State of Idaho
Department Of Environmental Quality
Technical Guidance Committee

Technical Guidance Committee Meeting

Agenda*

Thursday October 31, 2013

9:15 a.m. – 4:30 p.m.

Department of Environmental Quality
Conference Room C
1410 N. Hilton
Boise, Idaho

8:15 AM Call to Order/Roll Call
- Sign in sheet for attendees who wish to comment or present to the committee members
- Introduction of committee members, guests, and attendees

8:20 AM Open to Public Comment – ½ hour reserved for public to provide comments to the TGC on subjects not on the agenda

8:50 AM July 18, 2013 and August 8, 2013 Draft TGC Meeting Minutes: Review, Amend, or Approve (**Appendix A and B**)

9:00 AM 4.2 Nonprofit Corporations (**Appendix C**)
- Review for final approval

9:20 AM 4.10 Extended Treatment Package Systems (**Appendix D**)
- Review for final approval

9:40 AM DEQ Service and Testing Reminder – Explanation Letter (**Appendix E**)
- Review for final approval

9:50 AM Letter 1 – It Has Come to Our Attention (**Appendix F**)
- Review for final approval

10:00 AM Letter 2 – Voluntary Deadline to Comply (**Appendix G**)
- Review for final approval

10:10 AM Break – Ten Minutes

10:20 AM Drainfield to Surface Water Setback Determination Guidance and Model (**Appendix H**)
- Review for final On-Site Wastewater Program implementation recommendation

11:00 AM 1.4.2.2 Extended Treatment Package System Approvals (**Appendix I**)
- Review for final approval

11:30 AM 3.2.5 and 3.2.6 Equal Distribution and Serial Distribution (**Appendix J**)
- Review for final approval

12:00 to 1:00 P.M. Lunch

1:00 PM 4.3 Vested Rights and Nonconforming Uses (**Appendix K**)
- Review for final approval

1:30 PM 2.5 Ground Water Level (**Appendix L**)
- Review for final approval

2:00 PM 3.3 Wastewater Flows (**Appendix M**)
- Review for final approval

2:30 PM 4.25 Sand Mound (**Appendix N**)
- Review for final approval

3:00 PM Break – Ten Minutes

3:10 PM 2.2.3 The Method of 72 to Determine Effective Soil Depths to Porous Layers and Ground Water (**Appendix O**)
- Review for final approval

3:40 PM 4.24 In-Trench Sand Filter (**Appendix P**)
- Review for preliminary approval

4:10 PM Easement (**Appendix Q**)
- Review for preliminary approval

4:30 PM Adjourn
- Meeting may adjourn early dependent upon discussion, interest, and participation for each agenda item
- If needed meeting will run until 4:30 PM to resolve any lingering discussions or issues on the agenda items

*Begin and end time will be observed. Agenda items and their allotted times my vary dependent upon the amount of interest and participation for each item.

The call in number is (208) 373-0101 Bridge # 1

To Join a Conference Call

1) Auto-Attendant Transfer Option

Conference Call Auto-Attendant Number:

- Extension 0101: Inside DEQ phone system
- (208) 373-0101: Outside callers

Participants call auto-attendant number and are then prompted to enter their pre-arranged conference call bridge number and in this case press the number **1**. Once the bridge number has been entered, callers are automatically connected to their conference call.

Notification

As participants are added to a conference call, an audible chime is heard by participants already connected to the call. If the conference is in progress when the chime is sounded, it is advisable to acknowledge the new participant and ask who has joined the call. This will ensure that the new caller has gained access to the proper call.

GoToMeeting Instructions

To Join GoToMeeting

This will allow users joining the meeting via conference call to view the same computer material that the subcommittee members are seeing at the meeting location. To hear audio users will still need to call the conference call number above from their telephone.

