie introduced Andy Bary, a Senior Scientific Assistant who works in the Department of Crop and Soil Sciences for Washington State University in Puyallup. Andy was invited to the meeting to make a presentation on the nitrogen cycle, composting and manure management. In his presentation Andy explained the different forms of nitrogen, the nitrogen cycle, factors effecting nitrogen mineralization, how organic matter and nitrogen interacts, and the cumulative available nitrogen from an organic source. Andy went on to explain the biology of composting including a summary of the requirements for aerobic and thermophilic composting, oxygen consumption, the phases of aerobic composting, temperature changes in an average compost pile and the variety of ways one can compost. Andy asked for questions. A member asked if organic nitrogen was soluble in water. Andy said generally not. Another member asked about the time frame for availability of nitrogen in successive years. Andy said that after four or five years it becomes more difficult to discern (too small to measure) and there is not much impact. A member asked about the carbon to nitrate ratio; Andy indicated at 20 to 30 neither is available or it is minimal as they offset each other. Another member asked if it would help if a five year moratorium on fertilizer application was put in place. Andy indicated that he didn't think this would solve the problem. Last of all a member asked how the amount of moisture from irrigation or rainfall effects nitrates. Andy answered that in the winter temperatures are a driving factor because it becomes too cold for water to drive anything. When the soil warms up water drives but in a gross matter when it is too dry the microbes are not active. He added that if it's too wet it goes from an aerobic system to an anaerobic and you get N20 and N2 gas.

In his composting presentation Andy defined composting as a controlled degradation of matter (controlled rotting). He noted that WSU offers a week long class to train compost operators and some dairy personnel attend these as well. A member indicated that they had heard that 50 percent of nitrogen was volatilized in composting. Andy stated that it was dependent on the method and quantity. The member then asked if he could provide a range and Andy said no; he would rather get back with a correct number. The member continued and said that in deep soil sampling they had heard a reference made to pore water. Andy said that there is less pore space in composting as the soil is compacted. He added that water is in pores in every level of soil but this is immaterial to nitrates. Another member asked why biosolids are only heated up to 100 degrees if 131 degrees was the appropriate temperature to heat up to for compost. Andy answered that biosolid treatment plants are usually dealing with liquid materials and that 100 degrees will still work but in a different time frame; higher temperatures just take less time. A member asked the preferred temperature for manure composting. Andy indicated that the composting temperatures he referred to is what was required for pathogen reduction for vegetables. Since composted manure could be used to grow cow feed, e.g., triticale, corn silage, etc., composting temperature requirements would be less. Another member asked if Andy had done any work on composting materials that leach nitrates in the groundwater. Andy said only terms of manure and water moving through it and leaking to the soil. A member asked if fungus was more active in lower temperatures below 131 degrees. Andy said that above 160 degrees, between 130 to 160 degrees and below 120 degrees there are different types of microbes. Last of all a member asked if moisture content effects fungus in compost. Andy said yes. As a follow-up question a member asked what kind of fungus is left. Andy said all kinds but he doesn't analyze them and added that every time a compost pile is moved it discourages fungus growth. Ginny Prest reminded everyone of the fate of water in compost piles during the compost process – it is either retained or goes into the atmosphere and is evaporating as the composting process causes water to dry. A member asked that Andy's power point presentation be placed on the GWMA website.

<u>Nitrogen Loading Assessment Overview:</u> Melanie reminded everyone of the process and noted that as the assessment evolved it had become a larger challenge because the group wanted to do it

right and provide the best possible information. The goal of the meeting was to hear from the authors, what they did, their thought processes then ask questions for better understanding. After the working group review and comment period the study would be presented to the GWAC for their review and questions before being finalized. It had been the groups' goal to make the nitrogen loading assessment defensible, transparent, reproducible, and in a format that was consistent, easy to read and understand. Melanie also noted what the document was designed to be and not be. Melanie added that it addressed nitrogen loading to land surface not to ground water and it was not meant to point fingers. She also reminded the group of the ground rules for a productive meeting. Gary Bahr added his thanks to the team and those who peer reviewed the document. He stated that it had been the goal of the Washington State Department of Agriculture (WSDA) to get reliable data that met QAQC, literature review and literature assessment. Each assessment would provide a low, medium and high range and would include a spatial product so it could be related to GIS and reviewed and updated in the future. Gary introduced Margaret Drennan as she had done most of the analysis of the data. Gary noted Margaret had a master's degree in Environmental Engineering and worked for a period of time with dairy nutrient management.

Nitrogen Loading Assessment Presentation CAFO's (Margaret Drennan): Margaret spoke first on CAFO's (Concentrated Animal Feeding Operations) and provided some background information including studies utilized and the areas of focus. The CAFO Management Units were determined to be: irrigated cropland (which would be included in the Irrigated Ag section of the report), animal housing (pens, barns, and pastures), compost areas, and impoundments (lagoons ponds, and settling basins). She explained how pens and compost were identified and defined (for both dairy and non-dairy CAFO's). Margaret also stated that they were unable to calculate the loading rate of compost because they don't have the numbers available to analyze. She emphasized that they aren't claiming they don't have a loading rate and noted that if the information would become available it could be added in and redone.

A member asked if the raw data was on file and could be shared. The data had been sent to the County for layering in GIS. To share it with members would require specific computer programs and that data is too large just to place online otherwise. The member also asked about the average stock rates per pen utilized in the report and the reason for dividing them into dairy and non-dairy pens. Margaret stated that the per pen numbers came from the UC Davis report. The pens were broken down by dairy and beef cows because someone may want to look at this in the future because the nitrogen count in manures differs between cows. She added that the assessment used milking and dry cows; no calves or heifers. The member also asked why there was no calculation of nitrogen emission rates to the atmosphere. Margaret responded that this was outside of the scope of this report. The member asked if runoff would increase since the interface layer in CAFO lots inhibits infiltration. Margaret responded that any runoff is channeled to the lagoon. Another member asked if meteorological conditions are similar to California how does that apply to irrigated areas. Again, the response was that is not in the purview of this report.

Margaret began her review of lagoons and how they identified them, the limitations, their methodology, nitrogen concentration and liner permeability, thickness, depth and surface area. She also passed out a handout with general site information to aid in the presentation before providing the lagoon results and CAFO conclusions and recommendations. Margaret asked the group if they had any questions. A member noted that they had seen on page 22 of the report that dairies are required to do sampling. Ginny Prest responded and stated that these samples are not submitted to the State but are available when WSDA is inspecting. A member asked if they had calculated acreage for lagoons with liners. Margaret responded and said that they did some summary information; they had two different databases but they didn't match up. The member noted that in 2005 on-the-ground and aerial surveys were done and spreadsheets were compiled. A couple had caught her eye as very large. Margaret stated that they assumed there were compacted clay or bentonite liners not synthetic liners and that these may be avenues to look into in the future.

A member noted that there were 115 lagoons in the report and wondered if they had made any depth or average surface area calculations. Margaret responded that there were 240 lagoons and/or ponds but they did not calculate all of them as they assumed some were not manure storage ponds but irrigation storage ponds. She acknowledge that there was some gray area. The irrigation ponds were not part of the calculations.

<u>Nitrogen Loading Assessment Presentation Irrigated Agriculture (Kelly McLain and Perry Beale):</u> Kelly discussed the limitations of the assessment and turned the presentation over to Perry Beale who explained his methodology in this mass balance study. Perry collected most of the data through a telephone survey. A member asked if producers had provided recommended or applied applications. Perry indicated he received some of both. The member was concerned that the numbers provided were a large stretch since most growers refer back to the WSU handbook. Perry stated that he felt it was important to get local values. Perry provided several handouts and illustrations and noted that the goal had been to provide low, medium and high values. Both the low and high values were the actual reported values. For the medium value they used a weighted value which is the most accurate value.

A member was concerned that one survey represented a large amount of the acreage and therefore weighted the ultimate calculation. He was also concerned that the numbers only reflected a one year snapshot as winter kill, drought, a high commodity crisis, or the ability to mine the nitrogen already in the ground in ensuing years would significantly change the answers. He believed that a study should look over a period of 20 years. Perry thought the member made a good point. Melanie asked if the member had any suggestions as to how this might be done. The member stated that without time and money this would be difficult and expressed a concern that researchers had little comprehension of the real world. Margaret pointed out that the assessment was a starting point and that their biggest recommendation was to calibrate this against the deep soil survey. The member was also concerned that farmers provided accurate information. Perry felt that the bottom line was that data collection could continue as the process had been set up to accomplish this. Another member noted that she thought analyzing the deep soil sampling and comparing it to this data was within the scope of this project and asked how many people were contacted. Perry responded saying that he had contacted approximately 50 people and that some wouldn't give the amount of their acreage. The member also wanted to know how they had reached their estimates for composting. Perry said that typically an analysis was available and for manure they used information from the DNMP work they had done although slurries and solids/liquids were different. When asked for the amount of nitrogen in compost the answer was that some were as high as 10 percent. The member noted that she found a lot of over application of nitrogen in the Deep Soil Sampling variance in the spreadsheet for alfalfa. Perry said he had the data and the number was 8.2 percent and they do apply manure. There was concern about a faulty conclusion on fields in the deep soil sampling. It was noted that alfalfa can actually fix nitrogen. One last point was that a member didn't see where adjustments for denitrification had been made in the study.

<u>Nitrogen Loading Assessment Presentation Residential Commercial and Industrial (Vern Redifer):</u> Vern stated that he had compiled and written the report with help from Mike Martian and Cynthia Kozma of the Yakima County GIS Department. The goal was to look at loading from all of the sources in the residential, commercial, industrial and municipal areas in the GWMA. Sources included residential on-site sewage systems (ROSS); large on-site sewage systems (LOSS); commercial onsite sewage systems (COSS); fertilizers and small scale commercial and hobby farms. Vern noted that no sources had been found in municipal areas. They had learned that there are 6,044 households that utilize residential systems (ROSS) and were able to calculate the total nitrogen output in low, medium and high ranges using a variety of studies and information available through the County. Vern provided a data input summary and noted that they had also considered the migrant population effect on ROSS as a result of input from various members of the RCIM committee. Vern went on to explain that two large systems (LOSS) exist within the GWMA area as well. These are systems that are designed to handle more than 3,500 gallons per day and they must be registered with the Department of Health. Vern explained their methodology and conclusions. Vern moved on to commercial systems which are septic systems used for employees working at Ag businesses that operate year-round and are not classified as a LOSS by the Washington State Department of Health. He noted that there really are none, but since they knew businesses do operate and are not large enough to register with the Department of Health because they emit less than 3,500 gallons per day they had designed a category. Vern explained how the group had come up with their calculations and methodology and provided an output summary. He did the same for residential lawn fertilizer and small scale commercial and hobby farms noting that the output of nitrogen for these was relatively small. A member asked if the group had done any work on bio-solids. Perry Beale noted that it was part of the organic piece. Vern added that they had learned that bio-solid application was highly regulated by the Department of Ecology – both how it is applied and the agronomic rates of application. Vern added that the Department of Ecology could provide how many acres were approved for the application of bio-solids, but they don't know how many are actually applied.

<u>Nitrogen Loading Assessment Presentation Atmospheric Deposition (Kelly McLean):</u> Kelly explained the methods used to determine atmospheric deposition in the GWMA and provided the results. She noted the calculation was for lands in the GWMA only; excluding lagoons and pens and irrigated agriculture as those calculations were contained in their respective reports. They had even taken into account the poor air quality in December in Yakima County. Jim Davenport wanted to know how to get the total atmospheric deposition number for the GWMA. It was suggested that he take the total acreage (out of the Irrigated Ag piece) and multiply it by the number of total deposition (tons N/year). There was no good solution for pulling out the information for lagoons and pens and no good resolution. Melanie said that if anyone had an idea as to how to handle this dilemma, please make suggestions during the comment period as it was their desire to

make this the best useable document for the GWAC. Another member noted that the rates found in Tulare Lake (California) which was similar to the GWMA were nine pounds per acre. Vern stated that he had derived information from the National Atmospheric Deposition Program (NAPD) for just the GWMA area and also for Tulare County and both wet and dry deposition were around four pounds per acre. Mike also did a weighted average for the GWMA and Tulare. The member stated that Tulare County (not Tulare Lake Basin) had a concentration of dairy animals closest to the GWMA and better monitoring and came in at 17 lbs. per acre. She provided maps to Kelly.

Wrap-up and Next Steps: Gary provided an analysis of all sources and stated that over the entire GWMA acreage, irrigated agriculture (which makes sense because this represents the largest amount of acreage), CAFO lagoons, and CAFO pens were the largest contributors of nitrogen available for transport. However, on a per-acre basis the largest contributors of nitrogen available for transport are different – they are CAFO pens, lagoons, and onsite sewage systems (ROSS, LOSS and COSS) because they are more concentrated. Gary Bahr provided a summary of conclusions the WSDA had reached upon completion of the Estimated Nitrogen Available for Transport in the Lower Yakima Valley Groundwater Management Area study. He also provided a geospatial data set to illustrate how GIS tools could be used in the future and added that at present the tool did not include small farms, ROSS, COSS or LOSS. (Vern will provide this data and the two pieces will be married) The example was of a six mile diameter area which contained approximately 23,000 acres with a variety of farms. Gary also provided a list of future research that they would suggest be accomplished to further calibrate the system. A member noted that in the Irrigated Ag section of the report there was no mention of cover crops and their uptake. He thought this might affect approximately 1,000 acres. Gary said that all acres were crop mapped in 2015 but they did not discern if an apple orchard, for example, had a cover crop. The member thought this should have been assumed, but noted that the type of cover crop could vary. Vern said that most cover crops were put back into the soil which may contribute to nitrates; the member said some may or may not and that orchard grass takes up a significant amount of nitrates. Gary noted that they had talked about the limitations early on in the process. The member added that it might have been more accurate to take data from the WSU handbook. Gary pointed out that the Irrigated Ag Working Group decided the survey was the better route to take.

At Melanie's direction the group discussed when and how everyone should submit comments. It was agreed that everyone should forward their comments to Bobbie. They will be summarized and forwarded on to the presenters. All comments should be in by Friday, April 28. If members are unable to meet the deadline they should tell Bobbie when their comments will be ready. A member asked if they could see the other comments. Vern indicated they would be made available when compiled.

Resources Requested

None at this time

Recommendations for GWAC

None at this time

Deliverables/Products Status

None at this time

Proposed Next Steps

- Andy Bary's power point presentation will be placed on the GWMA website.
- Members should forward their comments on the draft Nitrogen Loading Assessment to Bobbie at Yakima County by Friday, April 28. They will be compiled and sent on to WSDA.
- Vern indicated other members' comments would be made available when compiled.

Funding Work Group

Charge from Groundwater Management Area Advisory Committee

Working Group Members

Vern Redifer (Chair); Bud Rogers; Dan DeGroot; David Bowen; Ginny Prest; Jason Sheehan; Jim Davenport; Laurie Crowe; Matt Bachmann; Rand Elliott; Rick Dinicola; Steve George; Stuart Turner.

Meetings/Calls Dates

Meeting: Wednesday, June 14, 2017, 10:00 AM to Noon
Call Number: 509-574-2353 pin: 2353#

Participants

Present: Vern Redifer (Chair); Dan DeGroot; David Bowen; Ginny Prest; Jim Davenport; Laurie Crowe*; Matt Bachmann; Rand Elliott; Rick Dinicola; Steve George; and Bobbie Brady (Yakima County Support Services). *via phone

Key Discussion Points

The meeting began at 10:07 AM. Vern explained the working group was meeting to discuss future funding sources. Everyone introduced themselves and reviewed the draft agenda. Matt Bachman introduced Rick Dinicola (USGS) who was attending the meeting because of his familiarity with funding sources that may be available through USGS. The group agreed that Vern should continue on as the chair.

Funding Sources and Alternatives/Projects to be Funded: Vern passed out an excerpt from the GWAC Work Plan which outlined the duties of the group as: determining and developing short and long-term funding strategies to sustain programs and recommended alternatives from federal, state and county sources. Vern stated that the most obvious need was to fund the monitoring efforts beyond 2017. However, he added that each working group had made a list of alternative recommendations which the GWAC will begin to review. Jim confirmed that he hoped to present the list of alternatives at the next GWAC meeting for the members review. Then, two weeks later (at its next meeting) the GWAC will decide whether to accept or reject each alternative. Jim estimated that the revised list of alternatives would be back to the Funding Group in about five or six weeks. At that time the group could begin to have serious conversations regarding funding sources.

A member expressed concern that the GWAC would have a huge multi-meeting discussion on individual pet projects and wondered if there could be a plan to derive general information from the monitoring efforts before moving on to smaller projects. Others agreed, but felt that ongoing education and outreach should be a part of the initial efforts to monitor. Jim stated that Livestock/CAFO had recommended an adaptive management process which seemed to be in line with this suggestion. Rand agreed that the group would not be able to fund every small project, *but felt that until the Funding Group actually had a chance to see the list of recommended* alternatives no decisions should be made. He felt that obviously the monitoring efforts would need to continue and some smaller items would begin immediately, but it was his recommendation that the group wait to see the list of alternatives before it committed itself to a specific path. Another member saw continuing efforts in monitoring, education and outreach, technical assistance and reporting to be a priority.

The group discussed the leadership of the GWMA in 2018. One member wondered if the GWAC would continue or if the lead entity would take over. As clarification Vern reminded everyone that the WAC required the GWAC to present a program by the end of 2017. Once the program is complete the requirements of the WAC are met and the GWAC work is done. At that time it would be optimal for a lead agency to take over.

The group also discussed whether Yakima County or the Yakima Health District would be the lead entity. Rand stated that Yakima County would probably be the lead entity (Jim confirmed that Livestock/CAFO had also made this recommendation). However, Rand thought that the Yakima Health District may have a role in monitoring, but that role had yet to be defined. Members agreed that Yakima County had done a good job in their role as lead agency thus far by representing well the diversity of interests and other members expressed their support.

A member wondered if perhaps there would be a group that met quarterly to review data and formulate policy. Vern stated that this kind of arrangement would lend itself to adaptive management. Another member wanted to see an oversight board managing the lead entity in order to make sure the job was done correctly. In addition, he believed that the oversight board should consist only of GWMA stakeholders (those people who actually live in the GWMA) and no federal, state or governmental agencies. Some members disagreed and others believed that such an oversight board might want government assistance. Rand wondered if a lead agency needed an oversight committee or an advisory committee. Another member said that an advisory committee could work hand-in-hand with the lead agency and help with funding endeavors. He didn't see it as a governing board but a group to help make policy, review and suggest how to deal with data and education and outreach. Others wondered if governmental agencies needed to be a part of the voting authority. David stated that there is no problem with a governmental agency being a non-voting member. At present the Department of Ecology receives a quarterly report from the lead agency which they review to ensure the lead agency is meeting the requirements of the contract thus providing a system of checks and balances.

A member asked if the group could first find funding for the lead agency; the lead agency could then look for funding for other activities. Vern stated that once Yakima County understood the tasks he would be able to put together a cost estimate for the ongoing management of the GWMA. A member asked how much Vern thought the lead agency would need to get started. Vern estimated $100,000 per year in lead agency administration (at least a full time person and staff support). Rand indicated that the Commissioners would be presenting funding requests to the State and they could determine personnel requirements and funding needs.

A member thought the list of alternatives would include recommendations that required funding and some that didn't. He felt it was important for the group to prioritize which alternatives should be funded first in order to help create and secure specific asks. He also thought that the more entities supporting the ask, the more likelihood funding would be provided. Vern agreed that it would make an impact if the diversity in the GWAC was behind a funding request (state and local agencies, the Farm Bureau, Dairy Federation and private citizens and citizen groups). Jim stated that the list of alternatives would be presented to the group with the WAC requirements which included cost and source of funding. He thought it would be very helpful for the group to help with this process. A member stated that they thought funding sources and a priority list of alternatives were tasks that needed to be done simultaneously. Jim agreed and said that as the group moves from a general knowledge to more specific knowledge it will become easier for the group to make decisions. Vern thought the group would also be able to characterize some of the alternatives as program or project oriented. He said that in the County Roads Department a list of roads and bridges requiring work is created on a priority basis. However they don't wait for Project No. 1 to get funded if funding becomes available for Project No. 7. Thus the list is both priority based and funding based. Vern reminded that group that most funding requirements will require the program recommendations.

Vern added that the group could talk about an Aquifer Protection Area which would provide a funding mechanism through a GWMA area tax. The Commissioners could not approve this but could put it to the voters for their vote. Jim suggested that the group get the recommendations in place first.

Jim then reminded everyone that the monitoring efforts have already been approved by GWAC and the group could discuss their funding today. After some discussion USGS agreed to work out a one year plan and a two year plan which would be in sync with the legislative funding schedule. They will include an estimate for the analysis portion of the work which may be eligible for matching funding from USGS. Matt will have this information available at the next meeting of the Funding Working Group.

Next Meeting Date: Vern said that a GWAC member wanted to participate in the Funding Working Group but was only available in the evening after work. The group agreed to meet again on Wednesday, July 12, 5:00-7:00 PM at the Department of Ecology.

The meeting adjourned at 11:55 AM.

Resources Requested

Recommendations for GWAC

Deliverables/Products Status

Proposed Next Steps

USGS agreed to work out a one year plan and a two year plan which would be in sync with the legislative schedule. They will include an estimate for the analysis portion of the work which may be eligible for matching funding from USGS. Matt will have this information available at the next meeting of the Funding Working Group.

Attachment B

GWAC's April 20 Tentative Schedule for Completion.

June 29 Compiled List of Alternative Strategies.

Draft Nitrogen Availability Assessment and Attachments.

Jean Mendoza's May 18 Alternatives Presentation.

Tentative Schedule for Completion of Groundwater Management Program

Data Collection Work Group

1. May 10
   - Discuss Nitrogen Availability Study
   - Discuss process to finalize and report Well Assessment Survey
   - Discuss status of well monitoring projects and QAPP

2. June 14
   - Discuss GIS application of Nitrogen Availability Study
   - Discuss draft final report of Well Assessment Survey
   - Discuss status of well monitoring projects

3. July 12
   - Discuss GIS application Applied Nitrogen Availability Study
   - Discuss final report of Well Assessment Survey
   - Discuss status of well monitoring projects

4. August 9

5. September 13

Irrigated Agriculture Work Group

1. May 16
   - Discuss implication of Nitrogen Availability Study to Irrigated Agriculture
   - Discuss Final Report to GWAC

2. June 20
   - Work complete, no more meetings.

Livestock/CAFO Work Group

1. May 4
   - Discuss implication of Nitrogen Availability Study to Livestock/CAFO
   - Discuss Draft Report to GWAC

2. June 1
   - Discuss Final Report to GWAC

3. July 6
   - Work complete, no more meetings.

RCIM Work Group

1. May 8
   - No meeting, work complete

Regulatory Framework Work Group

1. May 10
   - Discuss Draft Report to GWAC

2. June 14
   - Discuss Final Report to GWAC

3. July 12
   - No meeting, work complete

Funding Work Group

1. June 14
   - Initial meeting
   - List generic funding alternatives
   - Determine Scope of Funding Needs

2. July 12
   - Discuss Funding Needs

3. August 9
   - Discuss Funding Needs

4. September 13
   - Consider funding alternatives for recommendations chosen by GWAC
   - Funding for ongoing water monitoring program

EPO Work Group

1. May 3

2. June 7

3. July 5

4. August 2

<u>GWAC</u>

1. April 20—GWAC
   - Work Group reports
   - Nitrogen Availability Study Comment Process
   - Open discussion on Funding Working Group
   - Discuss plan for completion of work by December 2017
2. May 18
   - Work Group reports
   - Discuss and Accept Nitrogen Availability Study
   - Progress Report Well Monitoring
3. June 15
   - Work Group reports
   - Catch up meeting—address issues (if any) delayed from April/May meetings
   - Discuss Final Reports from RCIM, Livestock/CAFO, Irrigated Agriculture and Regulatory Framework Work Groups
   - Discuss GIS application of Applied Nitrogen Availability Study
   - Discuss final report of Well Assessment Survey
   - Progress Report Well Monitoring
4. July 20
   - Work Group reports
   - Consider draft consolidated working group final reports (including recommendations)
   - Progress Report Well Monitoring
   - Discuss GIS application of Applied Nitrogen Availability Study
   - Initial report of Funding Work Group
   - Consider final draft integrated working group final reports (including recommendations)
   - Consider funding alternatives for recommendations contained in working group final reports
5. August 17
   - Consider draft GWMA Program
6. September 21
   - Approve GWMA Program
7. October 1
   - Submit GWMA Program for SEPA Review
8. October 19
   - Respond to SEPA questions (if any)
9. December 21
   - Respond to SEPA questions (if any)
   - Wrap UP

Alternative land and water use management strategies for reaching program goals and objectives per WAC 173-100-100(4)			Evaluation Criteria per WAC 173-100-100 (4)						
Ref. #	Action	Proposed by	Feasibility	Effectiveness	Cost	Proposed funding	Time	Difficulty to implement	Degree of consistency with local comprehensive plans and water management programs
Remediation									
1	Pump, treat and reinject groundwater	WGD	not feasible, treatment area too large	not effective because of 3-dimensional size of treatment area	excessive				
2	Pump-and-fertilize. Use existing (or new) agricultural water wells to remove nitrate-contaminated groundwater and "treat" the water by using it to irrigate crops which will take up the nitrogen concentration in the irrigation water (presumes the existence of a proper nutrient management plan for the irrigated acreage).	Literature							
3	Fill irrigation ditches with water and let it sit there to leak into groundwater. Use groundwater recharge as a means to dilute nitrate concentrations in the groundwater.	WGD						irrigation district canal maintenance in winter, increased personnel?, irrigation district compensation, relation to water rights? problem of freezing of flow meters in laterals, interaction with Bureau of Reclamation	
4	Drill new 1,500 foot wells to replace contaminated wells .	WGD			$12 million				
5	Regionalize and connect users to a larger system with reliable quality water.—pipe connection to an existing system	WGD							
6	Blend better quality water with contaminated water to reduce nitrate concentrations	Literature	works for larger community systems with more than one water source.						
7	Construct a potable water line from nearby developed area into deadhead water stations at central rural location (permit potable water collection at deadhead water stations).	Literature							
8	Discontinue use of shallow wells. Rebuild, repair or replace poorly constructed wells.	WGD							
9	Remediate local nitrate contamination hotspots only .	Literature							
Administration/Lead Agency									
10	Identify or create an organization (Lead Entity) responsible for implementation and oversight of the LYV GWMA Groundwater Management Plan and acquisition of stable funding to support their activities. Potential entities include, Yakima County, South Yakima Conservation District (SYCD), Yakima County Health District, Washington State Department of Agriculture (WSDA), Ecology, and/or a yet to be formed entity.	L/C WG							
11	Implement an Adaptive Management Plan utilizing data collected, progress made, or lack of progress to inform the community on adjustments that need to be implemented. Plan could incorporate availability of technology, education and outreach, tracking exports, land use regulations, treatment systems, and other changes to inform decision makers regarding management changes necessary for a successful program.	L/C WG							
12	Let the lead agency determine who will do monitoring. Possible assignment of long-term monitoring after 2017 to Yakima Health District.	WGD							
13	Inform livestock operators and facilitate a dialogue with representatives of the regulatory agencies, other agricultural producers, and the general public through a public information/education program to protect the quality of the area groundwater resource. Information and incentives provided to Lower Yakima Valley agricultural operators will expedite implementation of BMPs.	L/C WG							
14	Collect, analyze, and interpret data to track water quality improvement progress, nutrients generated, applied, or exported, which will inform the implementation of an Adaptive Management Plan within the LYV GWMA.	L/C WG							

Alternative land and water use management strategies for reaching program goals and objectives per WAC 173-100-100(4)			Evaluation Criteria per WAC 173-100-100 (4)						
Ref. #	**Action**	**Proposed by**	**Feasibility**	**Effectiveness**	**Cost**	**Proposed funding**	**Time**	**Difficulty to implement**	**Degree of consistency with local comprehensive plans and water management programs**
15	Focus implementation of analyzed data based on information and data included in the *Nitrogen Loading Assessment, Soil Sampling Program, Ambient Groundwater Monitoring* Plan, USGS Reports, and other similar scientifically based publications.	L/C WG							
16	Increase education and outreach efforts by improving the availability of technical assistance to develop nutrient management plans for all livestock industries. Assist industry trade organizations to enhance their local efforts to bring information to their members. Help increase livestock operator awareness of the need for procedures for proper management of animal wastes and wastewater. Potential funding sources include industry, government, educational institutions, grants, industry associations, etc...	L/C WG							
17	Cooperate with the WCC and WSDA in their efforts to document regulatory compliance for dairies within the GWMA that are completing and implementing Dairy Nutrient Management Plans (DNMP). Explore the possibility of disclosing non-proprietary data produced through the DNMP process.	L/C WG							
18	Further develop a local forum for disseminating information and facilitating technical exchange regarding BMPs for livestock management and groundwater protection. Endorse and distribute materials by all effective means that will educate the public about the facts of livestock waste management and the science of groundwater protection.	L/C WG							
19	Quantify the nutrient value and rate of release of nitrate from livestock waste under various Lower Yakima Valley conditions to become part of the nutrient management guidelines.	L/C WG							
20	Voluntary development and implementation of NMPs by operations not already required to hold permits or a DNMP as an effective means of environmental protection.	L/C WG							
21	Allocate cost share funding or other funding assistance to operators implementing environmental protection measures.	L/C WG							
22	Develop strategies for marketing the economic, fertilizer value, and soil enhancing properties of appropriate application of manure and other livestock wastes.	L/C WG							
23	Provide Yakima County fiscal support to maintain its GIS data base on the GWMA over time.	Literature							
24	Overlay GIS density maps reflecting different sources of nitrogen in order to geographically indicate the total density from all sources.	Literature							
25	Map those areas that can tolerate more nitrogen application and areas that are more vulnerable to its application.	Literature							
26	Use USGS particle tracking model to indicate where groundwater moves faster (permeability).	WGD							
27	Assess groundwater contamination potential, making use of the available information on soils, geology, and groundwater in order to identify those areas that are the most vulnerable to contamination. These areas may be closer to surface water, areas where recharge is faster or more frequent, or areas where shallow soils overlie soluble bedrock. Identify strategies "upstream" of sensitive areas to reduce contributions of nitrate sources.	WGD							
28	Enact County ordinances that would affect the problem grower.	WGD						Difficult to enforce.	
29	Maintain the County's GWMA website.	WGD							
30	*Create an aquifer protection area.*	WGD	Requires vote of people within protection area		*Generates tax revenue*				
31	Consider the enactment of a county ordinance addressing the density of segments of nitrate producing agricultural activity within the areas currently zoned as agricultural within the GWMA.	WGD		Prospective application					
32	Consider creation of subcategories of agricultural zoning, limiting density in those areas where soils are more permeable or groundwater moves faster.	WGD		Prospective application					

Alternative land and water use management strategies for reaching program goals and objectives per WAC 173-100-100(4)			Evaluation Criteria per WAC 173-100-100 (4)						
Ref. #	Action	Proposed by	Feasibility	Effectiveness	Cost	Proposed funding	Time	Difficulty to implement	Degree of consistency with local comprehensive plans and water management programs
33	Consider "overlay" zoning ordinance adding special groundwater conservancy restrictions to otherwise conventionally zoned properties. Uses consumptive of groundwater quality resources are precluded or more generally regulated. Uses that are not consumptive of *groundwater quality resource are permitted. Specific limitations might include limitations of* water use, drainage, development density, septic use.	Literature		Prospective application					
34	Define "conditional uses" that can be allowed after assurance that groundwater resources would not be damaged.	Literature		Prospective application					
35	Consider a county ordinance concerning overapplication of manure.	WGD		Prospective application				Difficult to enforce	
36	Create county ordinance limiting total number or density of cows or dairies (lid).	WGD		Prospective application				Difficult to enforce	
37	Adopt a LYC GWMA or county-wide CAFO ordinance	L/C WG (no consensus in WG)	Lengthy public process to create a CAFO Ordinance. Uncertain outcomes and timing. Too much uncertainty to rely on this option for the plan at this time. The county might consider legislative action as an alternative if public outreach, voluntary compliance, implementation of identified BMP's, and other efforts are not effective.						
38									
39	Establish a quota system through zoning regulations establishing how much nitrogen could be applied (based on agronomic rates for individual crop types) within fixed zones.	WGD		Prospective application				Difficult to enforce	
40	Consider density limitations, building codes for farm structures, development standards for farm activities.	WGD		Prospective application					
41	Regulate crop mix to weight more toward nitrogen-light crops--	Literature						Difficult to enforce	
42	Consider limitation of septic systems (therefore building permit) where soil filtration rate is high, where housing density is already big, where nitrate concentration is already great downstream of the septic plume	Literature	Applied administratively, requires GIS mapping of soil zones					Growers view as governmental interference with economic choice if nitrogen-heavy crops generate better returns	
43	Property tax for properties with onsite septic systems, waived in the case of proper inspection and pumping	Literature							
44	Protect Critical Aquifer Recharge Areas	WGD							
45	Require bonding as prerequisite to permitting of livestock operations so as to assure financial capability for clean up in the instance of bankruptcy or other economic failure.	GWACD							
46	Measure the effects of GWAC program on Yakima County economics.	WGD							
47	Establish a more interactive and frequent relationship between Yakima County and NRCS.	WGD							
Education									
48	Develop post GWAC education and outreach campaign	EPO							
49	Broaden the pool of people GWMA is educating or communicating with.	EPO							
50	Maintain a public education program regarding nitrate pollution and health risk over a 5-10 year period. Provide all materials distributed to the public in English and Spanish.	EPO							
51	Billboard campaign – urging well testing	EPO							

Alternative land and water use management strategies for reaching program goals and objectives per WAC 173-100-100(4)			Evaluation Criteria per WAC 173-100-100 (4)						
Ref. #	Action	Proposed by	Feasibility	Effectiveness	Cost	Proposed funding	Time	Difficulty to implement	Degree of consistency with local comprehensive plans and water management programs
52	Create 1 FTE Bilingual Outreach Coordinator Position to implement a post-adoption outreach campaign (EPO meeting summary 8/1/2014 & proposed to GWAC 8/21/14 - voted low priority)	EPO	Low	Unknown	$83,000 annually		1 FTE	Requires clear, measurable outcomes[1], a "home" agency to house, provide oversight, and to measure effectiveness; and ongoing funding.	
53	Develop a K-12 education program about groundwater and best management practices--mobile program visiting schools.	EPO							
54	Employ/enlist college students to conduct surveys, consider outreach methodologies as part of classwork to assist with GWMA education	EPO							
55	Educate the public, particularly in towns, about lawn and garden nitrogen applications' contribution to nitrate concentrations	EPO							
56	Educate private well owners: Re: protect your family; know who's at risk; test your well regularly.	EPO							
57	Private well owners' responsibility to protect WQ	EPO							
58	Publish public information about proper septic system construction and operation	EPO							
59	Advise the public that GWMA is looking for abandoned wells. Wellhead protection education	EPO							
60	Offer incentives for property owners to identify and properly abandon wells.	EPO							
61	Offer incentives to drill deeper wells for homeowners served by shallow, poorly constructed, poorly located wells.	EPO							
62	Offer incentives to connect households on private wells near community water systems to connect to a community water system. (Nitrate Treatment Pilot Program-June 2011)	EPO							
63	Provide a resource hotline (as proposed by RCIM on 8/2014)	EPO							
64	Prepare a fact sheet/develop outreach campaign to growers that explains agronomic rates – applying nutrients at the right time/right place/right amount	EPO							
65	Study report outreach: Show/Identify how much nitrogen is left after nutrient uptake in crops.	EPO							
66	Encourage commodity groups to provide education on water management and fertilizer use through regular meetings.	EPO							
67	Outreach targeted to small farm/hobby farm/rachettes manure management	EPO							
68	Educate irrigation users on the consequences of too much irrigation.	EPO							
69	Inform farmers about technological improvements in irrigation that permit easier management of water, descriptions of specific improved technology, and economic viability of technological advancements .	EPO							
70	Enlist advocacy groups/Farm Bureau/federations/associations to host workshops/informational meetings regarding GWMA education goals and partnerships in success	EPO							
71	Make presentations at trade shows, communicate with agricultural consultants who have positive relationships with farmers suggesting that they change practices	EPO							
72	Partner with UW Pediatric Environmental Health Specialty Unit (PEHSU) to continue training local healthcare providers to recognize and address Nitrate risk in their patients (pregnant women and infants up to six months)	EPO	Feasible	Effective	Up to $30,000 annually (.25 FTE; + translation, printing, coordination)	Unknown	.25 FTE	Coordinate partnership through either DOH or YHD	
73	Advise the public that GWMA is looking for abandoned wells	WGD							
74	Encourage commodity groups to provide education on water management and fertilizer use through regular meetings	WGD							
75	Inform the public about the health risks related to nitrates in drinking water	J Mendoza							
76	Provide education about concepts that people must understand in order to evaluate our plans for reducing nitrate in groundwater.	J Mendoza							

Alternative land and water use management strategies for reaching program goals and objectives per WAC 173-100-100(4)			Evaluation Criteria per WAC 173-100-100 (4)						
Ref. #	Action	Proposed by	Feasibility	Effectiveness	Cost	Proposed funding	Time	Difficulty to implement	Degree of consistency with local comprehensive plans and water management programs
Research and Data Collection									
77	Use both method-based measurement and performance-based measurement.	WGD							
78	Establish performance objectives against which monitoring data can be compared--number of at risk wells, BMP implementation, funding success, reduction in number of underperforming farming practices	Literature							
79	Implement Ambient Groundwater Monitoring Plan	GWAC	Feasible						
80	Implement Drinking Water Quality Monitoring Plan	GWAC	Feasible						
81	Establish a fund and plan to analyze data collected in ambient water quality monitoring and drinking water well monitoring programs. Study short-term seasonal variations in nitrate concentrations over next year or two--addresses how changes in nutrient application over the agricultural cycle affects things. Study long-term trends that develop over several years--to track whether the overall picture is getting better, whether changes recommended by GWMA are having impact.	WGD							
82	Use hydro-geologically directed monitoring well placement to detect cause/effect remediation opportunities.	Literature							
83	Building from the WSDA's Nitrogen Availability Assessment, develop a Nitrogen Loading Assessment for all agricultural, residential and commercial properties, using newly collected data. Hire a technical consultant to conduct a literature review to determine the most relevant information and accurate factors for use in the Nitrogen Loading Assessment. Periodically repeat the grower survey used in the Nitrogen Availability Assessment to compare against the currently established data. Collect data on how many acres in the GWMA are fertilized in various crops with manure and how many with commercial fertilizer. Update and monitor the percentage of acreage in various crops, particularly silage corn and field corn. Study effect of contribution of nitrogen from cover crops used to form mulch. Determine acreage for triticale. Discover commercial fertilizer tonnage for Yakima County and/or for GWMA. Explore how much nitrogen leaches into groundwater from drains and wasteways. Study atmospheric deposition more comprehensively. Understand the difference between plant uptake and plant removal of nitrogen.	WGD, Literature							
84	Get fertilizer loading numbers per crop type. Get economic engine factors per crop type. Determine crop/fertilizer utility ratios. Consider economic benefit of various crop type categories. Consider agricultural usage categories (e.g., field crop, row crop, vineyard, orchard, dairy. Determine amount of land appropriate for each, and location best for each given soil, climate, effect upon groundwater, etc. Ensure adequate supply of each in order to permit opportunity of market choice.	Literature							
85	Recommend that the Yakima Health District or Yakima County continue the High Risk Well Assessment (survey to identify outreach messaging related to health risks and well sampling) periodically over a 5-10 year period. Collect more information on wells known to have high nitrate concentrations, perhaps identifying whether the concentration is self-caused	WGD							
86	Conduct recurrent drinking water testing where drinking water standards have previously been exceeded.	Literature							
87	Design and implement pilot studies focusing on innovative farm techniques which reduce nitrogen loading to crops and monitor results for future expansion of findings.	Literature							
88	Explore whether nitrate leaching is greater with vetch amended soil or commercial fertilizer amended soil. The results of one study indicate that vetch nitrogen, in comparison to *fertilizer nitrogen, leads to lower concentrations of soil inorganic nitrogen and greater* immobilization of added nitrogen in soil organic matter. This would reduce the potential for nitrate leaching.	Literature							

Alternative land and water use management strategies for reaching program goals and objectives per WAC 173-100-100(4)			Evaluation Criteria per WAC 173-100-100 (4)						
Ref. #	Action	Proposed by	Feasibility	Effectiveness	Cost	Proposed funding	Time	Difficulty to implement	Degree of consistency with local comprehensive plans and water management programs
89	Recommend that WSU Extension Service update Appendices A and B of the Washington Irrigation Guide.	WGD							
90	Recommend that Western Fertilizer Handbook, Western Plant Health Association, Ninth Edition (2002) be updated.	WGD							
91	Fund professional adaptation of Utah Fertilizer Guide for Washington State http://extension.usu.edu/files/publications/publication/AG_431.pdf	Literature							
Washington State Department of Agriculture									
92	Develop Nitrogen Loading Assessment as provided in Research and Data Collection above.	WGD							
93	*Summarize the DNMP reporting and provide information that would disclose the amount of* manure the CAFO's in the GWMA created and where it was distributed.	WGD							
94	Review and evaluate the WSDA Dairy Nutrient Management Program inspection protocols to assist in determining if additional resources should be allocated and identify any areas for improvement of the inspections themselves.	L/C WG							
95	Add staff to WSDA to oversee Dairy Nutrient Management Plans and complaints regarding manure spills.	WGD							
96	Promote on-going research for managing animal nutrients.	WGD							
Southern Yakima Conservation District									
97	Ask SYCD for projected plan to expand fiscal and administrative capacity	Literature							
98	Fund post GWMA education and outreach through Conservation District	WGD							
99	Put request for $$$ for SYCD in State Conservation Commission budget	WGD							
100	Enhance engineering expertise (personnel) within Conservation District--none there or at NRCS	WGD							
101	Charge dairies for Conservation District preparation of Dairy Nutrient Management Plans	WGD							
102	Recommend funding for Southern Yakima Conservation District review of Dairy Nutrient Management Plans	WGD							
103	Provide better funding and more staffing for Conservation District: hard money funding, increase property tax assessment, create exceptions to taxation for demonstrated testing and monitoring.	WGD							
104	Develop water sorption graph or chart. List volumes of water applied, soil types, absorption/compaction rates, depths to water, pre-season and post-season appropriate moisture levels.	Literature							
US Geological Survey									
105	Use USGS Particle Tracking Model	WGD							
106	Use USGS particulate tracking model to identify targets of education	WGD							
107	USGS Particle Tracking Model Overview--potentially combined with MT3D MODFLOW application to the vadose Zone	WGD							
Yakima Health District									
108	Study potential nitrate contamination attributable to improperly operated septic systems. Consider restoration/retrofit of older septic systems through incentives or county property tax breaks.	WGD							
109	Drill deeper water wells further from septic drain systems	WGD							
110	Require builders to demonstrate that septic system design will not add to nitrogen loading problem as condition of construction	WGD							
111	Publish and distribute homeowner guide on how to use septic systems	WGD							
Department of Ecology									
112	Publish the Department of Ecology's lists of certified laboratories that can test private wells for nitrates and pathogens and Ecology's providing funding to low income, private well users, in order to conduct this testing.	WGD							
113	Encourage an increase in the number and availability of soil testing laboratories.	Literature							
114	Make grants that complement projects related to non-point source pollution.	WGD							

Alternative land and water use management strategies for reaching program goals and objectives per WAC 173-100-100(4)			Evaluation Criteria per WAC 173-100-100 (4)						
Ref. #	Action	Proposed by	Feasibility	Effectiveness	Cost	Proposed funding	Time	Difficulty to implement	Degree of consistency with local comprehensive plans and water management programs
115	Provide grant funding for well decommissioning.	WGD							
116	Search for abandoned wells.	WGD							
117	Send a postcard to 10 % of known property owners on record having a well asking about knowledge of older wells.	WGD							
118	Compare Google Earth to Yakima County GIS images to determine building changes and thus possible well usage changes. Focus first on hotspot high density areas in GWMA. Ground truth suspected problem wells.	WGD							
119	Educate realtors and banking industry about disclosure of abandoned wells in property transfers.	WGD							
120	Educate public regarding liability of an ill-secured well.	WGD							
121	*Provide some form of protection for self-reporting of abandoned or improperly* decommissioned wells.	WGD							
122	Seek legislative change on requirements for well decommissioning, making them cheaper.	WGD							
123	Amend RCW 18.104.055 to dedicate a portion of "notice of intent" fees to a fund to be used by Ecology (or Health) for the proper decommissioning of wells in those cases where DOE (or Health) determines that such publicly-funded action is necessary in the public interest to protect or enhance the quality of public health ("infirmity" of the public health).	Literature							
124	Amend authority of Department of Ecology to gain access to properties where manure is spread outside land subject to nutrient management plans	WGD							
Residential, Commercial, Industrial, Municipal									
125	Encourage municipalities within the GWMA to extend municipal sewer systems within urban growth areas and retire ROSS and LOSS.	RCIM WG							
126	Encourage connection of residences within urban growth zones to sewer systems extended by municipalities.	RCIM WG							
127	Encourage the development of group septage-management or treatment systems in areas outside urban growth zones where the density of residential development could exacerbate the effect of multiple OSS on groundwater quality.	RCIM WG							
128	Establish or maintain ongoing, extended funding necessary for the Yakima County Department of Public Services and Yakima Health District to actively participate in water quality improvement, testing, monitoring, scientific data analysis, and infrastructure development.	RCIM WG							
129	Request Yakima County Public Services to perform an engineering study of locations outside urban growth areas where there is rural residential medium to high density *OSS and the nitrate concentration is greater than the state water quality standard* where community water systems could feasibly be constructed in lieu of individual water wells.	RCIM WG							
130	Request Yakima County Public Services to perform an engineering study of locations outside urban growth areas where there is rural residential medium to high density OSS and the nitrate concentration is greater than the state water quality standard where community waste water systems could feasibly be constructed in lieu of individual on-site septic systems.	RCIM WG							
131	Request that the Yakima Health District prepare a plan, as required and described by WAC 246-272A-0015, giving primary emphasis on educational programs for operation and maintenance of existing on-site septic systems (OSS), reserving a determination regarding the advisability of the establishment of regulatory or enforcement programs until data is available from the GWMA's monitoring well system.	RCIM WG							

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Ref. #	Action	Proposed by	Feasibility	Effectiveness	Cost	Proposed funding	Time	Difficulty to implement	Degree of consistency with local comprehensive plans and water management programs
132	Request the Yakima Health District to consider the nitrate density element when approving proposed septic systems, including those technologies verified by the U.S. EPA's Environmental Technology Verification Program, for reducing the nutrient nitrogen in domestic wastewater discharged from OSS, including fixed film trickling filter biological treatment, media filter biological treatment, and submerged attached-growth biological treatment.	RCIM WG							
133	Recommend that soil testing be performed below at least two ROSS drain fields (one with a shallow water table, one with a deeper water table) in high density areas to analyze nitrogen loads as the septage approaches the water table.	RCIM WG							
134	Request that the State Department of Health determine, prior to issuing or reissuing LOSS permits, that all employee counts are regularly reported, so that the LOSS will continue to operate as designed.	RCIM WG							
135	Recommend that the State Department of Health consider not approving additional LOSS or otherwise require an effective nitrate removal system.	RCIM WG							
136	Request that the Department of Ecology analyze the trends of nitrate data contained within reports required by NPDES and SDWA permits.	RCIM WG							
137	Educate the public regarding the importance of the integrity of wells, particularly those without a well log, and fund and encourage periodic well inspection by the Yakima Health District or professional well engineers.	RCIM WG							
138	Require that site inspections for possible abandoned wells be performed before building permits are issued for properties that are proposed to be redeveloped after prior development of domestic, agricultural or industrial uses.	RCIM WG							
139	Request that the Department of Ecology develop a plan for finding and decommissioning abandoned wells in the next 12 months, using the LYVGWMA as a pilot project.	RCIM WG							
140	Permit the repair or decommissioning of wells by general contractors, rather than exclusively by well-drillers, so as to diminish costs of decommissioning.	RCIM WG							
141	Assist hobby farmers to locate ROSS drain fields on their property so as to avoid animal farming over the drain field.	RCIM WG							
142	Request the county include the EPO flyer on OSS maintenance in correspondence with GWMA home owners for S years. i.e. tax bills, property transfers.	RCIM WG							
143	Make facility process improvements in waste treatment and food processing plants to reduce nitrogen and total discharge volume.	Literature							
144	Replace aging sewer system infrastructure and ensure proper system maintenance to reduce nitrate leaching.	Literature							
145	Require new developments to address impacts on groundwater quality through permitting review of "site plan review criteria."	Literature							
Technology									
146	Identify and support opportunities, including educational research institutions, for private, public, and industry investment in technology specific to addressing nitrate contamination in groundwater.	L/C WG							
147	AKART--industry can't keep up with technology, required if performance already meets performance standards?	WGD							
148	AKART problems--does standard mandate installation of new technologies even when existing ones accomplish the measured objective	WGD							

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149	Require nitrogen reducing technologies for onsite septic systems:	WGD			estimated installation costs $20,000, yearly operational costs about $1,500, recirculating sand filters, carbon systems, old system retrofits cost $5,000-7,000 per system				
150	Explore public investment in waste to energy technology	WGD							
151	Promote new products that are found through research	WGD							
152	Promote markets for those products	WGD							
153	Use commodity group "check off" money for research and development	WGD							
BMPs									
154	Inform farmers of those BMPs prioritized by Livestock/CAFO and Irrigated Agriculture Work Groups from HDR list to reflect greatest effectiveness in nitrate reduction	WGD							
155	Determine who implements the BMP and who monitors it and the time frame in which to measure/monitor it--problem with available expertise, timing, installation cost	WGD							
156	Identify and publish a list of poor management practices. Recommend that they be terminated or avoided.	Literature							
157	Establish a BMP monitoring well network. Monitor BMP performance and effectiveness with the monitoring well network first, then monitor water quality.	Bowen: Having a monitoring plan for the BMP's in place is part of the work the GWAC is required to do.							
Livestock									
158	Recommend that dairies and CAFOs use those Best Management Practices contained within Attachment B to the Livestock/CAFO Work Group's Report to GWAC	L/C WG	Feasible	GWAC has not reached consensus that pursuing this recommendation alone would accomplish Goals # 1, 2.					
159	Encourage the WSDA and Conservation Districts to continue education and outreach to livestock operators about impacts and practices related to compliance with relevant State and federal requirements for groundwater protection, particularly addressing those not currently acting in good faith toward that objective.	L/C WG	Feasibility depends upon available resources		2 additional FTE's cost ?	Industry, government, private or public research and development, foundations, and industry associations.			
160	*Implement an Education and Outreach Program (EOP) informing producers of Best* Management Practices (BMP's) including increased funding for the DNMP assistance program.	L/C WG							