1) Visit the Website Below

- https://global.gotomeeting.com/meeting/join/141312229

Meeting ID: 141-312-229

Appendix A

Technical Guidance Committee Meeting

Draft Minutes

Thursday, July 18, 2013

Department of Environmental Quality
Conference Room C
1410 N. Hilton
Boise, Idaho

TGC ATTENDEES:

Tyler Fortunati, R.E.H.S., On-Site Wastewater Coordinator, DEQ
Joe Canning, P.E., B&A Engineers
Bob Erickson, Senior Environmental Health Specialist, South Central Public Health District
David Loper, Environmental Health Director, Southwest District Health Department
Michael Reno, Environmental Health Supervisor, Central District Health Department
George Miles, P.E., Advanced Wastewater Engineering, Inc. (via telephone and GoToMeeting)

GUESTS:

Chas Ariss, P.E., Wastewater Engineering Manager, DEQ
Kellye Eager, Environmental Health Director, Eastern Idaho Public Health Department
Ryan Spiers, Alternative Wastewater Systems, LLC
Janette Young, Administrative Assistant, DEQ

CALL TO ORDER/ROLL CALL:

Meeting called to order at 9:15 a.m.
Committee members and guests introduced themselves.

MEETING MINUTES:

April 18, 2013 Draft TGC Meeting Minutes: Review, Amend, or Approve

The minutes were reviewed and no amendments were proposed. No public comment was received on the minutes.

Motion: Joe Canning moved to accept minutes as presented.

Second: Michael Reno.

Voice Vote: Motion carried unanimously.

Minutes will post as final. See DEQ website and **Appendix A**.

OPEN PUBLIC COMMENT PERIOD: This section of the meeting is open to the public to present information to the TGC that is not on the agenda. The TGC is not taking action on the information presented.

No public comments were submitted during the allotted agenda timeframe.

ETPS SUBCOMMITTEE UPDATE:

Tyler Fortunati presented an update to TGC on what the ETPS Subcommittee has discussed and produced to date. The ETPS Subcommittee voted to move the recommended changes to the ETPS program to the TGC. The TGC will hold a special meeting on August 8th, 2013 at the DEQ State Office with GoTo Meeting access and conference bridge call available. The draft agenda for this meeting is posted online at: http://www.deq.idaho.gov/media/1009356-agenda_080813.pdf

REVIEW OF SOLIDO ETPS PRODUCT:

Discussion on the review of an ETPS product called SOLIDO. This product has not undergone NSF Standard 40 testing. It has undergone PIA testing for approval of TSS and $CBOD_5$ (PIA website can be viewed at http://www.pia-gmbh.com/). The manufacturer was given time to present information on the SOLIDO product but did not call in. The committee is not comfortable approving a system that has not undergone NSF Standard 40 testing.

Motion: Michael Reno moved that the TGC not approve the SOLIDO system unless it successfully passes NSF Standard 40 testing.

Second: George Miles.

Voice Vote: Motion carried unanimously.

PRESENTATION OF DRAINFIELD TO SURFACE WATER SETBACK DETERMINATION GUIDANCE AND MODEL:

Tyler informed the TGC that the presentation of Drainfield to Surface Water Setback Determination Guidance and Model has been moved to the August 8th, 2013 meeting. The guidance is still under review with the Attorney General's office. Tyler explained that the Attorney General has stated that in order to utilize the guidance an applicant would have to apply for a variance. The draft guidance will be distributed to the TGC members prior to the meeting.

OLD BUSINESS/ FINAL REVIEW:

Chapter 7 O& M Content

This TGM Section was posted for public comment. There were no public comments received on this section.

Motion: Bob Erickson moved that the TGC recommend final approval to Chapter 7 and the movement of Operation and Maintenance information into Section 4 under the respective systems as amended.

Second: Michael Reno.

Voice Vote: Motion carried unanimously.

Section will post to TGM as final. See DEQ website and **Appendix B**.

4.6 Composting Toilet

This section was posted for public comment. There were no public comments received on this section. Tyler Fortunati reviewed changes and additions to this section. There was discussion regarding the allowable non-human wastes that can be disposed of in these types of systems. Additional clarification was added regarding non-human wastes.

Motion: David Loper moved that the TGC recommend final approval to DEQ of Section 4.6 as amended.

Second: Bob Erickson.

Voice Vote: Motion carried unanimously.

Section will post to TGM as final. See DEQ website and **Appendix C**.

Chapter 3 Edits to Sections 3.1, 3.2.1, 3.2.2, and 3.2.4

This section was posted for public comment. There were no public comments received on this section. Bob Erickson asked that figure 3-1 be amended to add the 5 foot setback to the property line from the drainfield. Joe Canning asked that the drainfield label and arrow be moved over in figure 3-2. Tyler Fortunati stated that both changes would be made on the final document.

Motion: David Loper moved that the TGC recommend final approval to DEQ of Sections 3.1, 3.2.1, 3.2.2, and 3.2.4 as amended.

Second: Michael Reno.

Voice Vote: Motion carried unanimously.

All changes to Chapter 3 will post to TGM as final. See DEQ website and **Appendix D**.

Chapter 2 Edits to Sections 2.6.3 and 2.7.2

This section was posted for public comment. There were no public comments received on this section.

Motion: Bob Erickson moved that the TGC recommend final approval to DEQ of Sections 2.6.3 and 2.7.2 as amended.

Second: Joe Canning.

Voice Vote: Motion carried unanimously.

All changes to Chapter 2 will post to TGM as final. See DEQ website and **Appendix E**.

Chapter 1 Edits to Sections 1.1, 1.2, and 1.3 and Creation of Section 1.4

This section was posted for public comment. There were no public comments received on this section. Discussion was held regarding ETPS technologies and the approval process. Mike Reno would like to see a stricter standard for initial approval of ETPS units in the State of Idaho so the existing problem of failing technologies does not become a bigger issue than it already is. Mike Reno would like to move away from statistical analysis for setting performance standards for ETPS units and move to a performance based approval system utilizing systems already installed in other states. Tyler Fortunati discussed NSF Standard 360 that is based on field performance and grab sampling. Tyler Fortunati stated that this standard is relatively new and no ETPS technologies have undergone testing under this standard. Mike Reno asked that Tyler Fortunati distribute that standard to the TGC for their review and consideration. Tyler Fortunati stated that the standard would be distributed prior to the meeting on August 8th.

Motion: Michael Reno moved that the TGC recommend final approval to DEQ of Sections 1.1, 1.2, 1.3, and 1.4 as amended with the exception to table section 1.4.4.2 regarding ETPS product approvals until the August 8th, 2013 meeting.

Second: Joe Canning.

Voice Vote: Motion carried unanimously.

Sections 1.1, 1.2, 1.3, and 1.4 (with the exception of subsection 1.4.2.2 which is tabled until the August 8th meeting) will post to TGM as final. See DEQ website and **Appendix F**.

10:40 a.m. Break

10:50 a.m. Meeting resumed.

4.1 General Requirements

This section was posted for public comment. There were no public comments received on this section. Discussion was held regarding when an engineer should be required for grey water systems. The TGC's consensus on this issue is that an engineer should only be required if the grey water system has some form of pressurization included in the design.

Motion: Joe Canning moved that the TGC recommend final approval to DEQ of Section 4.1 as amended.

Second: David Loper.

Voice Vote: Motion carried unanimously.

Section will post to TGM as final. See DEQ website and **Appendix G**.

NEW BUSINESS/ DRAFT REVIEW

3.2.5 and 3.2.6 Equal Distribution and Serial Distribution

Tyler Fortunati presented information on the public health district that had submitted public comments regarding failure rates of equal and serial distribution designs on slopes. The public comments are not backed by quantitative data but were stated to be based off of 25 years of observation and experience with failed systems on sloped sites. Joe Canning expressed his view that the best way to achieve serial distribution was through system pressurization. Discussion was held regarding different distribution designs on sloped sites using both serial and equal distribution.

Motion: David Loper moved that the TGC recommend preliminary approval to DEQ of Sections 3.2.5 and 3.2.6 as amended.

Second: Bob Erickson.

Voice Vote: Motion passed with a 4 Ayes and 1 Nay.

Section will post for public comment see **Appendix H** and provide public comment to Tyler Fortunati at 208-373-0140 or by email at tyler.fortunati@deq.idaho.gov.

4.3 Vested Rights and Nonconforming Uses

Tyler Fortunati and David Loper participated in a meeting on July 17th, 2013 with DEQ's Water Quality Division Administrator and the Health District Environmental Health (EH) Directors. The Health District EH Directors accepted the proposed revision to this section of the TGM with a couple clarifications. The first clarification regards a subsurface sewage disposal system that is not approved (previously written as unapproved) which was clarified to be any system, regardless of installation date, that has not had a subsurface sewage disposal system permit issued for it. The second clarification is that an

abandoned system is any system where the wastewater generating structure has been removed, regardless of the circumstance surrounding the structures removal. These amendments were made to the proposed revisions.