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161	Create and maintain a central depository of public information online, as part of an Education and Outreach Program (EOP) informing producers of the nitrate issue, community impacts, and Best Management Practices (BMP's).	L/C WG				Industry, government, private or public research and development, foundations, and industry associations.			
162	Increase funding for the local Conservation District and Natural Resources Conservation Service (NRCS) so that assistance programs for nutrient management planning, engineering, cost share, and loan funds are more available.	L/C WG				Industry, government, private or public research and development, foundations, and industry associations.			
163	Streamline current enforcement activities so as to improve customer service and protocols, increase clarity of process, escalate enforcement for facilities not following management practices, identify methods to discourage repeatedly unfounded complaints, and improve overall transparency.	L/C WG							
164	Collect data to track water quality improvement progress and nutrients generated, applied, or exported within the LYV GWMA. Generate data through soil testing, Ambient Groundwater Monitoring Plan implementation - including purpose built and existing wells, sampling of liquid and solid waste to be field applied, composted, or exported, the CAFO General Permit, and tracking nutrients applied by non-dairy operations.	L/C WG							
165	Support and advocate private, public, and industry investment in technology, including at research institutions, specific to addressing nitrate contamination in groundwater, especially where it creates improvements for the public good.	L/C WG							
166	Require more complete disclosure of Dairy Nutrient Management Plans.	WGD							
167	Incentivize technology and management of fertilizers and manures.	WGD							
168	Install separation systems--separate liquids from solids.	WGD							
169	Use anaerobic digestion in waste storage lagoons	WGD			Very expensive				
170	Install liners in liquid waste storage lagoons.	WGD							
171	Install impervious surfaces beneath silage/feed storage.	WGD							
172	Revise WAC 246-203-130 so that it defines "health hazard" and "nuisance" and includes specific and enforceable requirements designed to protect human health.	WGD, Literature							
173	Compost more manure	WGD							
174	Improve composting regulations	WGD							
175	Provide underlying soils information to each livestock opeeration so that individual evaluations can be made.	Literature							
176	Remove wastes from barnyards and other areas of animal concentrations and frequently convey them to waste storage or treatment facilities.	Literature							
177	Prevent contaminants from flowing into wells by ensuring that the external areas around well casings are properly sealed and that wastes are kept the recommended distance from wells.	Literature							
178	Entrain water (as rain or snow-melt) collected from roofs away from animal pen or manure collection facilities.	Literature							
179	Drain low areas where ponds accumulate to collect and manage waste waters.	Literature							
180	Treat manure supply in excess of that which can reasonably be applied as nutrient to agricultural lands as a "waste" product. Apply waste management strategies including land disposal at designated site, incineration, centralized waste-to-energy facility.	Literature							
181	Create a state CAFO Siting Team, composed of representatives of relevant state agencies with support from USGS, to which the county commission could refer proposed CAFO sitings or expansions. The CAFO Siting Team would provide a recommended site suitability determination, based upon a predetermined scoring system, including description of environmental risk factors and mitigation strategies.	WSDA, Gary Bahr							

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182	Amend Dairy Nutrient Management Act to extend WSDA's authority t land application acreage with which dairy facilities contract pursuant to nutrient management plans.	Literature							
Irrigated Agriculture									
183	Anecdotal results of deep soil sampling carried out by SYCD with farmers with pre-existing relationship with SYCD were informative. Word-of-mouth reporting within farmer community greatly increased acres sampled. Establish a multi-year deep soil sampling program where farmers subscribe for a duration with pre-determined fiscal remuneration for completed sampling. Cost share with farmer. Farmer to provide checklist indicating performance with BMPs. Test throughout growing year, in order to observe effects of fertilization throughout year. Share data with public.	WGD			Expensive	Federal or State			
184	Do deep soil sampling on fields within GWMA that apply biosolids.	WGD							
185	Make shallow (1, 2, 3 foot) soil testing reports prerequisites for funding, lending or building permits.	WGD							
186	Hire soil scientists to do publicly funded "spot auditing" soil checks for feedback to farmers and fertilizer sellers.	Literature							
187	Incentivize development and provide information about improvements made in nutrient management and agronomic rate application of fertilizer by specific developing technologies	Literature							
188	Commission the creation of a data assembly software that could receive, translate, assemble and analyze the data produced by agricultural equipment technology manufactured by different agricultural equipment manufacturers, so as to permit integration of data per field, crop or enterprise.	WGD, Doug Simpson							
189	Monitor nitrate concentrations of irrigation water at headgates.	Literature							
190	Stimulate news coverage of progress in irrigation technology.	WGD							
191	Land acquisition—purchase properties with greatest nitrate contribution and retire uses that generate nitrate.	Literature							
192	Incentives—provide credit against county real property tax for investment in source abatement.	WGD							
193	Develop farmer-specific irrigation water use programs including collection of data, records of irrigation management, education of farmer regarding new processes and technology.	WGD							
194	Create irrigation management plans (similar to nutrient management plans) for farms over a minum size and provide financial assistance for implemented plans.	WGD							
195	Encourage advanced irrigation management. Recognizing that there is significant cost involved in changing an irrigation system, look for strategic opportunities in the area where the use of more advanced irrigation management systems could have the greatest benefit for reducing nitrogen impacts to groundwater. One example of advanced irrigation management is electronic sensor irrigation water management (IWM). Identify federal, state and local incentive programs, such as grants, and low interest loans, to facilitate a transition to more advanced irrigation management in those areas	EPA Region 10							
196	Provide funding for a mobile irrigation lab to assess the efficiency of current or advised irrigation practices, either through a singular lab or component parts.	WGD							
197	Provide financial assistance for 1) conversions from rill irrigation to sprinkler or drip irrigation, 2) installation of flow meters and moisture meters to reflect over-irrigation, high water table, drought conditions, 3) the cost of hiring third party sampling , measuring equipment, personnel or self-test kits, 4) management of sprinkler systems so they do not drive nutrients past the root system.	WGD							
198	Establish a voluntary irrigation management cost-share program with SYCD. Data shared with public.	WGD							
199	Manage sprinkler systems so they do not drive nutrients past the root system.	WGD							

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Ref. #	**Action**	**Proposed by**	**Feasibility**	**Effectiveness**	**Cost**	**Proposed funding**	**Time**	**Difficulty to implement**	**Degree of consistency with local comprehensive plans and water management programs**
200	Advise farmers of the relative propensity of wheel lines, center pivots, and drip lines to cause leaching.	Literature							
201	Use available techniques to determine how much and when irrigation is needed instead of irrigating according to a prearranged schedule.	Literature							
202	Schedule water and nitrogen application according to the need for optimal crop yields.	Literature							
203	Analyze irrigation practices to discover whether frequency or volume creates greater propensity for leaching.	Literature							
204	Identify and decommission abandoned agricultural irrigation wells.	Literature							
205	Upgrade irrigation districts' open, earthen or concrete delivery laterals and head ditches to PVC pipe.	Literature							
206	Route irrigation-return flow through a constructed managed wetland to reduce concentrations of nutrients and suspended sediment.	Literature							
207	Add polyacrylamide (PAM) to irrigation water.	Literature							
208	Install effective backflow prevention devices on supply lines of water supplied from groundwater wells to avoid backflow from chemigation.	Literature							
209	Structure irrigation water pricing by volume per acre used with preference for lower volume use.	Literature							
210	Improve micro-irrigation system design and operation.	Literature							
211	Recommend that irrigation districts be authorized to condition delivery of irrigation water on irrigation practices consistent with agronomic rate of application of water.	WGD							
212	Require irrigated agriculture nutrient management plans. Record the source and type of fertilizer and number of acres fertilized with each.	WGD							
213	Establish water use "domains" (zones) to apply water use constraints, or well construction design constraints, for agricultural uses.	Literature							
214	Develop and implement Nutrient Management Plans (NMPs) for all producers (those that apply manure and those that apply synthetic fertilizer that include annual soil testing for phosphorus and nitrogen and which follow available guidance (i.e. Land Grant University) for developing appropriate land application rates for phosphorus and nitrogen. These NMPs can identify site specific conservation practices that are, or will be, implemented to minimize the transport of phosphorus or nitrogen to surface and ground waters. NMPs that are "adaptive" -- adjusted based on annual soil tests, the types of crops grown, and other site or field specific factors – allow producers to adjust their plans and practices as new information becomes available.	EPA Region 10							
215	Provide funding for nutrient management education or information distribution.	WGD							
216	Make Nutrient Management Plan records available upon Department of Agriculture determination of potential excessive application of nutrients.	Literature							
217	Incentivize investment in crops that require less fertilization, or which take up greater amounts of nitrogen.	Literature							
218	Distribute information to farmers on what can happen with applied manure, what should be applied and reasonable, agronomic rates of application.	WGD							
219	Integrate use of animal waste and synthetic fertilizer, balancing nutrient application amounts so as to maximize crop production and full nitrogen uptake.	Literature							

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220	Track nutrients and their application regardless of the end user, including commercial fertilizer.	L/C WG		Nutrients from animal waste are tracked now while in the control of dairy operations. Once those nutrients are transferred to a third party no further regulation exists.					
221	Keep track of synthetic fertilizer sales.	WGD							
222	Avoid fertilizer material and manure spills during transport, storage, and application.	WGD							
223	Use effective application schedules, placement, rate and time of application and speed of release for specific crop requirements.	Literature							
224	Where possible, apply nitrogen through to plant-specific root zone means, rather than broadcast application.	Literature							
225	Identify areas with highly permeable and susceptible soils where fertilization and pesticide application should be most carefully managed.	Literature							
226	Amend Yakima County Code 16C.09.070 to include excess fertilizer application to list of prohibited uses within critical aquifer recharge areas.	WGD							
227	Amend the list of prohibited uses under the Critical Aquifer Recharge Area ordinance 16C.09.070 (6) to include "activities that would add nutrients to the soil column beyond those amounts that can be taken up within a reasonable time by plant materials." Or perhaps, activities inconsistent with NCRS Code 590	Literature							
228	Inform farmers that fertilization and supplemental irrigation beyond the optimum rate will not necessarily produce better yields or higher profits without serious side effects.	WGD							
229	Develop an approach for data collection of volume and location of manure application off dairy sites.	WGD							
230	Place areawide limitation on number of acres where manure can be spread as fertilizer. Require permit to spread manure as fertilizer. Allow market in permits. Allow dairies to own permits which could be leased to other agricultural properties.	Literature							
231	Require soil sampling results and area fertilized from exported dairy manure as a precondition of exportation of dairy nutrients off dairy properties.	WGD		Problems: workability, potential conflict of interest if commercial fertilizer dealers are performing soil sampling for farmer/fertilizer customer.					
232	Regulate synthetic fertilizer and amount of water used if manure application is going to be regulated.	WGD							
233	Question sellers of synthetic fertilizers in order to learn their objectives, plans, strategies, seeking to discover win/win opportunities.	WGD							
234	Require a synthetic fertilizer or other nutrient applicators license (approach taken by pesticides, chemigation and fertigation) as condition to purchase nutrients.	WGD							
235	Require that "prescriptions" for soil amendment with organic or inorganic fertilizers be written by certified professionals, and that purchases of inorganic fertilizers limited to those for which prescriptions have been written.	Literature							

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236	Establish "safety coefficients" limiting application of nitrogen, whether organic (manure) or inorganic (synthetic), to take into account the problem of intervening cause, e.g., change in the weather or water supply that makes the application or the prior application of nitrogen excessive in the event of change in anticipated circumstances.	Literature							
237	Place a small tax on sale of synthetic fertilizer in order to collect volume data.	GWACD							
238	Subsidize price of alfalfa to induce greater production so as to remove nitrogen from soils.	Literature							
239	Monitor the timing of application of fertilizers to fields and how much water was then applied.	WGD							
240	Request Washington Conservation Commission and WSU Extension to dedicate additional funding to Yakima Valley for education and outreach, BMP implementation, irrigation water management, soil nutrient management and manure management and application.	WGD							
241	Monitor changes occurring in agricultural operations because of efficiencies and economics. *Evaluate whether those changes positively affect improvement in groundwater quality.*	WGD							
242	Develop a system that could be used to determine which farmers need assistance in understanding appropriate farming practices--establish a structure of recommendations establishing clear expectations, list problematic management practices, encourage voluntary compliance, develop peer encouragement system	WGD							
243	Investigate use of bio-char in lieu of nitrogen fertilizers	GWACD							
244	Recommend against farming around a water well.								
245	Intermittent fallowing (leaving lands dormant) to reduce both natural plant nitrogen and fertilizer nitrogen additions to the soil.	Literature							
246	Refrain from tilling under herbaceous remnants of prior crops, reducing plant nitrogen contributions to soil column.	Literature							
No Action									
247	Consider costs of health risks to families from nitrate exposures, costs incurred by growers and producers of various recommendations, costs of bottled water, costs to connect to *public water or sewer systems, cost for WSDA to monitor DNMP, costs of soil sampling*	WGD							

Washington State Department of Agriculture

In 2015, the Washington State Department of Agriculture (WSDA) entered into an Interlocal Agreement with Yakima County to study nitrogen sources within the Lower Yakima Valley Ground Water Management Area (GWMA).

Attached you will find the draft report of the study which was produced jointly by the Washington State Department of Agriculture, Natural Resources Assessment Section and Yakima County Public Works Department. This draft is presented to the Ground Water Advisory Committee Work Groups for review and comment. Comments will be evaluated and incorporated for inclusion into future drafts of this report.

Under the provisions of the Interlocal Agreement, this study is limited in scope in several respects. It presents modeled estimates of nitrogen availability throughout the GWMA, but did not calculate how much is actually transported to groundwater. Estimations of nitrogen transport to groundwater would require further analysis and would need to take into account attenuation processes in the soil and vadose zone.

The analyses performed do not reflect site specific conditions, rather they are intended to reflect calculations of potentially available nitrogen within the overall study area. And further, does not reflect individual decisions or management practices. The high, medium, and low nitrogen availability estimates are not intended to capture conditions in any specific portion of the study area. They are intended to provide insight into what sources would likely need additional focus and study to support any future fate and transport analyses or future management decisions.

This draft report has been reviewed by relevant experts for each report section. Peer review by staff of Washington State Departments of Ecology and Health included repeated cycles of draft review, meeting, and editing to reflect peer reviewer's comments. Inputs for the different analyses were reviewed by the relevant working groups (RCIM, Irrigated Agriculture, and CAFO). Finally, the irrigated agriculture analysis was reviewed by faculty in WSU's Department of Crop and Soil Sciences and by the Irrigated Agriculture Working Group.

We have given our best efforts to conduct this study within the parameters established for this project. We look forward to further review and input from the various work groups as we move forward. Questions relating to any aspects of the study should be directed to WSDA's Natural Resource Assessment Section.

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Estimated Nitrogen Available for Transport in the Lower Yakima Valley Groundwater Management Area

A Study by the

Washington State Department of Agriculture

and

Yakima County

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Acknowledgements

Dairy producers:

- voluntarily shared manure testing results with South Yakima Conservation District
- invited WSDA NRAS staff onto their farms to sample soil in pens and compost areas
- invited WSDA NRAS staff onto their farms to learn about operational practices

Irrigated Agriculture Working Group

- reviewed irrigated agriculture methodology and assumptions
- grower members of the IAWG supplied production information necessary for calculating triticale double-crop production acres
- Jim Trull, Scott Stephens, and SVID compiled crop nitrogen uptake data
- Jim Davenport and Stu Turner compiled water duty data for crops in this report

CAFO Working Group

- made recommendations on inputs for lagoon calculations

Peer review team:

- Melanie Redding (Department of Ecology)
- Ginny Stern (Department of Health)
- Nancy Darling (Department of Health)

WSDA Dairy Nutrient Management Program

- shared data from their lagoon assessment process
- worked closely with NRAS staff to make sure identification of facilities was as accurate as possible
- reviewed this report to make sure dairy operations were accurately described

South Yakima Conservation District

- collected and anonymized data from dairy producers
- reviewed GIS data for accuracy

Katie Hurlburt, WSDA Natural Resources Assessment Section

- conducted additional crop mapping and QA on the GIS data for this report

Joel Demory, WSDA Natural Resources Assessment Section

- conducted QA on data entry and calculations for this report

Dr. Ranil Dhammapala, Washington State Department of Ecology

- provided information on atmospheric deposition monitoring and recommendations for low, medium, and high potential rates of atmospheric deposition

Jean Mendoza, Groundwater Advisory Committee member

- provided a reference for nitrogen loss to atmosphere from irrigated agriculture

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Executive Summary

In recent years, a number of groundwater studies have pointed to concerns about nitrate levels in groundwater in the Lower Yakima Valley. Between 1988 and 2008, 12% of wells tested in the area had nitrate concentrations above the Safe Drinking Water Act Maximum Contaminant Level of 10 mg NO_3-N/L. Another 21% of wells tested were below this level but higher than 5 mg NO_3-N/L (reported in Ecology et al. 2010).

In response, the Washington State Department of Ecology (Ecology) began working with Yakima County to address the issue and provide solutions to prevent nitrate contamination of groundwater in the Lower Yakima Valley. They established the Lower Yakima Valley Groundwater Management Area (GWMA), and in 2011 the Groundwater Advisory Committee (GWAC) was formed.

- The GWMA includes the land area and groundwater located in the lower Yakima Valley from Union Gap to County Line Road in Yakima County, Washington, minus the Yakama Nation. The majority of the GWMA is used for agriculture, including about 99,000 acres of irrigated crop land and more than 50 active dairy farms (WSDA 2016). The remainder of the GWMA land area consists of towns, rural residences, roads, canals, and other nonagricultural lands.
- The GWAC has worked to assess and respond to the groundwater nitrate issues by addressing public education and health concerns, evaluating existing data on groundwater quality, designing new monitoring strategies, evaluating regulatory responsibilities, and determining potential nitrogen availability from the various potential sources.

As partners, Ecology, the U.S. Environmental Protection Agency, Yakima County, the Washington State Department of Agriculture (WSDA), and the Washington State Department of Health have been working to support the GWAC and associated workgroups with educational and scientific products that can assist in decision making to protect groundwater quality.

About the Study

In 2015, the Yakima County Public Services Department and GWAC partnered with WSDA to conduct a study to provide a scientific baseline estimate of the amount of potential nitrogen available for transport from different nitrogen sources within the GWMA boundaries. Nitrogen available for transport is nitrogen that has the potential to move from the land surface or soil profile into groundwater. The study addressed how much nitrogen could be available, but did not calculate how much is actually transported to groundwater. The processes controlling nitrogen movement through the soil were not evaluated, and loading to groundwater was not estimated.

Nitrogen sources are numerous and can include agricultural, human, natural soil organic matter, and atmospheric deposition. Together, state and local partners studied estimated potential nitrogen availability in the landscape from 4 distinct categories:

- Concentrated Animal Feeding Operations (CAFOs) - including livestock pens and manure lagoons;
- Irrigated agricultural activities - including nitrogen balance from the 15 types of irrigated crops that constitute 96% of the irrigated acreage in the GWMA;

- Residential, commercial, industrial, and municipal (RCIM) sources - including residential onsite septic systems (ROSS), large onsite septic systems (LOSS), commercial onsite septic systems (COSS), residential lawn fertilizers, and hobby and small-scale commercial farms;
- Atmospheric sources - including wet and dry deposition.

Nitrogen estimates were calculated for the land surface, bottom of the root zone, and at the extent of the treatment zone for animal agriculture, irrigated agriculture, RCIM, and atmospheric sources.

The estimates were completed using locally-derived information wherever possible, and information gaps were filled with data from scientific literature. Methodologies varied, depending on the source of nitrogen being studied. For example, some calculations used data gathered from aerial imagery. Some calculations compared inputs and outputs to determine the mass balance of nitrogen from various irrigated agriculture sources. Atmospheric calculations included adjustments to avoid double counting with other categories that already included atmospheric nitrogen. The body of the report addresses the methodologies used for each source studied.

The study was limited by a number of constraints, primarily the limited availability of local background data, the diversity of local or literature data used, and the various assumptions utilized for the calculations in each section of the report. This data used as inputs and the study itself have been reviewed by experts in each field. The data inputs used in each section were reviewed by the relevant GWAC workgroups (Irrigated Agriculture, CAFO, and RCIM). The irrigated agriculture calculations were reviewed by faculty from Washington State University's Department of Crop and Soil Sciences. In addition, the report draft has been reviewed by a peer review team composed of hydrogeologists from the Washington State Departments of Ecology and Health.

Study Results

The nitrogen available for transport was estimated at 3 levels (low, medium, and high) for each nitrogen source category evaluated in this study. The estimates were then assessed both on a per-acre basis and for the entire GWMA, providing 2 ways to consider the nitrogen sources. WSDA and Yakima County results were summarized in associated data spreadsheets and GIS based systems, allowing them to be updated in the future as additional data becomes available.

When the low, medium, and high nitrogen calculations were analyzed for all sources over the entire acreage of the GWMA (Table 1), irrigated agriculture, CAFO lagoons, and CAFO pens were the most significant contributors to potential nitrogen availability in all 3 scenarios. In the low range scenario, agricultural activities constitute 86% of the estimated total nitrogen available. In the medium and high range scenarios, agricultural activities constitute 95% and 96% of the estimated nitrogen available, respectively. The irrigated agriculture nitrogen percent is the highest in the low, medium and high categories due to the large number of acres of agriculture in the GWMA.

Table 1. Estimated nitrogen available for transport from all sources at low, medium, and high range in tons/year and % of total

Source		Low		Medium		High	
		Tons N/year	%	Tons N/year	%	Tons N/year	%
Irrigated Agriculture		532	62	2,870	66	8,685	76
CAFO	Pens	70	8	502	11	935	8
	Lagoons	142	16	781	18	1,421	12
RCIM	All septic (ROSS, LOSS, COSS)	47	5	83	2	135	1
	Residential fertilizer	10	1	26	1	41	0
	Small scale farms	4	1	11	0	18	0
Atmospheric Deposition		57	7	76	2	227	2

*All numbers in this table have been rounded to the nearest ton, or the nearest whole number, in the case of percentages. Some low but nonzero percentages have been rounded to zero.

When assessed on a per-acre basis (Table 2), the sources that contribute the most nitrogen differ from those contributing the most nitrogen over the entire GWMA. Nitrogen estimates from irrigated agriculture are the top contributor when assessed over the entire GWMA because of the large number of acres assessed, but are not in the top 3 on a per-acre basis.

Some management units have relatively small acreages, but contribute large amounts of nitrogen per acre. For example, the LOSS estimates at the low range are one of the top 3 contributors of nitrogen on a per-acre basis, but they have an extremely small total acreage in the GWMA (3 acres). The CAFO lagoon and ROSS estimates at the low, medium and high ranges are in the group of the top 3 highest contributors on a per-acre basis (shaded in blue in Table 2). CAFO lagoon and ROSS acreage in the GWMA are relatively small when compared to larger source areas such as irrigated agriculture, atmospheric deposition, and residential fertilizer.

Table 2. Estimated nitrogen available for transport per acre from all sources at low, medium, and high range

Source		Area (acres)	Low (lb/acre-year)	Medium (lb/acre-year)	High (lb/acre-year)
Irrigated Agriculture		96,186	11	60	181
CAFO	Pens	2,096	67	480	892
	Lagoons	210	1,354	7,448	13,542
RCIM	ROSS	398	223	403	662
	LOSS	3	195	209	225
	COSS	30	163	173	183
	Residential Fertilizer	4,381	4.7	11.7	18.6
	Small Scale Farms	2,096	4.3	10.7	17.1
Atmospheric Deposition		73,976	1.53	2.05	6.15

Blue shading indicates top 3 contributors in each range (low, medium, high).

Looking Ahead

NRAS has identified a number of data needs to add to these estimates. Both WSDA and Ecology are engaged in work that will aggregate information about lagoon conditions that could potentially be used to adjust these estimates. Calculations could be updated as data becomes available from the DNMP lagoon liner assessment ratings and Ecology CAFO permit reporting assessments and requirements. Washington State University research on lagoon seepage is beginning that may also provide relevant information. New field research on lagoon seepage could also be conducted if necessary to supply the needed data. The irrigated agriculture mass balance estimates could be compared to current and future deep soil sampling results to improve the accuracy of the analysis. An assessment of additional data for each impoundment classification (lagoon, flush/main lagoon, farm/irrigation pond, settling basin) could be used to apply seepage rates and nitrogen concentrations specific to each use. A statistically-based study of soil nitrogen concentrations beneath pens could be conducted to confirm estimates used in this study that were developed in other regions of the country. Additional areas of inquiry are discussed in the Conclusions and Recommendations section.

Even though estimates may be refined in the future, this comprehensive study was successful in making an initial estimate of potentially available nitrogen from different sources throughout the GWMA. Per-acre estimates from each source category can be reviewed spatially to identify areas where risk and vulnerability are potentially high. The use of this spatial component allows for more complex future analysis with the inclusion of other relevant data layers such as soil type, depth to groundwater, groundwater nitrate concentrations, soil sampling results, and proximity to public drinking water systems.

Introduction and study area

Yakima County is located in central Washington State. This study focuses on the lower Yakima Valley, located in the southeastern portion of the county and bordered by the Rattlesnake Hills to the north, the Yakama Nation to the west, and Benton County to the east. The Yakima Groundwater Management Area (GWMA) is shown in Figure 1, with major cities and roads noted. The current population of Yakima County is just over 240,000 people, and the major metropolitan area is the city of Yakima (Census 2010). The county's main industry is agriculture, with a 2013 farm gate value of $1.65 billion (USDA NASS 2014). The major commodities produced are apples, milk, and hay. The lower valley agricultural landscape includes more than 50 active dairy farms and approximately 100,000 acres of irrigated farmland (WSDA 2016). The Yakima River runs through the GWMA, and water for agriculture is collectively managed by 5 different irrigation districts: Roza, Sunnyside, Wapato, Zillah, and Grandview.

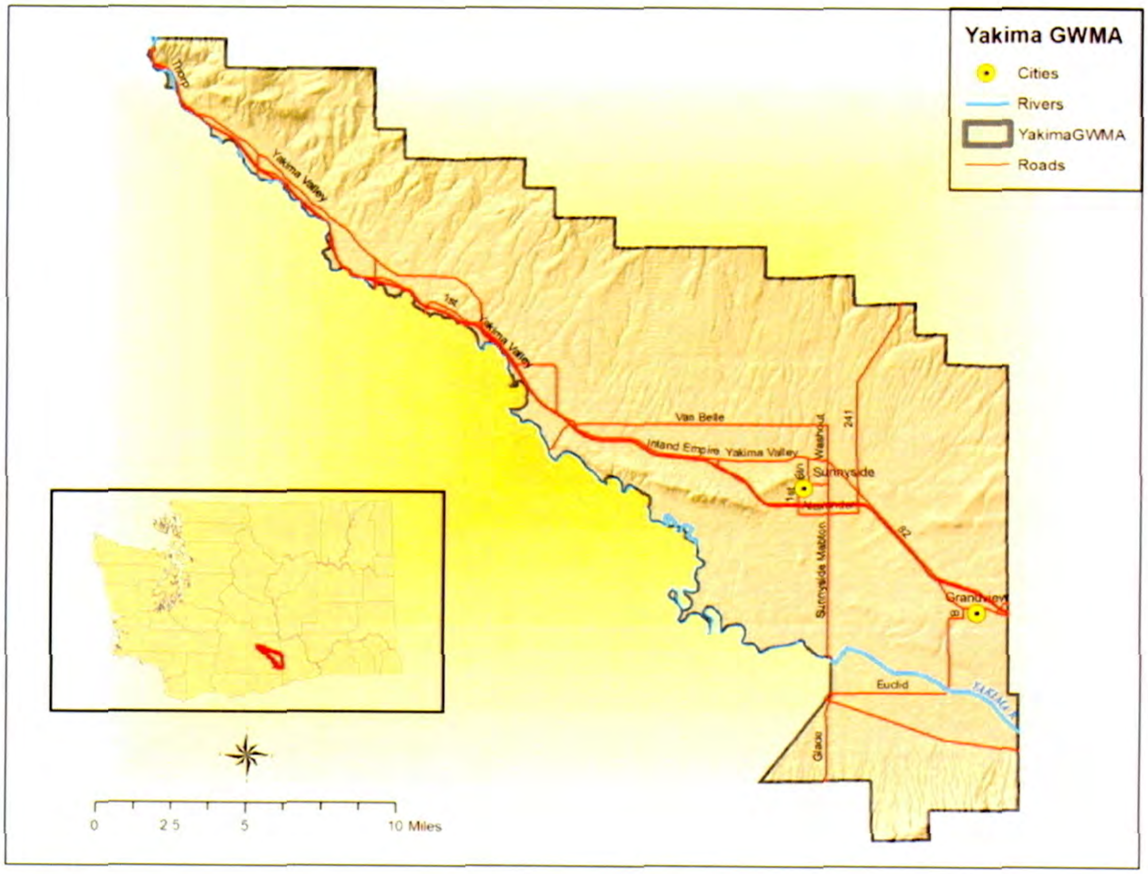


Figure 1. Map of Yakima ground water management area

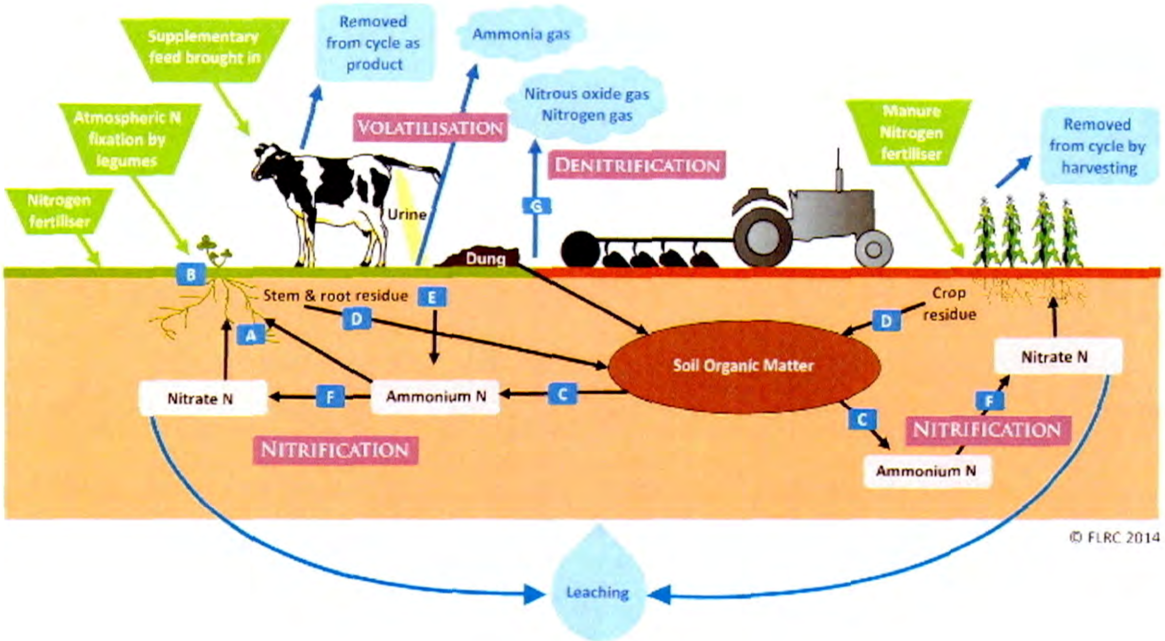
Within some areas of the GWMA, nitrogen has negatively impacted groundwater quality. The Washington State Department of Ecology (Ecology) summarized results from sampling studies conducted by Ecology, the US Geological Survey, and the Washington State Department of Health between the early 1990's and June 2008. A total of 1,726 nitrate testing samples from 453 well sites were summarized. Data sources included nitrate test results from 328 domestic wells, 93 public wells, and 33 wells of other types including some used for irrigation. Of wells with nitrate detections, 67% were less than 5 mg NO_3-N/L, 21% were between 5 and 9.9 mg NO_3-N/L, and 12% were greater than 10 mg NO_3-N/L. The Maximum Contaminant Level set by the US Environmental Protection Agency (EPA) for nitrate is 10 mg NO_3-N/L; concentrations approaching and above this level are of concern due to the potential impact to human health (EPA 2013a, Ecology et al. 2010). Shallower wells (which were more likely to be domestic wells) had more nitrate detections and exceedances than deeper wells (Ecology et al. 2010). An EPA study concluded that agriculture and livestock operations within the GWMA were significant contributors to nitrogen loading to the underlying groundwater (EPA 2013a).

In 2011, Ecology authorized the formation of the lower Yakima GWMA. This group, made up of area residents, representatives from the agricultural industry, and scientists and experts from county, state, and federal government agencies, is focused on identifying potential contaminant sources and preparing a management strategy for the affected area.

EPA conducted a multi-phase study to identify potential nitrate sources and other contaminants. After source identification, EPA conducted groundwater monitoring up- and downgradient from potential sources (including several large dairies) in 2010 (EPA 2013a). As a result of this groundwater sampling, in March 2013, EPA signed an Administrative Order on Consent (Consent Order) with 5 dairies in the lower Yakima Valley (EPA 2013b). The purpose of this consent order was to address sources of nitrate contamination in groundwater near and downgradient of the dairies' facilities. These dairies have begun additional work to control nitrate sources, collect data, and monitor groundwater quality to assess the effectiveness of the source control actions.

This report is the result of a request in 2015 by the GWMA's Ground Water Advisory Committee for the Washington State Department of Agriculture (WSDA) Natural Resources Assessment Section (NRAS) and the Yakima County Public Services Department to complete an estimate of nitrogen loading potential within different land use classes in the lower Yakima Valley. This report outlines estimated nitrogen available for transport from the following land uses: irrigated agriculture, concentrated animal feeding operations (which includes both dairies, dairy support such as heifer raising, and beef cattle feedlots), residential, commercial, industrial, and municipal sources. The land uses were divided into 3 separate sections for calculations: irrigated agriculture, concentrated animal feeding operations (CAFOs), and residential, commercial, industrial, and municipal (RCIM) sources. A separate section estimates the potential contribution to groundwater nitrogen from atmospheric deposition of nitrogen. The data was collected from a variety of sources and through different methods, including phone interviews, on-farm data collection, analysis of aerial imagery, ground surveys for spatial analysis, and local zoning and land use information.

Nitrogen has an extremely complex cycle in the environment, with a number of different pathways for accumulation and removal. Figure 2 shows how these pathways might work in an agricultural system (Fertilizer and Lime Research Centre, 2014).



A. Plant uptake of N; **B**. N fixation by legumes; **C**. Decomposition of organic matter to Ammonium; **D**. Plant residues and dung to soil organic pool; **E**. Enzyme conversion of Urea to Ammonium; **F**. Nitrification - the conversion of Ammonium to Nitrate; **G**. Denitrification - the conversion of Nitrate to Nitrous Oxide gas and then to Nitrogen gas.

Figure 2. Nitrogen cycling pathways in agricultural settings

This study is the first conducted in the lower valley that uses local information to address the potential pathways for nitrogen loading. It is also the first project completed for the GWMA that pairs estimated nitrogen surpluses with GIS-based land use information. The purpose of this report is to understand available nitrogen from nitrogen sources and enable the GWMA advisory committee to better direct remediation strategies throughout the region.

Methodology and Limitations

The objective of this report was to provide information to the Groundwater Advisory Committee that can be used to make decisions about how to use limited resources to meet the long-term goals of reducing nitrate concentrations in groundwater until they meet groundwater standards. This report is not intended as a final statement on potential nitrogen contributions from different sources, instead it represents a first step. Recommendations are made for future experimental research to improve estimates, and additional data sets have been identified for future inclusion that are currently available or will become available in the future. These calculations can and should be updated as new information becomes available.

Nitrogen loading potential was assessed differently in each section (irrigated agriculture, CAFO, and RCIM). Fate and transport of the nitrogen through the soil profile to groundwater is not explored in this document. For each operational unit the objective was to determine the total nitrogen available for transport at the end of the 'treatment zone'. This location is different for different sectors,

- for irrigated agriculture it is nitrogen available at the bottom of the root zone, when it becomes unavailable for plant uptake,
- for lagoons it is the bottom of the lagoon liner, when it is available to move through the soil profile under some conditions,
- for pens it is the bottom of the manure-soil interface layer, when it is available to move through the soil profile under some conditions,
- for septic systems it is the end of the drainfield,
- for residential fertilizer use it is the land surface, and
- for small scale commercial and hobby farms it is the land surface.

One challenge for both conducting this study and interpreting and comparing the results in the different sections is the diversity of data sources used for calculations. Data sources included self-reported data from producers, data from peer-reviewed literature, data from state and federal government studies, averaged data, specific local data, general national data, and estimates based on best professional judgment. Examples of just a few of the many data sources used for calculations in this study are:

- fertilizer use practices (self-reported survey information, local and crop specific data),
- analytical results from testing of lagoon nitrogen concentrations (self-reported, testing results from certified labs, sample not statistically selected),
- analytical results from testing of lagoon nitrogen concentrations (local data, EPA sampling and analysis procedures, sample not statistically selected),
- GIS data derived from ground-based mapping, human analysis of aerial imagery, and automated analysis of aerial imagery with ArcMap tools (local data, accuracy may vary depending on analysis method),
- estimates by experts in different specialties (local data, estimates may vary depending on expert judgment), and
- national- and state- level data and estimates for performance of septic systems (larger-scale data may not be accurate for local conditions).

An additional challenge in reviewing data presented in the literature and experimental results is the many units used and species of nitrogen reported in papers. Nitrogen is often reported as nitrate, nitrate-N, organic nitrogen-N, TKN, ammonia/ammonium, ammonia/ammonium-N, combinations of these, or as total nitrogen, which makes comparison of literature results difficult and sometimes impossible

This study relies on a wide variety of data sources, which has to be considered when interpreting and using the results. Not all sources will be considered equally credible according to the Water Quality Data Act (RCW 90.48.570-90.48.590, Water...2004). This can make it difficult to compare data sources and calculation results. In order to allow readers to evaluate data sources on a case-by-case basis each data source used, the calculation it was used for, the source, and potential concerns with the data source have been collected in a table (Appendix A: Data Sources, Uses, and Potential Concerns). Wherever possible, summary statistics have been presented and a careful choice has been made for what value (mean, median, or an alternative) to use in calculations.

The conclusions section of this report makes suggestions for critical additional research to refine these estimates through additional data collection. The spatial component of this data is extremely important. Wherever possible, nitrogen availability has been presented both as an aggregate over the entire GWMA and on a per-acre basis. This per-acre nitrogen availability can be spatially associated with sources to examine nitrogen availability at different scales and in different regions.

1. CONCENTRATED ANIMAL FEEDING OPERATIONS

WSDA authors: Margaret Drennan, Jaclyn Hancock, Gary Bahr

Background and literature review

Over the past 90 years, the number of cattle and dairy farms has been decreasing. The number of cattle and calves has increased relatively steadily during that time. The number of dairy cows was relatively stable between 1925 and 1969, but after 1969 the number of dairy cows began to increase steadily, which has continued until 2012. Between 1969 and 2012 USDA's estimate of dairy operations went from 7,868 cows on 301 farms to 99,532 milk cows on 97 farms (USDA NASS 2014). Dairy farms are increasing in size while the number of farms is decreasing. As of 2012, USDA also notes the presence of relatively low numbers of other livestock: hogs and pigs, sheep, goats, horses, and poultry (USDA NASS 2014). This USDA statistical data is available only at the county level.

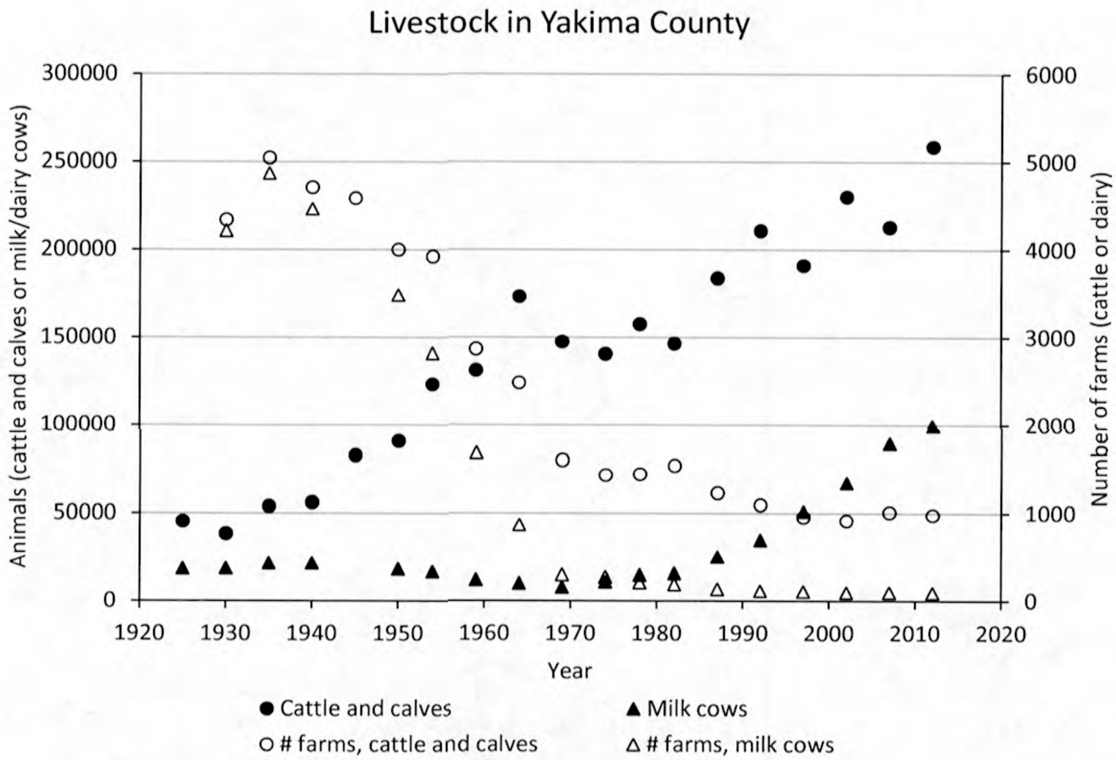


Figure 3. Livestock (cattle and dairy cows) in Yakima County since 1925[1]

Dairies are the only Washington State livestock operations whose manure management is inspected and regulated by WSDA, in accordance with Washington's Dairy Nutrient Management Act (Dairy...1998). Dairies are required to register with WSDA's Dairy Nutrient Management Program, develop nutrient management plans, maintain records of manure applications, and are inspected regularly by DNMP staff. As a result, dairies are the facilities about which most information is available. Dairy support animals (dry cows, calves, and heifers) are sometimes kept in adjacent facilities and sometimes (in the case of calf and heifer raising operations) moved offsite until maturity.

Whether nitrogen or other contaminants move from operational units to surface or ground water depends on dairy age, management practices, meteorological conditions, soil types, geological conditions, unsaturated zone thickness, and groundwater characteristics. Several studies have attempted to quantify nitrogen loading from entire farms and identify which sector (pens, lagoons, or irrigated fields) makes the largest contribution. Two studies in California used monitoring wells up- and downgradient from different management units in an attempt to measure nitrogen additions from each management unit (Harter et al. 2002, van der Schans et al. 2009). Harter

[1] (Commerce 1927, Commerce 1932, Commerce 1936, Commerce 1942, Commerce 1946, Commerce 1952, Commerce 1956, Commerce 1961, Commerce 1967, Commerce 1972, Commerce 1977, Commerce 1981, Commerce 1984, Commerce 1989, Commerce 1994, USDA NASS 1999, USDA NASS 2004, USDA NASS 2009, USDA NASS 2014)

monitored groundwater at 5 dairies for 4 years and found that it was very difficult to exclude effects from neighboring management units, they concluded that the largest nitrogen contributor on dairies was manure-treated cropland. Total contributions from cropland were much larger than pens or lagoons largely because the acreage of cropland was much larger and made it difficult to distinguish contributions from pens and lagoons (Harter et al. 2002). Another study in California used monitoring wells to calibrate groundwater models specific to 2 dairy farms in California. The study identified nitrate-N losses of 486 kg/ha-yr from manure-treated fields, 872 kg/ha-yr from pens, and 807 kg/ha-yr from lagoons (van der Schans et al. 2009). Another study conducted by a University of California at Davis (UC Davis) team assessed nitrate loading to ground water in prominent agricultural and dairy production areas within the Tulare Lake Basin and Salinas Valley of California. The UC Davis study estimated loading from pens at 75-1,000 kg N/ha-yr. Based on a variety of estimates of seepage rates from manure lagoons and lagoon nitrogen concentrations the UC Davis study estimated nitrogen loading from lagoons at 200-2,000 Mg/year for the entire study area. With a total lagoon area of 1,265 ha this results in a loading rate of 158-1581 kg N/ha-yr (Viers et al. 2012).

Pens

Dairies contain a variety of different operational units dedicated to animal housing, manure management and storage, and sometimes also crop production. Animal holding areas can include concrete-surfaced freestall barns, as well as holding areas which are generally constructed with compacted earth surfaces. These are referred to by a variety of names in different studies but will be referred to in this report as pens. Pens at facilities housing support animals have been classified as 'nondairy CAFO' pens while pens at facilities housing milking cows have been classified as 'dairy CAFO' pens.

The combination of weight and compaction due to the presence of cattle with the physical and chemical changes to underlying soil due to the mixing of soil and manure have been observed to form an interface layer under the deposited manure that allows very little infiltration of liquid to the underlying soil (Mielke et al. 1974). At one feedlot site, researchers were not able to record any infiltration during a 20-day period (Mielke et al. 1974). A study of 3 feedlots in Alberta, Canada confirmed that this interface layer formed within 2 months of cattle stocking. In addition, experimentally-determined permeabilities were similar for coarse- and fine-textured soils. However, despite this interface layer and expected low leaching potential, chloride leaching was detected at all 3 feedlots (Miller et al. 2008). Similarly, at feedlots in Kansas, despite apparently limited infiltration, soil testing beneath pens found elevated concentrations of ammonium, organic nitrogen, nitrate, chloride, and phosphorus. This study compared a mass balance approach to estimate nitrogen leaching from feedlots to subsurface soil testing results. Although elevated concentrations of contaminants were detected, movement of contaminants through the feedlot surface was much lower than what was expected from the mass balance calculation and concentrations were consistent with diffusion through the interface layer (Vaillant et al. 2009). Seepage rates through feedlot surfaces documented in other studies ranged from 0.005 to 2.4 mm/day (reported in Vaillant et al. 2009). The effectiveness of this manure-soil interface layer is dependent on maintenance and surface conditions. Dry conditions combined with animal hoof action or on-farm practices such as pen scraping can damage the aggregated structures, compromising the interface layer and allowing infiltration or altering subsurface conditions to favor nitrogen transformations and subsequent leaching (Mielke et al. 1974, Vaillant et al. 2009).

The UC Davis report identified 2 large beef cattle feedlots in the Tulare Lake Basin, with stocking rates of 125 and 300 animals/acre. The dairies studied in the Tulare Lake Basin had stocking rates of 50 animals/acre, which does not include support animals (Viers et al. 2012). As of the 2014 DNMP dairy registration, dairies in Yakima County had just over 100,000 milking and dry cows (the vast majority of which were located within the GWMA boundary), making for a stocking rate of around 50 cattle/acre, based on the NRAS estimate of pen acreage, similar to that of dairies in the UC Davis study.

The UC Davis study assessed these studies and local soil testing data (unpublished) to choose low and high nitrogen loading rates for pens. The authors chose 75 kg N/ha-yr as the low loading rate, based on a locally-observed recharge rate below corrals of 50 mm/year and soil moisture nitrate concentrations of 675 mg/L (unpublished data). Citing recharge rates as high as 300 mm/year reported in other studies the UC Davis study used 1,000 kg N/ha-yr as an upper limit for nitrogen loading from pens. However, the authors of that study suggest that the upper bound is an overestimate, potentially as much as an entire order of magnitude too high (Viers et al. 2012).

Lagoons

Depending on the dairy's management practices, manure and urine deposited in freestall barns and pens is transported to storage areas which may be liquid storage impoundments (generally through underground piping and pumping systems) or solids storage and composting areas where solids are dried, stacked, and sometimes composted for further use.

Liquid storage impoundments themselves serve a variety of on-farm uses. Lagoons can provide storage for manure and urine cleaned from barns, but may also capture runoff from roofs and other surfaces and process water from the milking parlor. In addition, lagoon liquid may be recirculated to clean barns with flush systems. Distinguishing between an impoundment primarily used for manure storage and one primarily used for irrigation water storage can be difficult. Contents are transferred between impoundments as needed to meet cleaning, storage capacity, and maintenance needs. The term lagoons is used here to refer to impoundments whose primary purpose is manure storage. In addition to lagoons, some dairies also have dedicated impoundments used for separating solids and liquids. The technical sophistication of these impoundments could range from a pond with a weeping wall to an engineered concrete basin with baffles directing and slowing flow to promote settling.

There is substantial variation both in the composition of solids, liquids, and dissolved constituents, and in seepage rates from lagoons, resulting in wide variation in the potential to impact ground water quality (Ham 2002; Harter et al. 2014). A study of 20 lagoons (14 swine, 5 feedlot, and 1 dairy) found seepage rates between 0.2 and 2.4 mm/day, with an average of 1.1 mm/day (Ham 2002). Groundwater monitoring up- and downgradient from lagoons confirms that contaminants leaching from lagoons contribute to shallow groundwater contamination (Harter et al. 2002, van der Schans et al. 2009, Viers et al. 2012). In one study, testing detected elevated concentrations of TKN (total Kjeldahl nitrogen, a measure of organic N and ammonium/ammonia N combined) outside the edges of 3 dairy lagoons, and the authors estimated a leaching rate of approximately 1 m/year (Harter et al. 2002).

Nitrogen concentration within lagoons has been tested in a number of studies, and is extremely variable. The UC Davis study conducted extensive literature review and modeling of lagoons and the authors used nitrogen concentrations of 500 and 1,000 mg N/L in their estimates (Viers et al. 2012). A survey of lagoon contents in California sampled more than 60 dairies in California's San Joaquin Valley in 1999 and 2000 and found lagoon TKN concentrations of 47-2,420 mg N/L, with an average of 560 mg N/L (Campbell Mathews et al. 2001). A University of California Cooperative Extension publication reports lagoon nitrogen concentrations from other research on California dairies: one study of 11 dairies found median lagoon total N concentrations ranging from 164-645 mg N/L and another study of 8 dairies found mean TKN in lagoons of 670 mg N/L (Pettygrove et al. 2010). Sampling at 5 Yakima Valley dairies by EPA found total nitrogen concentrations ranging from 290 to 1,800 mg N/L with an average of 1,212 mg N/L (EPA 2013a). These results are summarized in Table 3.

Table 3. Dairy lagoon manure sampling results derived from or used by studies in California and the Yakima Valley

Citation	Project Location	Actual or estimated nitrogen concentration (mg N/L)
EPA 2013a	Yakima Valley, 5 dairies	range 290 - 1,800 average 1,212
Viers et al. 2012	Tulare Lake Basin and Salinas Valley, California	500 1,000
Campbell Mathews et al. 2011	San Joaquin Valley, California	range 47-2,420* average 560*
Pettygrove et al. 2010 (reporting 2 studies)	California	165 – 645 670*

*TKN is a measure of organic N + ammonia N. In lagoons nitrate is very low or undetectable and TKN is comparable to total N.

PENS AND COMPOST AREAS

Methods, limitations, and assumptions

Limitations

Every effort has been made in this report to identify facilities and facility uses that are current as of 2015. Staff with WSDA's Dairy Nutrient Management Program (DNMP) worked closely with NRAS to correctly identify facilities and unit operations. However, facilities close and open, and the use of individual unit operations changes. As a result some dairies are included in this analysis that have since closed. Individual pens have been associated with either dairy or nondairy CAFOs. The majority of pens that have been identified as nondairy CAFOs are likely dedicated to raising or housing dairy support animals (calves and heifers). However, individual pens may hold calves during one time period and after those animals are moved out, heifers or adult cows may be moved into that same corral or pen. NRAS has attempted to capture primary uses of different pens but use practices are subject to variation. A small number of the pens identified as nondairy CAFOs are associated with 2 beef cattle feedlots. The calculation used for pens identified as dairy and nondairy

CAFOs is the same, both are based on the methods used by the UC Davis study team (Viers et al. 2012). The same rate was used for both dairy and nondairy CAFOs despite the fact that beef cattle feedlots, dairies, and heifer raising facilities have different characteristics and management practices that would be likely to affect nitrogen loss. Stocking rates, manure volume, manure nitrogen content, animal size, and feed choices would be likely to differ between dairy and nondairy CAFOs, all of which would affect the nitrogen loss at these facilities. NRAS did not have the amount of facility-specific on-site information that would be needed to generate different rates for dairy and nondairy CAFOs. Dividing pens into dairy and nondairy categories would allow different calculations to be conducted in the future if more facility-specific information becomes available. This analysis also does not account for any contribution from cattle kept anywhere other than CAFO pens, such as rangeland or pasture. An estimate of nitrogen available for transport from pasture land is included in Section **2.** IRRIGATED AGRICULTURE.

Manure composting areas were identified and the acreage was calculated as part of this analysis. Differences between composting areas and pens include surface construction, the lack of animal movement compacting surfaces, and the difference in moisture inputs between composting areas and pens. Due to these differences, as well as the diversity of potential compost management practices, NRAS did not feel use of the dairy/nondairy CAFO pen rate was appropriate for compost areas. The diversity of composting practices could include composting in windrows, composting in bags, spreading material out over a large surface to dry, turning frequency, moisture additions to maintain optimal composting conditions, or the use of a concrete pad for composting. With no information available in scientific literature about potential loading from compost areas, NRAS did not attempt a calculation for these areas. With the locations and dimensions of composting areas already identified, nitrogen loss from compost areas could easily be calculated in the future if new information becomes available.

Potential nitrogen loss from buildings housing animals was not assessed. Animals may spend time in freestall barns and milking parlors. These facilities are built with concrete floors and cleaned multiple times a day. Although poorly maintained or old concrete may develop cracks that could provide a pathway for contaminants to reach the soil profile, any potential losses from these types of buildings would be orders of magnitude smaller than potential losses from pens and lagoons. Additionally, material removed from these facilities is sometimes transported to lagoons onsite; making the analysis of what nitrogen originated at which unit operation challenging.

Calculating storage in corral subsurface soil was beyond the scope of this report. An accurate calculation would require historic information about dairy and beef cattle numbers and management practices. However, other research demonstrates that soil beneath corrals may hold large amounts of nitrogen that could be released when these facilities are turned to other uses and demonstrates the importance of appropriate decommissioning procedures (Vaillant et al. 2009, Viers et al. 2012).

Potential emissions of nitrogen compounds to the atmosphere from pens and corrals have not been estimated in this report. It is unknown what proportion of emissions from GWMA CAFOs may redeposit within the GWMA, as emissions may travel large distances before eventual deposition (Viers et al. 2012). The rates used for the pen calculations are based on leaching rates and soil and groundwater testing results from other studies. The influence of atmospheric nitrogen deposition would be accounted for in those testing results already; any atmospheric nitrogen deposited on pen surfaces and lost to soil or groundwater would contribute to nitrogen detected when soil and groundwater are tested. As a result, the pen acreage was removed from the atmospheric deposition summary calculation conducted in the atmospheric deposition section (4. ATMOSPHERIC DEPOSITION).

GIS methodology

The results of this study were summarized using geographic information systems (GIS). A spatial database called a file geodatabase contains all the GIS data for the livestock section of this study. This database contains both attributes and spatial locations of this data. It contains five feature classes and one table: YakimaGWMA (polygon, GWMA boundary), WSDACrop_2015 (polygons, crop identification), Lagoons (points), Ponds (points), and CAFO_Pen_Compost (polygons, boundaries of pens and compost areas). This database also contains a table, IrrigatedMassBalance, which contained the mass balance calculations and results.

Pen and compost area boundaries represent the locations of dairy and nondairy CAFO unit operations including corrals, feedlots, holding pens, and manure composting areas. These are displayed as polygons in the geodatabase and attributes include the category (dairy CAFO, nondairy CAFO, or compost), area in acres, and low, medium, and high potential nitrogen loss (if calculated). Polygons were drawn by WSDA staff using published 2014 dairy registration locations as a reference along with 2013 National Agricultural Imagery Program (NAIP) imagery from USDA. Dairy and nondairy CAFO pens were distinguished based on information from WSDA's Animal Services Division, facility size, and proximity to a known dairy location, which was based on records from WSDA's DNMP. DNMP staff were consulted to assure accuracy of both location and type of operation. Any roofed area likely to be a freestall barn or milking parlor was excluded.

Quality assurance was performed from November 2015 through February 2016 on all components of the geodatabase. This was a 3-step process. First, a random sampling of each dataset was performed using Excel's random number function and a field survey was conducted of the selected polygons and points in conjunction with USDA NAIP 2013 imagery to ensure the accuracy and location of the data. For the pen and compost boundaries, it was to ensure the operation was a CAFO or compost facility. The last step was to double-check all polygons and points with USDA NAIP 2015 imagery that became available in early 2016, which resulted in several updates due to changes in facility status. All geospatial data used in this study met WSDA data quality error rate of less than 10% (Beale and Baker 2009).

Metadata is included with the GIS database to further describe the additional aspects of the GIS data. This includes information such as the extent, credits, use limitations, scale, processing environment, author, and spatial reference.

Calculation methodology

The pen nitrogen calculation was based on the low and high loading range used in the UC Davis nitrogen loading study (Viers et al. 2012). The loading rates used in the UC Davis study were chosen based on several other research studies. The low range (75 kg N/ha-yr, or 67 lb N/ac-yr) was chosen based on unpublished research conducted by UC Davis study authors in the Tulare Lake Basin that was reported in the UC Davis study (Viers et al. 2012). Meteorological conditions in the GWMA are similar to the Tulare Lake Basin, with 7.55 inches or rain each year, on average, in Tulare, CA, and 6.8 in Sunnyside, WA (mean 1894-2012, WRCC 2012, Viers et al. 2012). The high range used in the UC Davis study (1,000 kg N/ha-yr, or 892 lb N/ac-yr) was based on research conducted in the Tulare Lake Basin and Salinas Valley by the study authors, as well as research in California's San Joaquin Valley (van der Schans et al. 2009) and in Kansas (Vaillant et al. 2009). Meteorological conditions in Kansas are significantly different from conditions in either the Tulare Lake Basin or the Yakima Valley (annual rainfall ranged from 24 to 36 inches at the study sites) (Vaillant et al. 2009). However, due to the lack of a large body of similar research to compare results with, there limited data to choose from. The high rate is likely a significant overestimation of the available nitrogen, due to factors that include lower precipitation and higher evapotranspiration in the Yakima Valley than in the regions where the research this nitrogen loading rate was based on was conducted. The lower precipitation and higher evapotranspiration would result in both lower groundwater recharge and higher losses of nitrogen to the atmosphere, reducing the nitrogen available to move through the pen surface.

The calculation itself consisted of multiplying either the low or the high rate by the acreage of each pen. The medium rate for pens was determined by averaging the results of the low and high rates for each individual pen; it has no physical significance. Individual pen results were added to determine estimated losses for all pens in the region.

$$N\ loading\ rate\ \left(\frac{lb\ N}{acre \cdot year}\right) \times Pen\ acreage\ (acre) = Potential\ N\ loading\ \left(\frac{lb\ N}{year}\right)$$

Results and discussion

The total area of pens and compost areas is summarized in Table 4. Areas were categorized as either dairy CAFO (pens associated with a dairy operation), nondairy CAFO (pens believed to be associated with either a beef cattle feedlot or dairy support, housing calves or heifers), or compost (areas at either dairy or nondairy facilities where composting is taking place). The total acres of dairy CAFO pens are the largest subset of the pens identified, making up 60.7% of the total 2,632 acres identified as pens or composting areas. The areas of nondairy CAFO pens and compost are similar; those facilities make up 18.9 and 20.4% of the total, respectively.

Table 4. Acres of dairy CAFO, nondairy CAFO, and compost in the GWMA, with the percentage each category represents of the total area identified

	Acres	%
Dairy CAFO pens	1,597	60.7
Nondairy CAFO pens	499	18.9
Compost	536	20.4
Total (pens and compost)	2,632	100

Based on the low and high rates discussed in the calculation methodology and the acreage of different facilities in Table 4, the following potential nitrogen losses were determined (Table 5).

Results were rounded to the nearest ton/yr or 1,000 kg/yr, to be consistent with the estimated accuracy of these calculations. Available nitrogen was calculated for the 2,096 acres of dairy CAFO and nondairy CAFO areas only, as discussed in the Limitations section above. No calculation was conducted for compost areas.

Table 5. Potential nitrogen available for transport from dairy and nondairy CAFOs

	lb N/ac-yr	kg N/ha-yr	Ton N/yr	kg N/yr
Low rate (Viers et al. 2012)	67	75	70	64,000
Medium rate (average)	480	538	502	456,000
High rate (Viers et al. 2012)	892	1000	935	848,000

The high rate is an entire order of magnitude above the low rate. With the information currently available, WSDA is not able to narrow this range.

Management practices onsite such as maintaining an intact interface layer to inhibit liquid movement through the pen surface, changes in precipitation and evapotranspiration from season to season, and animal stocking rates will all affect potential loading.

The 2 large feedlots in the Yakima Valley have a combined acreage of 291 acres. Because only dairies are required to share animal numbers with WSDA, the numbers of animals on these feedlots is unknown. The total number of cattle and calves in Yakima County is 258,663 as of the 2012 Census of Agriculture by USDA NASS. Also from the 2012 Census of Agriculture, the total number of dairy cows in Yakima County is 99,532, which would include only milking and dry cows, not other dairy support animals (calves and heifers) (USDA NASS 2012). The difference (159,131 animals) would include beef cattle on feedlots, cattle and calves on range, and dairy support animals (for example, calves and heifers at dedicated facilities). Of these animals, cattle on feedlots and dairy support animals are accounted for in the calculations, while cattle on rangeland or pasture are not. The census information is for the entire county rather than specific to the GWMA region, but it is likely that the majority of these animals are within the GWMA boundary.

In July 2015, NRAS conducted a soil sampling survey in pens and compost areas at 5 dairies within the GWMA. This data is used here to compare conditions observed beneath pens in the GWMA to conditions observed beneath pens in the Tulare Lake Basin and Salinas Valley, where the loading rates used in the UC Davis study were derived. Similar soil testing results would suggest that the loading rates used in the UC Davis study are appropriate for the GWMA.

Producers who participated in this study allowed NRAS staff onto their property, dig large pits to sample at depths up to 6 feet, and sample multiple locations on the property. Project quality assurance documentation (such as standard operating procedures or a quality assurance project plan) was not developed before sampling, and as a result this data is not considered credible under the requirements of Washington's Water Quality Data Act (RCW 90.48.570-90.48.590, Water...2004). This data should not be used for decision making and it was not used to develop the nitrogen loss rates used in this report. WSDA believes that there are 2 main potential sources of bias or error in this data set. The first is the lack of a statistically-based sampling procedure, meaning that the results may not be useful for assessing the subsurface nutrient concentrations at all the dairies in the GWMA, just at the dairies that were sampled. The second is the potential for sample cross-contamination due to sample transfer on equipment, meaning that making conclusions based on individual sample results is not recommended. Samples were analyzed at an accredited lab (Northwest Agricultural Consultants, Kennewick, WA). WSDA has used these results (in the aggregate) to gain a better understanding of nitrogen movement and retention in the soil underlying dairy pens and composting areas in the region. These data were compared to subsurface conditions reported in the literature that potential nitrogen loading rates were drawn from. The soil testing results were not used to identify specific rates to use, however, similarities between soil testing results from GWMA dairies and literature results give us more confidence that these rates are appropriate for this study.

Pen samples were collected from 12 locations at depths of 0 (surface) to 6 feet in 1-foot intervals. The table below displays the range in nitrate concentrations found in pens at each 1-foot depth interval (Table 6). Nitrate concentrations from different samples at the same depth were extremely variable. The average concentration decreased throughout the soil profile from 273.3 mg NO_3-N/kg at the surface to 30.4 mg NO_3-N/kg at a depth of 6 feet. The average nitrate concentrations by depth were also plotted in a nitrate profile in Figure 4.

Table 6. Soil sampling results beneath 12 pens in the Yakima Valley

Depth in pen (ft)	0	1	2	3	4	5	6
Minimum (mg/kg NO_3-N)	22.6	21.8	10.6	8.3	6.1	6.5	3.8
Maximum (mg/kg NO_3-N)	962.6	409.7	199.2	186.5	109.6	93.4	124.7
Average (mg/kg NO_3-N)	273.3	165.9	98.5	71.2	45.7	36.7	30.4
Median (mg/kg NO_3-N)	118.6	153.8	89.9	63.6	38	29.6	17.1
Standard dev. (mg/kg NO_3-N)	308.6	115.3	54.5	45.9	31.1	26.4	36.8

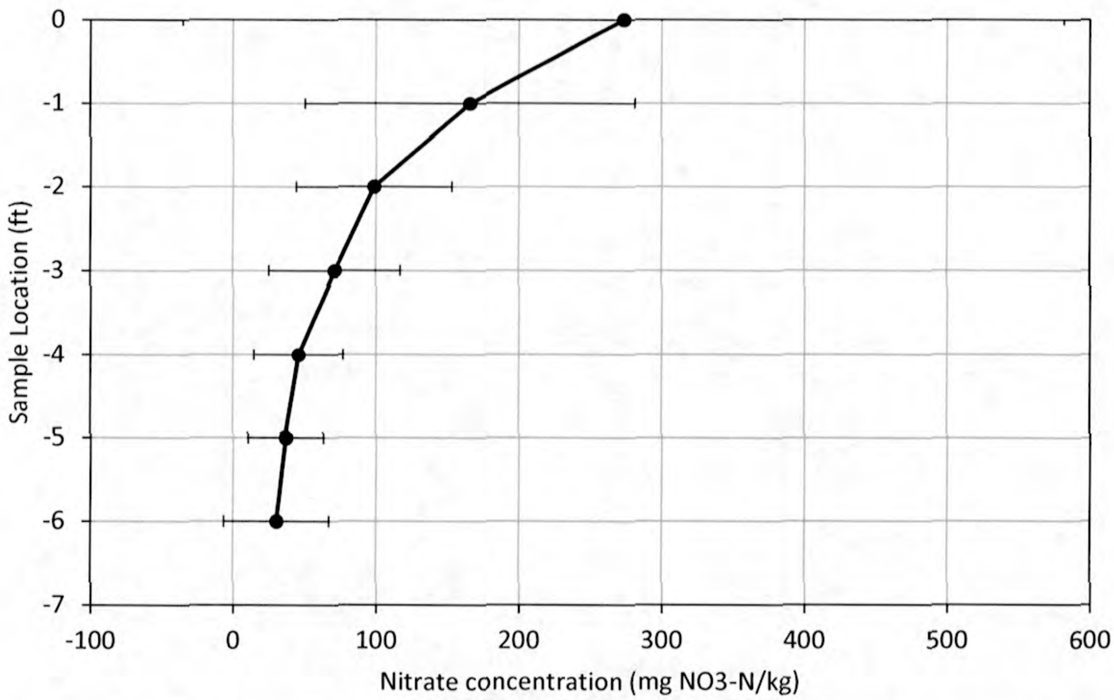


Figure 4. Average nitrate profile beneath 12 pens in the Yakima Valley. Error bars represent one standard deviation from the mean.

Pen soil samples were elevated at the surface and decreased with increasing depth. Soil sampling results are generally compared to a reference number to identify the depth at which numbers return to background levels; no such reference is available in this case. The trends in these results are consistent with those found by Viers et al. (2012) where soil nitrate concentrations were elevated around 200 mg NO_3-N/kg near the surface with a slow decrease to 20-50 mg NO_3-N/kg at depths of 10-15 m. A more detailed comparison is impossible because individual core results, aggregated data, and intermediate depths were not reported in that study. Another study that published soil testing results sampled soil to depths ranging from 1.8 to 4.7 m at 4 beef cattle feedlots in Kansas (Vaillant et al. 2009). A total of 18 soil cores were taken, of which 12 were below their chosen background level (4.1 mg NO_3-N/kg) for the entire core. The remaining 6 cores had elevated nitrate in the top meter of the core ranging from 10.7 mg NO_3-N/kg to 510 mg NO_3-N/kg and a return below the background concentration with increasing depth. Again, the soil testing results from GWMA dairies are similar to these results in magnitude of nitrate concentration, although the nitrate levels at depths greater than 1 m (3.28 feet) were higher in the GWMA soil sampling results than the Kansas feedlot results. Since this study (Vaillant et al. 2009) was the source that the UC Davis researchers (Viers et al. 2012) relied on to identify their high range loading rate of 1,000 kg N/ha-yr, similarity with these results gives us another indicator that this rate is appropriate for use in the GWMA. One large challenge in reviewing literature and comparing results in this field is the diversity of units and species of nitrogen reported in papers. Reporting of nitrogen as nitrate, nitrate-N, organic nitrogen-N, TKN, ammonia/ammonium, ammonia/ammonium-N, combinations of these, or as total nitrogen is common and makes comparison of literature results difficult and sometimes impossible. Next steps for field research in the GWMA to improve estimates of loading rates from pens should include development and execution of a credible statistical sampling program whose results could be used to develop a GWMA-specific rate with a narrower range.

LAGOONS

Methods, limitations, and assumptions

Limitations

As with the pen identification, every effort has been made in this report to identify facilities and facility uses that are current as of 2015. The distinction between a lagoon, a settling basin, a settling pond, or an irrigation pond can be hard to clarify. Different professionals in this industry use different terms for different manure storage impoundments, and different impoundments may be used for different purposes at different times of year. In addition, producers may mix manure and water in additional impoundments before land application. NRAS has identified lagoon impoundments which are primarily used for storage of manure, as opposed to impoundments which are primarily used for storing irrigation water or which are used for mixing manure and water for land application. These impoundments (primarily used for storing manure) will be referred to as lagoons in this report. This difficulty in classification may result in impoundments being placed in the wrong category, despite NRAS's efforts at accuracy.

Lagoon nitrogen concentrations depend on unit operations onsite and on-farm practices. Variations can include the use of flush versus scrape systems to clean barns, the type and efficiency of solids separation systems used, whether and where irrigation water is mixed with manure for land application, and seasonal effects such as precipitation and evaporation rates. Lagoon nitrogen concentrations used in this report are based on 2 data sources. The first is a relatively large subset of farms in the GWMA (approximately 20) whose operators voluntarily shared lagoon nitrogen testing results with WSDA for this study. The second was EPA's lagoon testing results from 5 dairies sampled in 2010 (EPA 2013a). All testing results from these 2 sources were combined and averaged. The resulting nitrogen concentration is higher than lagoon nitrogen concentrations reported in other studies.

Calculating storage in lagoon subsurface soil was beyond the scope of this report. An accurate calculation would require historic information about dairy and beef cattle numbers, management practices, and lagoon construction practices. However, other research indicates that soil beneath lagoons holds large amounts of nitrogen that could be released and emphasizes the importance of appropriate decommissioning at the end of use (Viers et al. 2012).

GIS methodology and lagoon identification

Lagoon points included in the geodatabase represent locations for both dairy and non-dairy lagoons. Point locations were derived using latitude and longitude locations from the WSDA DNMP database in conjunction with aerial imagery from Google Maps or USDA NAIP 2013 imagery. Identified lagoon points were compared with DNMP lagoon assessment data followed by direct consultation with DNMP staff to ensure accuracy. Lagoon area is an attribute and was determined using aerial imagery technology (area = length X width), known dimensions from DNMP (length X width), or using the polygon area (calculated area using GIS) from the DNMP assessment. Depth is also an attribute; depth used was the design depth of the impoundment. Lagoons where the design depth was unknown were assigned an estimated depth, which was the average of all known lagoon depth measurements. Whether depth was the actual design depth or an estimate was documented in an additional Depth Method attribute with values of Actual or Estimate.

The quality assurance procedure conducted for the lagoon points was the same as that for pens and compost areas. Randomly selected points were field surveyed to confirm the identification and accuracy of the lagoon location. Any errors were corrected, and all points were checked against USDA NAIP 2015 imagery.

Lagoon dimensions

WSDA's DNMP has recently completed a lagoon assessment project following NRCS Technical Note 23 (USDA NRCS 2013). The DNMP staff visited every lagoon on a dairy with a milk license, with the exception of the Consent Order dairies, either 2 or 3 times in 2015 in order to assess the lagoon both when it was near full and near empty. During these assessments staff recorded design length, width, storage capacity, and depth. Length, width, and depth of lagoons were determined from existing nutrient management plans and were likely measured at the time of lagoon construction. If DNMP did not have access to the design dimensions, staff used ArcGIS Collector to obtain the perimeter of the lagoon they visited. Length and width measurements at time of construction and Collector application polygons were taken along the border of the embankment and therefore reflect the area of the lagoon at maximum capacity. Surface area was calculated from the polygon or the length and width measurements.

NAIP imagery was utilized to identify additional lagoons that were not included in this assessment process. DNMP staff was consulted to determine if the impoundments identified in the aerial imagery were lagoons, ponds, or neither. Only polygons identified as lagoons were included in this analysis. NRAS staff used NAIP 2015 imagery to measure the length and width of these lagoons. NRAS staff then randomly selected a population of these lagoons for quality assurance checks. Staff visited each of these randomly selected lagoons to confirm identification and location.

Individual lagoon design depths were used when this data was available. The average design depth of the 105 lagoons with known depths was 11.3 ft. This average design depth was used as the depth for lagoons that did not have a measured design depth.

In addition, at each visit DNMP staff estimated the percentage of the lagoon's total capacity in use, and categorized each lagoon as either empty or full. The percentage of lagoon capacity utilized (and as a result, the liquid depth and surface area) varies depending on both season and on-farm management practices. The same farm may have several lagoons that transition from full to empty and back again throughout the year, while another is consistently full; farms may also use lagoons to store irrigation water in addition to manure or use lagoon contents to operate flush systems. During the lagoon assessment process, DNMP staff visited each lagoon either 2 or 3 times in an attempt to view each lagoon both while it was full and while it was empty.

In an attempt to capture a reasonable average yearly liquid depth and surface area to use, NRAS staff used the information recorded by DNMP staff on repeated lagoon visits during the lagoon assessment process. The total number of lagoons visited in 2015 was 115, of which 102 were visited twice and 13 were visited 3 times. Lagoon utilization (% full) varies dramatically depending on the season, so DNMP generally visited each lagoon during both the summer and the winter to account for seasonal variability. The percentage of total capacity utilized at successive visits to the same lagoon was averaged for each of the 115 unique lagoons visited to generate an average capacity used for each lagoon. This average capacity used for each lagoon was then itself averaged across all lagoons, resulting in an average percent capacity used for 2015 visits of 43%. The depth used in the Darcy's Law calculations is 43% of the actual or estimated design depth.

This percentage depth reduction was also used to adjust the surface area of the lagoons. Surface area of the lagoons was determined based on one of the methodologies discussed above (lagoon assessment or aerial imagery). Because of the side slope of lagoons, a reduction in depth results in a corresponding reduction in surface area. The surface areas used for calculations were adjusted based on NRAS's estimation that a lagoon with a working depth of 43% of its design depth would have a corresponding surface area reduction to 73% of the design surface area. The basis for this estimate is described in Appendix C: Lagoon Surface Area Reduction Methodology.

Lagoon nitrogen concentration

WSDA relied on pre-existing sources of information on lagoon nitrogen concentration for this study. One source of lagoon total nitrogen concentrations was the EPA's sampling in 2010, which was published in their 2013 report (EPA 2013a). This data set consists of 15 lagoon samples from 5 dairy farms (at each farm, 1 sample was taken at the inflow to the farm's lagoon system, and 2 samples were taken at the outflow of the farm's lagoon system). Influent concentrations were slightly higher than outflow concentrations, but a statistical comparison was not conducted (EPA 2013a). The average of the 5 influent concentrations was 1,317 mg N/L and the average of the 10 outflow concentrations was 1,159 mg N/L. The range of sample concentrations was 290- 1,800 mg N/L with a mean of 1,212 mg N/L (EPA 2013a).

Another source of lagoon nitrogen concentration data was lagoon testing conducted by the dairy producers themselves. Dairy producers are required to take yearly samples of lagoon content and have them analyzed by an accredited laboratory. This is regulatory data used by WSDA's DNMP to assess whether or not producers are making nutrient applications at agronomic rates. The South Yakima Conservation District (SYCD) asked dairy producers to voluntarily share lagoon testing results with WSDA for use in this assessment; SYCD collected testing results from producers, anonymized them, and forwarded the information to WSDA. A total of 23 lagoon total nitrogen testing results were provided. The exact number of dairy farms that shared data is not known; conservation district staff have estimated the number at 20 farms. The sample concentrations ranged from 180 – 3,624 mg N/L with a mean of 949 mg N/L. More detailed analysis of these data sources is presented in Appendix B: Lagoon Nitrogen Concentration Statistical Analysis.

The mean of the SYCD data set is lower than the mean of the EPA data set. There are many potential reasons for this difference. Neither data set was collected using a statistically-based sampling procedure. The SYCD data was voluntarily shared with WSDA; producers with high lagoon nitrogen concentrations may not have been comfortable sharing their testing results. The EPA study was an effort to identify potential contributors to groundwater contamination; dairies identified for sampling were large, far from other potential nitrate sources, in areas with consistent groundwater flow, and close to drinking water wells with known high nitrate levels. Details of on-farm practices at the dairies in both data sets are unknown. Flush or scrape cleaning systems and the presence and scale of solids separation may affect in-lagoon nitrogen concentrations. At a flush dairy, separated lagoon water is often recirculated to clean barns, while at a scrape dairy, lagoon contents are not generally recirculated. The degree of solids separation depends on the system (and corresponding removal of nitrogen contained in or bound to solids) and will also affect lagoon nitrogen concentration.

NRAS consulted supplemental data provided by DNMP to gain additional information about the types of dairy operations within the GWMA boundary. Of the 52 dairies in the data set, 12 were flush dairies, 39 were not flush dairies, and 1 was out of business. Most (83%) of the dairies have some type of solids separator system on site. A minority of the dairies (25%) rely solely on settling basins for solids separation, while 58% of the dairies have secondary processes including slope screen separators, centrifuges, barrel screen roller presses, screw presses, and gravity flow separation. A small number (15%) of dairies have no solids separation systems.

Total nitrogen concentration data used in other studies varies greatly. The UC Davis report used concentrations of 500 and 1,000 mg N/L for different calculations and estimates (Viers et al. 2012). Dairies in California's San Joaquin Valley have lagoon TKN concentrations between 47 and 2,420 mg N/L (Campbell Mathews et al. 2001). Lagoon nitrogen concentrations from 2 studies in California were reported in a University of California Cooperative Extension publication; they were total N of 164-645 mg N/L and TKN of 670 mg N/L (reported in Pettygrove et al. 2010). Local data was chosen over non-local literature data in an attempt to use the most accurate values. In addition, this provides a more protective estimate since local values were higher than those utilized in the literature. The SYCD testing results were combined with the EPA results, resulting in an average total nitrogen concentration of 1,053 mg N/L (n = 38); this is the value that will be used in the calculations in this section. Calculations in this section can be easily updated if additional data is made available.

Atmospheric deposition and volatilization in lagoons

The lagoon nitrogen concentration used for calculations in this report was derived from analysis of lagoon samples. Atmospheric deposition of nitrogen onto the surface of lagoons would already be accounted for by this testing, it would become part of the nitrogen content of the lagoon. The lagoon testing results did not include any assessment of the age of the material being tested. Without information about when the material was added to the lagoon and how long it was retained, it would be impossible to determine whether the tested nitrogen concentration represented material that had not yet experienced storage losses or had already experienced storage losses. It was assumed that the nitrogen testing results included a range of fresh and aged manure and that the sample would provide enough variety to be representative.

Since this data already accounts for atmospheric deposition to lagoons, the total area of all lagoons was removed from the atmospheric deposition analysis in section 4. ATMOSPHERIC DEPOSITION.

Lagoon liner permeability and thickness

Current NRCS standards for lagoon liners depend on site characteristics, proximity to wells, depth to groundwater, and soil and aquifer characteristics. Depending on conditions, a site may be considered too vulnerable for lagoon construction or may require the use of a synthetic, compacted clay, or potentially no liner. Rather than specifying hydraulic conductivity or permeability required of liners or underlying soils, current guidelines require that lagoon construction meet required specific discharge rates. These specific discharge rates have been based on historically used permeability of $1x10^{-7}$ cm/s, with an assumed order of magnitude reduction in permeability due to manure sealing, allowing liner permeability to be $1x10^{-6}$ cm/s (USDA NRCS 2009). Lagoon liner permeability options were also discussed with some GWMA workgroups in 2015. The groups agreed that 2 liner permeability scenarios should be considered in lagoon seepage calculations. Based on these discussions and limitations in the data available, liner permeabilities of 1×10^{-7} and 1×10^{-6} cm/s were used to determine a low and high rate seepage estimate, respectively.

Construction dates for lagoons in the GWMA are unknown. Without information on how many lagoons were constructed before the 2004 standard, it is impossible to say how many lagoons may have permeabilities higher than 1×10^{-6}. The current NRCS Engineering Handbook and other documentation outlines historic practices and guidance published by NRCS (USDA NRCS 2009, USDA NRCS 2016a, USDA NRCS 2016b).

- Prior to 1990: manure sealing was assumed to significantly reduce seepage from lagoons.
- Late 1980s: A guidance document (South National Technical Center (SNTC) Technical Guide 716) was released specifying that relying on manure sealing to reduce seepage in a finished lagoon was insufficient and specified some site conditions when clay liners should be used.
- 1993: South National Technical Center (SNTC) Technical Guide 716 was updated and reissued. All waste storage ponds are required to have a 1-foot liner and soil must meet certain characteristics (percent fines).
- 1998: Agricultural Waste Field Management Handbook is issued containing material from SNTC Technical Guide 716.
- December 2004, Practice Standard 313 is updated, still requiring a minimum 1-foot liner thickness and adding a required permeability less than $1x10^{-6}$ cm/s.

Clearly lagoons constructed prior to the current guidance documents are unlikely to meet current NRCS standards. However, no information is available about what seepage might be for lagoons constructed before 1990, or between the 1993 guidance and the 2004 guidance. As a result, it is impossible to estimate what the permeability endpoint would be to estimate a high seepage rate. In addition, lagoon liners can be damaged through inappropriate operation and maintenance activities, which would result in increased leakage rates. The only experimental data on lagoon water loss found was Ham's study of Kansas feedlot and swine lagoons, which identified a seepage rate of 1.1 mm/day. The authors used this rate and experimentally determined depths and liner characteristics of lagoons to calculate a liner permeability of $1.8x10^{-7}$ cm/s (Ham 2002). A top priority for additional research on potential nitrogen loss from lagoons would be to conduct similar water balance lagoon seepage measurements to determine typical rates for GWMA lagoons. This information could be used to narrow the large range of these estimates.

Although the date of construction is not known, the type of liner was known for most of the lagoons that were part of the DNMP lagoon assessment process. Liner types of the lagoons assessed (n=115) were bentonite amendment (45, or 39%), compacted clay (58, or 50%), flexible membrane (10, or 9%), and unknown (2 or 2%). Current NRCS standards for minimum liner thickness are based on the normal full pool storage depth. The average design depth of lagoons visited by DNMP was calculated to be 11.3 feet. For lagoons with depths of 16 feet or less, the minimum liner thickness required is 1 foot (USDA NRCS 2016a). The average liner thickness of several lagoons studied in Kansas was approximately 1 foot (Ham, 2002). No local data was used to support the 1 foot liner thickness used in the seepage calculations. Based on the current NRCS standard, WSDA has chosen to use the minimum liner thickness required for lagoon seepage calculations.

Calculation methodology

Potential seepage from dairy lagoons was calculated using Darcy's Law. This approach relies both on assumptions derived from the literature (liner permeability and thickness) as well as local information (GWMA lagoon surface areas, depths, and nitrogen concentrations). The result of these calculations is the amount of nitrogen expected to pass through the liner, which is then available to move through the soil profile under some conditions. Transport and fate of nitrogen through the soil profile after exiting the lagoon liner is not within the scope of this study.

For the following calculations, all significant figures were kept until the final nitrogen loss estimate was determined. At this point, calculations were rounded to the nearest 1 ton/year or nearest 1,000 kg/year.

First, the volume of fluid leaving the lagoon was estimated using Darcy's Law, then multiplied by the total N concentration to determine the nitrogen loss from lagoons within the GWMA.

$$Q = k * \frac{(H + d)}{d} * A$$

Where

Q = the calculated volumetric flow rate (L^3/T)

k = coefficient of permeability (hydraulic conductivity, $1x10^{-7}$ or $1x10^{-6}$ cm/s) ($L^3/L^2/T$)

d = thickness of soil liner (estimated at 1 foot) (L)

H = vertical distance between top of liner and top of liquid storage (L)

A = lagoon area (L^2)

L = length

T = time

$$N\ Loading = Q * C$$

C = Total N concentration, 1053 mg N/L

Results and discussion

Potential loading was calculated for each individual lagoon within the GWMA boundary. Actual measurements for lagoon depth and surface area were used when available. Estimates for these parameters were used when actual measurements did not exist as discussed above. An example calculation can be found in Appendix D: Darcy's Law Example Calculation.

Darcy's law calculations were run using the two different permeabilities discussed above ($1x\ 10^{-7}$ and $1x10^{-6}$ cm/s) to determine a low and high range estimate. Since this is the only parameter that differed between the two calculation scenarios, the estimated loss for high and low differs by a factor of 10. The medium rate was calculated by averaging the low and high rates. Table 7 displays the results from these calculations. The rate per area was determined by dividing the total loss by the total design surface area of lagoons in the GWMA.

Table 7. Estimated high and low loss rates based on Darcy's law

	Low	Medium	High
N Loss (kg N/year)	129,000	709,000	1,289,000
N Loss (ton N/year)	142	781	1,421
N Loss (kg N/ha-year)	1,518	8,348	15,178
N Loss (lb N/ac-year)	1,354	7,448	13,542

These estimates are much higher than those calculated in the UC Davis study (Viers et al. 2012). The totals are not comparable because of the much larger geographic area studied by the UC Davis authors, but the results can be compared on a per-acre basis. In the UC Davis study, the authors identified several different potential loading rates, including several upper limits via different methods and an expected range for loading under typical circumstances. The UC Davis report determined an upper and an alternative upper value for nitrogen loading of 5,100 tons N/year and 1,100 tons N/year, respectively. Using the total area of lagoons identified in the UC Davis study (3,126 acres) to calculate the loading rates on a per-acre basis give upper limits of 0.35 – 1.63 tons N/ac-yr, or 700 – 3,260 lb N/ac-yr. These upper limits were chosen based on liquid loss rates and lagoon nitrogen concentrations from research reviewed here: Ham 2002, van der Schans et al. 2009, Campbell Mathews et al. 2001, and Pettygrove et al. 2010. This research was conducted in Kansas and California. In addition to these upper limits, the authors of the UC Davis study also chose an estimated loading range based on unpublished data from the Tulare Lake Basin and Salinas Valley of 220 – 2,200 tons N/year. Making the same adjustment for lagoon area of 3,126 acres in the UC Davis study, this results in a loading rate range of 0.07 – 0.70 tons N/ac-yr, or 141 – 1,407 lb N/ac-yr (Viers et al. 2012).

The expected loading range for the UC Davis study is much lower than the range expected in GWMA lagoons from the Darcy's law calculation. The high end of the UC Davis expected loading range is similar to the low end of the GWMA expected range. Even the upper limits of the UC Davis expected loading are extremely low compared to the range identified for GWMA lagoons. One contributing factor is the difference in lagoon nitrogen concentrations between the UC Davis study and this calculation. The UC Davis study estimates were largely based on lagoon nitrogen concentrations of 500 mg N/L, although a lagoon nitrogen concentration of 1,000 mg N/L was discussed in that study also. In contrast, the Darcy's law calculations use a much higher lagoon nitrogen concentration of 1,053 mg N/L, which results in a large increase in estimated losses. In addition, the UC Davis estimates are based on experimentally determined rates, while the Darcy's law calculations are based on a theoretical model that, while it includes real world data on lagoon characteristics, is not calibrated with experimental data on lagoon seepage.

SETTLING PONDS

Some challenges of identifying settling ponds have been discussed above, in the lagoon limitations. Distinctions between impoundment functions may be difficult to identify and impoundment functions themselves can fluctuate. Different industry experts classify impoundments based on different criteria and experience. In addition, there are a wide variety of different construction techniques and operational techniques for settling ponds and basins. Some are earthen ponds that are drained and cleaned as needed. Some are concrete lined, engineered basins, which would make using permeabilities for a clay lined impoundment inappropriate. The lack of information about the diversity of settling basins and their construction techniques makes it impossible to make reasonable assumptions for calculation. The work involved in correctly identifying and characterizing settling ponds or basins well enough for an accurate calculation makes addressing settling ponds beyond the scope of this report.

Conclusions and recommendations

This work is intended to be used as a planning and management tool for the GWMA when determining where to use limited resources. Although the best available information has been used to assess nitrogen available for transport, many of these calculations are partially based on literature values and assumptions due to a lack of local data. Current and new work by state agencies may provide additional information about lagoon conditions that could be used to adjust the permeabilities chosen for the Darcy's law calculation: WSDA DNMP's assessment of Yakima County lagoons through the Natural Resources Conservation Service's Technical Note 23 (USDA NRCS 2013) and the CAFO permit recently issued by the Washington State Department of Ecology, which requires producers to assess lagoons by the process in Technical Note 23. However, translating these condition ratings into a functional permeability that could be used in Darcy's law may be challenging.

The single most useful piece of information that could be used to improve this estimate would be measured lagoon seepage rates in the GWMA, which could be used to refine and narrow the range of the lagoon estimate. In addition, both lagoon and corral estimates could be improved through additional statistical sampling of total nitrogen concentrations in lagoons and statistical sampling of soil nitrogen concentrations below pens.

In order to make sure nitrogen losses from corrals and lagoons are as low as possible, producers should be consistent with maintenance and inspection of facilities. Maintenance activities include:

- Check to make sure piping and pumps are free from leaks and operating well.
- Check and maintain lagoon interior to make sure no erosion is occurring at inlet and transfer pipes.
- Check lagoon interior for erosion due to waves caused by wind; repair as needed.
- Maintain an intact manure seal inside lagoons
- Keep vegetation low on the embankments so that burrows and cracks can be detected and repaired.

- Maintain proper freeboard in lagoons to prevent overtopping.
- Protect the manure-soil interface layer in pens; its presence is protective of groundwater.
- Manage pen moisture levels carefully - if the surface dries out completely cracks can form, serving as a channel for contaminants to get through the interface layer, but if liquid is allowed to pool that can also result in liquid movement through the interface layer.

2. IRRIGATED AGRICULTURE

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Background

Estimated nitrogen available for transport from irrigated agricultural production (including all nitrogen sources used) is discussed in this section. Use of both manure and commercial fertilizer on cropland associated with dairies is discussed here instead of the CAFO section of the report. In order to determine whether irrigated agriculture in the region is adding nitrogen or removing nitrogen, a mass balance technique was used, in which all inputs and outputs of nitrogen were accounted for. The largest and most complicated inputs in this mass balance are crop fertilizer applications. Crop fertilizer applications are influenced by crop type, crop nitrogen needs, application recommendations, and expected yields. Other inputs and outputs (potential nitrogen fixing, nitrogen removal through crop harvest, irrigation water use, and plant residual removal or incorporation) are also crop dependent. Because of the large number of different crops grown in the GWMA (50 different crop types), WSDA NRAS staff identified the top 15 crops by acreage (based on 2014 WSDA crop data) within the GWMA boundary (WSDA 2015). NRAS staff then interviewed commodity-specific experts to obtain a typical range of use rates for manure, compost, and commercial fertilizer for each of these top 15 commodities. These top 15 commodities represent 96% of the irrigated agricultural land within the GWMA, and irrigated agriculture makes up 57% (approximately 99,000 acres) of the total land area within the GWMA boundary (WSDA 2016). A significant proportion of this acreage (31,790 acres or 32%) is dedicated to crops and land uses (corn, triticale, pasture, and alfalfa) that support livestock operations. The other main crops in the region are tree fruit, grapes (both juice and wine), hops, wheat, mint, and asparagus. Table 8 shows the crops evaluated in this section and their respective acreage within the GWMA (WSDA 2016).

Table 8. Top 15 crops and their acreage in the GWMA

Crop	Acreage
Apple	17,333
Corn (silage)	16,778
Triticale	10,780
Grape (juice)	10,257
Alfalfa	7,989
Pasture	6,731
Cherry	6,336
Hops	5,961
Grape (wine)	5,126
Pear	3,331
Mint	1,418
Wheat	1,283
Corn (grain)	1,166
Asparagus	854
Peach/Nectarine	843

Methods, limitations, and assumptions

Limitations

This assessment is not intended to evaluate the practices of individual farming operations within the GWMA. Growers are not required to share fertilizer or soil amendment application information with outside entities (like WSDA) unless required through statutory requirement (for dairy operations) or legal discovery. The objective was to determine ranges bracketing commonly used application rates for manure, compost, and commercial fertilizer for the top 15 crops (by acreage) grown within the GWMA boundary. The data collected is categorized by commodity; this allows as much anonymity as possible to agronomists and growers who provided nutrient application information.

This report does not explicitly associate information on irrigation methods with the crop types and mass balance. Irrigation practices can affect the likelihood of nitrogen leaching through the soil profile. In addition, removed from the field relocated through irrigation return flows would represent another output in the mass balance, reducing total nitrogen available for transport to groundwater. In managed irrigation systems, water can be used as many as 4 or 5 times before being discharged from the system. Nitrogen concentration of this water will be increased by repeated use; accurately estimating this was beyond the scope of this study. In addition, it is possible for nitrogen-containing water to leak from unlined irrigation canals; an assessment of this potential was also beyond the scope of this study. Timing of fertilizer applications, plant uptake, irrigation applications, and crop residue incorporation was not part of this study. Timing of these events as well as timing of weather events such as rainfall, snowfall, and freezing temperatures can all affect whether or not nitrogen in the soil will be taken up by plants, be likely to move with runoff, or be available to leach through the soil profile.

This study does not include information on the use or benefits of nitrogen-fixing cover crops used within the GWMA boundaries. Although cover crops benefit soil health, reduce erosion, and can provide nutrients for future crops, the behavior and cultivation of different cover crops and/or winter crops used in double cropping systems was beyond the scope of this study.

Results from this study were not compared to the Yakima county deep soil sampling results: that was beyond the scope of this study. Grower responses about application practices and soil organic matter content were the only deep soil sampling results used in this study. An analysis of the deep soil sampling results for comparison to the mass balance would provide a valuable opportunity to calibrate and adjust the mass balance results.

This study does not distinguish between nitrogen availability as a result of nitrogen source applied. Commercial fertilizers are formulated to release a specific amount of nutrients at a specific rate over a certain period of time. In contrast, a large amount of the nitrogen present in an application of manure or compost fertilizers is organic nitrogen, which is not immediately available for plant growth. This organic nitrogen will mineralize over time, making more nitrogen available for plant growth for several years after the initial application. The actual nitrogen available in the first and subsequent years depends on the nitrogen source, weather and temperature conditions, and the breakdown rate of the organic matter containing the nitrogen. WSDA did not attempt to account for these nuances of nitrogen availability from different sources; all nitrogen contained in any fertilizer application is assumed to be immediately available in the first year after application, regardless of source.

Data Collection

Irrigated agriculture is mapped statewide by WSDA and includes the area within the Yakima GWMA boundary. This statewide data was clipped to the Yakima GWMA boundary to contain only those crops grown within the GWMA. The data was updated with WSDA's 2015 crop mapping to reflect current agricultural activates within this area. WSDA did some additional mapping work for field corn to distinguish between grain and silage corn acreage for this project. The crop data is captured in the GIS database as polygons with attributes that include locations, crop type, irrigation method, acres, and if it was documented as organic according to WSDA organic program GIS data.

Fertilizer application data was collected via telephone survey. In order to increase participation, participants' identities were not recorded; the goal was to gather enough data to develop a typical use range that would be used to estimate total usage for each commodity, not tie any application rates to specific farming operations. As mentioned above, data was collected for the top 15 crops (representing 96% of the total irrigated acreage in the GWMA) for applications of commercial fertilizer, compost, and manure.

In order to develop a representative estimate for each crop, WSDA's goal was to survey enough producers and crop consultants to get nutrient application data covering a minimum of 30% of the acreage for each target commodity. There are thousands of individual farms operating within the GWMA boundaries, making farmer-specific data collection very difficult. Crop consultants or agronomists are used by the majority of commercial farms operating in the valley. There are only a few companies that do this type of work, limiting the number of interviews required to access information. While these consultants are not usually farmers, they create prescriptions for fertilizer applications across multiple crops on many different farms.

The data collection goal was met for all commodities, with the exception of pasture, for which information on only 11% of the GWMA acreage could be collected. In total, WSDA included information about more than 58,000 acres of the 15 targeted commodities, or 61% of the acreage dedicated to those commodities in the GWMA (Table 9). All respondents were asked to provide a range of typical use for the three main inputs (commercial fertilizer, manure, and compost) to create a low and high use estimate, as well as questioned about average use rates (to design a weighted average to include in the final dataset).

Table 9. Acreage in each commodity, with data collection targets and collection results

Commodity	Total acreage of commodity in GWMA	30% goal (acres to collect)	Acreage collected	Percent of total acreage collected
Apple	17,333	5,200	14,165	82%
Corn (silage)	16,778	5,033	11,480	68%
Triticale	10,780	3,234	7,500	70%
Grape (juice)	10,257	3,077	3,849	38%
Alfalfa	7,989	2,397	6,194	78%
Pasture	6,731	2,019	725	11%
Cherry	6,336	1,901	3,826	60%
Hops	5,961	1,788	3,760	63%
Grape (wine)	5,126	1,538	2,500	49%
Pear	3,331	999	1,741	52%
Mint	1,418	425	780	55%
Wheat	1,283	385	490	38%
Corn (grain)	1,166	350	348	30%
Asparagus	854	256	506	59%
Peach/Nectarine	843	253	630	75%

Data about grower's fertilizer use practices was also drawn from the surveys conducted through the deep soil sampling process. A thorough statistical analysis comparing the deep soil sampling results to the WSDA interview data could be used to confirm the accuracy of the survey responses. Unfortunately, out of the commodities surveyed, juice grapes and hops are the only commodities that had multiple responses from both data sources. For the rest of the crops surveyed for this study, the respondents came largely from either the deep soil sampling results or the WSDA NRAS survey, without enough responses from both sources to allow a comparison.

Mass Balance

In a mass balance (in this case, focused on nitrogen) all material moving into or out of a system is accounted for. In this case, the system is defined as a 1-acre crop field. Inputs, or additions of nitrogen to the field, are categorized as positive (+). Outputs, or removals of nitrogen from the field, are categorized as negative (-). In addition, processes that transform nitrogen may be significant, and may result in either an increase (+) of available nitrogen in the field or a decrease (-). All known inputs, outputs, and transformations are summed, and the sign and magnitude of the resulting sum can be used to determine whether there is a net accumulation or a net loss of material in the field, or whether there are unknown material flows or transformations.

$$N\ accumulation\ or\ loss\ = Inputs \pm Transformations - Outputs$$

In this case, the list of inputs and transformations includes:

- commercial nitrogen applications (lb N/ac-yr) (evaluated at low, weighted average, and high values);
- manure nitrogen applications (lb N/ac-yr) (evaluated at low, weighted average, and high values);
- compost nitrogen applications (lb N/ac-yr) (evaluated at low, weighted average, and high values);
- atmospheric nitrogen deposition (lb N/ac-yr) (evaluated at low, medium, and high values);
- irrigation water nitrogen (lb N/ac-yr);
- calculated residual nitrogen incorporated (lb N/ac-yr) (evaluated at low, average, and high for some crops and one value for others);
- soil organic matter conversion to nitrate (lb N/ac-yr) (evaluated at low, average, and high values).

The outputs (or nitrogen losses) are:

- crop nitrogen uptake, removed through harvest (lb N/ac-yr) (evaluated at low, average, and high for some crops and one value for others); and
- nitrogen loss to atmosphere (lb N/ac-yr).

Determination of Inputs, Outputs, and Transformations

Commercial, manure, and compost nitrogen applications: Growers and agronomists reported use of commercial fertilizer, manure, or compost, as well as application rates and acreages. In order to account for the use of multiple nitrogen sources, within each commodity the proportion of acres each source was used on was a weighting factor in the final calculation. This weighting factor appears as a multiplier for each nitrogen source and was calculated separately for each commodity and nitrogen source. It was generated by calculating what proportion of acres that nitrogen source was used on out of the total acres of that commodity surveyed. For example, in apple production commercial nitrogen application was reported on 86.3% of the total surveyed acres, so 0.863 is used as a multiplier whenever inputs to apple production from commercial nitrogen applications are calculated. This weighting allows the survey data to be scaled from the hundreds of acres for which applications were reported to the theoretical 1-acre field the mass balance is calculated for and make standardized comparisons between crops and other nitrogen sources.

The low, medium, and high application rates were drawn directly from the survey results. The low and high rates used were the lowest and highest reported application rates for each nutrient source and commodity. The medium application rate was a weighted average of all single application rates reported where each reported rate was weighted by the acreage that survey respondent controlled before averaging.

Synthetic fertilizers are formulated to release nutrients at a specific rate over a certain period of time. The nitrogen in compost or manure is released over a longer period of time at a lower rate, and these products are often applied to improve soil health in addition to providing fertilization. In soils with a history of regular manure applications, the breakdown of organic matter from applications in previous years combines with the available nitrogen from the current year's application to make the full applied amount of nitrogen available during that growing season. For this calculation, WSDA assumes that growers using manure or compost have been applying manure or compost regularly and the nitrogen content from those materials is considered to be immediately available because of the nitrogen contributions from historic applications.

Atmospheric nitrogen deposition: This input is the same for every crop assessed. The low rate for atmospheric deposition for the lower Yakima Valley was taken from the most recently reported (2012) wet and dry atmospheric deposition at the Mt. Rainier National Atmospheric Deposition Program (NADP) station; 1.53 lb/ac (EPA 2016). The medium deposition rate is the result of a 5-day modeled average from December 2015; 2.05 lb/ac. To estimate a high rate, the medium atmospheric deposition was multiplied by a safety factor of 3 to account for potential higher deposition during weather conditions resulting in decreased circulation and poor air quality[2]. More details on the methodology and assumptions for atmospheric deposition can be found in Section 4. ATMOSPHERIC DEPOSITION.