Motion: Michael Reno moved that the TGC recommend preliminary approval to DEQ of Section 4.3 as amended.

Second: Joe Canning.

Voice Vote: Motion carried unanimously.

Section will post for public comment see **Appendix I** and provide public comment to Tyler Fortunati at 208-373-0140 or by email at tyler.fortunati@deq.idaho.gov.

4.4 Easement

Discussion was held on the proposed revision to this section of the TGM. Discussion regarded the requirement of having an attorney prepare the easement and allowing the applicant and the second party to the easement prepare the easement themselves. Discussion also revolved around the requirement of surveying the easement before a permit is issued, after a system is installed, or whether to require a survey at all. Discussion was also held on the restrictions on easements regarding multiple transport pipes being placed in a single trench. David Loper stated that he would like to review this practice with the Health District Environmental Health Directors. Tyler Fortunati stated that he would also provide the section to the Attorney General's office for their review and comments.

Motion: Michael Reno moved that the TGC table Section 4.4 until reviewed by the Attorney General's office.

Second: Bob Erickson.

Voice Vote: Motion carried unanimously.

Section 4.4 was tabled see **Appendix J**.

The meeting was adjourned for Lunch.
Lunch 12:10 p.m. – 1:25 p.m.

2.5 Ground Water Level

Discussion was held regarding the use of low chroma mottles to determine the seasonal normal and high ground water levels. David Loper asked that the restriction on only utilizing low chroma mottles for replacement systems be removed. David Loper advocated that these are an adequate way to determine ground water levels when done in conjunction with the issuance of a restrictive permit for new construction that is protective of the ground water. David Loper also stated that the applicant can be provided with the option to monitor ground water to ease the requirements of the permit while they construct. Tyler Fortunati stated that he has observed several test holes where low chroma mottles are not present but ground water is and that relying on low chroma mottles alone is not fully protective of the ground water. Tyler Fortunati stated that Idaho Code §39-102.3.a states that the State of Idaho's ground water policy is to prevent contamination of ground water from any source to the maximum extent practical. Ground water monitoring ensures that this is done, where low chroma mottles and estimating water levels does not. Tyler Fortunati stated that if a permit is issued for a subsurface sewage disposal system and it does not meet the separation distances as required by IDAPA 58.01.03.008.02.c then the permit issuer is directly violating the subsurface sewage disposal rules. Tyler Fortunati stated that low chroma mottles are more appropriate for replacement systems when there is not an allowance for a full season of ground water monitoring due to a public health issue. David Loper still advocated for the removal of the requirement to

only use low chroma mottles for the estimation of ground water levels on replacement systems only with the compromise that the statement regarding ground water monitoring being the preferred method of determining ground water levels be left in place.

Joe Canning stated he would like to see a recommendation on when ground water monitoring records would not be accepted due to low snow pack. Michael Reno stressed that care should be taken when NRCS data indicate that snow levels are below 75% of normal snow-water equivalent. The TGC developed section 2.5.5 in response to this request.

Bob Erickson recommended changing the ground water monitoring period for seasonal runoff and spring rain events from February 15th through June 15th to February 15th through June 30th.

Joe Canning discussed Figure 2-4 Temporary ground water monitoring well design, and recommended adding emphasis of mounded soil sloping away from the top of the well. This should be done to help reduce the chance of surface runoff accumulating around the temporary monitoring well and moving down the side of the casing which gives a false reading of ground water levels. Tyler Fortunati stated that he would have this amendment added to the figure.

Motion: Joe Canning moved that the TGC recommend preliminary approval to Section 2.5 as amended and post for public comment.

Second: Michael Reno.

Voice Vote: Motion carried unanimously.

Section will post for public comment see **Appendix K** and provide public comment to Tyler Fortunati at 208-373-0140 or by email at tyler.fortunati@deq.idaho.gov.

3.3 Wastewater Flows

Michael Reno asked that the inclusion of the non-domestic wastewater application checklist be added to section 3.3.1 and 3.3.2.

Motion: Michael Reno moved that the TGC recommend preliminary approval to Section 3.3 as amended and post for public comment.

Second: Joe Canning.

Voice Vote: Motion carried unanimously.

Section will post for public comment see **Appendix L** and provide public comment to Tyler Fortunati at 208-373-0140 or by email at tyler.fortunati@deq.idaho.gov.

2:50 p.m. Break

3:00 p.m. Meeting resumed.

4.25 Sand Mound

Tyler Fortunati presented the suggested changes to this section regarding slope correction factors, which was in the TGC parking lot. All of the proposed changes are directly from the Wisconsin Mound Manual and are consistent with its recommendations.

Discussion was held regarding the spacing of laterals within the absorption bed. Recommended lateral spacing was added to the design requirements. Discussion was held regarding the diversion of surface runoff around the mound on sloped sites. It was recommended that this consideration be made by the design engineer.

Tyler Fortunati explained that he added a two foot perimeter of level medium sand out from the top of the absorption bed. This is a mound manual recommendation and was included into the checklist calculations for disposal area sizing.

Tyler Fortunati stated that the Wisconsin Mound Manual utilizes a linear loading rate for the disposal area sizing on sand mounds. Idaho's sizing requirements based off of soil design subgroups does not appear to correspond to the linear loading rates used in the mound manual. Tyler Fortunati included the slope correction factors directly out of the mound manual as requested. These correction factors dramatically increase the downslope length of the mound with increasing slope percentages. The TGC requested that the slope correction factors remain in place.

Motion: Michael Reno moved that the TGC recommend preliminary approval to Section 4.25 as amended and post for public comment.

Second: Bob Erickson.

Voice Vote: Motion carried unanimously.

Section will post for public comment see **Appendix M** and provide public comment to Tyler Fortunati at 208-373-0140 or by email at tyler.fortunati@deq.idaho.gov.

2.2.3 The Method of 72 to Determine Effective Soil Depths to Porous Layers and Ground Water

Tyler Fortunati introduced this section as another tool that health district staff can use to determine effective soil depths when soil profiles are variable and do not meet the depths provided in the subsurface rules or TGM. The Method of 72 is used to determine effective soil depths to porous layers and ground water. The treatment units assigned to each soil design subgroup are consistent with the separation depths required in the TGC and subsurface rules. To find an effective soil depth the total soil profile below the drainfield must equate to 72 treatment units.

Discussion was held on how the Method of 72 compares to the percentage method used by some of the Health Districts. Bob Erickson requested an analysis of how the Method of 72 compares to the percentage method. The percentage method uses the total depth present compared to what is required for separation for that soil design subgroup.

Action Item: Compare the Method of 72 and the percentage method to determine how the two systems compare for use in variable soil profiles.

Motion: David Loper moved that the TGC recommend preliminary approval to Section 2.2.3 The Method of 72 to Determine Effective Soil Depths to Porous Layers and Ground Water as amended and post for public comment.

Second: Michael Reno.

Voice Vote: Motion carried unanimously.

Section will post for public comment see **Appendix N** and provide public comment to Tyler Fortunati at 208-373-0140 or by email at tyler.fortunati@deq.idaho.gov.

4.24 In-Trench Sand Filter

Tyler Fortunati held discussion with DEQ's Water Quality Division Administrator regarding the requirement of a complex installer license for in-trench sand filters due to the way that IDAPA 58.01.03.006.01.b is written. The Wastewater Program's interpretation of this rule is that pressurized in-trench sand filters require a complex installer where gravity flow in-trench sand filters require a basic installer permit. Based on IDAPA 58.01.03.004.09 DEQ feels it would be appropriate in this instance for the TGC to define the need for a complex and basic installer permit following the guidelines described above.

This section was rewritten to be in line with Method of 72 and remove what appeared to be inconsistencies in separation distance requirements.

Discussion was held regarding pressurized systems and whether to reduce vertical setbacks if the system is pressurized. Joe Canning would like to see the pressurized design placed back into this section. Tyler Fortunati stated that in its current form it appeared to give reduced separation in porous soils and when the biomat forms on the medium sand the effluent could flow through the more porous soils with inadequate treatment based upon the subsurface rules. Joe Canning requested that a modified design be proposed to include envelopment of the drainfield with pressurization to keep the reduced separation distance. Tyler Fortunati stated that he would include the proposal for the next review.

David Loper would like to review these changes more closely and see the modified proposal before moving forward with preliminary approval.