Irrigation water nitrogen: The nitrogen input from irrigation water is also unique to each commodity. It is based on the nitrogen content of the lower Yakima River and the irrigation water duty for each commodity. Yakima River nitrogen concentration was taken at the U.S. Geological Survey station on the Yakima River at Kiona during the 2012 irrigation season (April through September) (USGS 2012). This time period was chosen to represent the typical time frame during which irrigation water would be withdrawn for use, including both high flow conditions during the late spring (when nitrogen concentration would be low) and low flow conditions during the late summer (when nitrogen concentration would be high). Summary information about this data set was calculated, and the mean (0.809 mg N/L) of the 10 samples was used in the mass balance (Table 10).

[2] Medium and high deposition values were recommended by Dr. Ranil Dhammapala, an atmospheric scientist with Washington State Department of Ecology's Air Quality Program, during a meeting on November 3, 2016.

Table 10. Summary statistics for Yakima River nitrogen concentrations (n=10) (USGS 2012)

Minimum (mg N/L)	0.42
Maximum (mg N/L)	1.26
Mean (mg N/L)	0.809
Standard deviation (mg N/L)	0.366
Median (mg N/L)	0.675

Although the sampling location is located in the mainstem of the Yakima River and downstream of the irrigation districts serving the GWMA agricultural lands, WSDA believes that it serves as a good surrogate for potential irrigation water nitrogen levels in the area. The majority of the irrigation water in the lower Yakima Valley is surface water. Very little groundwater is used for irrigation with the exception of a drought year when use of emergency drought wells is permitted. A detailed analysis of sources of irrigation water was not within the scope of this project.

The second part of this input includes commodity specific irrigation water duty for the 15 commodities included in the mass balance. It also takes into account total precipitation and effective precipitation. The data was provided by the Jim Davenport and the Irrigated Agriculture Working Group (IAWG) of the GWMA. The water duty (in inches) values for apples and cherries were reflective of current use patterns, and were edited by Stu Turner, agronomist and member of the IAWG (Appendix F: Irrigation Water Use).

Calculated residual nitrogen: Calculated residual nitrogen is the nitrogen taken up during the growing season that is left in the plant after harvest. This term is based on plant nitrogen uptake during the growing season (which appears in the mass balance as an output) and the amount of nitrogen removed when the crop is harvested. As a result, it is different for each commodity. The components of the residual nitrogen calculation were estimated by the Jim Trull and Scott Stevens, as well as the IAWG and Sunnyside Valley Irrigation District and were based on regularly used resources. Depending on the crop type, the residual nitrogen taken up during the growing season but remaining after harvest may be left in the field and incorporated (as in the case of annual crops) or that residual nitrogen may be retained in the plant, in the new growth of vegetation during the season (as in the case of perennial crops). For perennial crops, some of this new growth will be removed during pruning and through seasonal leaf loss and will eventually still return to the soil, and some may be retained on the plant and not return to the soil. For this analysis, it was assumed that calculated residual nitrogen should be wholly counted as an input to the system for all crop types, despite the fact that some crops may differ in that regard; this is an input that can be varied as more information becomes available. Estimates of nitrogen removed during harvest and the inputs used are presented in Appendix G: Nitrogen Uptake Estimates. This appendix includes data on typical crop yields, nitrogen removed through harvest, nitrogen uptake by the plant during its growing cycle, and estimates of nitrogen applied.

Soil organic matter conversion to nitrate: This term represents the breakdown of organic matter (containing nitrogen) to nitrate-nitrogen available for both crop uptake and leaching below the crop root zone. This input was the same for every commodity analyzed. The native organic matter content of most lower Yakima Valley soils is around 1% but when these soils have a history of organic inputs such as manure, it can increase by 2 to 3 times[3]. This was confirmed by a review of the deep soil sampling results. WSDA reviewed results from the fall and spring sampling of 2015 (Table 11) and decided to use the average organic matter content of 2.17% to represent these soils.

Table 11. Summary statistics of organic matter percentage of sampling in the 2015 Yakima Valley deep soil sampling study (n = 108)

Minimum (%)	0.84
Maximum (%)	4.24
Mean (%)	2.17
Standard deviation	0.69
Median (%)	2.15

In general, organic matter in soils can mineralize to provide between 20 and 65 lbs N/ac per 1% organic matter for crop utilization. However, it is not well understood whether the available N is closer to 20 lbs N/ac or 65 lbs N/ac per % organic matter. Previously, practice has been to allow for a minimum of 20 lbs N/ac per % organic matter; however, based on recent soil testing data in the Yakima Valley it appears that the contribution from organic matter should be increased from 20 lbs N/ac to 35-50 lbs N/ac per 1% organic matter when the fields have a history of manure applications[3]. In this mass balance, WSDA used 2.17% organic matter (based on the deep soil sampling results) and conversion rates of 20, 42.5, and 65 lb N/ac for each 1% organic matter. One source for this soil organic matter content can be manure, and the average 2.17% organic matter content of the soil tested during the deep soil sampling may be due to a history of manure applications on those fields. However, there are a number of agricultural practices that producers use to increase the organic matter content of their soil. Direct seed and no-till practices both leave the soil undisturbed, preventing the rapid decomposition of organic matter that takes place when the upper layers of the soil profile are exposed to the atmosphere. Cover cropping can also be used to increase soil organic matter content.

Crop nitrogen uptake: This is the amount of nitrogen taken up by the plant from the soil during the growing season. The crop nitrogen uptake is also part of the calculation for residual nitrogen above. This output is unique for each commodity, and was estimated by the IAWG. This output represents the amount of nitrogen taken up by the crop during the growing season; the estimates, ranges, and sources are detailed in Appendix G: Nitrogen Uptake Estimates.

Loss to atmosphere: The numbers used in this output of the mass balance equation were taken directly from Table 36, pages 117-118 of the 2006 NRCS publication "Model Simulation of Soil Loss, Nutrient Loss, and Change in Organic Carbon Associated with Crop Production" (Potter et al. 2006).

The full equation, with all inputs and outputs, is:

[3] Personal communication, based on experience and best professional judgment of Virginia Prest, WSDA Dairy Nutrient Management Program manager and agronomist,

$$\begin{aligned} Est.\,N\,Loading\,per\,year \\ &= \Big(\big((Comm\,N \times proportion) + (Compost\,N \times proportion) \\ &+ (Manure\,N \times proportion) \\ &+ (Atmos\,N\,Dep + Irrigation\,Water\,N + Calculated\,Residual\,N \\ &+ N\,Soil\,Conversion)\big) - \big((Crop\,Uptake\,N + N\,Loss\,to\,Atmosphere)\big)\Big) \\ &\times (Total\,Commodity\,Acres) \end{aligned}$$

This calculation was used for each individual commodity of the top 15 identified.

GIS Compilation

The GIS data for the irrigated agriculture section of this study is stored in a file geodatabase that contains both attributes and spatial locations of this data. It contains five feature classes and one table: YakimaGWMA (polygon, GWMA boundary), WSDACrop_2015 (polygons, crop identification), Lagoons (points), Ponds (points), and CAFO_Pen_Compost (polygons, boundaries of pens and compost areas). This database also contains a table, IrrigatedMassBalance, which contained the mass balance calculations and results.

Metadata is included with the GIS database to further describe the additional aspects of the GIS data. This includes information such as the extent, credits, use limitations, scale, processing environment, author, and spatial reference.

Results and discussion

During the data collection phase of the irrigated agriculture component of this report, interviewees were asked what percentage of their acreage were fertilized with commercial fertilizer, manure, or compost. Table 12 shows the results from this portion of the survey; the most commonly used product is commercial fertilizer. The only exceptions are silage corn and triticale where more acres are fertilized with manure than with commercial fertilizer. In this table, crop acres fertilized with multiple products appear more than once. As a result, for some crops the percentages sum to more than 100%. For example, all acres grown (100%) of wine grapes were fertilized with commercial fertilizer. In addition, 20% of the acres of wine grapes were fertilized with compost. As a result the total acres fertilized for wine grapes adds up to 120%: 20% of the acres were fertilized with 2 different products. The only crops where growers or crop consultants reported use of all 3 fertilizer products were hops and triticale. The percentage of acres on which multiple sources were used is calculated in the last column.

Table 12. Summary of fertilizer types used for the top 15 crops by acreage in the GWMA

Crop	Commercial fertilizer (% acres)	Manure (% acres)	Compost (% acres)	Acres using multiple sources (%)
Apple	86.3	0	13.7	0
Corn (silage)	49.6	53.9	0	3.5
Triticale	27.2	74.8	0.8	2.8
Grapes (juice)	91.0	0	11.6	2.6
Alfalfa	91.8	8.2	0	0
Pasture	97.2	2.8	0	0
Cherry	80.5	0	19.5	0
Hops	97.3	2.7	16.0	16
Grapes (wine)	100.0	0	20.0	20
Pear	76.6	0	23.4	0
Mint	100.0	0	0	0
Wheat	93.9	22.4	0	16.3
Corn (grain)	71.3	62.6	0	33.9
Asparagus	100.0	0	0	0
Peach/Nectarine	81.0	0	19.0	0

Application rates reported by growers are presented in Table 13. The range of application rates is first, followed by the weighted average (used for the medium rate applications) in parentheses. For several crops (apples, alfalfa, and pears), some growers reported using no commercial fertilizer during some years. For almost all crops, the range spans an order of magnitude between low and high. This indicates the diversity of practices used by different growers. It also suggests that some growers are customizing application rates to crop needs each year, based on soil testing results.

Table 13. Ranges of application rates (with weighted average in parentheses) reported for commercial fertilizer, manure, and compost

Crop	Commercial fertilizer (lb N/ac)	Manure (lb N/ac)	Compost (lb N/ac)
Apple	0-150 (60)	0 (0)	15-100 (47) (47)
Corn (silage)	40-434 (214)	20-324 (203)	0 (0)
Triticale	60-225 (107)	20-350 (104)	170 (170)*
Grapes (juice)	50-100 (80)	0 (0)	21.5-90 (64)
Alfalfa	0-210 (74)	10-300 (161)	0 (0)
Pasture	50-200 (120)	17 (17)*	0 (0)
Cherry	20-125 (56)	0 (0)	15-72 (52)
Hops	25-225 (192)	132 (132)*	30 (30)*
Grapes (wine)	15-40 (25)	0 (0)	36.6-54.9 (46)
Pear	0-100 (57)	0 (0)	15-80 (58)
Mint	80-300 (269)	0 (0)	0 (0)
Wheat	60-120 (106)	90-240 (131)	0 (0)
Corn (grain)	100-300 (214)	50-220 (135)	0 (0)
Asparagus	40-100 (99)	0 (0)	0 (0)
Peach/Nectarine	30-80 (51)	0 (0)	15-30 (28)

When no range was reported only a single value is presented in this table.

To better understand the role different nutrient sources play in the amount of nitrogen available for transport, the mass balance inputs were examined (Figure 5). All inputs other than nutrient applications were categorized together ("Other"). The "other" category includes atmospheric deposition, irrigation water concentration, calculated residual nitrogen, and soil organic matter conversion; these inputs are not directly influenced by fertilizer applications. The magnitude of this category is largely determined by calculated residual nitrogen and soil organic matter conversion. Calculated residual nitrogen is unique to the individual crop type, while soil organic matter conversion is related to soil properties and the same calculation was used for all crops. For most crops, fertilizer applications consist mostly of synthetic fertilizer. Some exceptions are corn (silage and grain) and triticale, some of which consistently receive manure applications and are often grown to support dairy operations.

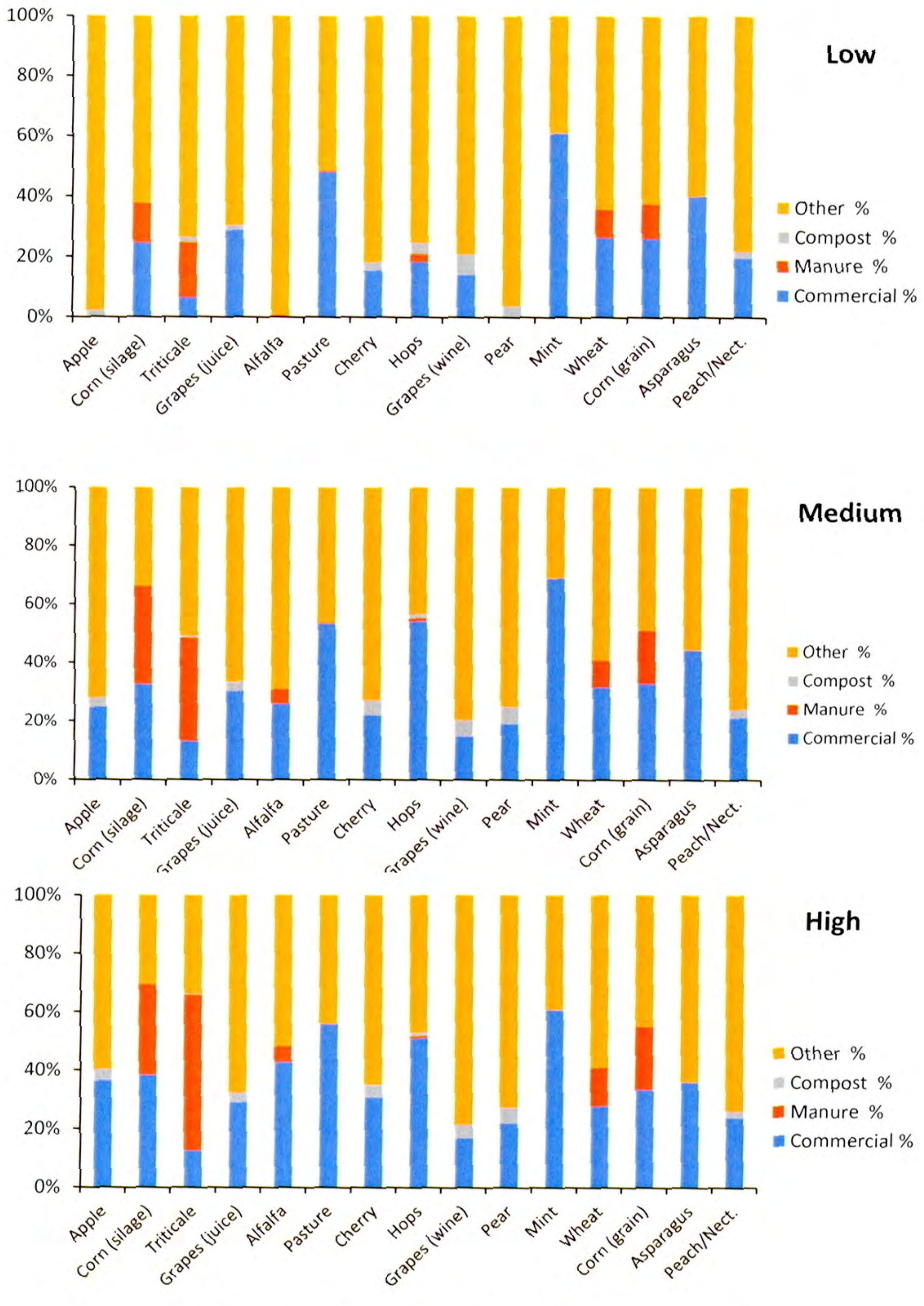


Figure 5. Inputs in the irrigated agriculture mass balance

Data on irrigation practices was collected through WSDA's agricultural land use mapping (Figure 6). For this report irrigation types were divided into 4 main categories based on whether the irrigation type is likely to result in water loss through the soil and contribute to available nitrogen: sprinkler, micro, macro, and miscellaneous. This information is summarized for both all the irrigated acreage in the GWMA and for the top 3 crops in terms of nitrogen surplus per acre (identified in Table 14).

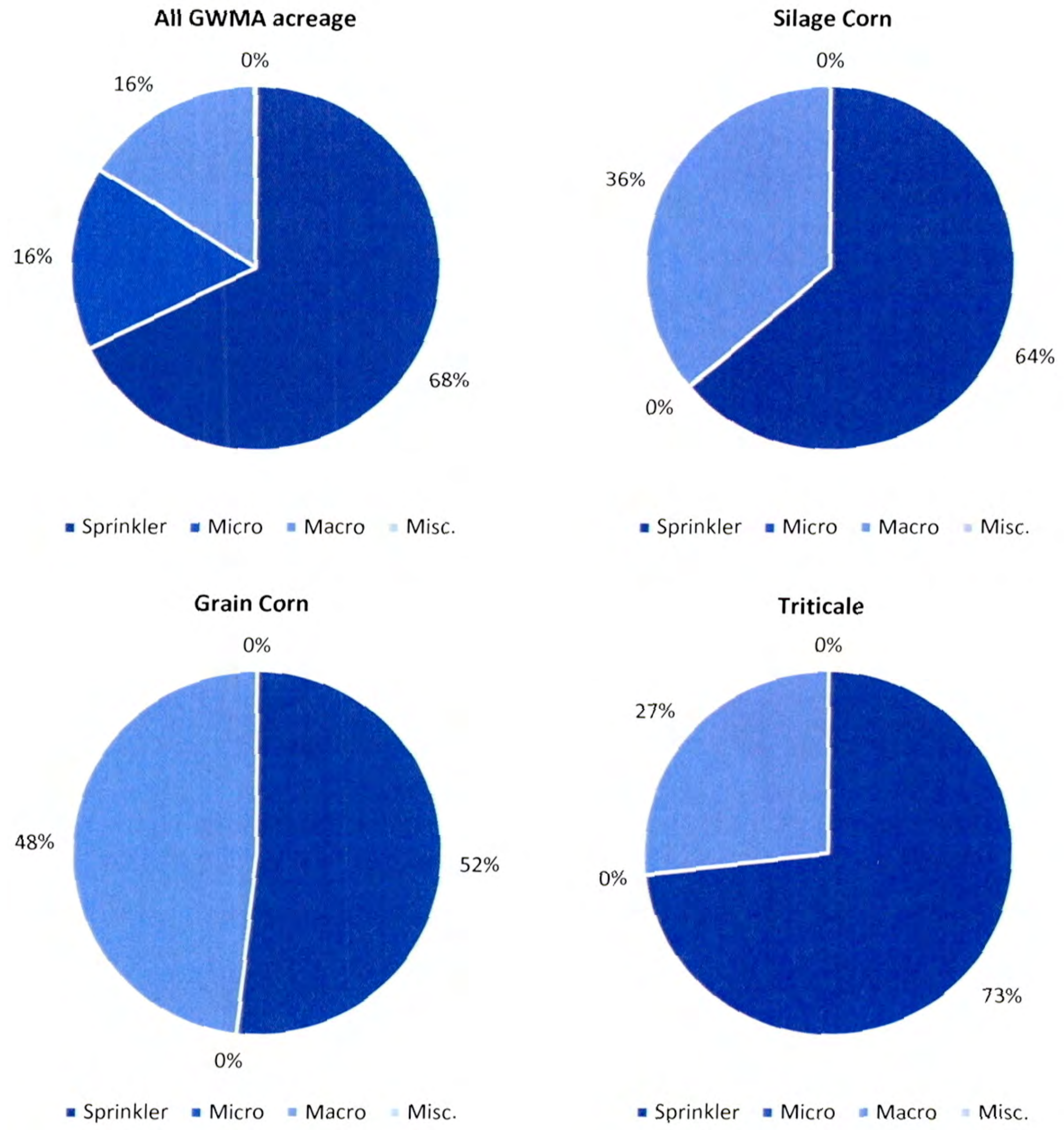


Figure 6. Irrigation types for all GWMA acreage and top 3 commodities with surplus nitrogen inputs (per acre). Due to rounding, categories with 0% are either 0 or values less than 1 that rounded to 0.

The most used irrigation type in the GWMA's irrigated acreage was sprinkler irrigation, which includes center pivot, big gun, sprinkler, wheel line, and combinations of these. Of the total irrigated acreage in the GWMA, sprinkler irrigation was used on 68%. Micro irrigation was the second most common and accounts for about 16% of the irrigation. Micro irrigation includes drip, micro sprinkler, drip/sprinkler, and combinations. The third most common was macro irrigation which includes flood, rill, and combinations with the sprinkler group; macro irrigation accounted for almost as much acreage as micro irrigation, accounting for over 15% of the GWMA acreage (these values have been rounded in Figure 6). The miscellaneous group included irrigation by hand or acreage for which the irrigation type is unknown; this group made up less than 1% of the irrigated acreage in the GWMA.

Because of the potential for irrigation type to affect nitrogen leaching, the irrigation types for the top 3 crops with nitrogen surpluses on a per acre basis (silage corn, grain corn, and triticale) were also analyzed individually. For each of these crops, over 50% of the acreage was irrigated with sprinklers. For silage corn, the second most common technique is macro irrigation (the most likely to result in excess water application and leaching), which accounts for approximately 36% of the acreage. Macro irrigation is also the second most commonly used irrigation type for both grain corn and triticale, used on 48% and 27% of the acreage, respectively. Micro irrigation and miscellaneous irrigation types were used on less than 1% of the acreages of silage corn, grain corn, and triticale. Without detailed information about water loss through excess application, nitrogen content of lost water, and soil testing results, WSDA was unable to specifically relate the individual irrigation practices to any potential nitrogen surpluses.

The results of the mass balance equation are shown below for the 15 commodities evaluated (comprising 96% of the total irrigated agricultural acreage in the GWMA). These values represent the estimated nitrogen surplus resulting from one year of inputs and outputs. These estimates do not account for nitrogen already present in the soil before fertilization. Values shown in Table 14 include low, average, and high potential nitrogen surplus in lb/ac-yr for each commodity resulting from one year's worth of applications and removals. Negative values represent a localized removal of nitrogen and do not offset excess nitrogen from other crops or areas within the GWMA.

Table 14. One year's worth of inputs and outputs for the top 15 crops in the GWMA

Commodity	Acreage	Sum of inputs and outputs for one year (lb N/ac-yr)		
		Low	Medium	High
Apple	17,333	-5	91	219
Corn (silage)	16,778	-200	25	242
Triticale	10,780	-135	-9	250
Grapes (juice)	10,257	61	132	197
Alfalfa	7,989	-365	-236	-46
Pasture	6,731	-186	-68	62
Cherry	6,336	27	105	210
Hops	5,961	-84	78	113
Grapes (wine)	5,126	40	94	156
Pear	3,331	-1	92	173
Mint	1,418	-166	73	157
Wheat	1,283	-79	23	113
Corn (grain)	1,166	-48	126	284
Asparagus	854	58	157	210
Peach/Nectarine	843	12	81	158

At the low end of the range, the sum of one year's worth of inputs and outputs for many crops is less than zero. The survey results these calculations are based on include both typical year-after-year application practices and a range of practices which should encompass both a producers best possible year (where high nitrogen in a pre-plant soil test allowed a producer to make very low or even no nitrogen applications) and worst possible year (where a producer needed to make high nitrogen applications to meet crop growth needs). In addition, a net negative sum from a year's worth of inputs and outputs doesn't mean that there is no nitrogen loss during the year – losses may still take place after fertilizer applications if heavy rainfall or irrigation applications take place before plant growth uses the applied nutrients. However, the presence of these low values in the range of practices suggests that producers are responsive to the information in pre-plant soil tests and work to tailor nutrient applications to crop growth needs as possible. Successive years with a net nutrient deficit are likely to be followed by higher nitrogen applications to maintain yields.

Table 15 has been shaded to illustrate which commodities, based on our survey, have agricultural practices that may remove nitrogen (green) or add excess nitrogen (yellow) to the system. Commodities that have a negative value for the sum of the inputs and outputs are displayed with a dashed line to reduce confusion. Practices used on these crops are not making nitrogen available for transport (considered over the course of a year) nor are they removing excess nitrogen available from fertilization practices of another commodity. Only positive values are summed for the totals estimated in the low, medium, and high scenarios.

Table 15: Sum of inputs and outputs for the top 15 crops in the GWMA (entire acreage)

	Estimated total N surplus in GWMA (ton N/yr)		
Commodity	Low	Medium	High
Apple	-	786	1,897
Corn (silage)	-	208	2,029
Triticale	-	-	1,346
Grapes (juice)	312	677	1,008
Alfalfa	-	-	-
Pasture	-	-	209
Cherry	87	333	666
Hops	-	232	337
Grapes (wine)	103	240	400
Pear	-	153	288
Mint	-	52	111
Wheat	-	14	72
Corn (grain)	-	74	165
Asparagus	25	67	90
Peach/Nectarine	5	34	67
Total	532	2,870	8,685

A nonzero result in a mass balance (Table 15) can indicate either unknown inputs, outputs, or transformations, or net accumulation or loss. Of the 15 crops assessed, 10 did not have a yearly nitrogen surplus when evaluated at the low range estimates. Only juice grapes, cherries, wine grapes, peaches/nectarines, and asparagus had calculated nitrogen surpluses at the low range. At the high level, the majority of crops had calculated excess nitrogen. The only crop that did not was alfalfa.

Alfalfa was not estimated to have a nitrogen surplus at any evaluation level (low, medium, or high). Alfalfa is a complex perennial crop. It removes large quantities of nutrients from the soil (Koenig et al. 2009). It can meet most of its nitrogen needs from the atmosphere through nitrogen fixation, but is dependent both on the presence of rhizobia bacteria in the soil and on whether or not supplemental nitrogen is added. Alfalfa is considered a "lazy" plant and will use nitrogen from other sources such as manure or commercial fertilizer if given the chance. The practice of nitrogen supplementation on alfalfa does occur within the GWMA. However, agricultural practices used for perennial crops like alfalfa and pasture remove the majority of the plant residue from the field during harvest (hay/silage) or through grazing, which may contribute to the fact that these crops largely did not have calculated nitrogen surpluses.

One of the reasons for differences in the excess nitrogen for different commodities lies in the unique cultivation practices for each crop. The orchard and vineyard crops listed above (apples, grapes, cherries, pears, and peaches/nectarines) are permanent crops. Producers of these crops don't have access to options like crop rotations or fumigation to deal with disease and pest pressure and as a result may rely on tools like high nutrient applications or applications of multiple nutrient sources in order to improve soil health and maximize fruit production. In addition, producers of crops intended for human consumption may be reluctant to make manure and compost applications because of concerns about pathogen transfer, reducing their fertilization options further. The majority of manure and compost applications observed were taking place on crops intended for animal feed or prior to planting permanent crops.

Annual crops such as silage corn, grain corn, triticale, and wheat use both commercial nitrogen and manure throughout the GWMA. Triticale is double-cropped (2 crops in one growing year) with silage corn, and triticale cultivation occurs on almost all sprinkler or center pivot irrigated fields in the GWMA. Triticale cultivation rarely occurs on rill irrigated fields. In this case, triticale is planted in the fall, harvested in the spring (April-May) with silage corn, wheat, or oats seeded immediately afterward and harvested late summer or fall (August-September). Generally, the nitrogen application for this corn/triticale cropping system is split – 1 application in the fall and 1 in the spring. Corn (silage and grain) use fairly even amounts of commercial nitrogen and manure on most of the acreage.

The crops with the highest estimated total nitrogen surplus (over the entire GWMA) aren't necessarily the crops with the highest surpluses per acre. The top 4 crops in terms of nitrogen surplus are also the 4 crops with the highest cultivated acreage. There are crops with comparable or higher nitrogen surpluses per acre (cherries, grain corn, and asparagus) but these crops are cultivated on far fewer acres. They may still represent localized risk to groundwater.

The mass balance sums at low, medium, and high range were combined with WSDA's cropland data layer to generate maps showing which areas of the GWMA have nitrogen surpluses under low, medium, and high range scenarios (Figure 7, Figure 8, and Figure 9). In these maps, commodities without calculated nitrogen surpluses are all represented as green while those with calculated nitrogen surpluses are represented as pink (0 – 500 ton N/yr) and red (greater than 500 ton N/yr).

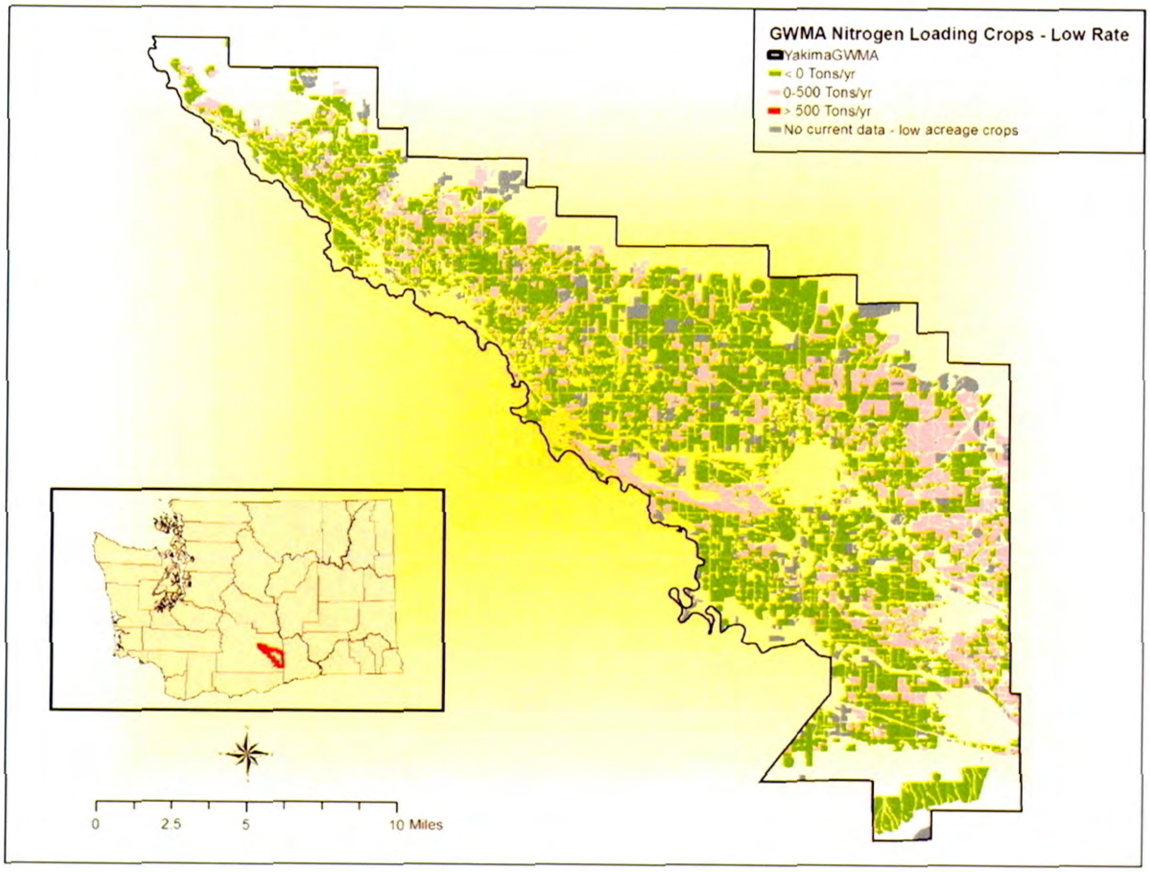


Figure 7. Map of Yakima GWMA with low range nitrogen availability estimates

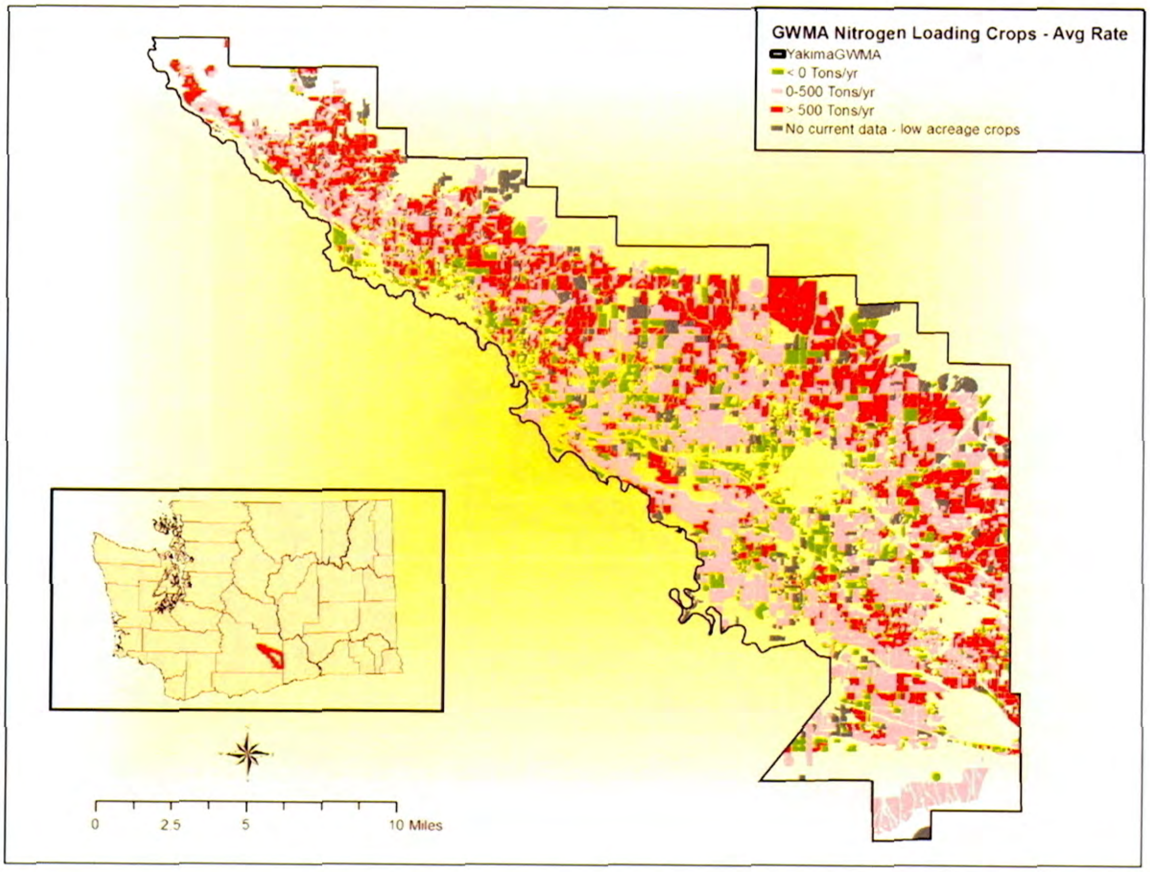


Figure 8. Map of Yakima GWMA with medium range nitrogen availability estimates

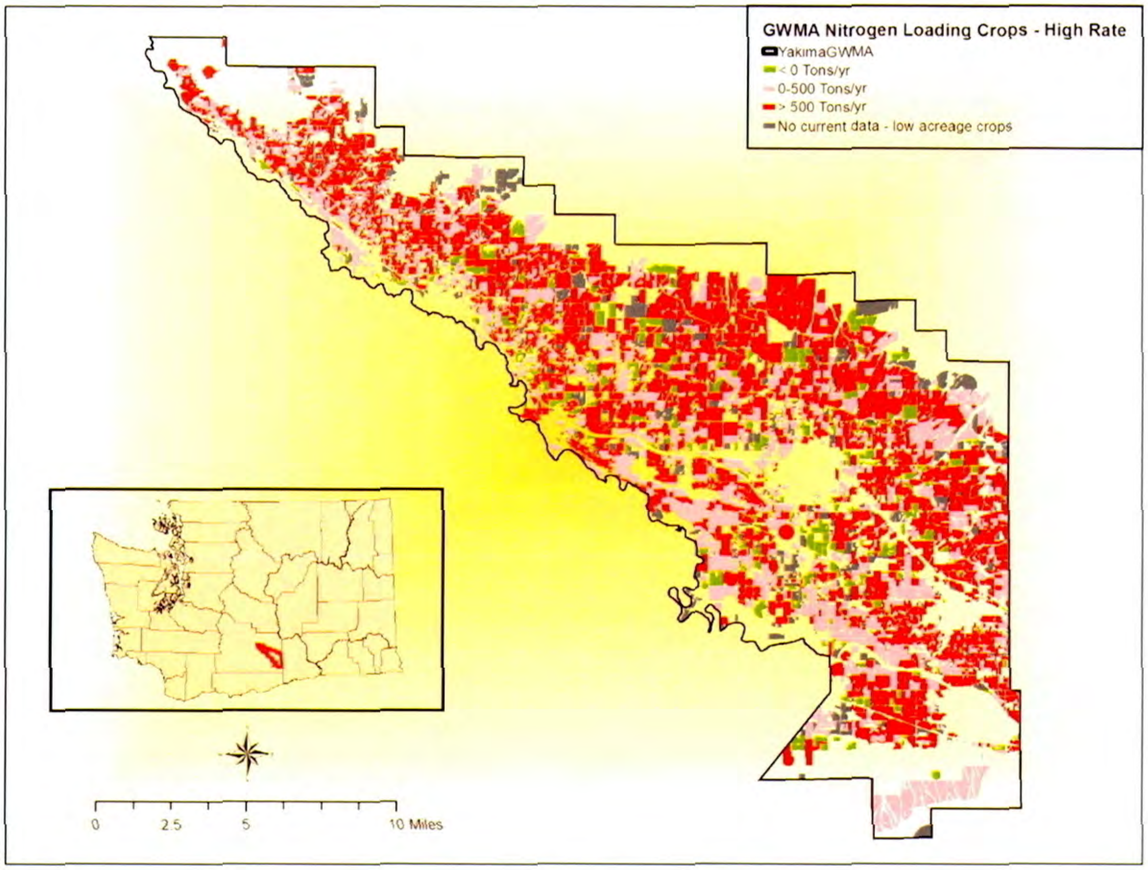


Figure 9. Map of Yakima GWMA with high range nitrogen availability estimates

Based on the information gathered through the survey and crop mapping, it is impossible to identify which part of the range (low, medium, or high) is the most likely scenario. It is likely that there are producers and crop types whose application practices occupy all parts of the range (some making low range applications, some making high range applications). Nutrient application decisions are complicated and depend on expected crop pricing, anticipated yields, recommendations from crop consultants and fertilizer guides, historical practices, and practices of other growers in the community. This variability, in combination with effects of fertilizer types used, irrigation type and practices, and nutrient application timing, will all affect whether or not any fertilizer application will result in a nitrogen surplus. Additional variation comes from soil type and organic matter content, soil nutrient content, manure nutrient content, handling, and storage before application, organic carbon cycling and mineralization, and fertilization and nitrogen fixing in alfalfa.

Conclusions and recommendations

Based on this initial survey data, WSDA has identified specific commodities where nitrogen surpluses could results in available nitrogen that could move from the soil profile into groundwater in the lower Yakima Valley. This information can be used to identify target regions where excess nitrogen is high or risk to groundwater may be elevated (based on available data like depth to groundwater or soil type). In addition, WSDA has identified both next steps to improve this study and recommendations for research that would supply useful information to growers making fertilization decisions:

- The next priority for additional work on the mass balance calculations should be comparing the estimated nitrogen surpluses from the different commodities to the deep soil sampling results for validation and improvement of the nitrogen mass balance.
- Most Washington State University Extension fertilizer guidance dates to the 1970's; updating and expanding this guidance would make a valuable information source available to growers. Information on considerations when combining nutrient applications from commercial sources with manure and compost applications should be included.
- Field research on the following topics would provide growers with information about the fate of fertilizer applications, plant uptake, and nitrogen availability from different fertilizer sources:
    - in-depth evaluation of potential nitrogen surpluses on higher risk and larger acreage crops and crops that receive applications of commercial fertilizer, manure, and compost combined;
    - research on manure nutrient content, manure application strategies, and the subsequent fate of nitrogen, other nutrients, and salts;
    - research to better understand organic matter in soils including plant nitrogen availability;
    - the long-term agronomic, environmental, and economic feasibility of available sustainable management practices.

3. RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL SOURCES

Yakima County authors: Cynthia Kozma, Michael Martian, Vern Redifer, P.E.

Background

Yakima County GIS Department was tasked with evaluating the nitrogen loading potential from non-agricultural sources within the GWMA boundaries. For this this assessment, the analysis was divided into five distinct categories:

1. Residential Onsite Sewage Systems (ROSS)
2. Large Onsite Septic Systems (LOSS)
3. Commercial Onsite Septic Systems (COSS)
4. Residential Lawn Fertilizers
5. Hobby Farms

This also includes a separate analysis for migrant worker impacts within the ROSS category.

Residential On-Site Sewage Systems

The Yakima County GIS Department developed a model to determine the nitrogen loading from individual residential on-site sewage systems located within the GWMA.

Methods

The Yakima County GIS Department incorporated all data sources having a geographical or spatial aspect into the county's GIS. The following was determined using geospatial analysis:

- There are 6,044 households within the GWMA that discharge wastewater to a ROSS. Figure 10 shows the location of each ROSS. The relative density of ROSS within the GWMA is shown in Figure 11.
- The average number of persons per household for each household discharging to a ROSS was obtained from census tract data provided by (OFM 2010). The household size used in the loading calculations for each ROSS is equal to the average household size for the census tract containing the household. The average household size for households discharging wastewater to a ROSS is 3.5 persons per household. The average household size ranges from 2.72 persons per household to 4.16 persons per household.
- The approximate location of each ROSS was determined. A ten foot buffer was graphically drawn around the building footprint to provide the best estimation of where a ROSS for each building would be located. If a parcel did not have a building footprint available, then a point was generated in the center of the parcel.
- The soil type underlying the approximate location of each ROSS was determined using (USDA NRCS 2014). Using GIS, the specific soil type was determined at each residential property within the GWMA and then each soil type was classified according to description to determine its corresponding maximum hydraulic loading rate based on Table VIII of

WAC 246-272A-0234. Table 16 shows the soil classifications, infiltration rate for each soil classification, and the number of ROSS within each soil classification (On-Site...2005)

Table 16. Maximum hydraulic loading rate

Soil type	Soil textural classification description	Loading rate for residential effluent (gal/sq. ft-day)	Number of ROSS
1	Gravelly and very gravelly coarse sands, all extremely gravelly soils excluding soil types 5 & 6, all soil types with greater than or equal to 90% rock fragments.	1.0	
2	Coarse sands.	1.0	
3	Medium sands, loamy coarse sands, loamy medium sands.	0.8	
4	Fine sands, loamy fine sands, sandy loams, loams.	0.6	
5	Very fine sands, loamy very fine sands; or silt loams, sandy clay loams, clay loams and silty clay loams with a moderate structure or strong structure (excluding a platy structure).	0.4	5,961
6	Other silt loams, sandy clay loams, clay loams, silty clay loams.	0.2	69
7	Sandy clay, clay, silty clay and strongly cemented firm soils, soil with a moderate or strong platy structure, any soil with a massive structure, any soil with appreciable amounts of expanding clays1	Not suitable	14

- Using the approximate location of each ROSS, a land elevation was determined at each site using the GIS land elevation contours. It is important to note that the GIS land elevation model was derived by interpolating between 10 foot contours developed by aerial photogrammetry.
- The estimated depth to groundwater measured from the land surface at the approximate location of each ROSS. It is important to note that GIS groundwater elevation model was derived by interpolating between 25 foot contours developed by (Vaccaro et al. 2009).

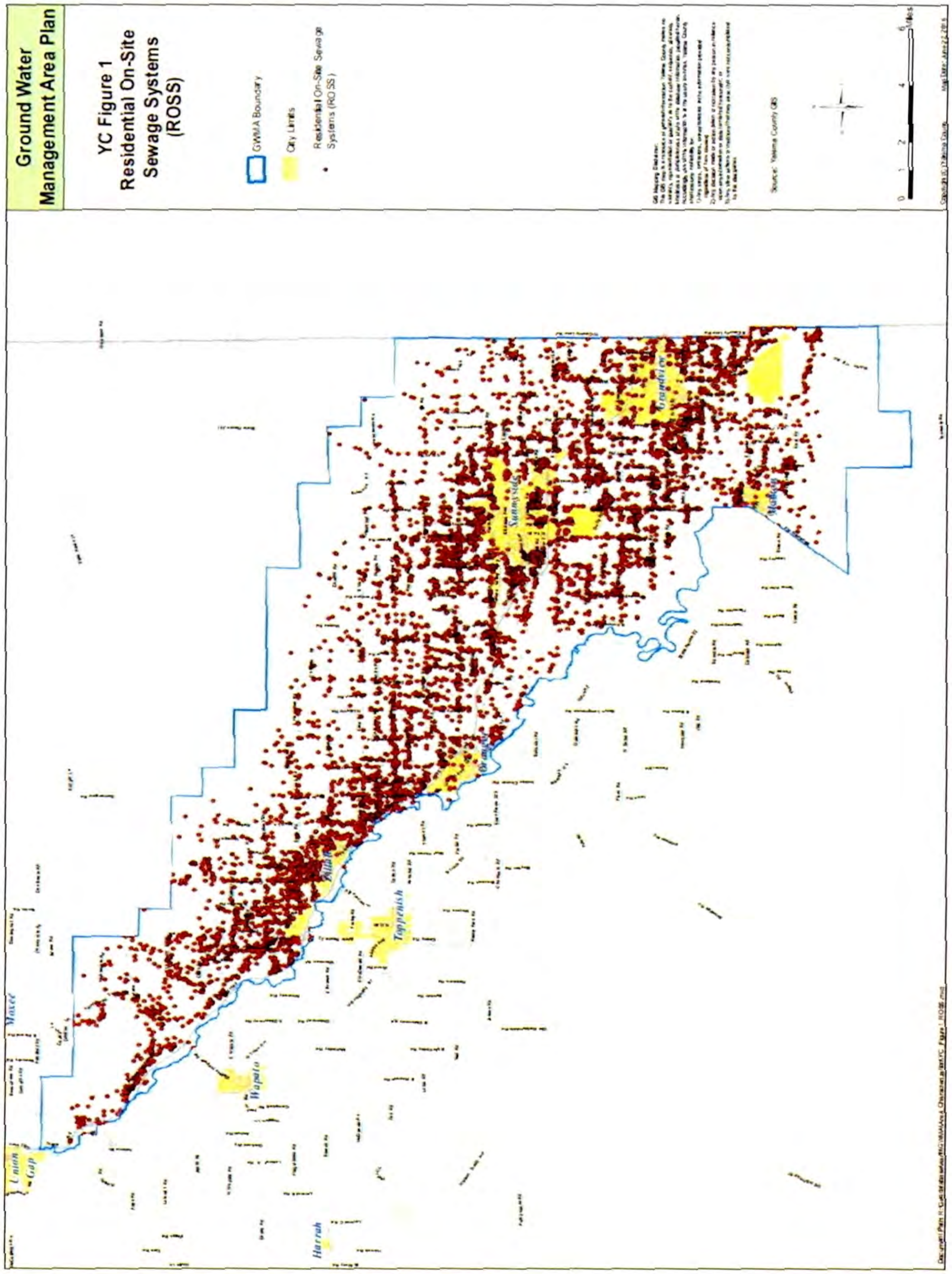


Figure 10: Residential on-site sewage systems

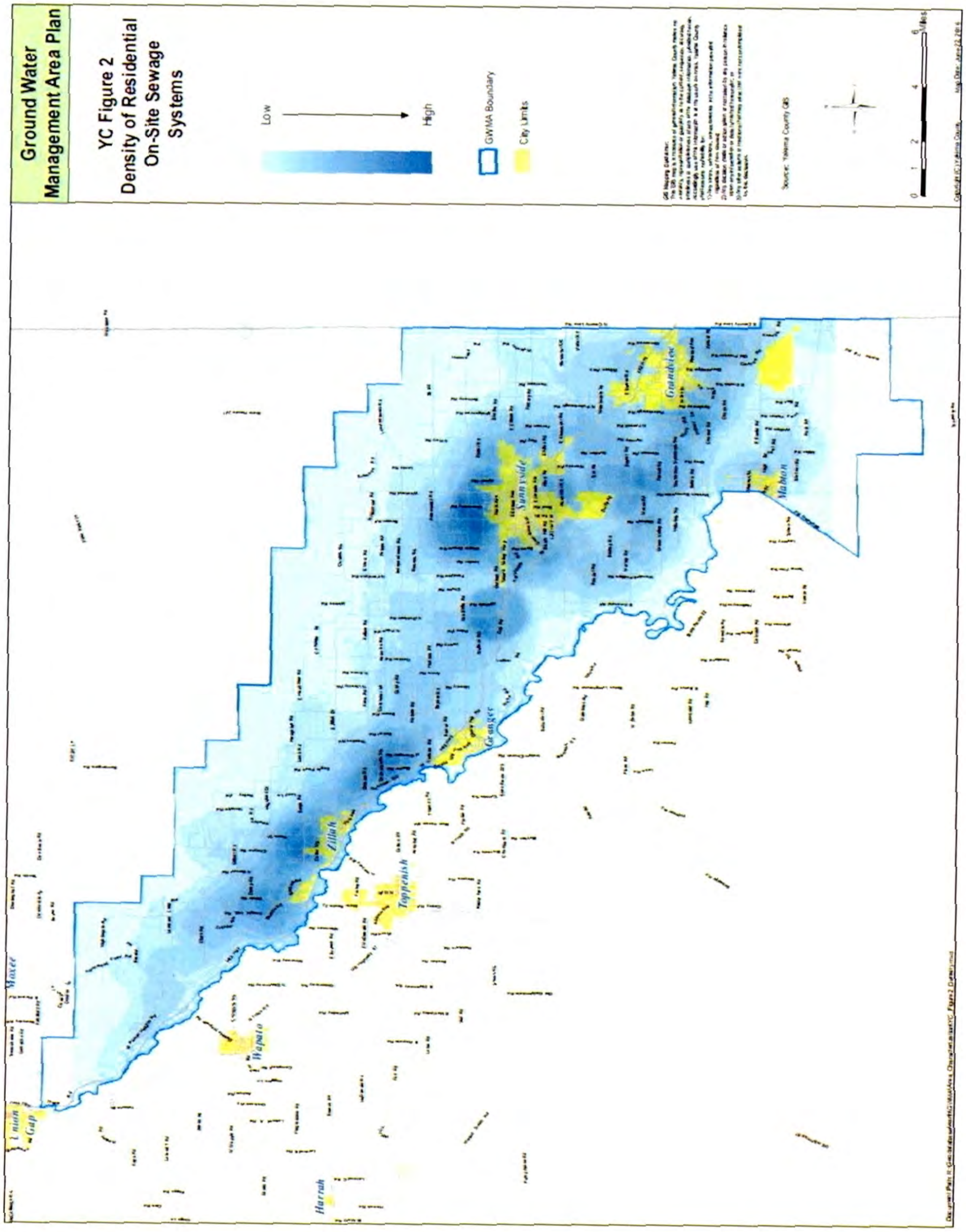


Figure 11. Density of residential on-site sewage systems

Nitrogen Loading to a ROSS

Nitrogen in residential wastewater is mainly generated from human body wastes and food materials from kitchen sinks and dishwashers. The amount of nitrogen present in the wastewater is typically expressed as a concentration in milligrams per liter (mg/L) and/or as a mass loading in grams/person/day. This assessment of nitrogen loading from on-site sewage systems utilizes the mass loading approach.