Motion: Bob Erickson moved that the TGC table Section 4.24 until the October 31, 2013 meeting.

Second: David Loper.

Voice Vote: Motion carried unanimously.

Section 4.24 was tabled see **Appendix O**.

NEXT MEETING:

The next regular TGC meeting is scheduled to be on October 31, 2013, 9:15 a.m. – 4:30 p.m. at the DEQ State Office building. A special meeting for the TGC regarding changes proposed by the ETPS Subcommittee will be held August 8, 2013 9:15 a.m. – 4:30 p.m. at the DEQ State Office building.

Motion: David Loper moved to adjourn the meeting.

Second: Michael Reno.

Voice Vote: Motion carried unanimously.

The meeting adjourned at 4:10 p.m.

Appendix B

Technical Guidance Committee Meeting

Draft Minutes

Thursday, August 8, 2013

Department of Environmental Quality
Conference Room C
1410 N. Hilton
Boise, Idaho

TGC ATTENDEES:

Tyler Fortunati, R.E.H.S., On-Site Wastewater Coordinator, DEQ
Joe Canning, P.E., B&A Engineers
Bob Erickson, Senior Environmental Health Specialist, South Central Public Health District
David Loper, Environmental Health Director, Southwest District Health Department
Michael Reno, Environmental Health Supervisor, Central District Health Department
George Miles, P.E., Advanced Wastewater Engineering, Inc. (via telephone and GoToMeeting)

GUESTS:

Chas Ariss, P.E., Wastewater Engineering Manager, DEQ
PaRee Godsill, Everlasting Extended Treatment, Inc.
Ryan Spiers, Alternative Wastewater Systems, LLC
Matt Gibbs, Infiltrator, Inc.
AJ Maupin, P.E., Wastewater Program Engineering Lead, DEQ
Kellye Eager, Environmental Health Director, Eastern Idaho Public Health Department (via telephone and GoToMeeting)
Raymond Keating, Environmental Health Specialist, Eastern Idaho Public Health Department (via telephone and GoToMeeting)
James Bell, Bio-Microbics, Inc. (via telephone and GoToMeeting)
Allen Worst, R.C. Worst & Company, Inc. (via telephone and GoToMeeting)
Janette Young, Administrative Assistant, DEQ

CALL TO ORDER/ROLL CALL:

Meeting called to order at 9:15 a.m.
Committee members and guests introduced themselves.

OPEN PUBLIC COMMENT PERIOD:

This section of the meeting is open to the public to present information to the TGC that is not on the agenda. The TGC is not taking action on the information presented.

No public comments were submitted during the allotted agenda timeframe.

ETPS SUBCOMMITTEE UPDATE:

Tyler Fortunati presented an update to TGC on what the ETPS Subcommittee has discussed and produced to date and what the TGC will be reviewing and approving today. He provided a brief overview of the process the Extended Treatment Package Subcommittee went through to create and revise the Extended Treatment Package System guidance documents that were presented to the TGC as part of this meeting.

NEW BUSINESS/DRAFT REVIEW:

4.2 Nonprofit Corporations

The Committee reviewed the proposed revisions and amendments to the Nonprofit Corporation guidance and structure. Tyler Fortunati stated that these changes will only impact newly proposed O&M Entities going forward and are not retroactive on previously approved O & M entities. Tyler Fortunati also stated it would be acceptable if existing O&M Entities decided to amend their bylaws to be in conformance with the program recommendations proposed in the revision of this guidance section. Discussion was held on whether DEQ could request Planning and Zoning Boards, or other similar County offices, to amend their subdivision ordinances to include a requirement that property owners notify O&M Entities of property ownership transfers through subdivision CC&Rs if the subdivision is engineered with ETPS septic systems.

Motion: Michael Reno moved that the TGC recommend preliminary approval of Section 4.2 Nonprofit Corporations and that DEQ issue the revised sections for public comment.

Second: Bob Erickson.

Voice Vote: Motion carried unanimously. See **Appendix A** and provide public comment to Tyler Fortunati at 208-373-0140 or by email at tyler.fortunati@deq.idaho.gov.