Table 3-7 of (EPA 2002a) reports that the total nitrogen (TN) loading to a ROSS ranges from six to seventeen grams per person per day and assumes a water use of 60 gallons/person/day (227 liters per person per day). Table 4.4 of (EPA 1992) reports the total nitrogen loading to a ROSS is approximately 11.2 grams per person per day. The nitrogen mass loading assessment for the residential on-site sewage systems within the GWMA utilizes a high, medium, and low approach. Accordingly, this ROSS assessment assumes a nitrogen loading of 17, 11.2, and 7 grams TN per person per day. These mass loading rates equate to TN concentrations of 26.4, 49.3, and 74.8 mg/L respectively assuming a water use of 227 liters/person/day Note: WAC 246-272A-0230 *Design Requirements-General* under section (2) (E) (ii) requires that designs for on-site systems, other than systems for single-family residences, be designed in accordance with (EPA 2002a) (On-Site...2005).

Nitrogen Removal by Denitrification

Wastewater discharged to a ROSS is subject to several biological processes including nitrification and denitrification. These processes can take place depending on the environmental conditions and occur most effectively when the soil is unsaturated because the wastewater is forced to percolate over the soil particle surfaces where treatment can take place and air is able to diffuse through the soil. Whether these processes occur and their effectiveness in treatment depends on the physical characteristics of the soils and the environmental conditions of the soil through which the wastewater percolates. Wastewater parameters, such as levels of nitrogen are removed to varying degrees. Organic or ammonia nitrogen is readily and rapidly nitrified biochemically in aerobic soil and some biochemical denitrification can occur in the soil, but without plant uptake, 60 to 90 percent of the nitrate enters the ground water. Under anaerobic soil conditions, nitrification will not occur, but the positively charged ammonium ion is retained in the soil by adsorption onto the soil particles. The ammonium may be held until aerobic soil conditions return allowing nitrification to occur (EPA 1992).

Factors found to favor denitrification are fine-grained soils (silts and clays) and layered soils (alternating fine-grained and coarser-grained soils with distinct boundaries between the texturally different layers), particularly if the fine-grained soil layers contain organic material. However, it is difficult to predict removal rates for wastewater-borne nitrate or other nitrogen compounds in the soil matrix (EPA 2002a). Table 3-17 (EPA 2002a) provides examples from studies conducted in 1976 and 1977 that showed that 10 to 40 percent of the total nitrogen can be removed by denitrification by soil infiltration in a conventional drainfield. In 1990, Jenssen and Siegrist found in their review of several laboratory and field studies that approximately 20 percent of nitrogen is lost from wastewater percolating through soil (EPA 2002a).

The predominant soil type underlying the ROSS drainfields located within the GWMA are characterized as very fine sands, loamy very fine sands; or silt loams, sandy clay loams, clay loams and silty clay loams with a moderate structure or strong structure (Table 16). The estimated depth to groundwater is equal to or greater than 10 feet at approximately 90% of the ROSS locations. When considered together, this information is useful to the extent that it is reasonable to assume that the environmental conditions underlying the drainfields are conducive to some level of denitrification. Accordingly, taking a conservative approach and relying on (EPA 2002a), this nitrogen mass loading assessment, in keeping with a high, medium, and low approach, uses denitrification percentages of 10, 15, and percent respectively. Plant uptake for this assessment is assumed to be zero.

Nitrogen Removal by Septage Pumping

WAC 246-272A-0010 defines a septic tank as "a watertight treatment receptacle receiving the discharge of sewage from a building sewer or sewers, designed and constructed to permit separation of settleable and floating solids from the liquid, detention and anaerobic digestion of the organic matter, prior to discharge of the liquid." "The mixture of solid wastes, scum, sludge, and liquids pumped from within septic tanks, pump chambers, holding tanks, and other OSS components." is defined as septage (On-Site...2005).

The total nitrogen content of septage generated in the GWMA is not available. However, Table 2-2 *Characteristics of Septage Conventional Parameters (1)* contained in (EPA 1994) reports that the average Kjeldahl nitrogen in septage is 588 mg/L with a range from 66 mg/L to 1060 mg/L. Accordingly, this assessment uses an average concentration in septage of 588 mg/L total nitrogen.

WAC 246-272A-0232 establishes the minimum liquid volume for a septic tank serving a single family residence as 900 gallons for a residence containing 3 or fewer bedrooms, 1,000 gallons for a four bedroom residence, and an additional 250 gallons per bedroom for each bedroom over four. The actual septic tank size at each OSS within the GWMA is unknown. For analysis purposes, this assessment assumes that the tank size at each ROSS meets, and is equal to, the minimum WAC requirements of 900 gallons (3,407 liters) (On-Site...2005).

The amount of nitrogen removed by pumping a 900 gallon tank when it is full using TN = 588 mg/L and a 900 gallon (3,407 liters) septic tank is 2.0 Kg (4.417 pounds). The effective annual rate of TN removal by septic tank pumping can be estimated by taking the TN removed by pumping and dividing by the length of time in years between pumping events. Similarly, the reduction in TN concentration in wastewater entering the septic tank compared to the wastewater leaving the septic tank can be estimated by taking the TN removed by pumping and dividing by the total water entering the septic tank during the time between pumping events. Doing so, using an average household size of 3.5 persons and a per capita water use of 60 gallons per day, results in TN concentration reductions of 2.3 mg/L, 1.4 mg/L, and 0.7 mg/L for 3,5, and 10 year pumping events respectively.

WAC 246-272A-0270 makes the owner of a ROSS responsible for operating, monitoring, and maintaining their ROSS including the requirement to employ an approved pumper to remove the septage from the tank when the level of solids and scum indicates that removal is necessary (On-Site...2005). The frequency of septic tank pumping at each ROSS in the GWMA is unknown. However, the Groundwater Advisory Committee for the GWMA initiated a "*Well Assessment Survey*" that was conducted by the Yakima Health District for 458 households within the GWMA. That survey included the question "Have you had your septic tank pumped recently?" Of the 458 surveys completed, 82% of the respondents answered "yes" and 18% of the respondents answered "no" or "I don't know." This survey, though not a valid statistical sampling (survey respondents volunteered and were not necessarily geographically dispersed), does provide information that indicates that the majority of households within the GWMA are more than likely having their septic tanks pumped periodically. Typical maintenance guidelines recommend that a septic tank be pumped every 3 to 5 years (EPA 2002b). Accordingly, this nitrogen mass loading assessment, in keeping with a high, medium, and low approach, assumes septic tank pumping occurs every 10, 5, and 3 years respectively.

Model Input Summary

Table 17 summarizes the inputs used for estimating the nitrogen loading from residential septic tanks:

Table 17. Input parameters for estimating total nitrogen from ROSS

Parameter	Units	Low	Medium	High
Household Size	Persons / Household	Census Tract Average	Census Tract Average	Census Tract Average
TN Loading to ROSS	gm/person/day	7	11.2	17
Denitrification	Percent	20	15	10
Septic Tank Size	Liters	3,407	3,407	3,407
TN in Septage	gm/L	0.588	0.588	0.588
TN in Septic Tank When Pumped	gm	2,003	2,003	2,003
Septic Tank Pumping Frequency	Years	3	5	10

ROSS Results

Model Output Summary

The low, medium, and high estimated net nitrogen loads from all of the ROSS within the GWMA using the input factors contained in Table 17 are 43.7 tons, 79.2 tons, and 130.3 tons respectively. The estimated nitrogen loads are summarized in Table 18.

Table 18. ROSS nitrogen loading estimate

	Units	TN Generated by 6,044 Households	Denitrification	Average Annual TN Removed by Pumping	Total N
LOW	Grams/Year	54,636,835	(10,927,367)	(4,035,377)	39,674,091
	Lbs/Year	120,454	(24,091)	(8,896)	87,466
	Tons/Year	60.23	(12.05)	(4.45)	43.73
MEDIUM	Grams/Year	87,418,937	(13,112,840)	(2,421,226)	71,884,870
	Lbs/Year	192,726	(28,909)	(5,338)	158,479
	Tons/Year	96.36	(14.45)	(2.67)	79.24
HIGH	Grams/Year	132,689,457	(13,268,946)	(1,210,613)	118,209,898
	Lbs/Year	292,530	(29,253)	(2,669)	260,608
	Tons/Year	146.27	(14.63)	(1.33)	130.30

About the Model

The model created for this assessment is maintained by the Yakima County Public Services Department. It has been designed such that it provides the ability to estimate the nitrogen loading from ROSS within the GWMA by changing any or all of the input parameters. As an example, using a denitrification rate of 15%, a TN Loading to a ROSS of 11.2 gm/person/day, and a septic tank pumping frequency of 4 years results in a TN of 78.3 tons.

Migrant Worker Effect on ROSS Nitrogen Loading

The number of persons living within the GWMA has a direct effect on the nitrogen loading from septic tanks and the above ROSS assessment only accounts for those persons living within the GWMA boundary on a permanent basis. Yakima County agricultural producers supplement their work force during peak periods by hiring migrant workers. A migrant worker is defined as a farm worker whose employment requires travel that prevented the worker from returning to his/her permanent place of residence the same day (USDA NASS 2014). In 2012 there were 9,598 migrant workers employed by agriculture throughout all of Yakima County (USDA NASS 2014). It is not known precisely where these migrant workers were employed or where they lived. However, it is possible to estimate the number of migrant workers working in the GWMA boundary by prorating the total number of migrant workers for the county by acres of crop land in Yakima County. This approach assumes that the estimated amount of migrant workers working within the GWMA also resided within the GWMA.

There are 360,906 acres of crops in Yakima County with 99,976 (28%) of those acres located within the GWMA (WSDA 2016). Prorating the number of migrant workers by crop acres results in a GWMA migrant worker population of 2,687 migrant workers (28% of 9,598). (USDA NASS 2014) does not provide information relative to the amount of time each migrant worker worked - a worker working just one day is recorded as one migrant worker and a worker working 30 days is also reported as one migrant worker. On the other hand, (ESD 2015), reports the total number of agricultural workers by month employed, but does not report the number of migrant workers. Nonetheless, by assuming that the monthly migrant workforce reported by (USDA NASS 2014) follows the same trending pattern as the total monthly agricultural workforce reported by (ESD 2015), an estimate of an annualized migrant population can be derived. Doing so results in an average annual migrant population within the GWMA of 224 persons (2,687 person months ÷12 months = 224 persons). Table 19 shows the calculations for the estimated migrant worker population. Consequently, employing the same methodology used for residential ROSS, the estimated additional TN loadings per year from migrant workers using the low, medium, and high format are 0.50 tons, 0.90 tons, and 1.40 tons respectively.

Table 19. Migrant workforce estimate

Month (A)	Total County Ag Workers / Month (B)	Monthly Distribution of Total County Ag Workers / month by % of Total ('C)	Prorated Migrant County Ag Workers / month = (B) X ('C) (D)	Prorated GWMA Migrant Ag Workers / yr = ('C) X 28% ÷ 12 (E)
Jan	20,120	0.058	555	13
Feb	22,540	0.065	622	15
Mar	23,220	0.067	640	15
Apr	25,540	0.073	704	16
May	26,410	0.076	728	17
Jun	38,550	0.111	1,063	25
Jul	39,920	0.115	1,101	26
Aug	33,080	0.095	912	21
Sep	38,440	0.110	1,060	25
Oct	35,720	0.103	985	23
Nov	24,320	0.070	671	16
Dec	20,130	0.058	555	13
Totals:	347,990	1	9,598	224

Nitrogen Loading from ROSS per Land Area

Nitrogen loading estimates per land area were determined using the OSS design requirements contained in WAC 246-272A-0230 as a means of comparing the nitrogen loading from ROSS with other potential nitrogen sources that are typically land area based. According to the WAC, the design flow for an OSS is determined by multiplying the number of bedrooms by 120 gpd based on an occupancy of 2 persons per bedroom. This results in a design load of 60 gpd per person per day. The design flow for each ROSS is estimated by multiplying the household size by 60 gpd (a household size of 4.16 persons would have a design flow of 250 gallons per day). It is important to note that the minimum design flow established by the WAC is 240 gallons per day0 (On-Site...2005).

The area of the drainfield for a ROSS is used to estimate the land area where nitrogen discharged from a septic tank is applied. The size of this area for each ROSS is estimated by first dividing the design flow for the ROSS by the infiltration rate for the soils underlying the drainfield. A household with a design flow of 250 gpd in a soil having an infiltration rate of 0.45 gallons/ft^2/day would have an estimated infiltrative surface of 556 ft^2. Second, taking a simple approach, the size of the drainfield can be approximated by assuming that infiltration trenches are one foot wide and 60 feet long (60ft^2/ trench) and that the lateral separation between trenches is five feet resulting in the need for 10 trenches and a drainfield size of 60 feet by 45 feet or 2,700 ft^2 . Finally, the nitrogen loading per land area can then be estimated by dividing the annual nitrogen load for the ROSS by the area of the drainfield. If the above household has a TN discharge of 28 lbs/yr, then the annual nitrogen loading per land area is 0.01 lbs/ft^2 (436 lbs/acre).

The size of each ROSS drainfield was estimated using the above methodology resulting in a total drainfield area for all of the ROSS in the GWMA of 398 acres. Consequently, the TN loadings summarized in Table 20 result in low, medium, and high land application rates of 223 lbs/acre, 403 lbs/acre, and 662 lbs/acre respectively. Total loadings from ROSS drainfields are summarized in Table 20.

Table 20: Estimated Total Nitrogen Loadings from ROSS Drainfields

	Low	Medium	High
Loading (lb N/acre)	223	403	662
Loading (kg N/hectare)	249	452	743
Loading (ton N/year)	44.2	80.1	131.7
Loading (kg N/year)	40,131	72,663	119,461

Large On-site Septic Systems

Background

A Large Onsite Septic System is a septic system having a design volume over 3,500 gallons. The design and operation of LOSS are overseen by the Washington State Department of Health (WDOH). WDOH records show that there are 2 LOSS located within the GWMA. The design capacity, location, and times of use of both of the LOSS were provided to the GIS Department by WDOH.

LOSS Results

One LOSS site is located outside of Zillah (Zillah LOSS) with a design capacity of 5,000 gallons. This LOSS serves the employees of a large fruit packing operation and warehouse. The LOSS is used by employees throughout the year with peak use during the fruit packing season. It is presumed that the loading to the LOSS is predominantly human waste from toilet flushing. The average loading generated by toilet flushing is 16.2 gallons/capita/day with a nitrogen loading of 8.7 grams/capita/day (EPA 1992) at Tables 4-2 and 4-4. WAC 246-272 B 06450(4) (b) requires that the size of a LOSS septic tank be equal to 3 times the daily design flow (Large...2011). As such, the design flow for the 5,000 gallon tank is 1,667 gpd. Dividing the design flow by 16.2 g/cap/day equates to 103 persons per day. The annual nitrogen loading from 103 persons, using the ROSS methodology and substituting a TN loading of 8.7 grams/capita/day, is a low of 575 lbs/year, a medium of 612 lbs/year, and a high of 649 lbs/year or 0.29 tons/year, 0.31 tons/year, and 0.32 tons/year from the Zillah LOSS. Of note is that this estimate is based on the peak loading during the packing season and does not reflect a smaller work force during the remainder of the year.

The second LOSS site is located outside of Granger (Granger LOSS) with a design capacity of 4,850 gallons. The design flow is 1,620 gpd (one third of the size of the tank). This LOSS serves migrant workers for approximately 30 days each year during the cherry harvest season. It is presumed that the migrant workers reside at this site and that the loading to the LOSS is typical of the loading to ROSS. Accordingly, the number of persons this LOSS was designed to serve is 27 persons. Using the same methodology used to calculate the total nitrogen load for ROSS, a nitrogen load for the LOSS was determined. This results in a low of 9 lbs/year, a medium of 16.0 lbs/yr and a high 27 lbs/year of total nitrogen from the Granger LOSS. Results from LOSS systems are summarized in Table 21.

Table 21: Estimated Loading from LOSS systems

	Low	Medium	High
Loading (lb N/acre)	195	209	225
Loading (kg N/hectare)	218	235	252
Total loading (ton N/year)	0.29	0.31	0.34
Total loading (kg N/year)	265	285	307

Commercial On-site Septic Systems

Background

The term "Commercial" Onsite Septic Systems, as used in this report, refers to septic systems that are used for employees working at agricultural businesses that operate year-round and are not classified as a LOSS by WDOH. The most likely location for these facilities within the GWMA are at confined animal feeding operations (CAFOs).

COSS Results

The Washington State Department of Agriculture reported that there were 52 operating CAFOs located within the GWMA in 2014. Each CAFO was classified by WSDA by herd size ranges as shown in Table 22. Presumably, each CAFO provides a restroom facility for its employees. It is not known if the facilities are a COSS or some type of portable facility. This nitrogen loading assessment for COSS assumes that there is a COSS at each CAFO location.

It is assumed that the loading to the COSS is predominantly human waste from toilet flushing. The number of employees at each CAFO is unknown but can be estimated using a paper published by the University of California in 2004 titled "*For Wages and Benefits, Bigger Dairies May be Better*" written by Barbara Reed (Reed 1994). The following is extracted from that paper:

Number of employees: Larger dairies had a higher cow-to-employee ratio than smaller dairies. Dairies of more than 700 cows averaged 151 cows per employee; dairies with fewer than 250 cows averaged 82 cows per employee. Dairies with fewer than 250 cows employed 3.5 workers on average; dairies with more than 700 cows employed 12 workers. The largest number of employees reported for any dairy was 31 (1,900 cows).

This assessment uses a cow to employee ratio of 82 for CAFOs smaller than 700 cows and a cow to employee ratio of 151 for CAFOs larger than 700 cows. The number of cows is assumed to be the highest number in the range, with 8,000 cows used for the largest CAFOs. This methodology is represented in Table 22.

Table 22. GWMA CAFO herd size and employee estimate

Mature Herd Range (cows)	Number of CAFOS	Employees/ CAFO	Total Employees
200 to 699	14	9	126
700 to 1699	18	11	198
1700 to 2699	10	18	180
2700 to 3699	4	25	100
3700 to 4699	1	31	31
4700 to 5699	1	38	38
5700 to 6839	2	45	90
6840 and above	2	53	106
Total	52		869

The average loading generated by toilet flushing is 16.2 gallons/capita/day with a nitrogen loading of 8.7 grams/capita/day (EPA 1992) at Tables 4-2 and 4-4. The annual nitrogen loading from 869 persons, using the ROSS methodology and substituting a TN loading of 8.7 grams/capita/day, is a low of 4,865 lbs/year, a medium of 5,170 lbs/year, and a high of 5,475 lbs/year. Results from COSS are summarized in Table 23.

Table 23: Estimated Loading from COSS

	Low	Medium	High
Loading (lb N/acre)	163	173	183
Loading (kg N/hectare)	182	194	205
Total loading (ton N/year)	2.43	2.59	2.74
Total loading (kg N/year)	2207	2345	2483

Residential Lawn Fertilizer

Methods

The overall nitrogen loading assessment includes an estimate of nitrogen from fertilizers applied to residential lawns located within the GWMA. The GIS Department developed a method for approximating the area of maintained lawn areas. This method involved the use of ArcMap Spatial Analysis and color infrared orthophotography to determine "green" spaces within the residential areas of the GWMA. The infrared photography shows actively growing vegetation as variations of red on the orthophotography.

A classification tool in ArcGIS was "trained" to search for these red spots and identify them as grass, trees, or shrubs. These areas represent a "green" layer within the GIS and are considered areas where fertilizer may be applied. Using the green layer, four representative areas within the GWMA were examined to determine the percentages of land area that were green. Each of the areas were one square mile in size and the buildings and crop lands were subtracted from the green areas. The four areas examined were:

- An urban area located within the City of Sunnyside city limits (Urban) representing urban density properties. The average parcel size for this urban area is 0.28 acres and the amount of green area is 33.4% of the total acreage resulting in an average green area per parcel of 0.09 acres.
- A suburban area located outside the City of Sunnyside, but within the Sunnyside Urban Growth Boundary (Suburban), representing suburban density properties. The average parcel size for this suburban area is 4.95 acres and the amount of green area is 25.2% of the total acreage resulting in an average green area per parcel of 1.25 acres.
- A rural area that encompasses the unincorporated community of Outlook (Rural High) representing rural properties within the GWMA that are relatively small in size. The average parcel size for this suburban area is 4.90 acres and the amount of green area is 13.0% of the total acreage resulting in an average green area per parcel of 0.64 acres.
- A rural area within the County (Rural Low) representing rural properties within the GWMA that are relatively large in size. The average parcel size for this rural area is 23.7 acres and the amount of green area is 3.1% of the total acreage resulting in an average green area per parcel of 0.73 acres.

Table 24 summarizes the representative areas.

Table 24. Representative lawn areas in the GWMA

Representative Area	Average Parcel Size (acres)	Green Area (acres)	Percent Green	Green Area per parcel (acres)	Green Area per parcel (sf)
Urban	0.28	20.04	33.4%	0.09	4,074
Suburban	4.95	161.28	25.2%	1.25	54,337
Rural High Density	4.9	83.2	13.0%	0.64	27,748
Rural Low Density	23.7	19.84	3.1%	0.73	32,004

Residential lawn areas for the entire GWMA were approximated using Table 24 values and the following criteria:

- Each residential parcel located within an incorporated City was given a lawn area of 0.09 acres.
- Each residential parcel located within an urban growth boundary and outside of an incorporated city was given a lawn area of 1.25 acres.
- Each residential rural parcel (outside of an urban growth boundary) that had a total parcel area equal to or less than 5.0 acres was given a lawn area of 0.64 acres.
- Each residential rural parcel (outside of an urban growth boundary) that had a total parcel area greater than 5.0 acres was given a lawn area of 0.73 acres.

Table 25 summarizes the approximated total lawn area within the GWMA using the above criteria:

Table 25. Residential lawn areas

Representative Area	Application	Green Area per Parcel (acres)	Number of Parcels	Green Area in GWMA (acres)
Urban	All parcels located in incorporated cities	0.09	7,180	646
Suburban	All parcels located in UGA outside of cities	1.25	892	1115
Rural high density	All rural parcels <= 5 acres	0.64	3,285	2102
Rural low density	All rural parcels > 5 acres	0.73	709	518
Totals			12,066	4,381

The lawn care practices used by residents within the GWMA are unknown relative to the amount of nitrogen applied to their lawns each year. Anecdotal evidence indicates that some residents fertilize their lawns regularly and some do not fertilize their lawns at all. Consequently, this estimate for the amount of nitrogen used on lawns within the GWMA is entirely based upon the assumption that residents that do fertilize their lawns do so once each year using a typical commercial lawn fertilizer such as Scotts® Turf Builder. This product's application guidelines equate to the application of 23.3 pounds of nitrogen per acre for each application. (13.35 lb. bag, 20-0-8 analysis, covers 5,000 sf).

Residential Fertilizer Use Results

In keeping with the high, medium, and low approach, it is assumed that the percent of residents who fertilize are 80, 50, and 20 percent respectively. Accordingly, the high nitrogen loading estimate is 40.8 tons, the medium estimate is 25.5 tons, and the low estimate is 10.2 tons. It is important to note that this lawn loading assessment does not take into consideration any nitrogen lost to plant uptake, denitrification, and volatilization as is normal practice. Given the coarseness of the assumptions contained in the assessment already, it is believed that any further refinement is unjustified. Table 26 shows the low, medium, and high estimated loading from residential fertilizer use.

Table 26: Estimated N loading from Residential Fertilizer

	Low	Medium	High
Loading (lb N/acre)	4.7	11.7	18.6
Loading (kg N/hectare)	5.2	13	20.9
Total loading (ton N/year)	10.2	25.5	40.8
Total loading (kg N/year)	9,260	23,152	37,043

Small-Scale Commercial and Hobby Farms

Background

"Small-scale commercial and hobby farms" is a term used in this report to represent residential land uses other than lawns that may contribute nitrogen to the GWMA area. These land uses are attributable to relatively small parcels that that are not included in the Washington State Department of Agriculture's Crop inventory. Nitrogen contributions on these parcels may come from individual gardens, pastures, pets, and other animals.

Methods

The GIS Department developed an ArcGIS model to determine the potential number of hobby farms in the GWMA. To do so, using the GWMA parcel information, all parcels located within the city limits were removed, all parcels greater than 10 acres were removed, non-residential properties were removed, and parcels that overlapped with the WSDA's Cropland Data Layer were removed. The remaining parcels were then categorized into 3 size categories - (1) Acres 0 ≤ 2.5, (2) Acres ≥ 2.51 and Acres ≤ 5.00, and (3) Acres ≥ 5.01 and Acres ≤ 10.0. Once the parcels were categorized, the parcels were matched to the residential lawn data in order to remove the lawn area from the parcel area and to eliminate double counting of nitrogen loading. In addition, a building allowance of 2,000 ft^2 for each parcel was also deducted from the parcel area to arrive at an effective area for hobby farms.

Small-Scale Commercial and Hobby Farms Results

The analysis yielded the results shown in Table 27.

Table 27. Parcel size and total acres

Parcel Size Range of Small-Scale Farm (acres)	Number of Parcels	Total Parcel Area (acres)	Lawn Area (acres)	Building Allowance @ 2,000 sf/parcel (acres)	Effective Area (acres)
0 to 2.5	2335	2,481.5	1,804.1	107.2	570.2
2.51 to 5.0	311	1,075.6	223.0	14.3	838.4
5.1 to 10.0	110	776.1	83.3	5.1	687.7
Totals	2756	4,333.2	2,110.4	126.5	2,096.3

The recommended amount of fertilizer applied to each of these groups as proposed by the GWMA's RCIM Work Group is shown in Table 28. In keeping with the high, medium, and low approach, it is assumed that the percent of residents who fertilize are 80, 50, and 20 percent respectively similar to the assumption for residential lawn fertilizer.

Table 28. Percent of fertilizer application by hobby farm size

Parcel Size of Small-Scale Farm (acres)	Nitrogen Fertilizer Application (lb/acre/yr)	Nitrogen Fertilizer Application (kg/hectare/year)
0 ≤ 2.5	14	15.7
2.51 ≤ 5.0	21	23.5
5.01 < 10.0	28	31.4

The loading rate was then applied to the corresponding Small-Scale Farm size using the effective area. The results are shown in Table 29.

Table 29. Total nitrogen loading for hobby farms

Parcel Size of Small-Scale Farm	Small-Scale Farm Effective Area (acres)	Application (lbs)	TN Low at 20% (tons)	TN Medium at 50% (tons)	High at 80% (tons)
0 ≤ 2.5 Acres	570.2	14	0.80	2.00	3.19
2.51 Acres ≤ 5.0 Acres	838.4	21	1.76	4.40	7.04
5.01 Acres ≤ 10.0 Acres	687.7	28	1.93	4.81	7.70
Total (ton N/year)			**4.48**	**11.21**	**17.94**
Total (kg N/year)			**4,068**	**10,171**	**16,273**

4. ATMOSPHERIC DEPOSITION

WSDA author: Kelly McLain

Background

Atmospheric deposition is the process by which aerosol particles collect or deposit themselves on the earth's surfaces. It can be divided into two general sub-processes: dry and wet deposition. Nitrogen emissions in the Pacific Northwest may come from transportation, agriculture, power plants, industrial, and natural sources. In coastal areas, transport of nitrogen due to emissions in Southeast Asia may also be a source. In urban areas, emissions will mainly be in the form of oxidized sulfur compounds (NO_x) while in agricultural areas emissions from fertilized cropland and CAFOs will be largely in reduced forms (ammonia and ammonium). In general, emissions of both oxidized and reduced nitrogen have been increasing in recent decades (Fenn 2003). Emissions may travel distances ranging from meters to thousands of kilometers before subsequent wet (through precipitation) or dry redeposition takes place (Viers et al. 2012). Monitoring of deposition is conducted by the National Atmospheric Deposition Program, which conducts both monitoring of and modeling of N species emissions concentrations and deposition throughout the United States. Monitoring is conducted mainly at fairly remote sites; there are 5 wet deposition monitoring stations in Western Washington and 1 in Eastern Washington (in Whitman County) (NADP 2017). In conjunction with this wet deposition modeling, EPA uses emissions and ambient concentration data to model dry deposition based on emissions and one dry deposition station in Mt. Rainier National Park (now discontinued) (EPA 2015, EPA 2016).

WSDA reviewed similar studies to assess what, if any, atmospheric deposition information was available from other agricultural areas on the west coast. A significant nitrogen loading study by the University of California at Davis (Viers et al. 2012) includes atmospheric deposition data for California's Central Valley. EPA modeling in the Tulare Lake Basin and Salinas Valley was reviewed for that study to identify atmospheric deposition levels of 9 and 5 lb N/ac-yr, respectively. These numbers greatly exceed atmospheric deposition estimates for this study area. There are a few reasons why the levels seen in the Tulare Lake Basin and the Salinas Valley are not comparable to those estimated in Yakima. The first major difference between the regions is proximity to major urban areas; a significant source of deposition in California's Central Valley is the San Francisco Bay area transportation corridor. The Yakima Valley does not have a transportation or population hub of similar magnitude and proximity. In addition, the scale of animal agriculture in the Central Valley is an order of magnitude greater than that found in Yakima County (approximately 640 dairies compared to about 50 in the GWMA). Finally, the numbers in the Tulare Lake Basin and Salinas Valley are likely higher due to the effect of the Sierra Nevada – winds travelling from heavily populated areas meet the Sierra Nevada and deposit atmospheric pollutants in the adjacent valleys (Viers et al. 2012). Again, this is not a scenario seen in the Yakima Valley where winds travel mostly away from the mountains towards the Columbia River Basin. It is not surprising that the nitrogen deposition estimates from would be much higher in the UC Davis study than in the Lower Yakima Valley GWMA.

Methods, Limitations, and Assumptions

Limitations

The lower Yakima Valley has low annual rainfall (6.8 inches) and moderate winter snowfall (12.4 inches per year), from mean yearly records kept from 1894 – 2012 at Sunnyside, WA (Western Regional Climate Center 2017). As mentioned above, Washington State has 5 wet deposition monitoring stations in the National Atmospheric Deposition Program but only 1 located on the eastern side of the Cascade Mountains (NADP 2017). One limitation of this study is the very small amount of deposition data collected in the study area. The location of the eastern Washington NADP station (in Whitman County, NADP 2017) is similar in precipitation but not in geography or land use practice (Whitman County produces dryland crops such as wheat, barley, and dry peas) (WSDA 2016). There is also a limited amount of development and only small transportation corridors located in Whitman County, as compared to our study area in the lower Yakima Valley, surrounded by mountains, reasonably sized cities and towns, and bisected by a major interstate. In addition, the Yakima Valley is largely planted in irrigated cropland and a large number of concentrated animal feeding operations (none of which are found in Whitman County) (WSDA 2016). Use of the wet deposition data from the Whitman County station would likely underestimate the influence of atmospheric deposition on the geographic footprint of the lower Yakima Groundwater Management Area. This limitation makes it more difficult to use Washington measurements in the analysis.

Another limitation of this estimate is categorization of ecosystems and development types that may result in deposited atmospheric nitrogen available for transport to groundwater. It is expected that in most urban areas (with a high percentage of impervious surface), any atmospheric deposition would likely be retained in the natural ecosystem through turfgrass sequestration or make its way to surface water via stormwater runoff. Natural areas are often nitrogen limited and atmospheric deposition in those regions may be used in the production of increased biomass and not available for leaching (Viers et al. 2012). It is assumed that atmospheric deposition does not contribute significantly to groundwater loading in these systems. However, this study does not include a refined analysis to exclude these areas.

Methods

The mechanism for nitrogen loading through atmospheric deposition to cropland is mobilization to groundwater through irrigation; atmospheric deposition to cropland is included as an input in the mass balance conducted in Section **2.** IRRIGATED AGRICULTURE. As a result, this section of the report excludes the acreage from the irrigated agriculture section. In addition, the known areas of pens and lagoons are excluded (both of these estimates already account for atmospheric nitrogen deposition).

In order to establish low, medium, and high estimated available nitrogen due to atmospheric deposition, WSDA relied on 2 main sources; a state atmospheric scientist with the Washington State Department of Ecology (Dr. Ranil Dhammapala[4]) and the data available for wet and dry deposition from the NADP-managed Mt. Rainier station.

[4] Medium and high deposition values were recommended by Dr. Dhammapala during a meeting on November 3, 2016.

The lowest number used is the combination of the most recently available annual wet and dry deposition data from the NADP Mt. Rainier station. Deposition reported includes dry nitric acid, dry ammonium, dry nitrate, wet ammonium, and wet nitrate (EPA 2016). This is believed to be a good surrogate for low deposition due to the considerable transportation corridor along I-5 in western Washington mimicking farm-related emissions and deposition seen in eastern Washington.

The average estimate provided by Dr. Dhammapala takes into account modeled deposition in the lower Yakima Valley over a 5-day period during December, when stagnant air and regular inversions result in poor regional air quality. For the highest rate estimate, WSDA again relied on feedback from Dr. Dhammapala to include a multiplier of 3 times the average rate to generate an expected upper limit for atmospheric deposition.

An underlying assumption included in this analysis is that deposition within the design surface area of each lagoon is conveyed to the lagoon liquid and accounted for as lagoon nitrogen concentration in the lagoon seepage calculation.

The total area used in the final annual calculations excludes 210 acres of lagoons, 2,096 acres of dairy and non-dairy livestock pens, and 98,881 acres of irrigated agricultural land. Atmospheric deposition on these areas was incorporated into calculations elsewhere in this report. The total remaining acreage used in the calculation below is 73,976 acres (ton N/yr calculation) or 29,937.05 hectares (kg N/yr calculation).

Results

The low, medium, and high atmospheric deposition rates are listed in the table below (Table 30).

Table 30. Low, medium, and high atmospheric deposition rates

	Deposition rate (kg N/ha)	**Deposition rate (lb N/ac)**
Low	1.69	1.53
Medium	2.30	2.05
High	6.89	6.15

The low rate of 1.53 lb/acre is the result of the most recently reported year (2012) of wet and dry atmospheric nitrogen deposition at the Mt. Rainier station (EPA 2016).

The medium rate, as mentioned above, is the result of a 5-day modeled average from December 2015. The final estimate of 2.05 lb/acre was provided by state atmospheric scientist Dr. Ranil Dhammapala.

The high rate multiplies the medium rate by a safety factor of 3, accounting for transient atmospheric conditions retaining local emissions in the valley when air quality is already poor. This high rate of 6.15 lb/acre is also in the range of values used in the UC Davis study of the Salinas Valley and Tulare Lake Basin (Viers et al. 2012).

Conclusions and Recommendations

The total estimated deposition across the entire GWMA (excluding irrigated agricultural lands, animal pens and manure lagoons) is shown in Table 31.

Table 31. Estimated atmospheric nitrogen deposition in the GWMA

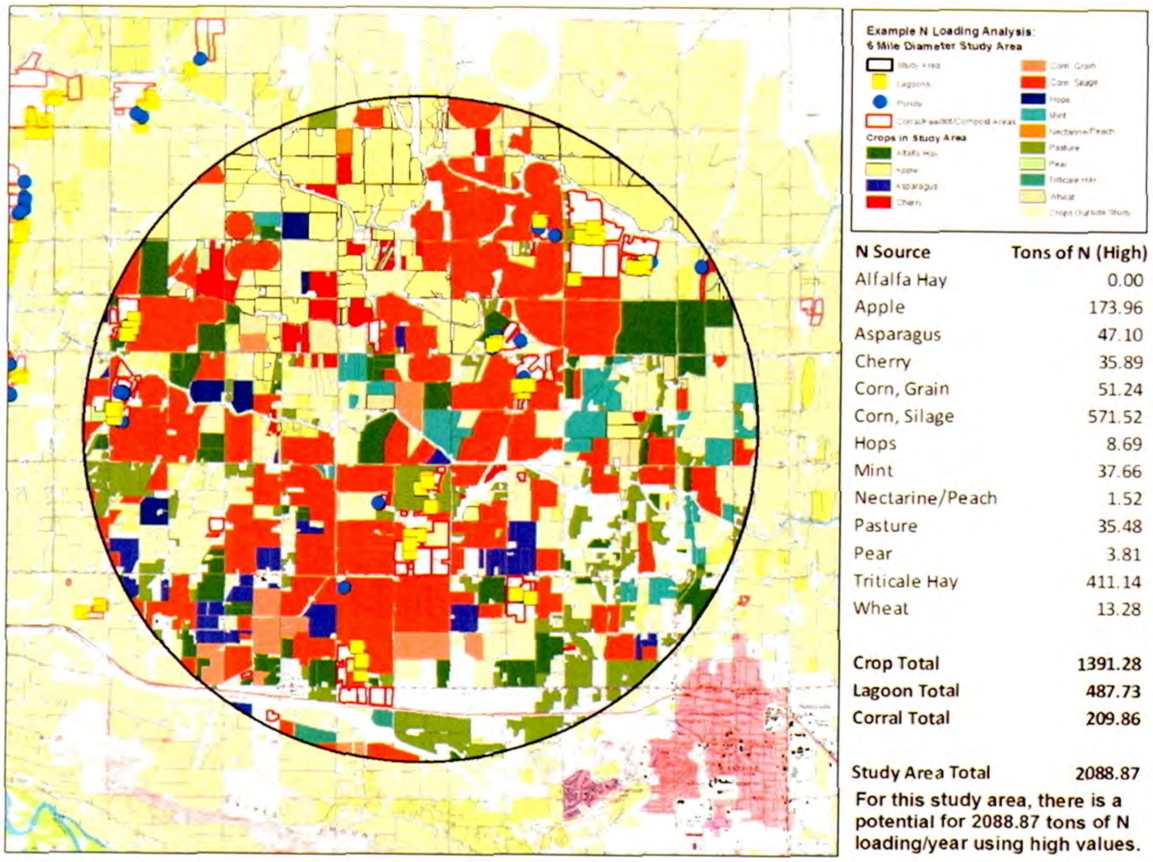
	Total Deposition (kg N/yr)	Total Deposition (tons N/yr)
Low	51,000	57
Medium	69,000	76
High	206,000	227

These estimates likely represent a significant overestimate of loading potential from atmospheric deposition. The number used as the rate is the amount of nitrogen deposited on the landscape, but the amount of nitrogen that subsequently is available for transport to groundwater is very different. Deposited nitrogen may be used by the ecosystem or be transported with precipitation to surface water before it leaches to groundwater. There are likely environments in the GWMA where very little or none of the deposited nitrogen reaches groundwater. A more detailed literature review and GIS analysis of regions likely and unlikely to result in leaching of deposited nitrogen to groundwater would result in a large improvement of the accuracy of this estimate. This would not have to involve additional modeling or monitoring work. However, the deposition numbers used are also estimates based on best professional judgment and evaluation of limited data. In the future, the GWAC may benefit from additional model runs and collection of local wet and dry deposition information to refine this estimate of the potential impacts of atmospheric deposition on the system.

Conclusions and Recommendations

Usage Example

To demonstrate how the nitrogen estimates could be used, an example area was examined in detail (Figure 12). An area with a 3-mile radius was assessed with the high rate nitrogen estimates for agricultural activities (irrigated agriculture and CAFO lagoons and pens), This area was chosen simply because it contains both a substantial acreage of irrigated agriculture as well as a number of CAFOs. This example contains 13 of the 15 crops assessed in the irrigated agricultural section. The high rate estimated available nitrogen from this region is over 2,000 ton N/year, of which 67% came from irrigated agriculture, 23% came from CAFO lagoons, and 10% came from CAFO pens.



N Source	Tons of N (High)
Alfalfa Hay	0.00
Apple	173.96
Asparagus	47.10
Cherry	35.89
Corn, Grain	51.24
Corn, Silage	571.52
Hops	8.69
Mint	37.66
Nectarine/Peach	1.52
Pasture	35.48
Pear	3.81
Triticale Hay	411.14
Wheat	13.28
Crop Total	**1391.28**
Lagoon Total	**487.73**
Corral Total	**209.86**
Study Area Total	**2088.87**

For this study area, there is a potential for 2088.87 tons of N loading/year using high values.

Figure 12. Example assessment of available nitrogen in ton N/year for an area located near Sunnyside, Washington

Similar to the irrigated agriculture assessment over the entire GWMA, the top 3 crops with nitrogen surpluses were silage corn, triticale, and apples. The large acreage of silage corn is shown in orange throughout the assessed area, and apple fields are shown in cream in the top part of the circle. Several fields with triticale are visible in the bottom part of the map, but most triticale on this graph is double cropped with silage corn; those fields are represented as silage corn. This example demonstrates the importance of evaluating contributions from different nitrogen sources at an appropriate scale; different regions in the GWMA will have very different nitrogen sources.

Conclusions

The ranges calculated (between low and high evaluation points) were very large for irrigated agriculture, lagoons, and pens (an entire order of magnitude). For RCIM sources, the ranges were much smaller. For this reason, agricultural activities (both irrigated agriculture and activities at CAFOs) should be the first candidate for additional research to narrow the range of estimated available nitrogen.

In all scenarios (low, medium, and high), evaluated over the entire acreage of the GWMA, the largest nitrogen contributors are irrigated agriculture, CAFO lagoons, and then CAFO pens. These activities account for 86, 95, and 96% of the available nitrogen in low, medium, and high scenarios, respectively (Figure 13). However, the large contribution to available nitrogen from irrigated agriculture is largely due to the high acreage of irrigated agriculture, with about 99,000 acres of irrigated land in the GWMA. The nitrogen from different land uses was also evaluated on a per-acre basis (Table 32). In this analysis, the top contributor to estimated available nitrogen at all evaluation levels was CAFO lagoons. With per-acre nitrogen losses 1-2 orders of magnitude above any other contributor, in an area with large a number of lagoons, based on these calculations, the lagoons will supply the most nitrogen. Additional top contributors on a per-acre basis vary in the low, medium, and high scenarios. In the low rate scenario, the top 3 are CAFO lagoons, ROSS, and LOSS. In the medium and high rate scenarios, the top 3 are CAFO lagoons, CAFO pens, and ROSS. This variability in per-acre available nitrogen estimates suggests that evaluating small geographic areas individually based on the activities present will be very important to identify management needs in different regions. An example of this approach was shown in Figure 12 and more work of this type could be conducted by the county.

Table 32. Estimated nitrogen available per acre from all sources at low, medium, and high range

Source		Area (acres)	Low (lb/acre-year)	Medium (lb/acre-year)	High (lb/acre-year)
Irrigated Agriculture		96,186	11	60	181
CAFO	Pens	2,096	67	480	892
	Lagoons	210	1,354	7,448	13,542
RCIM	ROSS	398	223	403	662
	LOSS	3	195	209	225
	COSS	30	163	173	183
	Residential Fertilizer	4,381	4.7	11.7	18.6
	Small Scale Farms	2,096	4.3	10.7	17.1
Atmospheric Deposition		73,976	1.53	2.05	6.15

Blue shading indicates top 3 contributors in each range (low, medium, high).

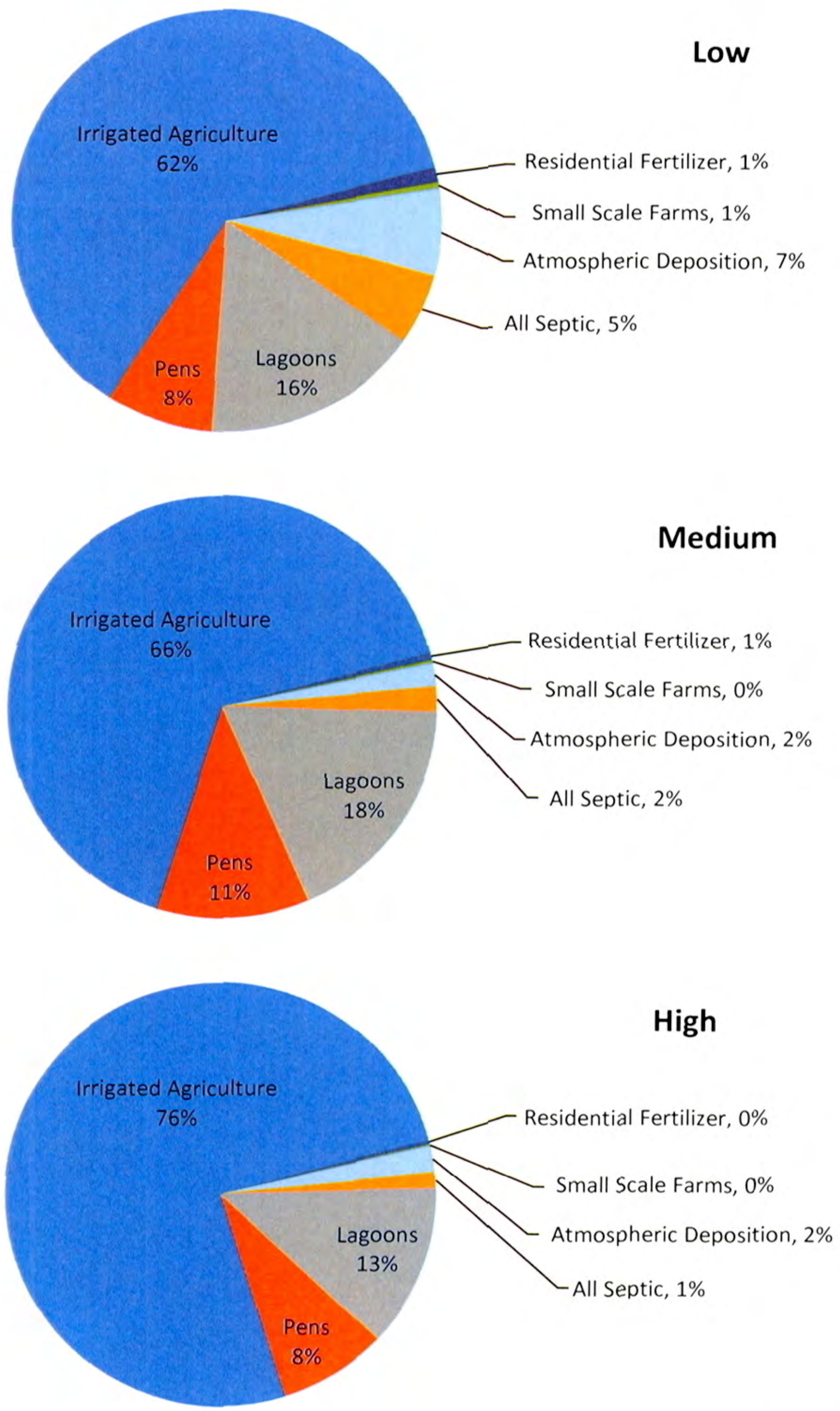


Figure 13. Low, medium, and high estimates from all sources, with percentage of total for each category

Recommendations

WSDA has identified top priorities for improving the estimates made in this study. These items were chosen because they relate to land uses with large acreages, large estimates of available nitrogen, or they would provide calibration for modeled estimates.

- Update all calculations as and when new information becomes available (for example, if information on lagoon liner condition ratings or seepage rates becomes available, that information should be incorporated into these estimates).
- Compare irrigated agriculture mass balance predictions to the deep soil sampling results to calibrate the model.
- Conduct a statistically-based study of lagoon seepage rates in the GWMA to improve seepage estimates.
- Conduct a statistically-based study of soil nitrogen concentrations beneath pens to provide local data for pen nitrogen loss estimates.
- Conduct a statistically-based study of lagoon nitrogen concentrations to confirm lagoon nitrogen concentrations used in this study.

In addition to these recommendations, there are other steps that could be taken to improve these estimates. These additional options are lower priority because WSDA believes they are less likely to result in changes to the estimates.

- A sensitivity analysis over all inputs to identify which inputs have the largest effect on the estimates; those inputs should be the top priority for additional study.
- Categorize impoundments by primary use, and use-specific parameters could be included in the estimate (for example, main or flush lagoons vs secondary lagoons).
- Research construction dates of existing lagoons, pair with liner condition ratings and historic NRCS recommendations, and generate effective permeabilities for each lagoon.
- Conduct a statistically-based study of soil nitrogen concentrations beneath lagoons to estimate nitrogen loss rates and storage in the soil.
- Identify impoundments are used as settling basins or ponds and review construction techniques to determine whether additional analysis for settling basins is needed.
- Conduct a statistically-based study of soil beneath composting areas to provide data for compost area nitrogen loss estimates.
- Review literature on the fate of deposited nitrogen for different ecosystems and land uses; pair with GIS analysis to determine the fate of deposited nitrogen for different land uses.

During this project WSDA has also identified some critical information gaps affecting growers.

- Most Washington State University Extension fertilizer guides currently available date to the 1970's. Updating these would provide crop growers with valuable information to use in decision making.
- Synthesis of existing data and new research on several topics would also help: soil organic matter mineralization, organic fertilizer composition and breakdown rates, and the interactions and effects when fertilizers of different types (for example, manure and commercial fertilizer) are applied during the same growing season.

These study results can be used in several different ways to aid the GWAC as they choose how to allocate limited resources.

- Review contributions from all sources simultaneously, spatially throughout the GWMA, to identify areas where available nitrogen is high or where contributions from several sources overlap.
- Review nitrogen availability data in conjunction with other data layers (depth to groundwater, soil type, documented groundwater nitrogen concentrations, deep soil sampling results, proximity to drinking water supply wells, or proximity to vulnerable or marginalized communities) to identify areas with elevated risk of nitrogen moving to groundwater and areas where elevated groundwater nitrogen concentrations will be particularly harmful.

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Appendix A: Data Sources, Uses, and Potential Concerns

Section	Data	Source	Use	Concerns
CAFO: Pens and compost areas	Pen locations and dimensions	2014 dairy registration locations USDA National Agricultural Imagery Program 2013, 2015 imagery	Pen calculation	Potential for human error. Changes in operation since data collection.
CAFO: Pens and compost areas	Pen location QA	WSDA NRAS QA procedure (Beale and Baker 2009)	Pen calculation	Entire data set not ground truthed.
CAFO: Pens and compost areas	Dairy CAFO pens	NAIP 2013, 2015 imagery WSDA DNMP WSDA Animal Services	Pen calculation	Potential for human error. Changes in operation since data collection.
CAFO: Pens and compost areas	Non-Dairy CAFO pens	NAIP 2013, 2015 imagery WSDA DNMP WSDA Animal Services	Pen calculation	Potential for human error. Changes in operation since data collection.
CAFO: Pens and compost areas	Compost locations	NAIP 2013, 2015 imagery 2014 dairy registration locations	Pen calculation	Potential for human error. Changes in operation since data collection. Potential misidentification of silage storage as compost area.
CAFO: Pens and compost areas	High rate for pens	Viers et al. 2012	Pen calculation	Data is not specific to Yakima Valley. Research conducted in California's San Joaquin Valley and in Kansas where meteorological conditions are very different from Yakima.
CAFO: Pens and compost areas	Low rate for pens	Viers et al. 2012	Pen calculation	Data is not specific to Yakima Valley. Research conducted in California's Tulare Lake Basin where meteorological conditions are similar to Yakima.

Section	Data	Source	Use	Concerns
CAFO: Lagoons	All lagoon locations	WSDA DNMP staff NAIP 2013, 2015 Google Earth	Lagoon calculation	Potential for human error. Potential misidentification of irrigation pond or settling pond as lagoon and vice versa.
CAFO: Lagoons	Lagoon location QA	WSDA NRAS QA procedure (Beale and Baker 2009)	Lagoon calculation	Entire data set not ground truthed.
CAFO: Lagoons	Lagoon capacity	DNMP lagoon assessment project	Lagoon calculation	Provides an average snapshot in time. Lagoon capacity varies throughout year.
CAFO: Lagoons	Length and width of lagoons	Nutrient management plans DNMP staff onsite data collection using ArcGIS Collector	Lagoon calculation	Potential for human error.
CAFO: Lagoons	Individual lagoon design depth	DNMP lagoon assessment Average from DNMP lagoon assessment	Lagoon calculation	All lagoons do not have recorded design depth.
CAFO: Lagoons	Lagoon total nitrogen concentration	EPA 2013a Self-reported data to SYCD	Lagoon calculation	Potential bias in both sources. EPA data set: small sample size, not statistically selected. SYCD data set: voluntarily self-reported, not statistically selected.
CAFO: Lagoons	Lagoon liner permeability and thickness	USDA NRCS 2009, USDA NRCS 2016a, USDA NRCS 2016b	Lagoon calculation	Unknown what percentage of lagoons were constructed to NRCS standards. Permeability and liner thickness chosen may not accurately represent range of lagoon construction.
Irrigated Agriculture	Acreage of crops in GWMA	WSDA crop mapping	Irrigated agriculture mass balance	Potential for human error.
Irrigated Agriculture	Fertilizer application data	Telephone survey	Irrigated agriculture mass balance	Potential bias from self-reported data, only a subset of each commodity represented in data.
Irrigated Agriculture	Atmospheric Deposition	Dr Ranil Dhammapala EPA 2016	Irrigated agriculture mass balance	Few deposition monitoring stations: may not accurately reflect deposition in GWMA

Section	Data	Source	Use	Concerns
Irrigated Agriculture	Irrigation water nitrogen concentration	Lower Yakima River nitrogen levels at USGS Yakima River station at Kiona (USGS 2012) Washington State Irrigation Guide precipitation data	Irrigated agriculture mass balance	Located downstream of irrigation districts serving the GWMA. Does not account for potential increase in nitrogen concentration if water is used by successive growers.
Irrigated Agriculture	Crop residue left in fields and incorporated	Irrigated Agriculture Work Group "Estimated Nitrogen Usage for Agricultural Production in the GWMA"	Irrigated agriculture mass balance	Potential bias from IAWG.
Irrigated Agriculture	Crop uptake	Irrigated Agriculture Work Group "Estimated Nitrogen Usage for Agricultural Production in the GWMA"	Irrigated agriculture mass balance	Potential bias from IAWG.
Irrigated Agriculture	Nitrogen loss to atmosphere	Potter et al. 2009	Irrigated agriculture mass balance	
Irrigated Agriculture	Soil organic matter conversion to nitrate-nitrogen	Virginia Prest, WSDA DNMP SYCS deep soil sampling 2015 results	Irrigated agriculture mass balance	Changing assumptions based on new information; not yet established science.
RCIM	Number of households and number of people per household	Census 2010	Residential on-site sewage system calculation	Information is outdated.
RCIM	Soil type, soil classification, infiltration rate	USDA NRCS 2014	Residential on-site sewage system calculation	
RCIM	Total nitrogen per person per day	EPA 2002a	Residential on-site sewage system calculation	

Section	Data	Source	Use	Concerns
RCIM	Denitrification in septic	EPA 2002a	Residential on-site sewage system calculation	
RCIM	Total nitrogen content of septage	EPA 1994	Residential on-site sewage system calculation	
RCIM	Average size of septic tank	WAC 246-272A-0232 (On-site…2005)	Residential on-site sewage system calculation	Actual sizes of septic tanks are unknown, the assumption that each tank meets or is equal to the minimum requirement may not be valid.
RCIM	Septic tank pumping frequency	GWMA Survey "Well Assessment Survey" EPA 2002b	Residential on-site sewage system calculation	Survey of GWMA residents is voluntary and not necessarily geographically dispersed.
RCIM	Number of migrant workers	USDA NASS 2014 Prorated total Yakima County number by crop acres within GWMA ESD 2015	Residential on-site sewage system calculation	Proration of migrant workers by crop acres may not be valid, some crops require migrant workers and others do not.
RCIM	Design capacity, location, and times of use for LOSS	Washington Department of Health GIS Department	Large on-site septic system calculation	
RCIM	Average loading generated by toilet flushing	EPA 1992	Large on-site septic system calculation	Value may be outdated considering new technology.
RCIM	Design flow for LOSS	WAC 246-272B 06450(4) (b) (Large…2011)	Large on-site septic system calculation	No actual measurements of flow from LOSS system.
RCIM	Locations of COSS	WSDA DNMP number of CAFOs in GWMA	Commercial on-site septic systems calculation	Assumes all COSS are on CAFOs and that every CAFO has a COSS.

Section	Data	Source	Use	Concerns
RCIM	Number of employees using COSS	Reed 2004	Commercial on-site septic systems calculation	Assumes COSS at CAFOs in Yakima Valley will be the same as those in California.
RCIM	Area of maintained lawn areas	ArcMap Spatial Analysis by Yakima County	Residential lawn fertilizer calculation	Tool may misidentify some areas as lawn and miss other areas.
RCIM	Lawn fertilization frequency and rate	Scott's Turf Builder	Residential lawn fertilizer calculation	Assumes proportion of residents who fertilize Assumes that residents who fertilize follow fertilizer guidelines.
RCIM	Number of hobby farms	ArcGIS model developed by Yakima County	Small-scale commercial and hobby farms calculation	Potential for model error.
RCIM	Fertilizer application for hobby farms	RCIM Work Group	Small-scale commercial and hobby farms calculation	Potential bias in data from RCIM workgroup.
Atmospheric Deposition	Atmospheric Deposition	Dr Ranil Dhammapala EPA 2016	Atmospheric deposition estimates over GWMA	Few deposition monitoring stations: may not accurately reflect deposition in GWMA

Appendix B: Lagoon Nitrogen Concentration Statistical Analysis

Descriptive statistics were calculated for the two datasets for comparison purposes; a summary of these statistics is displayed in Table 33. With the exception of the maximum, standard deviation, and sample size all values in the EPA data set were higher than those in the SYCD data.

Table 33. Comparison of EPA and SYCD lagoon N concentration (mg N/L)

	EPA	SYCD	Combined
Sample Size	15	23	38
Minimum	290	180	180
Q1	1000	355	455
Median	1400	768	1028
Mean	1212	949	1054
Mode	1200	336	1200
Q3	1600	1092	1401
Maximum	1800	3633	3632
Standard Deviation	492	802	702

Figure 14 displays the data from both sources on one boxplot. Two measurements in the SYCD data set are classified as outliers because they exceed 1.5 times the interquartile range (the difference between the 1st and 3rd quartile). These measurements are displayed as small circles in the figure.

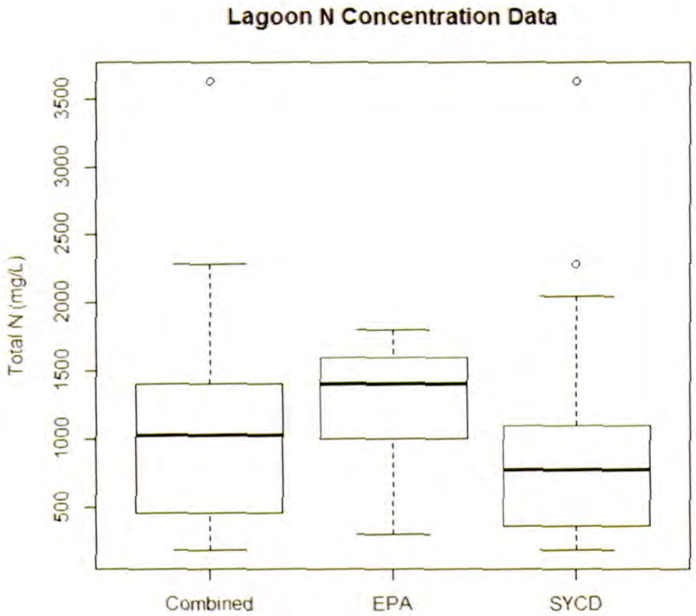


Figure 14. Boxplots of EPA and SYCD lagoon N concentration data

Appendix C: Lagoon Surface Area Reduction Methodology

Manure storage lagoons are constructed with sloping interior and exterior sides. As a result, a change in the liquid level within the lagoon changes the liquid surface area. Since liquid surface area was used as an input in the Darcy's law calculations in the CAFO section, it was necessary to calculate the needed adjustment to surface area based on the average lagoon capacity that was used to adjust the lagoon design depths. When DNMP conducted the lagoon assessment, the site information recorded was surface area, based on delineation of the lagoon perimeter, and side slope for lagoons where the liquid level was low enough to allow determination of side slope. The following diagram (Figure 15) shows a profile (side) view of a typical manure storage lagoon. In this diagram (which is not drawn to scale) the vertical dimension has been increased to show the liquid level and side slopes, which were used to adjust the surface area. The excavation depth H is used with the liquid depth D to determine what reduction in surface dimensions (length, width, and surface area) is necessary based on the side slope X. The interior side slope (often written as a proportion, X:1) determines the amount of lateral shift (X) for every 1-unit change in height. This determines the total reduction in a horizontal dimension; the difference between the excavation depth H and the liquid level D (H-D) is multiplied by the horizontal translation in side slope for every 1-unit reduction in height, which would be multiplied by two to find the total reduction in one horizontal dimension (length or width):

$$(H - D)X$$

Figure 15. Profile view of typical manure storage lagoon construction. Not drawn to scale; the vertical scale on this diagram is exaggerated to show the side slopes and liquid level clearly.

This surface area adjustment depends on the typical liquid depth, the interior side slope, and also on the lagoon shape in plan view (from the top). Reducing the depth of a round lagoon from the full design depth to 43% of the full design depth would reduce the full surface area by a different proportion than the same reduction for a rectangular lagoon, for example. In order to estimate this surface area reduction it was necessary to generally characterize the range of lagoon shapes represented. The GIS data was informally reviewed; the vast majority of dairy lagoons had plan outlines ranging from a square to a rectangle with length equal to twice the width (L = 2W). Other shapes represented were largely regular rectangles with proportions of length greater than twice the width (from L = 3W to L = 5W). Less than 5 lagoons were triangular; these other shapes (long rectangles and triangles) were an estimated less than 10% of the lagoons in the study. Because of this relative uniformity in shape, surface area reductions were calculated for only two shapes: square and L = 2W rectangle. These calculations provided enough information about the trend that the surface area reduction would follow to make a conservative estimate. In order to do these sample calculations it was necessary to determine an example depth, surface area, and side slope to work with. The values used were derived from the field measurements taken during the DNMP's lagoon assessment process. Note that numbers are reported in these examples to 4 decimal places and rounded at the end, corresponding to the method used for the actual calculations in which all digits were retained during the calculation.

Average surface area at full capacity: 70659.7289 ft^2 (n = 90)

Average depth at full capacity: 11.3029 ft (n = 105)

Average side slope: 3:1 (n = 99)

Average depth at reduced capacity:

$$0.4326 \times 11.3029\, ft = 4.8896\, ft$$

A typical square lagoon with these average values is used for a sample calculation. The following diagram (Figure 16) shows the parameters needed for the calculation: surface area at full capacity is used to calculate side length. Side length at full capacity is then used to calculate side length at reduced capacity, which is used to calculate surface area at reduced capacity. The percent reduction is based on the surface area at full capacity and the surface area at reduced capacity.

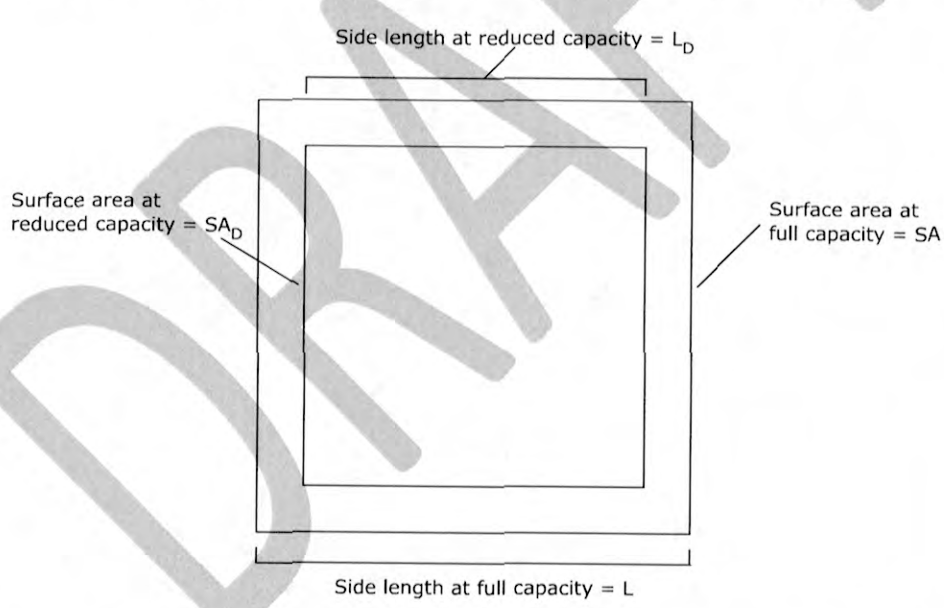


Figure 16. A typical square manure storage lagoon, with side length and surface area shown at both full and reduced capacities

$$SA = 70{,}659.7289\, ft^2, surface\ area\ at\ full\ capacity$$

$$SA_D = Surface\ area\ at\ reduced\ capacity, unknown$$

$$L = \sqrt{SA} = 265.8190\, ft$$

$$L_D = L - 2(H - D) = 265.8190\, ft - 2((11.3029\, ft - 4.8896\, ft)3) = 227.3395\, ft$$

$$SA_D = L_D^2 = 51{,}683.2623\, ft^2$$

$$\frac{SA_D}{SA} = 0.7314; 73\%\ reduction$$

A typical rectangular lagoon (L = 2W) with the same average values for surface area at full capacity, depth at full capacity, reduced depth, and side slope was used for the same calculation (Figure 17).

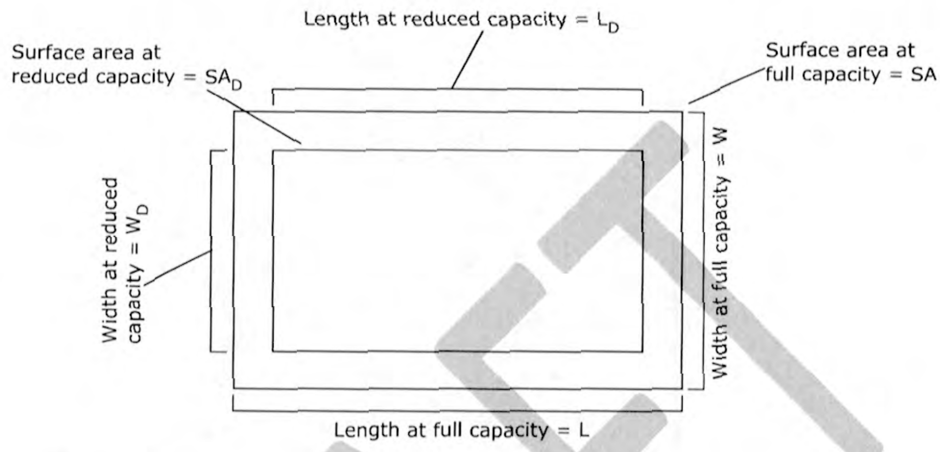


Figure 17. A typical rectangular manure storage lagoon, showing length, width, and surface area at full and reduced capacities

$$SA = 70{,}660\ ft^2, surface\ area\ at\ full\ capacity$$

$$SA_D = Surface\ area\ at\ reduced\ capacity, unknown$$

$$W = \sqrt{\frac{SA}{2}} = 187.9624\ ft$$

$$L = 2 \times W = 375.9248\ ft$$

$$W_D = W - 2(H - D)X = 187.9624\ ft - 2((11.3028\ ft - 4.8896\ ft)3) = 149.4830\ ft$$

$$L_D = L - 2(H - D)X = 375.9248\ ft - 2((11.3028\ ft - 4.8896\ ft)3) = 337.4453\ ft$$

$$SA_D = W_D \times L_D = 50{,}442.3290\ ft^2$$

$$\frac{SA_D}{SA} = 0.7139; 71\%\ reduction$$

Based on the preceding calculations, the surface area reduction due to the depth reduction used to adjust the depths for the Darcy's law calculation is 73% for a square lagoon and 71% for a rectangular lagoon. Additional longer, thinner rectangular lagoons would continue the same trend, with a larger surface area reduction due to the depth reduction. As a result, the 73% reduction was chosen to adjust the surface areas for Darcy's law in order to use the most conservative value available.

Appendix D: Darcy's Law Example Calculation

Darcy's Law

$$Q = k * \frac{(H + d)}{d} * A$$

Where:

Q = the calculated volumetric flow rate (L^3/T)

k = coefficient of permeability (hydraulic conductivity, either $1x10^{-7}$ or $1x10^{-6}$ cm/s) ($L^3/L^2/T$)

d = thickness of soil liner (estimated at 1 foot) (L)

H = vertical distance between top of liner and top of liquid storage (L)

A = lagoon area (L^2)

L=length

T=time

$$N\ Loading = Q * C$$

Q = volumetric flow rate calculated using Darcy's Law (L^3/T)

C = Total N concentration, 1053 mg N/L

<u>Example Calculation</u>

Inputs:

k= $1x10^{-7}$ cm/s= $1x10^{-9}$ m/s (low range hydraulic conductivity)

d= 1 ft = 0.3048 m

H= 11.3028 ft = 3.4451 m * 0.4326 = 1.4903 m

A= 70659.7289 ft^2 = 6467.5036* 0.7314 = 4801.5322 m^2

C= 1052.6965 mg N/L = $10.526965x10^{-4}$ kg N/L

Darcy's Law:

$$Q = 1\text{x } 10^{-9}\text{m/s} * \frac{(1.4903\text{ m} + .3048\text{ m})}{.3048\text{ m}} * 4801.5322\text{ m}^2$$

$$Q = 2.8279\text{ x } 10^{5}\text{ m}^3/\text{s}$$

$$Q = 2.8279\text{ x } 10^{5}\text{ m}^3/\text{s} * \frac{86400\text{ s}}{\text{day}} * \frac{365\text{ day}}{\text{year}} = \mathbf{891.8085\ m^3/year}$$

Potential N Loss:

$$\text{N Loss} = 891.8085\text{ m}^3/\text{year} * 10.526965\text{x}10^{-4}\text{ kg N/L} * \frac{1000\text{ L}}{m^3}$$

N Loss = 938.8037 kg N/year = **939 kg N/year**

N Loss = 938.8037 kg N/year * 1 ton/907.1848 kg =1.0348 tons N.year = **1 ton N/year**

Appendix E: Sensitivity Analysis on Darcy's Law

In order to identify which inputs to the Darcy's law calculation would have the greatest influence on the calculation's result, WSDA conducted a sensitivity analysis. Each input parameters was evaluated (keeping all other parameters constant) at a range of values Figure 18). Average parameters were used for this analysis, and then the outcome flow was evaluated for variation in each parameter individually (while the other parameters were held constant). Each parameter was evaluated for a range from 75% of the average to 125% of the average, with step sizes of 5%.

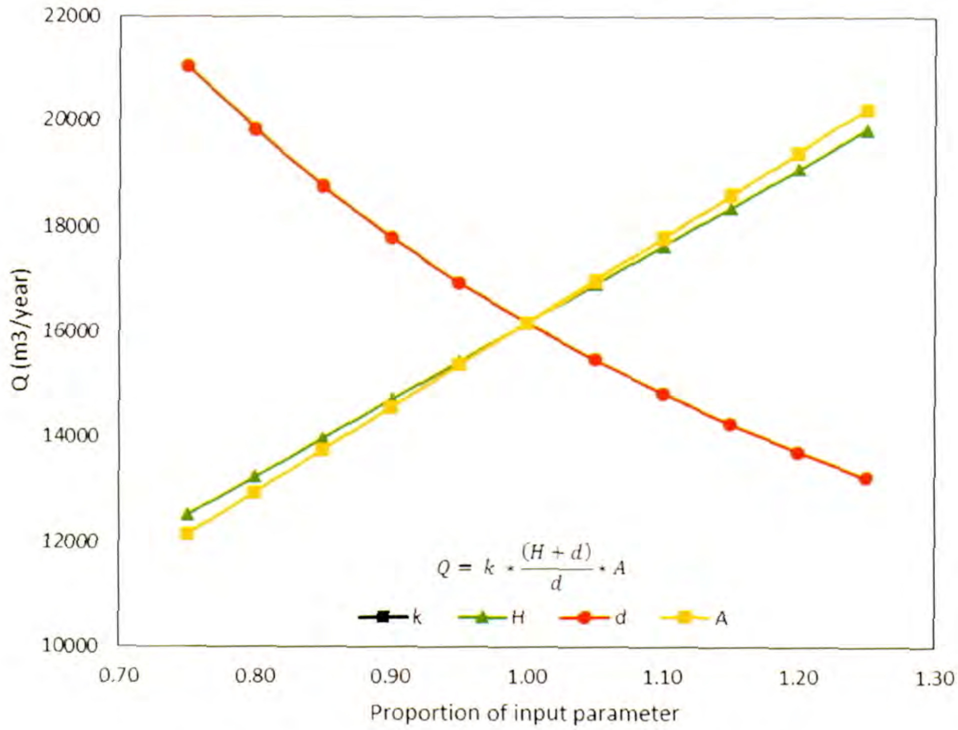


Figure 18. Results of sensitivity analysis on Darcy's law

As a result, NRAS concluded that the flow resulting from Darcy's law, calculated for an individual lagoon, is equally sensitive to all inputs. Permeability (k), surface area (A), and depth (H) are directly proportional to flow. K is invisible because it is hidden by one of the other parameters. Liner thickness (d) is inversely proportional to flow.

Appendix F: Irrigation Water Use

Source: Jim Davenport, Stuart Turner								
	Water Duty (in/acre)	Water Duty (in/acre)	Water Duty (in/acre)	**Water Duty (in/acre)**	**Water Duty (in/acre)**	**Water Duty (ac-ft/ac)**	**Water use (liters/ac)**	**Irrig water lb N/ac (based on 0.809 mg N/L, USGS 2012)**
Location	Yakima	Sunnyside	Prosser	**Average**	**Stu's #'s***	**Average**		
Total Precip (in)	7.98	6.70	7.74	7.47				
Effective Precip (in)	3.04	3.00	3.40	3.15				
Crop Type								
Silage Corn	28.20	29.31	28.13	28.55		2.38	2934316.238	5.23
Field Corn (Grain)	28.20	29.31	28.13	28.55		2.38	2934316.238	5.23
Triticale				28.55		2.38	2934658.872	5.23
Apple	42.42	44.37	42.42	43.07	30.00	2.50	3083704.594	5.50
Grape, Juice	26.14	27.35	26.04	26.51		2.21	2724966.959	4.86
Alfalfa Hay	35.31	37.01	35.30	35.87		2.99	3687425.426	6.58
Pasture	37.29	39.07	37.30	37.89		3.16	3894376.268	6.95
Cherry	42.94	44.94	42.92	43.60	30.00	2.50	3083704.594	5.50
Grape, Wine	26.14	27.35	26.04	26.51		2.21	2724966.959	4.86
Hops	29.52	30.76	29.39	29.89		2.49	3072397.677	5.48
Pear	39.25	41.09	39.21	39.85		3.32	4096187.602	7.31
Wheat	22.67	24.35	22.85	23.29		1.94	2393982.666	4.27
Mint	34.35	35.93	34.32	34.87		2.91	3583950.006	6.39
Asparagus**				0.00		0.00	0	0.00
Nectarine/Peach***	39.81	41.70	39.76	40.42		3.37	4155120.623	7.41

Washington State Irrigation Guide, Appendix A, *Climatic Stations for Consumptive Use*, WA210-VI-October 1985

*Stu Turner best professional judgement numbers are used for water duty for apples and cherries.

**No data

***Washington State Irrigation Guide, Appendix A, Climatic Stations for Consumptive Use, WA210-VI-October 1985 (added by WSDA)

Appendix G: Nitrogen Uptake Estimates

Source: Jim Trull, SVID, Scott Stephens

ESTIMATE OF NITROGEN USAGE FOR AGRICULTURAL PRODUCTION IN THE GWMA

Crop	Typical Yield[1]/Acre	Yield (Scott)[4]	Nitrogen Removed in Harvested Portion of the Crop - (lbs/acre)	Removal (Scott)[4]	Reference[3]	Nitrogen Uptake in Plant in Growing Cycle (lb./acre)	Uptake (Scott)[4]	Estimate of Nitrogen Applied[2] (lbs/acre)	Range		Scott's opinion[4]	Yield parameters[4]
									Production	Application		
Silage Corn	30 tons	30	250	270	A		250-290	250	25-40	12-592	22-40	Tons at 68% moisture
Grain Corn	4-8 tons	6-6.5	186	170-190	A	214	290-325	250	2.5-8.0	90-375	5.5-8	Tons Grain weight
Triticale	8 tons	7.5-8	455	190-210	B		200-225	0-100	5.0-15	0-575	6-10	Tons at 50% moisture
Apples	20 tons	20	120	40-60	A		80-120	50-100			15-40	
Grapes, Juice	10 tons	10	125	20-40	A		80-100	80			8-16	
Alfalfa Hay	8 tons	8	448	400	A	449	480				7-11	Tons at 15% moisture
Pasture	6 tons	6	300	270	A		270+				5-7	Tons at 15% moisture
Cherries	5 tons	5-6	95	25-40	A		60-100		4-8	30-50	4-8	
Grapes, Wine	6 tons	6	100	15-30	A		50-65	83	2.5-5.0	0	4-8	
Hops	1 ton	1.25	180	150-250	A		200-300		0.3-1.5	150-175	1-1.8	
Pears	20 tons	25	85	40-60	A		80-160		20-27.5	150	18-35	
Wheat	120 bu	125	175	187	A	226	275		65-120	90-213	115-140	

Crop	Typical Yield[1]/Acre	Scott's opinion	Nitrogen Removed in Harvested Portion of the Crop - (lbs/acre)	Removal (Scott) See References below	Reference[3]	Nitrogen Uptake in Plant in Growing Cycle (lb./acre)	Uptake (Scott) See references below	Estimate of Nitrogen Applied[2] (lbs/acre)	Range		Scott's opinion	Yield parameters
									Production	Application		
Mint	160 lb	160	160	280	D		280-320		68-70	0-275	140-180	
Asparagus	3000 lb	3500	95	20	A		50				?	
Nectarine/Peach	15 tons	15	95	50	A		95				?	

[1]. SYCD and IAWG

[2]. Various sources

[3]. References: A-Western Fertilizer Handbook; B - NRCS Crop Nutrient Tool; C-SYCD; D- WSU Fertilizer Guides

[4]. Reference from the following resources:

International Plant Nutrition Institute (ipni.net)

USDA Crop Nutrient Tool

Potash Corp (http://potashcorp-ekonomics.com/)

(wfsag.com) Potach and Phosphate Institute-Agriliance

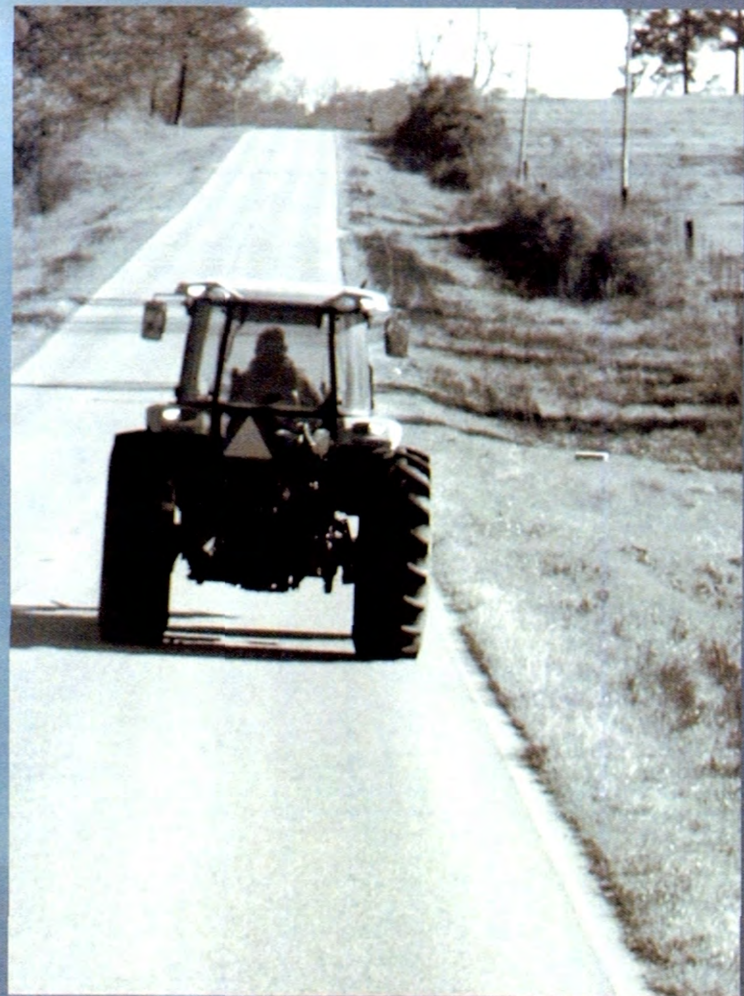
ALTERNATIVE MANAGEMENT STRATEGIES TO REDUCE NITRATE IN GROUNDWATER

Lower Yakima Valley Groundwater Management Area

May 18, 2017

Jean Mendoza

A Thought Problem – Should I Pass?



A Statistical Solution

- I know this road well
- The only traffic is from a few neighbors and about 15 logging trucks a day
- It only takes a second to pass a slow moving tractor
- There are 24 x 60 x 60 = 86,400 seconds in a day
- Dividing by 15 tells me that the chances are one in 5,760 that a logging truck is on the other side of the hill
- The odds are on my side if I pass

WAC 173 – 100 - 100

Each program shall include, as appropriate, the following:

(4) An alternatives section outlining various land and water use management strategies for reaching the program's goals and objectives that address each of the groundwater problems discussed in the problem definition section.

WAC 173 – 100 - 100

If necessary, alternative data collection and analysis programs shall be defined to enable better characterization of the groundwater and potential quality and quantity problems. Each of the alternative strategies shall be evaluated in terms of feasibility, effectiveness, cost, time and difficulty to implement, and degree of consistency with local comprehensive plans and water management programs such as the coordinated water system plan, the water supply reservation program, and others.

WAC 173 – 100 - 100

The alternative management strategies shall address water conservation, conflicts with existing water rights and minimum instream flow requirements, programs to resolve such conflicts, and long-term policies and construction practices necessary to protect existing water rights and subsequent facilities installed in accordance with the groundwater management area program and/or other water right procedures.

Investigate Use of Bio-Char

- Reduced leaching of nitrogen into ground water.
- Possible reduced emissions of nitrous oxide.
- Increased cation-exchange capacity resulting in improved soil fertility.
- Moderating of soil acidity.
- Increased water retention.
- Increased number of beneficial soil microbes.

Request: EQUIP program funding contingent on sharing information

- Good data is essential for public policy and planning
- Tax payers provide 75% of the cost for many large purchases
- Tax payers are entitled to a return on this investment
- The only way to know whether public monies are spent wisely is to analyze the data

Soil Moisture Sensors

Encouraging Sensor Use & Data Sharing

- Provide workshops with testimonials and field demonstrations
- Offer rebates on purchase cost if farmer shares his data
- Create a data base so that farmers and the public can see the savings from water conservation and decreased leaching to the aquifer
- Provide tax incentives for purchase and installation

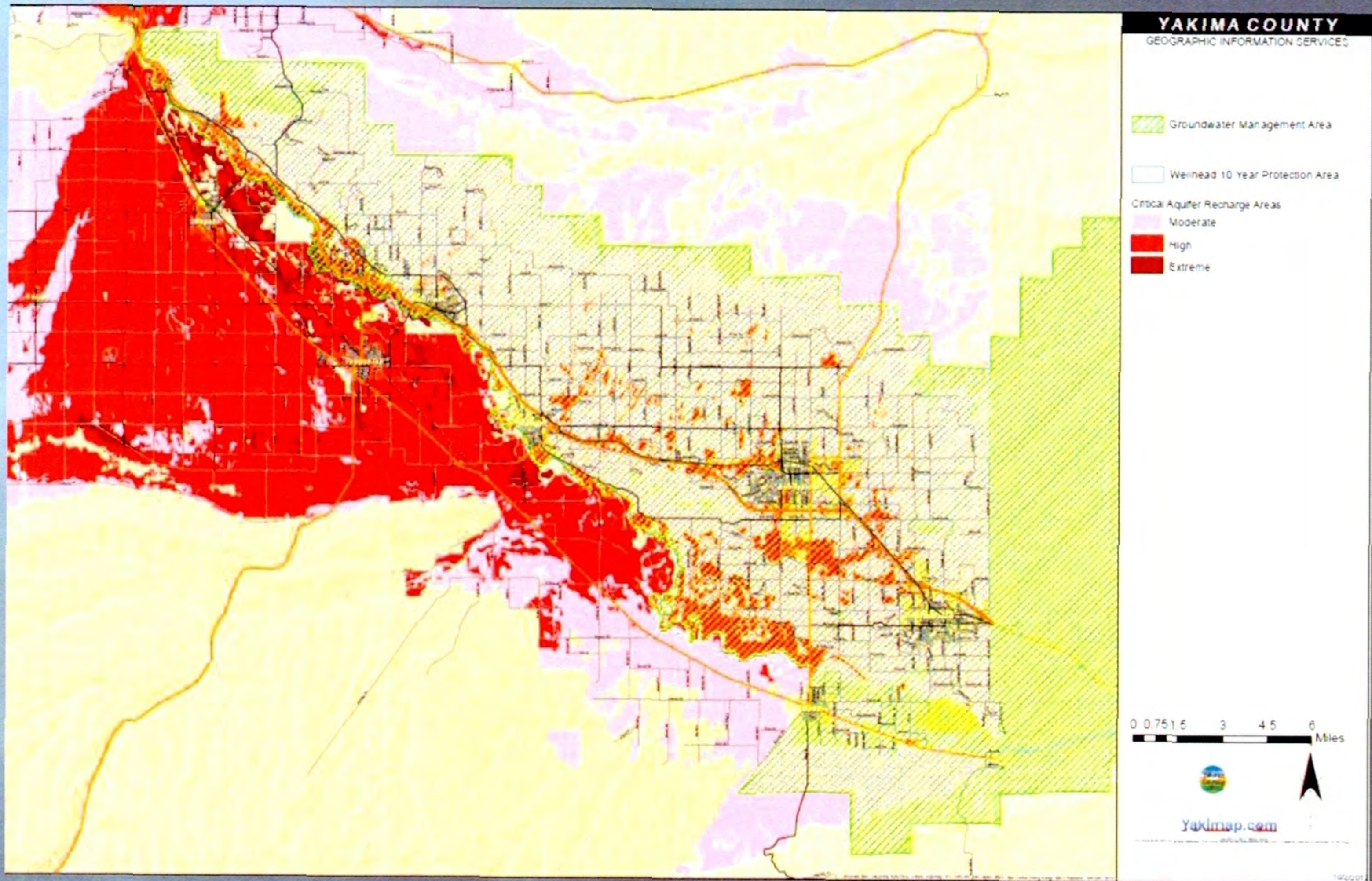
A Small Tax on Synthetic Fertilizer

- We do not have enough information about the amount of synthetic fertilizer that is applied to crops in the valley
- Tax information provides an easily accessible data base that describes the amount of synthetic fertilizer that is applied in the Yakima Valley

Improve Composting Regulations

- Enforce the existing laws
- Require compliance with NRCS guidelines in order to obtain a permit for industrial scale composting
- Require soil testing and/or groundwater monitoring
- Tell policy makers that there is a need to fund adequate monitoring & regulation
- No composting on highly vulnerable soils and critical aquifer recharge areas

Critical Aquifer Recharge Areas



Bonding for High Risk Operations

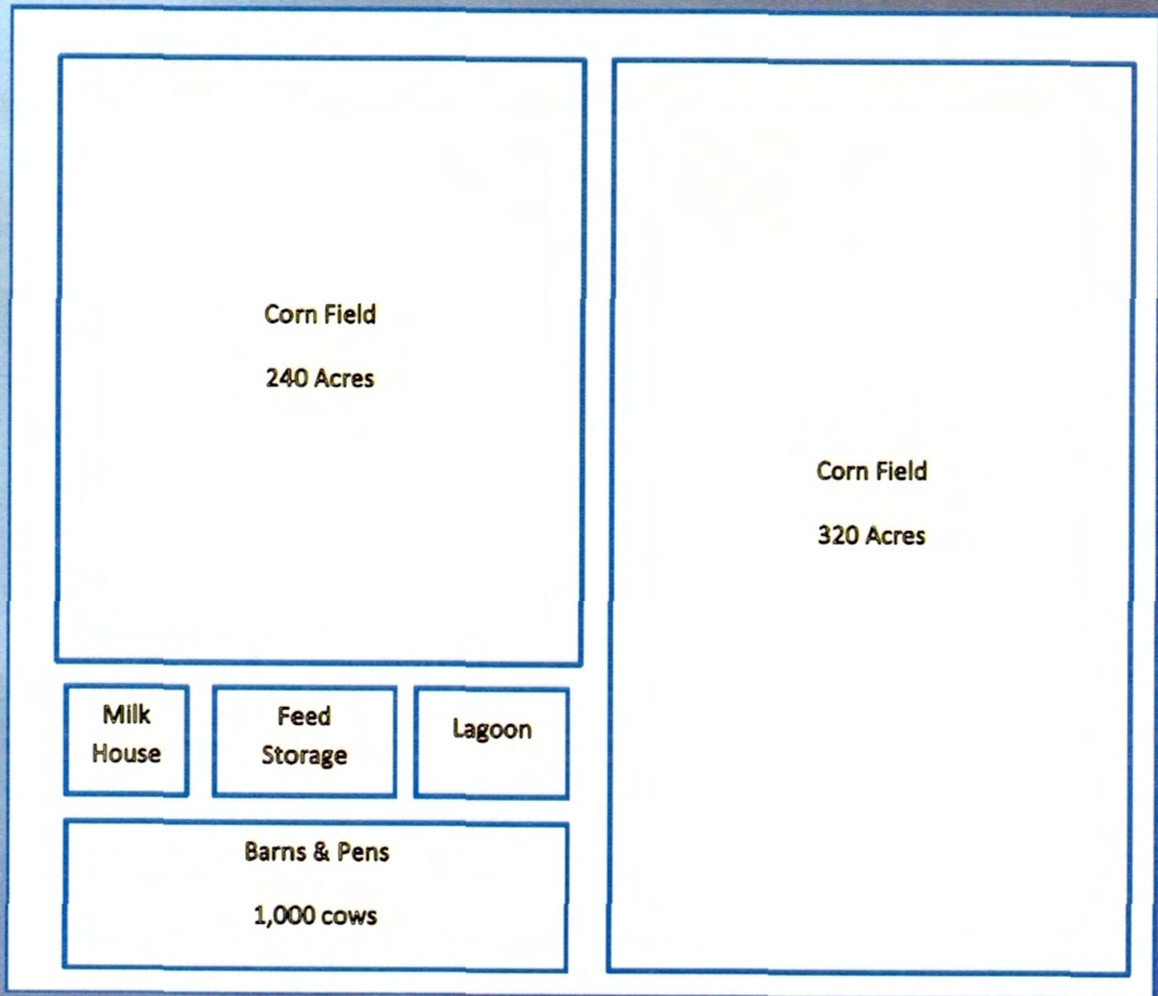
- Some operations pose a higher risk to the environment, the groundwater & surface water than others
- By posting a bond there is assurance that the public will be protected in cases of pollution
- There will be funds for clean up
- Tax payers will not be stuck with the costs
- People who are impacted by spills and pollution will be compensated for their losses

Use of Check-Off Monies for Research and Development

- Various commodity groups pay a certain fixed amount of each unit of produce to commissions
- This money is usually spent for marketing purposes
- Portions of this funding could be used for research and development to find better ways to protect the environment
- The GWMA has the authority to request such changes

Picture a Yakima Valley Dairy on a Section of Land

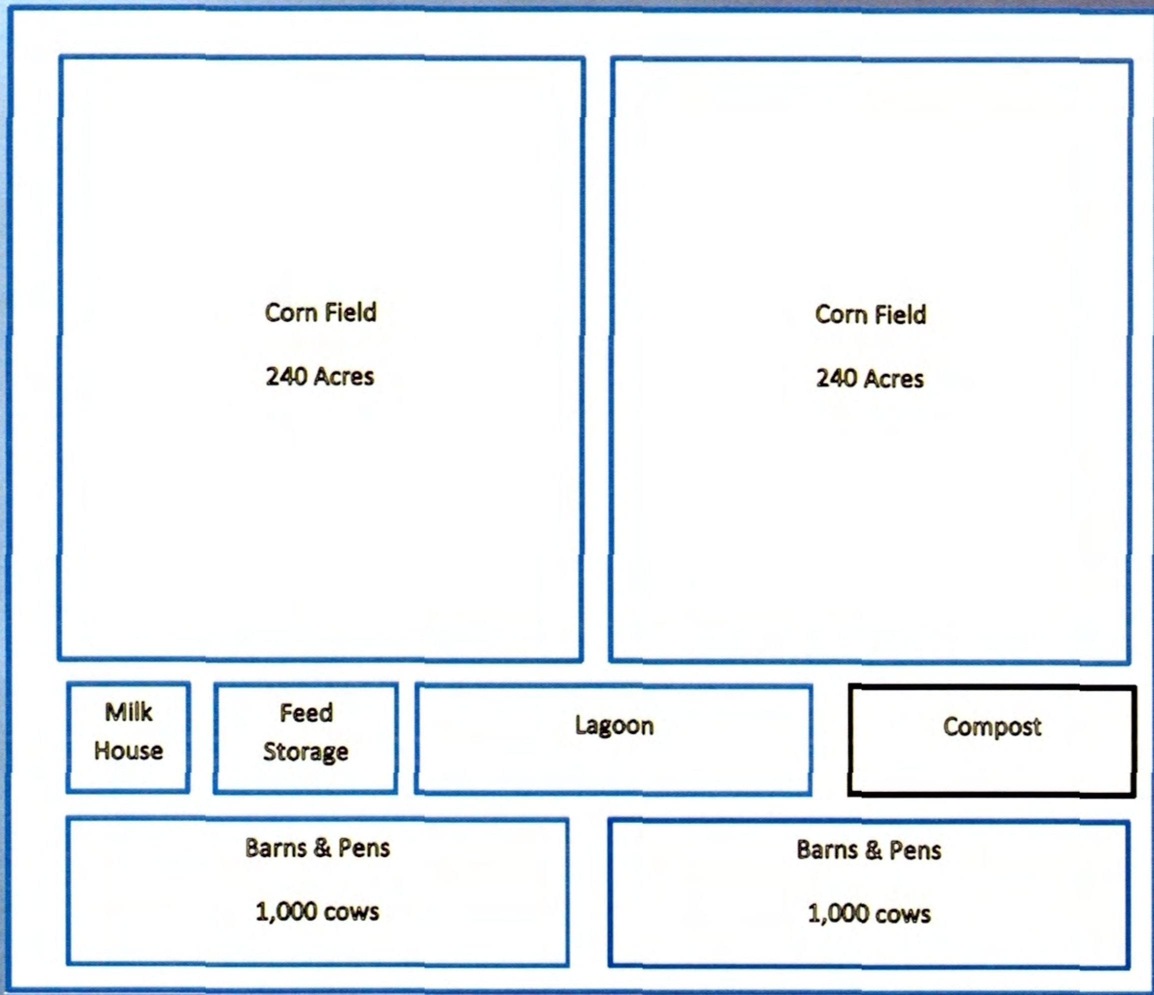
A Hypothetical Dairy on 640 Acres



A Simple Model - I

- Warden Silt Loam – Well drained
- 50 feet to groundwater
- Cows produce 20 tons manure/year x 10 lbs N/ton = 200 lbs N per year per cow
- 1,000 cows produce 200,000 lbs N/year
- Apply 250 lbs N/acre/year for corn
- 560 acres of corn requires 140,000 lbs of N/year
- If half of the N produced is volatilized then the dairy needs an extra 40,000 lbs N/year
- Only risk to the aquifer is leakage from the pen and lagoon

A Simple Model - II



A Simple Model - II

- 2,000 cows produce 400,000 lbs N/year
- Apply 250 lbs N/acre/year for corn
- 480 acres of corn requires 120,000 lbs of N/year
- If half the N is volatilized (twice as much) then there is an excess of 80,000 lbs of N per year. It can be composted or over-applied
- There is twice as much leakage from the doubled acreage in lagoons and pens
- There is potential leakage from the composting area

Regulatory Solutions

- The Franklin County Code states, "No more than two operations that are greater in size than one thousand three hundred (1,300) (milking cow head count) shall be located within an operations two-mile buffer."
- The Adair County, MO County Code states, "The CAFO shall own or lease one acre of land for each 4 AU of capacity wet handling systems or must own or lease one acre for each 8 AU of capacity for dry waste handling system."

Thanks for Listening

It's my opinion and it's right

Attachment C

"What You Can Do to Protect Well Water" English/Spanish Flyer

LOWER YAKIMA VALLEY
GROUNDWATER
ADVISORY
COMMITTEE

What you can do to protect well water

Groundwater Management Area (GWMA):
The purpose of the GWMA is to reduce nitrate contamination concentrations in groundwater below state drinking water standards

Steps to assure you have safe drinking water

Things to consider if you are a private household well owner:

Have your water tested – at least once a year for nitrates and coliform bacteria. High nitrates can harm pregnant women, newborn babies and the elderly, and high bacteria counts can cause illnesses. More information on Lower Yakima Valley Groundwater Management Area at http://www.yakimacounty.us/1617/Ground-Water-Management-Area. A list of certified labs and information on water testing are available online at http://www.yakimacounty.us/344/Drinking-Water-Testing.

Locate all wells on your property, both active and inactive. Make sure to cap your wells securely with manufactured or welded caps to prevent pollution and objects from entering your well.

Have your septic pumped - Neglecting septic system maintenance can result in backed-up sewage, expensive repairs and surface seepage that can pollute your well. A system for a four-person household should be pumped every three years.

Use less water – Not only does your septic system function better with less water, pumping more water from your well can pull nearby pollution toward your home.

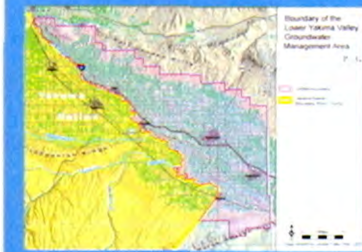
Manage fertilizers and chemicals – Excess fertilizer moves easily through the soil and contributes to high nitrate levels. Spilled chemicals can reach your well water. Recycle household and hazardous wastes at the County collection facility. Never dump these items on your property or pour them down the drain.

Shield animal waste – Animal yards and piles of composting manure are sources for nitrates and bacteria. Take steps to prevent runoff and soil seepage.

Install backflow preventers – on all your outdoor faucets. Sometimes water can siphon backwards through a hose and down your well. Be very careful when you attach a chemical sprayer to your hose.

Do your part to keep groundwater safe and clean.

GROUNDWATER MANAGEMENT AREA



The purpose of the Lower Yakima Valley Groundwater Management Area is to reduce nitrate contamination where concentrations do not meet drinking water standards.

GWAC Working Groups

- *Data Collection, Characterization, Monitoring*
- Education and Public Outreach
- Funding
- Irrigated Agriculture
- Livestock/CAFO
- Regulatory Framework
- Residential, Commercial, Industrial and Municipal

To get involved, call (509) 574-2300

More information at: www.yakimacounty.us

LOWER YAKIMA VALLEY
GROUNDWATER ADVISORY COMMITTEE

Qué puede hacer para proteger el agua de pozo

Área de Manejo de Aguas Subterráneas (GWMA):

El propósito de GWMA es reducir concentraciones de contaminación de nitratos en aguas subterráneas por debajo de los estándares de agua potable del estado.

Pasos para asegurar que tenga agua potable

Cosas a considerar si tiene una vivienda con pozo privado:

Haga pruebas a su agua – Al menos una vez al año para nitratos y bacterias coliformes. Los altos niveles de nitratos pueden afectar a mujeres embarazadas, a los recién nacidos y a los ancianos, y las altas concentraciones de bacterias pueden causar enfermedades. Más información sobre el Área de Manejo de Aguas Subterráneas del Valle Bajo de Yakima en: http://www.yakimacounty.us/1617/Ground-Water-Management-Area. Una lista de laboratorios certificados e información sobre pruebas de agua está disponible en línea en: http://www.yakimacounty.us/344/Drinking-Water-Testing.

Localice todos los pozos en su propiedad, activos e inactivos. Asegúrese de tapar sus pozos de forma segura con tapas prefabricadas o soldadas para evitar que contaminación y objetos caigan a su pozo.

Haga un bombeo a su fosa séptica – Descuidar el mantenimiento de su sistema séptico puede resultar en que se regresen las aguas residuales, reparaciones costosas y filtración superficial que puede contaminar su pozo. Un sistema para un hogar de cuatro personas debe bombearse cada tres años.

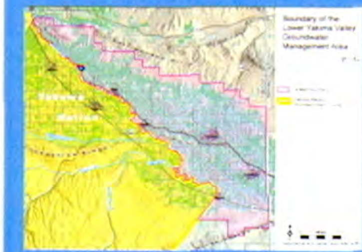
Utilice menos agua – No solo su sistema séptico funciona mejor con menos agua, sino también el bombear más agua de su pozo puede atraer contaminación cercana hacia su hogar.

Maneje los fertilizantes y productos químicos – El exceso de fertilizante se mueve fácilmente a través del suelo y contribuye a altos niveles de nitrato. Productos químicos derramados pueden alcanzar el agua de su pozo. Recicle los residuos domésticos y peligrosos en los centros de recolección del Condado. Nunca tire estos productos en su propiedad ni los vierta en el drenaje.

Aísle los residuos animales– Los corrales de animales y los montones de estiércol son fuentes de nitratos y bacterias. Tome medidas para evitar el escurrimiento y la filtración del suelo.

Instale válvulas preventivas de reflujo – en todas sus llaves de agua fuera de la casa. A veces, el agua puede sifonar de regreso a través de una manguera y hacia su pozo. Tenga cuidado cuando conecte rociadores de químicos a su manguera.

ÁREA DE MANEJO DE AGUAS SUBTERRÁNEAS



El propósito del Área de Manejo de Aguas Subterráneas del Valle Bajo de Yakima es reducir la contaminación de nitratos donde la concentración no cumplen con standares de Agua potable.

Grupos de trabajo GWAC

- Recolección de datos, caracterización, monitoreo
- Educación y divulgacion al publico
- Financiacion
- Agricultura de riego
- Ganado/CAFO
- Marco Regulatorio
- Residencial, comercial, industrial y municipal

Para participar, llame al: (509) 574-2300

Para más información visite: www.yakimacounty.us

Haga su parte para mantener las aguas subterráneas limpias y seguras.

Attachment D

RCIM Final Report to the GWAC.

RCIM Working Group Report to the GWAC

Residential and non-residential Onsite Sewage Systems (OSS) are present throughout the Lower Yakima Valley Ground Water Management Area (LYVGWMA) outside of those areas served by municipal sewage collection and treatment systems. Outside of the municipal sewage systems, OSS provide some level of sewage treatment and disposal for both residential and non-residential activities. Residential OSS are especially common in and near the urban growth boundaries of many of the valley's municipalities. Non-residential OSS are scattered throughout the project area serving a variety of public and private entities. OSS comprise one of the several potential sources contributing nitrate-N to the underlying shallow alluvial groundwater system.

Non-agricultural sources of potential contamination of groundwater within the GWMA boundaries include the following:

Residential Onsite Sewage Systems (ROSS):

"Septage" is "the mixture of solid wastes, scum, sludge and liquids pumped from within septic tanks, pump chambers, holding tanks and other OSS components." WAC 246-272A-0010. The total nitrogen content of septage generated in the GWMA varies under individual circumstances. An area-wide average is not available.

The minimum liquid volume for a septic tank serving a single family residence containing three or fewer bedrooms is 900 gallons. A septic tank serving a single family residence containing four bedrooms may be 1,000 gallons. Each bedroom after that requires an additional 250 gallons of septic capacity. The actual size of each ROSS within the GWMA is unknown. Permitting for OSS is done by the Yakima County Health District. That agency is also authorized by WAC 246-272A-0015 (5) to "develop a written plan that will provide guidance to the local jurisdiction regarding development and management activities for all OSS within the jurisdiction." The elements of the plan are listed in the WAC.

The owner of a ROSS is responsible for operating, monitoring and maintaining their ROSS, including the requirement to employ an approved pumper to remove the septage from the tank when the level of solids and scum indicates that removal is necessary. Typical maintenance guidelines recommend that a septic tank be pumped every three to five years (EPA-S 2002). The frequency of septic tank pumping in each ROSS in the GWMA is unknown. In a survey conducted by Yakima County, without statistical sampling methodology, 82 percent of 458 surveys collected indicated that they had had their "septic tank pump recently."

There are 6,044 [6180?] residential households within the GWMA that discharge wastewater to an onsite sewage system. Nitrogen in residential wastewater is mainly generated from human body wastes and food materials from kitchen sinks and dishwashers. The amount of nitrogen present in the wastewater is typically expressed as a concentration in milligrams per liter (mg/L) and/or as a mass loading in grams/person/day.

The highest density of OSS is within and near urban growth areas associated with municipalities. Specifically:

- The highest density of OSS are found on the east and north side of Sunnyside where OSS density ranges from 80 to 100 OSSs per section.
- West of Sunnyside near Outlook where OSS density approaches 80 OSS per section.
- In the Zillah to Buena area where density approaches 80 OSS per section.
- Slightly lower OSS density is found south of Grandview, Sunnyside, and Mabton where the OSS range from 50 to 70 per section.

Density of 1-10 ROSS per section are considered to be low density, 11-40 ROSS per section is considered medium density, and over 40 ROSS per section are considered to be high density by the EPA.

Wastewater discharged to a ROSS is subject to several biological processes including nitrification and denitrification. These processes can take place depending on the environmental conditions and occur most effectively when the soil is unsaturated because the wastewater is forced to percolate over the soil particle surfaces where treatment can take place and air is able to diffuse through the soil. Whether these processes occur and their effectiveness in treatment depends on the physical characteristics of the soils and the environmental conditions of the soil through which the wastewater percolates. Wastewater parameters, such as levels of nitrogen, are removed to varying degrees. Under good conditions (and proper operation and management) organic or ammonia nitrogen is readily and rapidly nitrified biochemically in aerobic soil and some biochemical denitrification can occur in the soil, but without plant uptake, 60 to 90 percent of the nitrate enters the groundwater. Under anaerobic soil conditions, nitrification will not occur, but the positively charged ammonium ion is retained in the soil by adsorption onto the soil particles. The ammonium may be held until aerobic soil conditions return allowing nitrification to occur (EPA 1992). Within the GWMA, moderate denitrification occurs about three months a year and poor denitrification occurs about three months (saturated soil). These factors determine that the total denitrification average in the GWMA is in the range of 10-13 percent.

Conventional ROSS technology relies on primary treatment (settling) for solids and organic reduction prior to dispersion to the ground. Innovative ROSS technologies combine the primary treatment with biological treatment to achieve a higher level of treatment. The biological processes promote the removal of nitrogen from wastewater through the multi-step bacterial conversion of ammonia and organic nitrogen to nitrates (nitrification) and the reduction of nitrates to gaseous nitrogen (denitrification). The optimum nitrogen removal of properly operating conventional ROSS technology is up to 20 percent. The projected nitrogen removal of properly operating innovative ROSS technology could be up to 50 percent.

The predominant soil types underlying the ROSS drain fields located within the GWMA are characterized as silt loams that are porous and have a well-developed structure. The estimated depth to groundwater is equal to or greater than 10 feet at approximately 90 percent of the ROSS locations. It is reasonable to assume that the environmental conditions underlying the drain fields are conducive to some level of denitrification and that approximately 87 percent of the nitrate leaches to groundwater as inherent in the system design.

Large Onsite Sewer Systems (LOSS):

A LOSS is a septic system having a design volume over 3,500 gallons. Washington State Department of Health records show that there are two LOSS located within the GWMA. One is located outside of Zillah with a design capacity of 5,000 gallons. The second LOSS site is located outside of Granger with a design capacity of 4,850 gallons. Annual reports for LOSS are submitted to the Washington State Department of Health but are not always timely or do not follow the recommended reports in the Operations and Maintenance manuals. The Operation Permit is required to be renewed annually. The number of people using the system is not reported so actual capacity is unknown.

Commercial Onsite Sewer Systems (COSS):

A COSS is a septic system used for employees working at agricultural or other businesses that operate year-round and are not classified as a LOSS by the Washington Department of Health. The most likely locations of these facilities within the GWMA are wineries, schools, agriculture packing lines, small businesses (stores, fire stations), agricultural business offices and maintenance buildings, churches, dairies and feedlots. There are no reporting requirements for COSS.

Residential Lawn Fertilizers:

Residential lawns exist primarily within towns or urban growth areas within the GWMA. Anecdotal evidence indicates that not all residents fertilize their lawn regularly, and some do not fertilize their lawns at all. Rough estimates are necessary to evaluate how much nitrogen is applied within the GWMA to residential lawns. Nitrate accumulation in the groundwater is not just a matter of nitrogen application rates but also water application rates. While not everyone fertilizes regularly, overwatering occurs at municipal properties, including residences, schools and businesses, particularly if they water daily. Both can have an effect on the loading of even a small amount of nitrogen. Higher population density areas can have a higher percentage of lawn area and the associated potential for more fertilization and overwatering that could be a factor in N loading.

Hobby Farms:

The term "hobby farm" is intended to represent a residential land use other than lawns that may contribute nitrogen within the GWMA area. These land uses are on relatively small parcels that are not included in the WSDA's crop inventory (10 acres or less). Nitrogen contributions on these parcels may come from individual gardens, pastures, pets, and other animals. Co-location of septic drain fields and hobby farming operations, particularly animal farming operations, may cause drain field failure and reduction of denitrification potential.

Biosolids:

Biosolids are a nutrient rich soil amendment. The Department of Ecology's biosolids program is administered independently of other agencies, but coordinated with health districts. As used in the Department of Ecology's regulations, "biosolids" is the term used to refer to sewage sludge or septage that has been or is being treated to meet standards so that it can be applied to the land. Sewage sludge is the solid, semisolid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Biosolids are produced by treating sewage sludge to meet certain quality standards that allow it to be applied to the land for beneficial use.

Land application of biosolids must be pre-approved at application rates based upon agronomic crop requirements, pre-plant soil tests, evaluation of crop type and yield estimates, soil types, use of irrigation. Permittees receive coverage under a statewide general permit. Permit coverage is mandated for those who produce and/or land apply biosolids. The Department of Ecology's regulatory program incorporates site specific approvals with specific testing and analysis procedures, development of land application plans that prescribe specific practices and prohibitions, and a review and approval process for land application of the wastewater solids. Land application may only occur on permitted sites with pre-established buffers and setbacks. Application rates require advance approval. Intermittent post-harvest tests are also conducted. Natural Selection Farms at 6800 Emerald Road, Sunnyside is the only business approved to secure state approval of sites that can accept application of biosolids. Yakima County also receives some biosolids at County landfills.

Discharges to Surface Water:

The State Department of Ecology's records indicate that as of March 1, 2017, 46 State Waste Discharge Permits (SWDP) or federal National Pollutant Discharge Elimination System (NPDES) permits have been issued within the GWMA. They include industrial (Baker Commodities, Inc., Valley Processing, Inc., Centennial Tank Cleaning, DRR Fruit Products Co., Inc., Del Monte Foods, Inc., Fruit Smart, Inc., Hyatt Vineyards Winery, J.M. Eagle, Johnson Foods, Kenyan Zero Storage, LTI, Inc., Powell Christiansen, Inc., Port of Sunnyside, Schutt's Mint Distilling, Seneca Foods, LLC, Shonan (USA), Inc., Ste. Michelle Wine Estates, USDA Yakima Agricultural Research Laboratory, Valley Manufactured Housing, Inc., VB Homestead Farms, Inc., Welch Foods, Yakima Chief, Inc.), fruit packer (Baker Produce, Inc., Pride Packing Co., Seneca Foods, LLC, Windy Point, LLC), construction (Sunnyside Valley Irrigation District, Golob Dairy LLC, Sunnyside School District, Roza Irrigation District), Sand and Gravel (O. L. Luther Company, Inc., Terry and Mike Drollinger), CAFO (Skyridge Farms, Snipes Mountain Dairy, Inc., DeRuyter Bros. Dairy) and municipal (Cities of Grandview, Granger, Sunnyside and Zillah, Sunnyside POTW, Sunnyside Valley Irrigation District). This list changes with time as new permits are added or terminated.

Water Wells:

The Department of Ecology maintains a Well Construction and Licensing System (WCLS). The System maintains a log of Notices of Intent to Construct or Decommission a well and any well reports that have been received for a Notice of Intent. You can also search for a Washington State licensed well operator and Drilling Companies. https://fortress.wa.gov/ecy/publicwellconstructionandlicensing/query_pages/base_page.asp
3,853 notices of intent to drill water wells in Yakima County were filed with the Department of Ecology in the decade following 2006.

The Yakima Health District (YHD) inspects about 50 percent of newly constructed wells, seeking proper bentonite or other sealing, tags, etc. YHD determines the GPS coordinates of each inspected well.

A relatively small number of existing water wells within the GWMA, including those tested for nitrate contamination in the groundwater aquifer, have been inspected in the GWMA area. No analysis of well data has been performed yet which would indicate the level below surface aquifer that nitrate contamination begins. Nor has analysis of well integrity been performed yet which would indicate whether the well itself is acting as a conduit for its shown contamination because of poor casing, poor construction or poor sealing.

Water wells can facilitate the downward migration of nitrogen. Water can flow downward outside a well casing. If a casing is cracked or deteriorated, water can migrate down the well shaft. An abandoned water well casing may permit downward flow of contaminants. Negative pressure created by the well pump can pull water from more shallow, contaminated parts of the aquifer downward more quickly that it would otherwise migrate. Improperly abandoned wells (that were not sealed to prevent the downward migration of shallow groundwater) can serve as conduits for downward water migration.

WAC 173-160-261 requires that "dug wells" still in use, or not yet decommissioned, must be properly capped, so as to prevent pollutants, objects, animals and people from entering the well.

Washington state law requires property owners to properly decommission abandoned groundwater wells. The landowner may be responsible for any injury or occurrence of groundwater contamination caused by an abandoned well not properly decommissioned. Decommissioning a well generally means filling the entire casing of the well with concrete. Washington's Well Construction Act Ch. 18.104 RCW requires that decommissioning of an abandoned well must be done by a water well driller licensed in Washington State. Property owners intending to decommission a well must give notice of their intent to decommission the well. Notice is filed with the Department of Ecology. See:
http://www.ecy.wa.gov/programs/wr/wells/abandon-wells.html

Any improperly decommissioned wells beneath agricultural or livestock operations, including crop fields onto which nutrients have been applied, can provide a direct conduit for contaminants to reach the ground water.

Recommendations:

Encourage municipalities within the GWMA to extend municipal sewer systems within urban growth areas and retire ROSS and LOSS.

Encourage connection of residences within urban growth zones to sewer systems extended by municipalities. Encourage the development of group septage-management or treatment systems in areas outside urban growth zones where the density of residential development could exacerbate the effect of multiple OSS on groundwater quality.

Establish or maintain ongoing, extended funding necessary for the Yakima County Department of Public Services and Yakima Health District to actively participate in water quality improvement, testing, monitoring, scientific data analysis, and infrastructure development.

Request Yakima County Public Services to perform an engineering study of locations outside urban growth areas where there is rural residential medium to high density OSS and the nitrate concentration is greater than the state water quality standard where community water systems could feasibly be constructed in lieu of individual water wells.

Request Yakima County Public Services to perform an engineering study of locations outside urban growth areas where there is rural residential medium to high density OSS and the nitrate concentration is greater than the state water quality standard where community waste water systems could feasibly be constructed in lieu of individual on-site sewage systems.

Request that the Yakima Health District prepare a plan, as required and described by WAC 246-272A-0015, giving primary emphasis on educational programs for operation and maintenance of existing on-site sewage systems (OSS), reserving a determination regarding the advisability of the establishment of regulatory or enforcement programs until data is available from the GWMA's monitoring well system.

Request the Yakima Health District to consider the nitrate density element when approving proposed onsite sewage systems, including those technologies verified by the U.S. EPA's Environmental Technology Verification Program, for reducing the nutrient nitrogen in domestic wastewater discharged from OSS, including fixed film trickling filter biological treatment, media filter biological treatment, and submerged attached-growth biological treatment.

Recommend that soil testing below at least two (one with a shallow water table, one with a deeper water table) ROSS drain fields in High Density areas be performed to analyze Nitrogen loads as the septage approaches the aquifer.

Request that the State Department of Health determine, prior to issuing or reissuing LOSS permits, that all employee counts are regularly reported and that all O&M Manual requirements are performed, so that the LOSS will continue to operate as designed.

Recommend that the State Department of Health consider not approving additional LOSS or otherwise require an effective nitrate removal system.

Request that the Department of Ecology analyze the trends of nitrate data contained within reports required by NPDES and SDWA permits.

Educate the public regarding the importance of the integrity of wells, particularly those without a well log, and fund and encourage periodic well inspection by the Yakima Health District or professional well engineers.

Require that site inspections for possible abandoned wells be performed before building permits are issued for properties that are proposed to be redeveloped after prior development of domestic, agricultural or industrial uses.

Request that the Department of Ecology develop a plan for finding and decommissioning abandoned wells in the next 12 months, using the LYVGWMA as a pilot project.

Permit the repair or decommissioning of wells by general contractors, rather than exclusively by well-drillers, so as to diminish costs of decommissioning.

Assist hobby farmers to locate ROSS drain fields on their property so as to avoid animal farming and driving over the drain field.

Request the county include the EPO flyer on OSS maintenance in correspondence with GWMA home owners for 5 years. I.e. tax bills, property transfers

Statement of Purpose (section 2.3.1(e) of work plan):
Nitrate load in the drinking water aquifers will have a strong potential to increase in OSS high density areas if no action is taken on OSS.

Attachment E

Groundwater Quality Regulation in Washington

Groundwater Quality Regulation in Washington

Groundwater quality in Washington is regulated by the federal Safe Drinking Water Act and Clean Water Act, the state Water Pollution Control Act and Water Resources Act and the Department of Health's authorizing statute.

Safe Drinking Water Act

The U.S. Environmental Protection Agency (EPA) has broad authority, under Section 1421 of the Safe Drinking Water Act, 42 U.S.C. 300g-1(b)(1)(A), (B), to establish national primary drinking water standards, "if the Administrator determines that . . . the contaminant may have an adverse effect on the health of persons"; "is known to occur . . . in public water systems with a frequency and at levels of public health concern;" or there is "a meaningful opportunity for health risk reduction for persons served by public water systems.

> For each contaminant that the Administrator determines to regulate under subparagraph (B), the Administrator shall publish maximum contaminant level goals and promulgate, by rule, national primary drinking water regulations under this subsection. 42 U.S.C. 300g-1(b)(1)(E)

The EPA set the maximum contaminant level for nitrate, nitrite and total nitrate and nitrite in 40 CFR § 141.62:

Contaminant	**MCL (mg/l)**
(7)Nitrate	10 (as Nitrogen)
(8)Nitrite	1 (as Nitrogen)
(9)Total Nitrate and Nitrite	10 (as Nitrogen)

EPA may delegate its enforcement authority under the Safe Drinking Water Act to states if they adopt drinking water regulations that are no less stringent than the federal standards. 42 U.S.C. 300g-2(a), 300h-1. "States are responsible for reviewing, establishing, and revising water quality standards." "States may develop water quality standards more stringent than required" by federal regulations 40 CFR § 131.4 (a). Washington State's Department of Ecology (DOE) has adopted Chapter 173-200 WAC, *Water quality standards for groundwaters of the State of Washington.* Washington's drinking water quality standard for nitrate is 10 milligrams per liter (mg/L), or 10 parts per million (ppm). State law requires public water systems to sample for many contaminants, including nitrate, on a regular basis. Public water systems with nitrate levels over 10 ppm must notify the people who receive water from them.

DOE's groundwater regulations, WAC 173-200, implement Washington's Water Pollution Control Act, Ch. 90.48 RCW, and Water Resources Act of 1971, Ch. 90.54 RCW. The goal of the regulations is to maintain the highest quality of the state's groundwaters and protect existing and future beneficial uses of the groundwater through the reduction or elimination of the discharge of contaminants to the state's groundwaters. The regulations set groundwater quality standards that, together with the state's technology-based treatment requirements, seek to protect the environment, human health and existing and future beneficial uses of groundwaters. The regulations apply to all groundwaters of the state that occur in a saturated zone or stratum beneath the surface of land or below a surface water body. They do not apply to:

> (a) contaminant concentrations found in saturated soils where those contaminants are chemicals or nutrients that have been applied at agronomic rates for agricultural purposes if those contaminants will not cause pollution of any groundwaters below the root zone;
>
> (b) contaminant concentrations found in saturated soils where those contaminants are constituents that have been applied at approved rates and under approved methods of land treatment if those contaminants will not cause pollution of any groundwaters below the root zone; or
>
> (c) clean up actions approved by the Department under the Model Toxics Control Act, ch. 70.105D RCW, or approved by the United States Environmental Protection Agency under the Comprehensive Environmental Response Compensation and Liability Act, 42 U.S.C. 9601 et seq., WAC 173-200-010.

WAC 173-200-040 (2) establishes "groundwater concentrations" that groundwaters of the state may not exceed. Nitrate concentrations in groundwater may not exceed 10 mg/L. WAC 173-200-040 (2) (Table 1). "No person shall engage in any activity that violates or causes the violation of [ch. 173-200 WAC]." WAC 173-200-100 (2). Violations of maximum concentrations may be addressed by enforcement "through all legal, equitable, and other methods available to the department including, but not limited to: issuance of state waste discharge permits, other departmental permits, regulatory orders, court actions, review and approval of plans and specifications, evaluation of compliance with all known, available, and reasonable methods of prevention, control, and treatment of a waste prior to discharge, and pursuit of memoranda of understanding between the department and other regulatory agencies." WAC 173-200-100 (3).

If DOE determines that a potential to pollute the groundwater exists, it may request a permit holder or responsible person to prepare and submit a groundwater quality evaluation program for its approval. Each evaluation program must be based on soil and hydrogeologic characteristics and be capable of assessing impacts on groundwater at the "point of compliance." The evaluation program approved by DOE may include (a) groundwater monitoring for a specific activity; (b) groundwater monitoring at selected sites for a group of activities; (c) monitoring of the vadose zone; (d) evaluation and monitoring of effluent quality; (e) evaluation within a treatment process; or (f) evaluation of management practices. WAC 173-200-080 (2). The "point of compliance" is the location where the "enforcement limit," is "measured and shall not be exceeded." WAC 173-200-060 (1). The "enforcement limit" is established in accordance with WAC 173-200-050.

When drinking water in private wells contains nitrate above the MCL, EPA may determine that an imminent and substantial danger exists. EPA may then take action, including collecting samples to investigate the sources of the contamination. In addition, where appropriate, EPA may issue orders to require provision of alternative water supplies by persons who caused or contributed to such conditions. EPA may also judicially enforce its orders, through action seeking civil penalties of not more than $25,000 for each day of such violation. If violation of EPA's orders is "wilfull," EPA may seek criminal penalties of fines or imprisonment for not more than three years. 42 U.S.C. § 300g-2(b). Citizens may also seek protection of underground sources of drinking water, under 42 USC 300j-8, so as to mandate EPA regulatory or litigative action.

The U.S. EPA may also designate sole source drinking water aquifers under Section 1427 of the Safe Drinking Water Act, 42 U.S.C. 300h.

Clean Water Act

The Clean Water Act (CWA), 33 U.S.C. §1251 et seq., establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Under the CWA, EPA has implemented pollution control programs such as setting wastewater standards for industry and water quality standards for all contaminants in surface waters. The CWA makes it unlawful to discharge any pollutant from a point source into navigable waters, unless a National Pollutant Discharge Elimination System ("NPDES") permit is obtained (33 U.S.C. 1342) NPDES permitting authority has been delegated to Washington State Department of Ecology. (33 U.S.C. 1342 (b)).

The Department of Ecology (DOE) is the primary agency in Washington State responsible for the protection of both ground and surface water quality. DOE's Water Quality Program operates primarily pursuant to the Water Pollution Control Act, Chapter 90.48 RCW. The Act makes it "unlawful for any person to throw, drain, run, or otherwise discharge into any of the waters of this state, or to cause, permit or suffer to be thrown, run, drained, allowed to seep or otherwise discharged into such waters any organic or inorganic matter that shall cause or tend to cause pollution of such waters." (RCW 90.48.080)

DOE may implement measures to protect both ground and surface waters from pollutants, and has established regulations for the protection of ground and surface water quality, permitting of discharging activities, and financing of water quality protection activities. This regulation lists numerical limits for specific contaminants ("water quality criteria") that apply to all groundwaters in the state. These criteria are used when evaluating the performance of permitted discharge activities (such as sprayfields and holding ponds), implementation of best management practices implementation, or when conducting clean-up activities at historical or current waste sites.

DOE's water quality standards incorporate an "antidegradation policy," an otherwise existing part of state water quality law (WAC 173-200-030). This policy forbids degradation which would harm existing or future beneficial uses of groundwater (drinking water, irrigation and support of wildlife habitat). The standards provide numeric values which must not be exceeded to protect the beneficial use of drinking water. Washington's water quality standards are enforceable through DOE's actions. Washington's Water Pollution Control Act authorizes DOE to "bring any appropriate action, in law or equity, including action for injunctive relief . . . as may be necessary to carry out the provisions of that Act (RCW 90.48.037), including its prohibition of the discharge of organic or inorganic matter that may cause pollution of ground or surface water. (RCW 90.48.080).

DOE's water quality standards apply to both point source activities and nonpoint source activities. Point source activities are activities where a source of pollution can be readily distinguished, such as the industrial discharge of waste onto or into the ground. State law requires point sources to operate under permits that set conditions for discharges. These permits may be issued to a specific entity with conditions designed to protect water quality.

A "point source" is "any discernible, confined, and discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture." (WAC 273-226-030 (21)).

"Nonpoint sources" are more diffuse in nature. They often consist of many small pollutant sources that have a cumulative effect, like highway runoff, on-site septic systems in developed areas, and application of pesticides or nutrients in both agricultural and urban areas. Some nonpoint sources are managed through the development of siting and design standards.

DOE's permits describe penalty provisions which may be put into effect if discharge limitations (or other conditions specified in the permit) are not met. Repeated violations of the permit can result in closure of the discharging activity and fines for potential clean-up activities.

"General permits" may be issued to a group of entities with common discharge characteristics and conditions. (WAC 273-226-020). Permits issued under chapter 273-226 WAC are designed to satisfy the requirements for discharge permits under sections 307 and 402(b) of the federal Water Pollution Control Act (33 U.S.C. §1251) and the state law governing water pollution control (Ch. 90.48 RCW). (WAC 273-226-020). All point sources must apply for and obtain a general permit as a condition of operation. General permits have been issued to industries and municipalities for treated discharges into surface waters such as Sulphur Creek Wasteway or the Yakima River. -200.)

General permits are issued for fixed terms not exceeding five years from the effective date. Point source facility operators must apply to the Department of Ecology for coverage under a general permit. (WAC 227-226) All permitees covered under a general permit must submit a new application for coverage under a general permit or an application for an individual permit at least 90 days prior to the expiration date of the general permit under which the permittee is covered. When a permittee has made timely and sufficient application for the renewal of coverage under a general permit, an expiring general permit remains in effect and enforceable until the application has been denied, a replacement permit has been issued by the DOE, or the expired general permit has been canceled by the DOE. Coverage under an expired general permit for permittees who fail to submit a timely and sufficient application shall expire on the expiration date of the general permit. (WAG 173-226-200).

A general permit may be modified, revoked and reissued, or terminated, during its term if information is obtained by DOE which indicates that cumulative effects on the environment from dischargers covered under the general permit are unacceptable. (WAG 173- 226-230 (1)(d)). DOE may require any discharger to apply for and obtain an individual permit, or to apply for and obtain coverage under another more specific general permit. Also, any interested person may petition the DOE to require a discharger authorized by a general permit to apply for and obtain an individual permit (WAC 173-226-240 (2), (3)).

DOE may revoke, or "terminate coverage under" a general permit where terms or conditions of the general permit are violated, conditions change such that either temporary or permanent reduction or elimination of permitted discharges is required, or DOE determines that the permitted activity endangers human health, safety, or the environment, or contributes to water or sediment quality standards violations (WAC 173-226-240 (1) (a), (c), (d)).

Currently, the permit framework is reactive, a permit is not required unless there is or was a documented discharge to surface waters. The permitting process now requires a facility to submit a complete Nutrient Management Plan with the permit application. The Nutrient Management Plan is approved by DOE and becomes the facility's effluent limitation. After a facility is permitted, it must submit an updated Nutrient Management Plan if it wants to make changes to its operation.

Under §303(d) of the Clean Water Act, states are required to develop lists of impaired waters. These are waters for which technology-based regulations and other required controls are not stringent enough to meet the water quality standards set by the state. The law requires that states establish priority rankings for waters on the lists and develop Total Maximum Daily Loads for these waters. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards. A TMDL is generally administered by establishing limits on the discharge of pollutant materials otherwise permitted under the NPDES program—a program that relates to discharges to surface water only.

DOE issues permits for large on-site systems and these systems are required to monitor. In other cases, general permits establish standards for management. The standards apply to all underground waters in the saturated zone (generally at or below the water table), but do not apply in the root zone of saturated soils where agricultural pesticides and nutrients have been applied at agronomic rates for agricultural purposes and pollution does not occur below the root zone (WAC 173.200.010(3)(a)).

<u>State Department of Health</u>

The Washington State Department of Health (DOH) is authorized to adopt regulations "to protect public health" (RCW 43.20.050(2)). These may include rules for Group A public water systems, as necessary to assure safe and reliable public drinking water and to protect the public health. Those rules set requirements regarding: (i) The design and construction of public water system facilities, including proper sizing of pipes and storage for the number and type of customers; (ii) Drinking water quality standards, monitoring requirements, and laboratory certification requirements; (iii) Public water system management and reporting requirements; (iv) Public water system planning and emergency response requirements; (v) Public water system operation and maintenance requirements; (vi) Water quality, reliability, and management of existing but inadequate public water systems; and (vii) Quality standards for the source or supply, or both source and supply, of water for bottled water plants.

DOH requires that nitrate levels (concentrations) (as N) in Group A public water systems not exceed the maximum contaminant level ("MCL") of 10 mg/L, and that nitrite levels (concentrations) not exceed the MCL of 1 mg/L. WAC 246-290-310(3)(Table 4). The requirements for Group B public water systems are the same. WAC 246-291-170 (2)(b) Nitrate and nitrite are "primary inorganic contaminants" and the MCL for nitrate and nitrite are "primary MCLs". When primary MCL's are exceeded by a public water system the water purveyor must "determine the cause of the contamination" and "take action as directed by the Department of Health." WAC 246-290-320(1)(b)(iii).

DOH is also sets rules for Group B public water systems, as defined in RCW 70.119A.020., These rules establish minimum requirements for the initial design and construction of a public water system and "rules and standards for prevention, control, and abatement of health hazards and nuisances related to the disposal of human and animal excreta and animal remains" RCW 42.30.050 (2) (b), (c).

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) (Pub. L. No. 94-590, 90 Stat 2795, 42 U.S.C. §§6901-6987, 9001-9010) contains both regulatory standards and remedial provisions to achieve goals of conservation, reducing waste disposal, and minimizing the present and future threat to human health and the environment. RCRA provides a comprehensive national regulatory structure for the management of nonhazardous solid wastes (subtitle D, 42 U.S.C. §§ 6941/y-6949a) and hazardous solid wastes (subtitle C, 42 U.S.C. §§ 6921/y-6939b). "Solid waste" is defined as "any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities . . . " 42 U.S.C. §6903(27).

Materials are discarded if they are either abandoned or recycled or are inherently waste-like. 40 C.F.R. § 261.2. Materials are "disposed" if they are discharged, deposited, injected, dumped, spilled, leaked or otherwise placed into or on land or water such that it may enter into the environment or be emitted into the air or discharged into any waters, including groundwaters 42

U.S.C. §6903(3). Agricultural wastes, including manures, crop residues, or commercial chemical fertilizers applied to the soil in amounts greater that can be used as fertilizers or soil conditioners may be the disposal of solid waste.

Residential, Commercial, Industrial and Municipal Groundwater Quality Regulation

Sewage System ("Septic") Tanks

"Septage" is "the mixture of solid wastes, scum, sludge and liquids pumped from within septic tanks, pump chambers, holding tanks and other OSS (onsite sewage system) components" WAC 246-271A-0010.

The location, design, installation, operation, maintenance, and monitoring of onsite sewage systems is regulated by Chapter 246-272A WAC. The chapter is intended to coordinate with other statutes and rules for the design of onsite sewage systems under chapter 18.210 RCW and chapter 196-33 WAC. Onsite sewage systems are often called "septic" systems.

A local board of health must apply to the state Department of Health to approve local regulations. They must be at least as stringent as the regulations of the state department WAC 246-272A-0015 (9), (10).

The minimum liquid volume for an onsite sewage (septic) tank serving a single family residence containing three or fewer bedrooms is 900 gallons. A septic tank serving a single family residence containing four bedrooms may be 1,000 gallons. Each bedroom after that requires an additional 250 gallons of septic capacity. The Yakima Health District is also authorized by WAC 246-272A-0015 (5) to "develop a written plan that will provide guidance to the local jurisdiction regarding development and management activities for all OSS within the jurisdiction."

The owner of a Residential Onsite Sewage System is responsible for operating, monitoring and maintaining their ROSS, including the requirement to employ an approved pumper to remove the septage from the tank when the level of solids and scum indicates that removal is necessary. Typical maintenance guidelines recommend that a septic tank be pumped every three to five years

(EPA-S 2002).

The local health officer may require the owner of a failing onsite sewage system located within 200 feet of a public sewer service to hook up to that system WAC 246-272A-0025. Design specifications for onsite sewage (septic) tanks are located at WAC 246-272C.

The amount of land necessary for the installation of an onsite sewage (septic) tank varies depending upon soil type. Table X in WAC 246-272A.0320 establishes the minimums. Table V in WAC 246- 272A-0220 describes the soil types.

TABLE X

Minimum Land Area Requirement
Single-Family Residence or Unit Volume of Sewage

Type of Water Supply	Soil Type (defined by WAC 246-272A-0220)					
	1	2	3	4	5	6
Public	0.5 acre 2.5 acre1	12,500 sq. ft.	15,000 sq. ft.	18,000 sq. ft.	20,000 sq. ft.	22,000 sq. ft.
Individual, on each lot	1.0 acre 2.5 acres1	1 acre	1 acre	1 acre	2 acres	2 acres

TABLE V

Soil Type Descriptions

Soil Type	Soil Textural Classifications

1	Gravelly and very gravelly coarse sands, all extremely gravelly soils excluding soil

Soil Type	Soil Textural Classifications
	types with greater than or equal to 90% rock fragments.
2	Coarse sands.
3	Medium sands, loamy coarse sands, loamy medium sands.
4	Fine sands, loamy fine sands, sandy loams, loams.
5	Very fine sands, loamy very fine sands; or silt loams, sandy clay loams, clay loams and silty clay loams with a moderate or strong structure (excluding platy structure).
6	Other silt loams, sandy clay loams, clay loams, silty clay loams.
7 Unsuitable for treatment or dispersal	Sandy clay, clay, silty clay, strongly cemented or firm soils, soil with a moderate or strong platy structure, any soil with a massive structure, any soil with appreciable amounts of expanding clays.

WAC 246-272A-0270 provides that the owner of an onsite septic system is responsible for its operation, monitoring, maintaining, repairing, altering or expanding an OSS. The owner must also assure that an evaluation of a simple gravity septic system's components happens at least once every three years and that an evaluation of all other systems occurs every year. The solids and scum must be pumped from the septic system whenever necessary. The septic system must not be covered by structures or impervious material. Surface drainage must be trained away from the septic system. The soil above the drain field should not be compacted by vehicles or livestock. Information about the septic system should be disclosed to any future buyer of the property.

Regulations for large on-site sewage (septic) systems (LOSS) are found at WAC 264-272B.

Biosolids

Biosolids are a nutrient rich soil amendment derived from public waste treatment plant septage. The Department of Ecology's biosolid program is administered independently of other agencies, but coordinated with health districts. As used in the Department of Ecology's regulations, "biosolids" is the term used to refer to sewage sludge or septage that has been or is being treated to meet standards so that it can be applied to the land. Sewage sludge is the solid, semisolid, or liquid residue generated during the treatment of domestic sewage in a treatment works.

Biosolids are produced by treating sewage sludge to meet certain quality standards that allow it to be applied to the land for beneficial use. Septage is a class of biosolids that comes from septic tanks and similar systems receiving domestic wastes WAC 173-308-050. Land application of biosolids requires pre-approval of application rates that are based upon agronomic crop requirements. Permittees receive coverage under a statewide general permit. Permit coverage is mandated for those who produce and/or land apply biosolids. The Department of Ecology's regulatory program incorporates site specific approvals with specific testing and analysis procedures, development of land application plans that prescribe specific practices and prohibitions, and a review and approval process for land application of the wastewater solids. Land application may only occur on permitted sites with pre-established buffers and setbacks. Application rates require advance approval based on pre-plant soil tests, evaluation of crop type and yield estimates, soil types, use of irrigation. Intermittent post-harvest tests are also conducted.

Municipal Lawns

There are no known laws or regulations regarding homeowner maintenance of residential lawns.

There are also no known laws or regulations regarding municipal maintenance of parks or grounds.

"Hobby Farms"

A "Hobby Farm" is a tract of land 10 acres or less that is not contained within the agricultural acreage reported by the Washington State Department of Agriculture, which may or may not contain a residence, upon which minimalist agriculture is maintained without the intention of profit. There are no known laws or regulations regarding maintenance of animals or herbaceous material on "hobby farms."

Underground Injection Wells

Part C of the Federal Safe Drinking Water Act (SDWA), 42 U.S.C. §300h-3, regulates underground injection wells. Washington's regulations about underground injection wells are found at WAC 173-218. Most UIC's in Yakima County are road based and county-owned, put in place to receive surface water runoff from county roads.

Irrigated Agriculture

Regulations About Fertilization

There are no federal, state or local regulations specifically pertaining to the application of nitrogen-based fertilizer to agricultural crops, so long as they are applied at an agronomic rate.

Regulations About Irrigation Practices

There are no federal, state or local regulations specifically pertaining to the application of irrigation water to agricultural crops. State water law generally precludes wasting water.

Washington's Right to Farm Law

Washington State's right to farm law, RCW 7.48. 300-320, was first enacted in 1979, with the purpose of protecting agricultural activities conducted on farm and forest lands from lawsuits sounding in nuisance. As a consequence, "agricultural activities conducted on farmland and forest practices, if consistent with good agricultural and forest practices and established prior to surrounding nonagricultural and nonforestry activities, are presumed to be reasonable and shall not be found to constitute a nuisance". RCW 7.48.305 (1). The defense does not apply however if "the activity or practice has a substantial adverse effect on public health and safety." "Agricultural activities and forest practices undertaken in conformity with all applicable laws and rules are presumed to be good agricultural and forest practices not adversely affecting the public health and safety." RCW.7.48.305 (2). In 2005, Washington's right to farm law was amended to provide for full recovery of costs of litigation in the defense of nuisance suits where the right to farm law was a successful defense. RCW 7.48.315.

Yakima County's Agricultural Zoning

Yakima County's Agriculture (AG) Zoning District is by far the most prevalent use district in the Lower Yakima Valley, followed by the Remote/Extremely Limited Development Potential (R/ELDP) district on the ridges and along the Yakima River, and some Rural Transitional (RT) Zoning Districts near the cities and towns. The AG zone allows a broad array of agricultural uses under Type 1 review, including: Animal Feeding Operations, land application of soil amendments or agricultural waste at agronomic rates. CAFOs are allowed in the AG and R/ELDP zones under Type 2 review. New or expanding CAFOs, feedlots and other agricultural uses may be subject to environmental review under the State Environmental Policy Act (SEPA) depending upon the size of the proposal and whether the project falls below SEPA's flexible exemption thresholds.

Livestock/CAFOs and Groundwater Quality Regulation

The effects of livestock operations on groundwater quality are addressed through the Clean Water Act's regulations and Washington's Dairy Nutrient Management Act. The Department of Ecology has authority under Washington's Water Pollution Control Act to enforce the Clean Water Act. Voluntary financial and technical assistance programs are available from the National Resource Conservation Service to eligible landowners and agricultural producers to help them manage natural resources in a sustainable manner.

Clean Water Act

The Clean Water Act's regulations (40 CFR, Part 122) define dairies with 750 or more animals and feedlots with 1,000 or more animals as Large Concentrated Animal Feeding Operations (CAFO). Large CAFOs are defined as point sources of water pollution and must obtain an NPDES permit if they have the potential to discharge to surface waters. The Washington Department of Ecology administers the CAFO permit, decides when a facility is required to apply for a permit, approves the nutrient management plan that is required under the permit and is responsible for enforcing the permit.

On February 3, 2017, the Department of Ecology announced its reissuance of a new Concentrated Animal Feeding Operation (CAFO) National Pollutant Discharge Elimination System (NPDES) and a new State Waste Discharge General Permit. These permits became effective on March 3, 2017, and expire March 2, 2022. They were reissued as two separate permits, the CAFO State Waste Discharge General Permit (state permit) and the CAFO NPDES and State Waste Discharge General Permit (combined permit). The state and combined permits regulate the discharge of pollutants such as manure, litter, or process wastewater from CAFOs into waters of the state. The state permit conditionally authorizes discharges to groundwater only. The combined permit conditionally authorizes discharges to surface and groundwater, including agricultural stormwater. Coverage under a general permit will be available to facilities that meet the definition of a CAFO and that have a discharge or that voluntarily apply for permit coverage.

The two CAFO permits require large-scale livestock operations to use specific practices that better protect groundwater, rivers, lakes and marine waters from manure pollution. Discharges conditionally authorized by the CAFO permits must not cause or contribute to a violation of water quality standards. Previously only five of the dairies in Yakima County were covered by the permit. Now, more livestock activities, including dairies, will be covered by the CAFO permit.

Washington State Department of Health regulations regarding keeping of animals, WAC 246-203-

130, provide that:

> (1) Any person, firm or corporation is prohibited from keeping or sheltering animals in such a manner that a condition resulting from same shall constitute a nuisance.
>
> (2) In populous districts, stable manure must be kept in a covered watertight pit or chamber and shall be removed at least once a week during the period from April 1st to October 1st and, during the other months, at intervals sufficiently frequent to maintain a sanitary condition satisfactory to the health officer. Manure on farms or isolated premises other than dairy farms need not be so protected and removed unless ordered by the health officer.
>
> (3) Manure shall not be allowed to accumulate in any place where it can prejudicially affect any source of drinking water.

Dairy Nutrient Management Act

Washington's Dairy Nutrient Management Act (Ch. 90.48 RCW) ("DNMA") authorizes the Department of Agriculture to "protect water quality from livestock nutrient discharges," and to "help maintain a healthy agricultural business climate." The DNMA requires dairies licensed to sell Grade A milk to register with the Department of Agriculture; develop a Nutrient Management Plan (NMP) to prevent the discharge of livestock nutrients to surface and ground water, which NMP must be approved by the local conservation district within six months after licensing and be "certified" within two years after licensing (RCW 90.64.026); not discharge to waters of the state, and maintain land application records that demonstrate agronomics application of manure and process waste water.

Local Conservation Districts are authorized to provide dairies and other farms with technical assistance and planning services (RCW 89.08.560) and are required to approve and certify all NMPs. "Farm Plans" developed by conservation districts for farmers must include "livestock nutrient management measures" RCW 89.08.560. The South Yakima Conservation District often writes the NMPs for dairy farms and later certifies them.

The required elements of an NMP specified by the State Conservation Commission include the collection, storage, transfer and application of manure, waste feed and litter, and any potentially contaminated runoff at the site. Plans should focus on management of nitrogen, and phosphorus as well as preventing bacteria and other pollutants, such as sediment, from reaching surface or ground water. Excess nutrients must be exported off site. The elements of a NMP must include methods and technologies of the nature prescribed by the Natural Resources Conservation Service (NRCS), a department of the U.S. Department of Agriculture. RCW 90.64.026(3).

NRCS provides technical assistance to farmers and other private landowners and managers. NRCS has six mission goals: high quality, productive soils; clean and abundant water; healthy plant and animal communities; clean air; an adequate energy supply; and, working farms and ranchlands.

NRCS helps landowners develop conservation plans and provides advice on the design, layout, construction, management, operation, maintenance, and evaluation of recommended, voluntary conservation practices. NRCS activities include farmland protection, upstream flood prevention, emergency watershed protection, urban conservation, and local community projects designed to improve social, economic, and environmental conditions. NRCS conducts soil surveys, conservation needs assessments, and the National Resources Inventory to provide a basis for resource conservation planning activities.

NRCS conservation practice standards contain information on why and where the practice is applied, and sets forth the minimum quality criteria that must be met during the use of that practice. State conservation practice standards are available through the Field Office Technical Guide (FOTG). NRCS believes that Nutrient Management for the protection of groundwater, although different on each farm, is best accomplished through best management practices beginning with those stated in Standards 590, 449 and 313.

Ch. 90.64 RCW does not require that the best management practices recommended by the NRCS be followed. Nutrient Management Plans are required to be maintained on the farm for review by inspectors. The DNMA requires that all dairies be inspected for implementation of their Nutrient Management Plans and to ensure protection of waters of the state. Most dairies keep their NMP and associated sampling data on location.

The DNMA does not authorize the Department of Agriculture to compel nutrient management consistent with NMPs. Representatives of the Department of Agriculture state that most "enforcement" is accomplished through the "soft enforcement" efforts that the Department accomplishes through its administrative activities under its Dairy Nutrient Management Program.

Although "farm plans" are not subject to disclosure under Washington's public records law, (RCW 42.56.270 (17)), plans, records, and reports obtained by state and local agencies from dairies, animal feeding operations, and concentrated animal feeding operations not required to apply for a National Pollutant Discharge Elimination System Permit are disclosable under Washington's public records law (Ch. 42.56 RCW), but only in ranges that provide meaningful information to the public while ensuring confidentiality of business information regarding: (1) number of animals; (2) volume of livestock nutrients generated; (3) number of acres covered by the plan or used for land application of livestock nutrients; (4) livestock nutrients transferred to other persons; and (5) crop yields. The ranges of the information required to be disclosed by the public disclosure law (Ch. 42.56 RCW) are set forth in the Washington Department of Agriculture's rules implementing that law and Ch. 90.64 RCW, WAC 16-06-210 (29).

The Department of Agriculture's regulations implementing the DNMA are published at chapter 16-611 WAC. WAC 16-611-010 defines "agronomic rate" as "the application of nutrients to supply crop or plant nutrient needs to achieve realistic yields and minimize the movements of nutrients to surface and ground waters."

The Department of Agriculture's mission under the Dairy Nutrient Management Act is to "protect water quality from livestock nutrient discharges" and to "help maintain a healthy agricultural business climate." The DNMA does not authorize the Department of Agriculture to compel nutrient management consistent with dairy nutrient management plans, Washington's Water Pollution Control Act authorizes the Department of Ecology to "bring any appropriate action, in law or equity, including action for injunctive relief . . . as may be necessary to carry out the provisions of that Act (RCW 90.48.037), including its prohibition of the discharge of organic or inorganic matter that may cause pollution of ground or surface water. (RCW 90.48.080).

The DNMA does not authorize the Department of Agriculture to compel nutrient management consistent with NMPs. The Department of Agriculture encourages compliance by providing technical assistance as a first step as required by RCW 43.05, but when that is not successful the Department has authority under both RCW 90.64 and RCW 90.48 and has informal (warning letters and notices of correction) and formal (civil penalties and orders) enforcement tools available.

In 2013-2014, WSDA issued 17 notices of correction, one order, and 11 notices of penalty for discharges of pollutants to surface waters, statewide, as well as 122 warning letters and 27 notices of correction for potential to pollute. WSDA usually begins with informal enforcement, using warning letters and notices of correction, then proceeding to formal enforcement through civil penalty or administrative order. Most penalties include a settlement process including reduction in penalty, requirements to adopt specific management practices, to abstain from discharge and collection of entire penalty in the event of non-performance.

Washington's Water Pollution Control Act

Washington's Water Pollution Control Act authorizes the Department of Ecology to "bring any appropriate action, in law or equity, including action for injunctive relief . . . as may be necessary to carry out the provisions of that Act (RCW 90.48.037), including its prohibition of the discharge of organic or inorganic matter that may cause pollution of ground or surface water (RCW 90.48.080).

The Washington Departments of Ecology and Agriculture signed a Memorandum of Understanding (MOU) in 2003 to guide coordination and cooperation between the two agencies for dairies, CAFOs and other animal feeding operations. A key element of the MOU is that WSDA inspectors must provide field inspections and technical assistance to DOE for CAFO and other AFO related water quality activities. The two agencies continue to coordinate on livestock and manure related complaints and in implementing the CAFO permit. An updated MOU was signed in 2009. The MOU can be found at

http://agr.wa.gov/FP/Pubs/docs/MOUAgricultureEcology2011Final.pdf

Under the MOU, DOE is responsible to EPA for Clean Water Act compliance for AFOs and CAFOs. DOE maintains authority under Ch. 90.48 RCW to take compliance actions on any livestock operations where human health or environmental damage has or may occur due to potential or actual discharges, for pasture or rangeland based operations, for manure spreading operations when it is determined the manure was not applied by a dairy, for non-dairy AFOs, CAFOs and permitted CAFOs, and ultimately for permitted dairies. Where compliance actions are against non-permitted dairies, DOE recognizes WSDA as lead. Where DOE is involved in investigations and compliance actions against non-permitted dairies, DOE will discuss the compliance actions with WSDA to ensure that timely compliance actions are sufficient to protect human health and the environment. DOE is responsible for the approval of best management practices used to show compliance with water quality standards. DOE must provide available monitoring data and trend analysis for livestock related pollutants to WSDA upon request. DOE's TMDL process must involve WSDA as a stakeholder if livestock issues are anticipated.

The Ecology/WSDA MOU requires that both agencies provide the other all livestock related records that either may possess as necessary to fulfill state and federal requirements for livestock under the Clean Water Act (MOU ¶ C.2), and that the two agencies will coordinate in response to public disclosure requests for AFOs, CAFOs and dairies (MOU ¶ C.4)

WSDA is responsible for implementing Ch. 90.64 RCW and is required to follow Ch. 43.05 RCW. WSDA is responsible for inspections and may initiate compliance actions on permitted dairies, but must notify DOE if there is a discharge to waters of the state and provide a Recommendation for Enforcement. WSDA is responsible for inspections, complaint response and warning letters for all non-dairy permitted CAFOs. DOE is responsible for complaint response for non-dairy AFOs and CAFOs but WSDA may respond for initial complaint response if resources are available and may write warning letters. WSDA must coordinate, but seldom becomes involved, with DOE when compliance actions beyond warning letters are necessary for non-dairy AFOs and CAFOs or permitted CAFOs. WSDA must enter complaint inspections and warning letters on non-permitted AFOs and CAFOs into DOE's PARIS database.

NRCS offers voluntary financial and technical assistance programs to eligible landowners and agricultural producers to help them manage natural resources in a sustainable manner. Those under contract with NRCS to participate in voluntary programs must adhere to relevant standards for funded projects. Current financial assistance programs in Washington State include:

- Agricultural Management Assistance (AMA): helps agricultural producers use conservation to manage risk and solve natural resource issues through natural resources conservation.

- Conservation Stewardship Program (CSP): helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resources concerns.

- Environmental Quality Incentives Program (EQIP): provides financial and technical assistance to agricultural producers in order to address natural resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, reduced soil erosion and sedimentation or improved or created wildlife habitat.

Yakima County's Role in Groundwater Quality Protection

Yakima County's role in groundwater quality protection is enabled by Washington's Growth Management Act and the State Environmental Policy Act.

Growth Management Act

The Washington State Growth Management Act (GMA), primarily codified in Ch. 36.70A RCW, requires counties and cities planning under the act to adopt comprehensive plans and development regulations consistent with the GMA. The GMA establishes goals to guide the development and adoption of comprehensive plans and development regulations of those counties, like Yakima, that are required or choose to plan under RCW 36.70A.040. Relevant goals include:

> Encourage economic development . . . that is consistent with adopted comprehensive plans, promote economic opportunity for all citizens of this state, especially for unemployed and for disadvantaged persons, promote the retention and expansion of existing businesses and recruitment of new businesses, recognize regional differences impacting economic development opportunities, and encourage

growth in areas experiencing insufficient economic growth, all within the capacities of the state's natural resources, public services, and public facilities.

Maintain and enhance natural resource-based industries, including . . . agricultural . . . industries. Encourage the conservation of . . . productive agricultural lands, and discourage incompatible uses.

Protect the environment and enhance the state's high quality of life, including air and water quality, and the availability of water. RCW 36.70A.020

The GMA requires that:

Each comprehensive plan shall include a plan, scheme, or design for each of the following: A land use element designating the proposed general distribution and general location and extent of the uses of land, where appropriate, for agriculture, timber production, housing, commerce, industry, recreation, open spaces, general aviation airports, public utilities, public facilities, and other land uses. The land use element shall include population densities, building intensities, and estimates of future population growth. The land use element shall provide for protection of the quality and quantity of groundwater used for public water supplies." (RCW 36.70A.070(1) Emphasis supplied.)

The GMA identifies both agriculture and groundwater quality as protectable resources. GMA recognizes the importance of rural lands and rural character to Washington's economy, its people, and its environment. Rural lands and rural-based economies enhance the economic desirability of the state, help to preserve traditional economic activities, and contribute to the state's overall quality of life. (RCW 36.70A.011). The statute also recognizes that, in order to retain and enhance the job base in rural areas, rural counties must have flexibility to create opportunities for business development. Rural counties must have the flexibility to retain existing businesses and allow them to expand. Not all business developments in rural counties require an urban level of services. Many businesses in rural areas fit within the definition of rural character.

When defining the county's rural element, a county should foster land use patterns and develop a local vision of rural character that will: help preserve rural-based economies and traditional rural lifestyles; encourage the economic prosperity of rural residents; foster opportunities for small-scale, rural-based employment and self-employment; permit the operation of rural-based agricultural, commercial, recreational, and tourist businesses that are consistent with existing and planned land use patterns; be compatible with the use of the land by wildlife and for fish and wildlife habitat; foster the private stewardship of the land and preservation of open space; and enhance the rural sense of community and quality of life (RCW 36.70A.070(5)).

RCW 36.70A.030 (15) defines "Rural character" as the:

"Patterns of land use and development established by a county in the rural element of its comprehensive plan:

(a) In which open space, the natural landscape, and vegetation predominate over the built environment;

(b) That foster traditional rural lifestyles, rural-based economies, and opportunities to both live and work in rural areas;

(c) That provide visual landscapes that are traditionally found in rural areas and communities;

(d) That are compatible with the use of the land by wildlife and for fish and wildlife habitat;

(e) That reduce the inappropriate conversion of undeveloped land into sprawling, low-density development;

(f) That generally do not require the extension of urban governmental services; and

(g) That are consistent with the protection of natural surface water flows and groundwater and surface water recharge and discharge areas.

"Rural development" means:

Development outside the urban growth area and outside agricultural, forest, and mineral resource lands designated pursuant to RCW 36.70A.170. Rural development can consist of a variety of uses and residential densities, including clustered residential development, at levels that are consistent with the preservation of rural character and the requirements of the rural element. Rural development does not refer to agriculture or forestry activities that may be conducted in rural areas. (RCW 36.70A.030 (16))

"Rural governmental services" includes:

Those public services and public facilities historically and typically delivered at an intensity usually found in rural areas, and may include domestic water systems, fire and police protection services, transportation and public transit services, and other public utilities associated with rural development and normally not associated with urban areas." (RCW 36.70A.030 (17))

Yakima County enacted its Comprehensive Plan (Plan 2015) in 1997. Three plan Eplements, Natural Setting, Land Use and Utilities, include goals and policies related to water quality. Plan 2015's goals and policies are implemented through various titles of Yakima County Code. Yakima County's zoning code, YCC Title 19[3], applies to all of unincorporated Yakima County. Table 19.10.020-1 lists the zoning classifications applicable throughout the unincorporated areas. Table 19.14-1 lists which specific land uses are allowed within particular zoning districts.. Each permitted use is subject to a particular level of review: Type 1 - permitted; Type 2 - administrative review; Type 3 - conditional; Type 4 - quasi-judicial review. YCC 19.30.030.

The Agriculture (AG) Zoning District is by far the most prevalent use district in the Lower Yakima Valley, followed by the Remote/Extremely Limited Development Potential (R/ELDP) district on the ridges and along the Yakima River, Valley Rural (VR) on the valley floor and some Rural Transitional (RT) Zoning Districts near the cities and towns. The AG zone allows a broad array of agricultural uses under Type I review, including: Animal Feeding Operations, land application of soil amendments or agricultural waste at agronomic rates. CAFOs are allowed in the AG and R/ELDP zones under Type II review and by Type III hearing review in the VR.

The Growth Management Act requires counties to designate critical areas (RCW 36.70A.060(2), 170(d)). "Critical areas" include the following areas and ecosystems: (a) Wetlands; (b) areas with a critical recharging effect on aquifers used for potable water; (c) fish and wildlife habitat conservation areas; (d) frequently flooded areas; and (e) geologically hazardous areas. "Fish and wildlife habitat conservation areas" do not include such artificial features or constructs as irrigation delivery systems, irrigation infrastructure, irrigation canals, or drainage ditches that lie within the boundaries of and are maintained by a port district or an irrigation district or company RCW 36.70A.030(5). "Development regulations" may be established for critical areas so as to prohibit or refine permitted uses under existing zoning requirements RCW 36.70A.172(1)).

As amended by Yakima County Ordinance 13-2007, the Yakima County Code now addresses regulation of land use within critical areas in Ch. 16C. Application of that chapter to agricultural activities defined in YCC 16C.01.050(3)(a) is limited due to the provisions of RCW 36.70A 700-760. (YCC Title 19 became effective October 1, 2015, replacing YCC Titles 15 and 15A, pursuant to Yakima County Ordinance 7-2013.) Regulation of agricultural activities on designated agricultural and rural lands is retained in Ch. 16A. Critical areas subject to the Shoreline Management Program are addressed in YCC Ch. 16D.

RCW 36-70A.700 through .760 establish a "Voluntary Stewardship Program" under which counties may choose to adopt a voluntary practices approach in lieu of protecting critical areas in areas used for agricultural activities through development regulations adopted under RCW 36.70A.060. Yakima County adopted the voluntary practices approach by ordinance. This approach involves the establishment of a "watershed group" to develop a "work plan to protect critical areas while maintaining the viability of agriculture in the watershed" RCW 36.70A.720 (1).

The Growth Management Act requires local jurisdictions to designate and protect areas with a critical recharging effect on aquifers used for potable water, or areas where a drinking aquifer is vulnerable to contamination that would affect the potability of the water. RCW 36.70A. YCC 16C.09.01 (1).

A "critical aquifer recharge area" is an area "with a critical recharging effect on aquifers used for potable water, including areas where an aquifer that is a source of drinking water is vulnerable to contamination that would affect the potability of the water, or is susceptible to reduced recharge" WAC 365-190-030 (3).

Regulations of the Washington Department of Commerce provide that:

> (2) The quality and quantity of groundwater in an aquifer is inextricably linked to its recharge area. Where aquifers and their recharge areas have been studied, affected counties and cities should use this information as the basis for classifying and designating these areas. Where no specific studies have been done, counties and cities may use existing soil and surficial geologic information to determine where recharge areas exist. To determine the threat to groundwater quality, existing land use activities and their potential to lead to contamination should be evaluated.
>
> (3) Counties and cities must classify recharge areas for aquifers according to the aquifer vulnerability. Vulnerability is the combined effect of hydrogeological susceptibility to contamination and the contamination loading potential. High

> vulnerability is indicated by land uses that contribute directly or indirectly to contamination that may degrade groundwater, and hydrogeologic conditions that facilitate degradation. Low vulnerability is indicated by land uses that do not contribute contaminants that will degrade groundwater, and by hydrogeologic conditions that do not facilitate degradation. Hydrological conditions may include those induced by limited recharge of an aquifer. Reduced aquifer recharge from effective impervious surfaces may result in higher concentrations of contaminants than would otherwise occur. WAC 365-190-100

Yakima County has prohibited certain uses in critical aquifer recharge areas YCC. 16C.09.07. Currently, those limitations include:

> (1) Landfills. Landfills, including hazardous or dangerous waste, municipal solid waste, special waste, wood waste and inert and demolition waste landfills;
>
> (2) Underground Injection Wells. Class I, III and IV wells and subclasses 5F01, 5D03, 5F04, 5W09, 5W10, 5W11, 5W31, 5X13, 5X14, 5X15, 5W20, 5X28, and 5N24 of Class V wells;
>
> (3) Wood Treatment Facilities. Wood treatment facilities that allow any portion of the treatment process to occur over permeable surfaces (both natural and manmade);
>
> (4) Storage, Processing, or Disposal of Radioactive Substances. Facilities that store, process, or dispose of radioactive substances;
>
> (5) Mining. Hard rock; and sand and gravel mining, unless located within the mineral resource designation; and
>
> (6) Other Prohibited Uses or Activities. (a)Activities that would significantly reduce the recharge to aquifers currently or potentially used as a potable water source;
>
> (b)Activities that would significantly reduce the recharge to aquifers that are a source of significant base flow to a regulated stream.

"Susceptible Groundwater Management Areas," defined as "areas that have been designated as moderately or highly vulnerable or susceptible in an adopted groundwater management program developed pursuant to Chapter 173-100," are among those designated CARAs. YCC 16C.09.02(3). The Lower Yakima Groundwater Management Area is currently developing such a program, but it has not yet been "adopted."

Unless the work plan to protect critical areas contemplated by RCW 36.70A.720 (1) is first put in place, and adopted within the groundwater management program, those provisions of the Growth Management Act requiring establishment of development regulations within CARAs would not apply to agricultural activities within the CARA. Again, application of the critical areas aspects of the Growth Management Act to agricultural activities defined in YCC 16C.01.050(3)(a) is limited due to the provisions of RCW 36.70A 700-760.

The county commission may also "create one or more aquifer protection areas for the purpose of funding the protection, preservation, and rehabilitation of subterranean water" (RCW 36.36.020). The creation of an aquifer protection area is subject to the vote of residents within a proposed area. Fees imposed within a designated critical aquifer recharge area may be used to address:

> (1) The preparation of a comprehensive plan to protect, preserve, and rehabilitate subterranean water, including groundwater management programs adopted under chapter 90.44 RCW. This plan may be prepared as a portion of a county sewerage and/or water general plan pursuant to RCW 36.94.030;
>
> (2) The construction of facilities for: (a) The removal of waterborne pollution; (b) water quality improvement; (c) sanitary sewage collection, disposal, and treatment; (d) storm water or surface water drainage collection, disposal, and treatment; and, (e) the construction of public water systems;
>
> (3) The proportionate reduction of special assessments imposed by a county, city, town, or special district in the aquifer protection area for any of the facilities described in subsection (2) of this section;
>
> (4) The costs of monitoring and inspecting on-site sewage disposal systems or community sewage disposal systems for compliance with applicable standards and rules, and for enforcing compliance with these applicable standards and rules in aquifer protection areas created after June 9, 1988; and,
>
> (5) The costs of: (a) Monitoring the quality and quantity of subterranean water and analyzing data that is collected; (b) ongoing implementation of the comprehensive plan developed under subsection (1) of this section; (c) enforcing compliance with standards and rules relating to the quality and quantity of subterranean waters; and (d) public education relating to protecting, preserving, and enhancing subterranean waters. RCW 36.36.040

Yakima County's Zoning Ordinance also implements a number of Plan 2015 policies intended to reduce the number of individual wells approved in the higher density RT zone.

Washington State Environmental Policy Act

Washington State's Environmental Policy Act, Ch 43. 21C RCW, requires state agencies and local governments to consider the environmental implications of potential actions. It is like the National Environmental Policy Act, enacted by Congress in 1970. Using a check list of environmental factors, governmental officials must consider the threshold question whether a potential action has "a probable significant, adverse environmental impact" RCW 43.21C.031 (a). If not, an environmental assessment or determination of non-significance may be published. If so, then an environmental impact statement is required. The environmental impact disclosure process imposed by these requirements is used by local governments exercising their police power in zoning, subdivision or other permitting actions to identify factors militating toward denial of specific development proposals or conditions that may be attached to the approval of those proposals.

When the Yakima County Planning Department receives an application for approval of a particular activity, it circulates a completed checklist of environmental factors to other governmental agencies with jurisdiction of the potential activities in order to solicit their expertise with respect to the anticipated action. Whenever those agencies suggest concerns, those concerns may be incorporated as a basis to deny or impose conditions upon approval of the proposed action.

Yakima Health District

The board of the Yakima County Health District consists of seven members, including three members of the board of county commissioners; two elected officials of the cities and towns within Yakima County be appointed by their legislative bodies and two citizens from within Yakima County with an interest in public health appointed by county commissioners YCC 6.04.010.

The Health District approves the acceptability of site conditions for installation and construction of onsite septic systems. WAC 246-272A-0015(5) requires that the Yakima Health District prepare a written plan to provide guidance to Yakima County regarding development and management activities for all onsite septic systems within the county. At a minimum the plan should include a description of the Yakima Health District's capacity to provide education and operation and maintenance information for all types of systems in use within the county; a description of how the local health officer will remind and encourage homeowners to complete the operation and maintenance inspection required by WAC 246-272A-0270; and, a description of its capacity to adequately fund its onsite septic system plan.

The Yakima Health District inspects about 50 percent of newly constructed wells, seeking proper bentonite or other sealing, tags, etc. It determines the GPS coordinates of each inspected well and reports the same to the Department of Ecology.

WAC 246-272A-0015(9) authorizes the Health District to adopt its own rules for septic systems more stringent than rules adopted by the State Department of Health, provided that they are approved by the Department of Health.

Attachment F

Draft Livestock/CAFO Working Group Report to the GWAC.

LYV GWMA Groundwater Management Plan – Livestock/CAFO

Draft Livestock/CAFO Working Group Report to GWMA

The GWAC Work Plan proposed to define the extent of the potential of nitrates to accumulate in groundwater caused or potentially caused by livestock yards, corrals and lagoons at livestock and consolidated animal feeding operations (CAFOs). Manure field application processes and effects were excluded from the Livestock/CAFO Working Group's analysis.

The Livestock/CAFO Working Group defers to the WSDA's Nitrogen Availability Study[1] with respect to the amount of nitrogen available from livestock yards, corrals and lagoons at livestock and CAFO operations. The Working Group has not defined nor quantified the available source's contribution to the groundwater problem. The Working Group defers to the Data Collection Working Group to examine groundwater quality trends by cause; evaluate and predict the likelihood of future problems and conflicts if no action is taken; identify areas where insufficient data exists to define the nature and extent of existing or potential groundwater nitrate contamination; develop a plan to obtain the data necessary to define the nature and extent of existing or potential groundwater nitrate contamination sources.

Dairy and Livestock Operations:

The size and growth of the livestock industry in Yakima County is described in the WSDA's Nitrogen Availability Study.

Manure and other animal wastes supply nutrients to crops because they contain nitrogen and other elements essential to plant growth, and the recycling of animal nutrients to increase soil fertility and crop yield is an historic practice. Manures are recommended over commercial fertilizers where desired to build the soil profile by increasing and diversifying soil organisms, increasing moisture holding capacity, thus reducing the need for inputs. Manure is a "dairy nutrient" under Washington States Dairy Nutrient Management Act. Ch. 90.64 RCW " 'Dairy nutrient' means any organic waste produced by dairy cows or a dairy farm operation." RCW 90.64.010 (11).

Livestock operations have the potential to release nitrate, chloride, sulfate, and bacteria to surface or groundwater (Harter, et al., 2002; Harter, et al., 2008; Harter, et al., 2014; Park, et al., 2012; Unc, et al., 2012). Whether groundwater contamination occurs depends on contaminant characteristics, management practices, meteorological conditions, soil types, geological conditions, and groundwater characteristics (Viers, et al., 2012). Contaminant sources can be animal holding areas, manure storage impoundments (either lagoons or settling ponds/basins), and manure applications to cropland (Harter, Davis, Mathews, and Meyer 2002).

The national statistical average of manure production of milk cows (in 2000) was 15.24 tons per animal unit of manure excreted per year. The national statistical average of nitrogen per ton of manure excreted is 10.69 pounds of nitrogen per ton. (Kellog, et al., 2000). The formulas used by the Environmental Protection Agency to calculate animal manure production, nitrogen

[1] WSDA, Estimated Nitrogen Available for Transport in the Lower Yakima Valley Groundwater Management Area, Draft, April 2017.

production and losses due to volatilization or denitrification (EPA, 2012c, attributable to WSDA) in the Yakima Valley are as follows:

> Annual manure production is calculated using the following formula: [((# of milking cows)*1.4*108) + ((# of dry cows)*1.4*51) + ((# of heifers)*0.97*56) + ((# of calves *0.33*83)]*365/2000 (WSDA 2010)
>
> Nitrogen production is calculated using the following formula: [((# of milking cows)*1.4*.71) + ((# of dry cows)*1.4*.3) + ((# of heifers)*0.97*.27) + ((# of calves *0.33*.42)]*365/2000 (WSDA 2010)
>
> Losses due to volatilization or denitrification during storage are estimated at 35%.[2] This does not include application losses.

Concentrated Animal Feeding Operations:

Federal rules, Title 40 Part 122, under the federal Clean Water Act define dairies with 750 or more animals and feedlots with 1000 or more animals as Large Concentrated Animal Feeding Operations (CAFO). Large CAFOs can be further defined as point sources of water pollution if they can or do discharge to surface waters, becoming subject to the National Pollutant Discharge Elimination System (NPDES) requirement for permit. However, unlike other point sources that have continuous or regular discharges to surface waters, CAFOs are not considered to automatically have a surface water discharge. Consequently, they may be required to obtain an NPDES CAFO permit only if they have a discharge or potential to discharge.

In Washington, the NPDES permit program, including the CAFO permit, is the responsibility of the Department of Ecology. On February 3, 2017, the Department of Ecology announced its reissuance of a new Concentrated Animal Feeding Operation (CAFO) National Pollutant Discharge Elimination System (NPDES) and a new State Waste Discharge General Permit. These permits become effective on March 3, 2017, and expire March 2, 2022. They were reissued as two separate permits, the CAFO State Waste Discharge General Permit (state permit) and the CAFO NPDES and State Waste Discharge General Permit (combined permit). The state and combined permits regulate the discharge of pollutants such as manure, litter, or process wastewater from CAFOs into waters of the state. The state permit conditionally authorizes discharges to groundwater only. The combined permit conditionally authorizes discharges to surface and groundwater, including agricultural stormwater. Coverage under a general permit will be available to facilities that meet the definition of a CAFO and that have a discharge or that voluntarily apply for permit coverage.

The Concentrated Animal Feeding Operation (CAFO) permit requires large-scale livestock operations in Washington to implement specific practices to better protect groundwater, rivers, lakes and marine waters from manure pollution. Discharges conditionally authorized by the CAFO permit must not cause or contribute to a violation of water quality standards.

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[2] NRCS Waste Ag Handbook. Nutrient characteristics chapter 4. see page 4-13 table 4-5
https://www.wcc.nrcs.usda.gov/ftpref/wntsc/AWM/handbook/ch4.pdf
Nutrient losses chapter 11 see. Page 11-16 table 11-5 for nutrient losses
https://www.wcc.nrcs.usda.gov/ftpref/wntsc/AWM/handbook/ch11.pdf

The Department of Ecology has the authority to decide when a facility is required to apply for a permit, approves the nutrient management plan that is required under the permit and is responsible for enforcing the permit. Ecology issued a CAFO General permit in 2006 that covered 5 of the 69 dairies in Yakima County. None of the 11 small or medium sized dairies in the county were considered CAFOs and were not covered by the prior CAFO permit.

The permittee is prohibited from discharging manure, litter, feed, process wastewater, other organic by-products, or water that has come into contact with manure, litter, feed, process wastewater, or other organic by-products, to surface waters of the state from the production area except when:

1. Precipitation events cause an overflow of manure, litter, feed, process wastewater, or other organic by-product management and storage facilities which are designed, constructed, operated, and maintained to contain all manure, litter, feed, process wastewater, and other organic by-products including the contaminated runoff and direct precipitation from a 25-year, 24-hour rainfall event for the location of the facility and still have lagoon design freeboard; and,

2. The production area is operated in accordance with the applicable inspection, maintenance, recordkeeping, and reporting requirements of this permit.

Also, a permittee is prohibited by the permit from discharging manure, litter, feed, process wastewater, or other organic by-products from their land application fields, unless the discharge is generated only by precipitation, not caused by human activities during the precipitation, and the permittee is otherwise in compliance with the permit. The permit establishes production area runoff controls, including the requirement that the permittee must keep manure, litter, and process wastewater from being tracked out onto public roadways. If manure, litter, process wastewater, or other sources of pollutants are tracked out onto public roadways, the permittee must clean-up the material tracked onto the roadway.

The permit establishes conditions related to solid manure, litter, and feed storage, composting facilities, above- and below-ground infrastructure, diversion of clean water, prevention of direct contact between animals and water, handling of chemicals, management of dead animals, sampling and analysis of manure, litter, process wastewater, and other organic by-products, and soil sampling.

The permittee must land apply manure, litter, process wastewater, or other organic by-products in accordance with their yearly field nutrient budgets and at the appropriate rates and times. If the permittee generates more manure, litter, process wastewater, or other organic by-products than the land application fields available to the permittee can appropriately utilize according to their yearly field nutrient budgets, the permittee must find other avenues of appropriately utilizing the excess manure, litter, process wastewater, or other organic by-products (e.g. export, composting). The permittee's staff must have sufficient training to be able to land apply in accordance with the yearly field nutrient budgets and at appropriate rates and times to comply with permit conditions.

The permittee must manage the application of irrigation water so that the amount of water applied from precipitation and irrigation does not exceed the water holding capacity in the top two feet of soil, thereby preventing the downward movement of nitrate.

The permittee must use field discharge management practices on their land application fields to limit discharge of manure, litter, process wastewater, and other organic by-products to down-gradient surface waters or to conduits to surface or groundwater.

The permittee is permitted to "export" manure, i.e., to relinquish control of how the manure is used. When exporting manure, the permittee must provide the most recent manure, litter, process wastewater, or other organic by-product nutrient analysis to the recipient as part of export. The permittee must keep records of its manure exports.

The Livestock/CAFO Working Group has found consensus that the Department of Ecology's reissued CAFO permits are an affirmative action in addressing groundwater nitrate concentrations within the GWMA, but have not found consensus whether the conditions contained in the reissued CAFO permits are overly, satisfactorily, or insufficiently restrictive.

Dairy Nutrient Management Plans:

In Washington State, dairies that are licensed to sell Grade A milk who generate large quantities of animal waste that can pollute surface water and groundwater must have an "approved" Nutrient Management Plan (NMP) on site within six months after licensing, which plan must be "certified" within two years after licensing. (RCW 90.64.026) The purpose of such plans is to prevent the discharge of livestock nutrients to surface and ground waters of the state. An employee of the South Yakima Conservation District often writes the NMP. "Approved" means the local conservation district has determined that the facility's plan to manage nutrients meets all the elements identified on a checklist established by the Washington Conservation Commission. "Certified" means the local conservation district has determined all plan elements are in place and implemented as described in the plan. To be certified, both the dairy operator and an authorized representative of the local conservation district must sign the plan. Dairies whose NPDES permits require dairy nutrient management plans need not be otherwise "certified." "Farm Plans," developed by conservation districts for farmers, must include "livestock nutrient management measures." RCW 89.08.560.

The required elements of the plan address the collection, storage, transfer and application of manure, waste feed and litter, and any potentially contaminated runoff at the site. The primary goals of the plans are to protect water quality from dairy nutrient discharges. Excess nutrients must be exported off site. Plans focus on management of nitrogen, and phosphorus as well as preventing bacteria and other pollutants, such as sediment, from reaching surface or ground water.

The elements of a dairy nutrient management plan must include methods and technologies of the nature prescribed by the Natural Resources Conservation Service, a department of the U.S. Department of Agriculture. RCW 90.64.026(3).

Nutrient management plans are required to be maintained on the farm for review by inspectors. The DNMA requires that all dairies be inspected for implementation of their nutrient management plans and to ensure protection of waters of the state. Most dairies keep their NMPs and associated sampling data on location.

The Department of Agriculture's regulations implementing the DNMA are published at chapter 16-611 WAC. WAC 16-611-010 defines "agronomic rate" as "the application of nutrients to supply crop or plant nutrient needs to achieve realistic yields and minimize the movements of nutrients to surface and ground waters." The same section defines "nutrient" as "any product or combination of products used to supply crops with plant nutrients including, but not limited to, manure or commercial fertilizer." The phrase "transfer of manure" is defined as "the transfer of manure, litter or process waste water to other persons when the receiving facility is in direct control of application acreage, rate or time and transfer rate and time."

Dairy producers must maintain records to demonstrate that applications of nutrients to crop land are within acceptable agronomic rates. Those records should demonstrate that applications of nutrients to the land were within acceptable agronomic rates. Soil analysis should include annual postharvest soil nitrate nitrogen analysis; triennial soil analysis that includes organic matter; pH, ammonium nitrogen; phosphorus, potassium; and electrical conductivity. Nutrient analysis is required for all sources of organic and inorganic nutrients including, but not limited to, manure and commercial fertilizer supplied for crop uptake. Manure and other organic sources of nutrients must be analyzed annually for organic nitrogen, ammonia nitrogen, and phosphorus.

Nutrient application records should include field identification and year of application, crop grown in each field where the application occurred, crop nutrient needs based on expected crop yield, nutrient sources available from residual soil nitrogen including contributions from soil organic matter, previous legume crop, and previous organic nutrients applied, date of applications, method of application, nutrient sources, nutrient analysis, amount of nitrogen and phosphorus applied and available for each source, total amount of nitrogen and phosphorus applied to each field each year; and the weather conditions twenty-four hours prior to and at time of application. Manure transfer records, including imports or exports should include date of manure transfer; amount of nutrients transferred, the name of the person supplying and receiving the nutrients, and a nutrient analysis of manure transferred. Irrigation water management records should include field identification and the total amount of irrigation water applied to each field each year.

Local Conservation Districts provide dairies with technical assistance and planning services and are required to approve and certify all nutrient management plans.

The Livestock/CAFO Working Group was able to reach consensus that Dairy Nutrient Management Plans are important tools for managing nitrate concentrations in groundwater within the GWMA but unable to reach consensus whether alternative or additional regulatory approaches should be implemented.

Lagoons:

Liquid manure stored in lagoons can be a source of nitrate and other contaminants. Contents of lagoons often consist of liquid manure (including urine), rainfall and snowmelt, any other liquid corral runoff, and process water from feeding pens and milking areas. Design, construction, and management of lagoons are all very important for the protection of groundwater. In studying dairy, beef, and swine lagoons, researchers found substantial variation in the composition of solids, liquids, and dissolved constituents and leakage rates causing a wide variation in the potential to impact groundwater quality (Ham 2002); Harter, et al., 2014, Vander Schans, et al, 2009).

The distinction between a lagoon, a settling basin, a settling pond, or a pond can be hard to clarify. Different professionals use different terms for different manure storage impoundments, and different impoundments may be used for different purposes at different times of year. Producers may mix manure and water in additional ponds before land application.

Different industry experts classify impoundments based on different criteria and experience. In addition, there are a wide variety of different construction techniques and operational techniques for settling ponds and basins. Some are earthen impoundments that are drained and cleaned as needed. Some ponds are concrete lined, engineered basins, which would make using permeabilities for a clay lined impoundment inappropriate

Lagoon nitrogen concentration depends on farm practices and unit operations on-site. Operational differences are often related to whether a dairy uses a flush or scrape system to clean barns, the type of solids separation systems utilized and whether irrigation water is mixed with liquid manure for land application, and potential seasonal effects.

Under the 2017 CAFO permit, the permittee must have adequate storage space for the manure, litter, process wastewater, feed, and any other sources of pollutants on-site during the storage period for the area where the CAFO is located. Lagoons and other liquid storage structures built, expanded, or having major refurbishment (e.g., complete emptying and re-compaction to restore the earthen liner) done after the issuance of this permit must achieve a permeability of 1×10^{-6} cm/s without consideration for manure sealing and there must be a minimum of two feet of vertical separation between the bottom of the lagoon (measured from the outside of the earthen liner) and the water table, including seasonal high water table. Lagoons must be inspected, maintained as to structure and volume, and permanently decommissioned when closed.

Animal Holding Areas or Corrals:

Animal holding areas or corrals at animal feeding operations are typically unvegetated areas that include pens, freestalls, corrals, and resting and feeding areas. Some areas have extensive concrete and other areas are dominated primarily with a flooring or surface of unlined and compacted soil that can be susceptible to leaching or runoff to contaminant areas. If properly constructed and maintained, concrete floor surfaces can contain wastes and minimize leaching. Corral surfaces become compacted with use and become dense enough to slow down the downward movement of water and pollutants. Manure accumulating on the surface mixes with the soil layer and forms a low-permeability interface layer that further reduces the permeability of corral and pen surfaces (Harter, et al., 2014, Mielke, et al., 1974, Miller, et al., 2008). Nitrogen loading from corrals and pens at dairy and feedlot facilities is governed by engineered sloping, soil type, dairy or feedlot age, unsaturated zone thickness, stocking rate, rainfall, and evapotranspiration rates. In some situations, increased short-term leaching in corrals may occur due to cracking during seasonal weather events.

Pens and Composting Areas:

There are 2,632 acres within the GWMA identified by WSDA as pens or composting areas. (1,597 acres Dairy CAFO, 499 acres Nondairy CAFO, 536 acres compost). The nitrogen loading rates of animal pens vary depending upon number and size of stock contained within them and the management of those pens. Nitrogen leach potential in pens and compost areas is mitigated by low annual precipitation and management of the amount of manures in those pens. Beef cattle feedlots and dairies have different stocking rates. The majority of pens that have been identified as non-dairy CAFOs are most likely dedicated to raising or housing dairy support animals (calves and heifers). However, individual pens may hold calves during one time period and after those animals are moved out, heifers and adult cows may be moved into that same corral or pen.

Management practices are required on site of dairy CAFO pens, such as maintaining an intact interface layer to inhibit leaching through the pen surface, changes in precipitation and evapotranspiration from season to season, and animal stocking rates will all affect potential loading.

Composting may occur in windrows, composting in bags, spreading material out over a concrete pad or large surface area to dry, turning frequency, potential moisture additions to material that has dried out.

Buildings Housing Animals:

Animals may spend time in free stall barns, milking parlors or loafing sheds. These facilities are built with concrete floors and are cleaned multiple times a day. Potential leaching from these types of buildings, even anticipating cracks in concrete floors that could provide a pathway to leaching, is much smaller than potential from pens and lagoons.

LIVESTOCK/CAFO WORK GROUP GWAC RECOMMENDATIONS

The Livestock/CAFO Work Group (Work Group) reviewed the regulatory framework and evaluated the potential contributions of livestock industries to groundwater nitrate levels within the boundaries of the Lower Yakima Valley Groundwater Management Area (LYV GWMA). This section presents areas of agreement within the Work Group, which in general provide the best management of dairy and livestock wastes. The following information is contained in this section:

- The Work Group Composition
- The Work Group Approach
- Problem Definition
- Water Quality Goal
- Existing Management Strategies and Programs
- Alternative Management Strategies
- Recommended Management Strategies
- Implementation Plan
- Recommended Methodology to Monitor for Progress

Work Group Composition:

The participants are representatives of State Agencies-Agriculture and Ecology, the Yakama Nation, Dairy Federation, South Yakima Conservation District, Community Members, Yakima County Farm Bureau, Agricultural Consultants, and Environmental Advocacy Groups-Friends of Toppenish Creek and Concerned Citizens of the Yakama Reservation.

Work Group Approach:

The task was to evaluate the potential contribution of the dairy and livestock industry to groundwater nitrate in the LYV GWMA associated with livestock waste used for application to agricultural lands; unplanned leakage or discharges from waste storage structures; infiltration of nutrient-containing water through feedlot surfaces, composting activities, feed storage, lagoons, and animal mortality practices.

A work plan was developed to guide the efforts of the Livestock/CAFO Work Group. The Work Group tasks were: to evaluate existing management strategies and programs, identify and evaluate alternative management strategies, and provide strategy and implementation recommendations to the Groundwater Advisory Committee (GWAC) for their consideration and adoption.

The nitrogen-containing discharges from livestock operations are regulated by different agencies, the goals and recommended strategies discussed below are closely tied to those regulatory requirements.

LCWG 2.1.1 Problem Definition:

The purpose of the Groundwater Management Area is to reduce the nitrate contamination concentrations in groundwater below state drinking water standards. Nitrate exposure reduces the ability of red blood cells to carry oxygen which can lead to serious human health conditions, especially in infants, and pregnant women. The Livestock/CAFO Work Group was tasked with identifying potential sources of nitrates in groundwater associated with barns, pens, corrals, lagoons/ponds, composting, feed storage, and animal mortality.

LCWG 2.1.2 Water Quality Goals to Reduce Levels of Nitrates in Groundwater to Safe Drinking Water Standards:

The goal of the LYV GWMA and Livestock/CAFO Work Group is to reduce nitrate levels in the groundwater to meet or exceed safe drinking water standards below 10 mg/L. Our expectation is to see some measurable improvement within five years of program implementation. Additional information is needed to determine the length of time required to meet the baseline goal of 10 mg/L.

The framework to monitor progress has been approved by the LYV GWMA Groundwater Advisory Committee (GWAC) in the Ambient Groundwater Monitoring Plan with plans to implement in 2017. The monitoring plan includes a series of purpose built wells and existing wells with in the LYV GWMA boundaries.

Legacy levels of nitrate in the soil have potential to be an impact for decades. Implementation of the following recommended management strategies will reduce legacy impacts, reduce current discharges, and lead to some immediate improvements to groundwater quality. Going forward, implementation of best management practices will reduce the amount of nitrate, including the legacy contaminants, being driven through soils to groundwater.

LCWG 2.1.3 *Existing Management Strategies and Programs:*

Existing strategies and programs recognize that manure and other animal wastes supply nutrients and other elements to crops essential for plant growth. Manure and other animal wastes are used to supply necessary nutrients to certified organic food production facilities. Additionally, conventional crop production has benefited from supplementing or replacing inorganic fertilizer with animal waste nutrients such as nitrate.

Discharges of wastewater, solid manure, and water that comes into contact with manure and feed to surface waters are regulated under law as described below:

- Dairies (Class A license) are required under Chapter 90.64 RCW, Chapter 16-611 WAC, to develop Dairy Nutrient Management Plans (DNMPs). Facilities are inspected by the Washington State Department of Agriculture (WSDA) for compliance. Assistance is provided by Conservation Districts under Chapter 89.08 RCW. These plans include descriptions of the waste collection and treatment systems, mechanisms for waste storage and transfer, nutrient utilization plans including crops, acreage, estimates of the nutrient value of the waste, and maintenance structures. The minimum elements of a DNMP are summarized in Attachment A. Associated NRCS Conservation Practice Standards identified by the Work Group are listed in Attachment B.

- The Federal Clean Water Act (CWA) establishes water quality goals for navigable surface waters of the United States. One of the mechanisms for achieving the goals of the Clean Water Act is the NPDES system of permits, which the United States Environmental Protection Agency (EPA) administers. The EPA has delegated responsibility and authority to administer the NPDES permit program to the State of Washington. In addition to this delegation under the CWA, the state legislature in Revised Code of Washington 90.48 defines Ecology's authority and obligations in administering the NPDES permit program. Ecology directly implements the Code of Federal Regulations (CFRs) when developing state NPDES permits. Ecology does not have the authority to issue NPDES permits to CAFOs that are federal or tribal facilities (with the exception of some limited areas on Puyallup Tribe property).

- Chapter 90.48 RCW – The State Water Pollution Control Act declares that maintaining the highest possible standards to insure purity of all waters of the state is the policy of the State. Healthy water quality must be maintained for public health, public enjoyment, protection of terrestrial and aquatic life, and the industrial development of the state. All known, available, and reasonable methods must be used by industries and others to prevent and control pollution. In addition, it is unlawful for any person to discharge pollutants that cause or tend to cause pollution to waters of the state (RCW 90.48.080). The only time a discharge is lawful for commercial and industrial operations is when a permit to discharge is obtained from Ecology prior to the discharge occurring (RCW 90.48.160).

- Chapter 173-226 WAC – Waste Discharge General Permit Program the purpose of Chapter 173-226 WAC is to establish a state general permit program for the discharge of pollutants to waters of the state under the authority granted to Ecology in RCW 90.48. Permits issued under Chapter 173-226 WAC may be state waste discharge general permits or combined NPDES and state waste discharge general permits

- Chapter 173-200 WAC – Water Quality Standards for Groundwaters of the State of Washington, and Chapter 173-201A WAC, Water Quality Standards for Surface Waters of the State of Washington the ***water quality standards*** for the State of Washington determine ***beneficial uses*** of waters of the state. Any permits issued must include ***effluent limitations*** so that allowed discharges meet the water quality standards, including antidegradation.

- A dairy that meets the definition of a Concentrated Animal Feeding Operation (CAFO) or that has been designated a "*significant contributor of pollution" under RCW 90.64.020 is required* to obtain an Ecology CAFO General Permit under Chapter 90.48 RCW.

- Feedlots under the Animal Feeding Operation (AFO) or Concentrated Animal Feeding Operation (CAFO) definitions may be subject to the federal Clean Water Act regulating their waste discharges to surface waters through NPDES permits administered by the Department of Ecology (Ecology).

- The guidelines provided by the existing regulations and policies (such as the DNMPs) provide systems of BMPs for the livestock industry to limit waste discharge to surface waters and groundwater. The work group identified specific guidelines which are mostly based on NRCS Practices as approved for use in the State of Washington but may include best practices; identified by WSU, included in Ecology Guidelines, or based on RCW as passed by the legislature. NRCS Practices identified by the Work Group are listed in Attachment B.

- Memorandum of Understanding between WSDA and Ecology related to the State of Washington's effort to protect water quality related to livestock activities under the authority of Chapter 90.48 RCW, Water Pollution Control Act and Chapter 90.64 RCW, Dairy Nutrient Management Act.

- Washington State Department of Health WAC 246-203-130 – Keeping of Animals.

- Resource Conservation Recovery Act (RCRA) may be applied if organic or non-organic fertilizer are applied in amounts greater than appropriate agronomic rates. WAC 173-350, Solid Waste Handling Practices, lists specific exemptions and guidance regarding volumes and agronomic rates.

- Animal Mortality Composting is regulated under RCW 70.95.306 – Composting of bovine and equine carcasses – Guidelines – Exemption from solid waste handling rules.

- Manure Composting is addressed in WAC 173-350-220 including guidance for conditionally exempt facilities regarding volumes and protocols for Solid Waste Permit exemptions.

The Work Group generally believes that the majority of livestock operators act in good faith, or would if they were educated on impacts and practices toward compliance with relevant State and federal requirements for groundwater protection. The Washington State Department of Agriculture, WSDA, and Conservation Districts are currently tasked with education and outreach.

Limited assistance programs with nutrient management planning, engineering, cost share, and loan funds are available through the local Conservation District's and Natural Resources Conservation Service (NRCS). The Work Group believes current assistance is not sufficient to meet existing need due to inadequate staff and fund availability. Resource limitations has hampered implementation. Implementation of the management strategies recommended in this section will enhance the ability of operations to comply with existing regulations, including the DNMP.

LCWG 2.1.4 Alternative Management Strategies:

No entity or group of entities have the resources to focus on the LYV GWMA issue therefore dedicated funding will need to be identified for implementation of the Livestock/CAFO section and the GWMA program. Some of the potential implementation funding sources discussed include industry, government, private or public research and development, foundations, and industry associations.

Strategies in this section can be coordinated by or with Yakima County, South Yakima Conservation District (SYCD), Yakima County Health District, Washington State Department of Agriculture (WSDA), Ecology, and/or a yet to be formed entity specifically focused on groundwater issues.

There is universal agreement within the Work Group that implementation of an Education and Outreach Program (EOP) informing producers of the nitrate issue, community impacts, and that Best Management Practices (BMP's) needs to be aggressively pursued. A central depository of public information online needs to be implemented and maintained.

There is agreement that current enforcement activities could be streamlined to improve customer service and protocols should be reviewed to increase clarity of process, escalate enforcement for facilities not following management practices, identify methods of discouraging repeatedly unfounded complaints, and improve overall transparency.

A priority for the Work Group is the collection of data to track water quality improvement progress and nutrients generated, applied, or exported within the LYV GWMA. The data will be generated through soil testing, Ambient Groundwater Monitoring Plan implementation - including purpose built and existing wells, sampling of liquid and solid waste to be field applied, composted, or exported, and the CAFO General Permit. Tracking of nutrients applied by non-dairy operations needs to be implemented.

Going forward there is consensus that an Adaptive Management Program will need to be implemented by the organization overseeing the implementation of the LYV GWMA Management Plan. Data collected, progress made, or lack of progress will inform the community on adjustments that need to be implemented. Technology, education and outreach, tracking exports, land use regulations, treatment systems, and other changes will inform decision makers in regards to management changes required for a successful program.

Private, public, and industry investment in technology, including at research institutions, specific to addressing nitrate contamination in groundwater should be supported and advocated for, especially where it creates improvements for the public good.

Ecology's CAFO GP, effective March 3, 2017, wasn't designed to address specific issues identified within the boundaries of the LYV GWMA but portions of the permit apply directly to discussions in the work group. The Concentrated Animal Feeding Operation (CAFO) permit requires large-scale livestock operations to implement specific practices to better protect groundwater, rivers, lakes and marine waters from manure pollution. It builds on the WSDA Dairy Nutrient management Program.

A general consensus could not be reached on the following two topics: potential for Yakima County to pass a LYC GWMA or county-wide CAFO Ordinance; and opinions regarding All Known Available and Reasonable Technology (AKART).

- Yakima County would need to go through a lengthy public process to create a CAFO Ordinance with uncertain outcomes and timing, too much uncertainty to rely on it for the plan at this time. The County may consider legislative action as an alternative if public outreach, voluntary compliance, implementation of identified BMPs, and other efforts set out throughout the Groundwater Management Plan are not effective.

- Discussions regarding AKART centered on what and who would determine if a technology was reasonable. Would it be based on measurable improvement, is it required by law, would it require changes in the middle of a project, is it science based, and will it be site specific? Within current statute, regulatory agencies are ultimately responsible for making a determination regarding AKART and appropriate technologies for site specific situations.

LCWG 2.1.5 Recommended Management Strategies:

Recommended management strategies are not intended to limit the use of any other practice proven to be effective. The Work Group recognizes the design of site-specific systems of BMPs that are tailored to fit the needs of each operation will be necessary.

The Work Group recommends implementation of the following strategies:

Identification or creation of an organization (Lead Entity) responsible for implementation and oversight of the LYV GWMA Groundwater Management Plan and acquisition of stable funding to support their activities. Potential entities include, Yakima County, South Yakima Conservation District (SYCD), Yakima County Health District, Washington State Department of Agriculture (WSDA), Ecology, and/or a yet to be formed entity.

Implement an Education and Outreach Program (EOP) informing producers of Best Management Practices (BMP's) including increased funding for the DNMP assistance program, and a central depository of public information to be maintained online.

Streamline current enforcement activities to improve customer service. Agency protocols should be reviewed and amendments considered to increase clarity of process, the ability to escalate enforcement for facilities not following management practices, identify methods of discouraging repeatedly unfounded complaints – i.e., WSDA pesticides program, and improve overall transparency.

Collection of data to track water quality improvement progress; nutrients generated, applied, or exported; and inform the implementation of an Adaptive Management Plan within the LYV GWMA. The data will be generated through soil testing, Ambient Groundwater Monitoring Plan implementation - including purpose built and existing wells, and sampling of liquid and solid waste to be field applied, composted, or exported.

The Work Group recommends a review and evaluation of the WSDA Dairy Nutrient Management Program inspection protocols to assist in determining if additional resources should be allocated and identify any areas for improvement of the inspections themselves.

The Work Group recommends tracking of nutrients and their application regardless of the end user, including commercial fertilizer. Nutrients from animal waste are tracked while in the control of dairy operations. Once those nutrients are transferred to a third party no further regulation exists.

Identify and support opportunities, including educational research institutions, for private, public, and industry investment in technology specific to addressing nitrate contamination in groundwater.

LCWG 2.1.6 Recommended Implementation:

The Lead Entity will need to prioritize and implement the following:

Inform livestock operators and facilitate a dialogue with representatives of the regulatory agencies, other agricultural producers, and the general public through a public information/education program to protect the quality of the area groundwater resource. Information and incentives provided to Lower Yakima Valley agricultural operators will expedite implementation of BMPs.

Collect, analyze, and interpret data to track water quality improvement progress, nutrients generated, applied, or exported, which will inform the implementation of an Adaptive Management Plan within the LYV GWMA.

Focus implementation of analyzed data based on information and data included in the Nitrogen Loading Assessment, Soil Sampling Program, Ambient Groundwater Monitoring Plan, USGS Reports, and other similar scientifically based publications.

Increase education and outreach efforts by improving the availability of technical assistance to develop nutrient management plans for all livestock industries. Assist industry trade organizations to enhance their local efforts to bring information to their members. Help increase livestock operator awareness of the need for procedures for proper management of animal wastes and wastewater. Potential funding sources include industry, government, educational institutions, grants, industry associations, etc.

Cooperate with the WCC and WSDA in their efforts to document regulatory compliance for dairies within the GWMA that are completing and implementing Dairy Nutrient Management Plans (DNMP). Explore the possibility of disclosing non-proprietary data produced through the DNMP process.

Further develop a local forum for disseminating information and facilitating technical exchange regarding BMPs for livestock management and groundwater protection. Endorse and distribute materials by all effective means that will educate the public about the facts of livestock waste management and the science of groundwater protection.

Quantify the nutrient value and rate of release of nitrate from livestock waste under various Lower Yakima Valley conditions to become part of the nutrient management guidelines.

Voluntary development and implementation of NMPs by operations not already required to hold permits or a DNMP as an effective means of environmental protection.

Allocate cost share funding or other funding assistance to operators implementing environmental protection measures.

Develop strategies for marketing the economic, fertilizer value, and soil enhancing properties of appropriate application of manure and other livestock wastes.

Regulatory agencies need to:

Streamline current enforcement activities to improve customer service. Review and amend Agency protocols to increase clarity of process, escalate enforcement for facilities not following management practices, identify methods of identifying and discouraging repeatedly unfounded complaints - i.e., WSDA Pesticides Program, and improve transparency.

Work closely with the Lead Entity, industry, and the general public to support efforts that will physically and financially implement the plan.

LCWG 2.1.7 Monitoring:

Work plans will be developed by the Lead Entity as warranted to describe the monitoring process and data collection and analysis for the strategies.

The data and information collected will be evaluated on an ongoing basis with annual updates, the results will be compiled and summarized as part of the GWMA 5-year progress report.

Progress in receiving funding, the level of technical and financial assistance provided to help develop and implement BMPs, and the results from their implementation will be tracked and reported annually.

2.1.8 – Process for periodic review and revision of the groundwater management plan:

Lead Entity and GWAC determination.

2.1.9 Develop the GWMA Program Report:

Combined éffort of Work Groups and Lead Entity

2.1.10 Prepare Final Report

Combined effort of Work Groups and Lead Entity

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Table of Contents for WA

NRCS Standards Relevant to LYV GWMA Livestock/CAFO Work Group

Title	File Size (Kb)	Revision Date	STGC Review Date
Amendments for Treatment of Agricultural Wastes (591) Standard	26	01/27/2014	01/27/2014
Anaerobic Digester (366) Standard	223	01/11/2011	01/11/2011
Animal Mortality Facility (316) Standard	72	01/11/2011	01/11/2011
Composting Facility (317) Standard	35	01/11/2011	01/11/2011
Dam (402) STANDARD	67	02/25/2013	02/25/2013
Diversion (362) STANDARD	57	02/25/2013	02/25/2013
Feed Management (592) Standard	58	01/15/2013	01/15/2013
Filter Strip (393) Standard	159	02/11/2015	02/11/2015
Heavy Use Area Protection (561) Standard	97	02/12/2015	02/12/2015
Monitoring Well (353) Standard	98	02/11/2015	02/11/2015
Nutrient Management (590) Standard	83	02/18/2014	02/18/2014
Pond Sealing or Lining, Bentonite Sealant (521C) Standard	34	11/04/2015	01/11/2011
Pond Sealing or Lining, Compacted Clay Treatment (521D) Standard	29	11/04/2015	01/12/2011
Pond Sealing or Lining, Flexible Membrane (521A) STANDARD	81	02/25/2013	02/25/2013
Pond Sealing or Lining, Soil Dispersant (521B) Standard	33	11/04/2015	01/11/2011
Pumping Plant (533) Standard	152	02/12/2015	02/12/2015
Roof Runoff Structure (558) STANDARD	97	02/12/2015	02/12/2015
Short Term Storage of Animal Waste and By Products (318) – National NRCS Standard http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1263507.pdf			
Solid/Liquid Waste Separation Facility (632) Statement of Work	22	01/11/2008	01/11/2008
Sprinkler System (442) Standard	110	11/04/2015	05/23/2014
Stream Crossing (578) Standard	115	02/12/2015	02.12/2015
Vegetative Treatment Area (635) Standard	74	01/29/2016	01/29/2016

Waste Facility Closure (360) STANDARD	75	02/25/2013	02/25/2013
Waste Recycling (633) STANDARD	47	02/25/2013	02/25/2013
Waste Separation Facility (632) STANDARD	48	01/27/2014	01/27/2014
Waste Storage Facility (313) Standard	320	02/11/2015	02/11/2015
Waste Transfer (634) Standard	119	02/12/2015	02/12/2015
Waste Treatment (629) Standard	36	02/12/2015	02/12/2015
Waste Treatment Lagoon (359) STANDARD	67	02/25/2013	02/25/2013
Water Well (642) Standard	180	02/12/2015	02/12/2015
Well Decommissioning (351) Standard	171	02/11/2015	02/11/2015
Groundwater Testing (355) Standard	160	02/11/2015	02/11/2015

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GWAC Work Plan Excerpt – Funding Working Group

5.0 Funding (From GWAC Work Plan)

5.1 Problem Definition - Determine funding short-term and long-term needs

a. Data Collection, Characterization, Monitoring (DCCM)

b. Livestock & CAFO - Yards, corrals, lagoons, manure field application

c. Irrigated Agriculture

d. Pollutants from Residential, Commercial, Industrial, Municipal and Domestic

e. Regulatory Framework

f. Education and Outreach

g. Prepare and submit funding needs to GWAC

h. Incorporate GWAC comments and prepare final report

5.2 Funding Strategy - Determine and develop short-term and long-term funding Strategy

a. Data Collection, Characterization, Monitoring (DCCM)

b. Livestock & CAFO - Yards, corrals, lagoons, manure field application

c. Irrigated Agriculture

d. Pollutants from Residential, Commercial, Industrial, Municipal and Domestic

e. Regulatory Framework

f. Education and Outreach

g. Prepare and submit funding needs to GWAC

h. Incorporate GWAC comments and prepare final report

5.3 Implementation - Seek and apply for all funding opportunities local, state, federal including private-public venture

a. Seek and obtain private, local, state, federal and tribal financial assistance

b. Prepare and submit preliminary funding strategy status report to GWAC

c. Incorporate GWAC comments, finalize final grant report and submit to Ecology

5.4 Monitoring - Develop a long-term monitoring system for evaluating the effectiveness of each strategy and where to spend effort, time and funding

5.5 Review - Develop a plan and process for the periodic review of funding needs and where to obtain funding

5.6 Develop GWMA Program Report (combine with other workgroups)

5.7 Submit Final GWMA Program Report (combine with other workgroups)