4.10 Extended Treatment Package Systems

The Committee reviewed the proposed revisions and amendments to the Extended Treatment Package System guidance. Michael Reno suggested that a requirement be added that the service provider must submit documentation that the ETPS unit and its associated components have been installed according to the manufacturer's recommendations prior to the installation permit being finalized. The health districts cannot verify this for each technology since they have not been trained by the manufacturer. Tyler Fortunati stated that this requirement could be supported by IDAPA 58.01.03.005.15 and should be written into the installation permit.

Mike Reno would also like to see the submission of annual reports be required to be done by mail. This provides an incentive not to falsify records, reports, or test results through the threat of prosecution for mail fraud.

The committee asked that a few adjustments be made to some of the figures in this proposed section that included the addition of risers on the septic and ETPS tanks and the correction of a spelling error.

Michael Reno voiced concern over the lag time between when an ETPS unit is sampled in November and the test results show that the unit is out of compliance and the receipt of the report on July 31 when no corrective action is taken by the out of compliance ETPS unit. The unit may be operating out of compliance for several months with no attempt at fixing the system. Michael Reno would like to be able to issue a Notice of Violation to the O&M Entity for not following the retesting requirements. Tyler Fortunati clarified the Attorney General's comments on issuing an NOV. An NOV cannot be issued against an O&M Entity and can only be issued to a property owner in relation to the status of the ETPS unit. Tyler Fortunati explained that in this type of situation the property owner's system would be considered a failing system if they were past the 90 day service and sampling period after the initial failed test result. If this is the case the district should issue the property owner an NOV and follow the failing system enforcement process.

10:50 a.m. Break

11:00 a.m. Meeting resumed.

4.10 Extended Treatment Package Systems (**Appendix B**) (Continued)

The committee discussed the responsible parties under Section 4.10.5 ETPS System Failure, Disapproval and Reinstatement. Tyler Fortunati clarified that only the manufacturer and property owner are responsible per IDAPA 58.01.03.002.04 according to the Attorney General's office. Instead of suspending Nonprofit O&M Entities the emphasis has shifted to a disapproval of a manufacturer's product. This happens if more than 10% of the manufacturer's ETPS units are out of compliance statewide instead of by the compliance status of individual O&M Entities. George Miles requested clarification on manufacturer product disapproval asking if one of the manufacturer's ETPS models is not working, do all the manufacturer's products become disapproved. Tyler Fortunati stated at this point that is the intent because of the concern that the products are not being operated in compliance or consistently functioning in compliance with the subsurface rules. The manufacturer would be provided the opportunity to hold a contested case hearing and may have their product approvals reinstated by following Section 4.10.5.3 of the proposed guidance. Tyler Fortunati will discuss the disapproval process and allowances with the Attorney General's office and the Water Quality Division Administrator to ensure the disapproval process is acceptable.

Motion: Michael Reno moved that the TGC recommend preliminary approval of Section 4.10 Extended Treatment Package System and that DEQ issue the revised sections for public comment.

Second: David Loper.

Voice Vote: Motion carried unanimously. See **Appendix B** and provide public comment to Tyler Fortunati at 208-373-0140 or by email at tyler.fortunati@deq.idaho.gov.

The meeting was adjourned for Lunch.
Lunch 12:00 p.m. – 1:10 p.m.

DEQ Service and Testing Reminder – Explanation Letter

The committee reviewed the letter to be sent out to homeowners from their O&M Entity. This letter would be provided to the O&M Entities on DEQ letterhead and is meant to be included in the annual O&M Entity mailings. The letter provides a reminder of service and testing requirements, and information on where a homeowner can access resources related to ETPS systems. Some small revisions were made by the committee.

Motion: Bob Erickson moved that the TGC recommend preliminary approval of DEQ Service and Testing Reminder – Explanation Letter, with the changes added today and that DEQ issue the revised letter for public comment.

Second: George Miles.

Voice Vote: Motion carried unanimously. See **Appendix C** and provide public comment to Tyler Fortunati at 208-373-0140 or by email at tyler.fortunati@deq.idaho.gov.

Letter 1 – It Has Come to Our Attention

Letter 1 is meant to be sent out by the regulatory agency when there is a refusal of service and/or testing, and includes the service reminder letter as an additional enclosure. This letter would go out after receipt of the annual report for a property owner. The annual report from the O&M Entity must include adequate documentation as outlined in Section 4.10 of the TGM prior to the regulatory agency issuing this letter. The letter is meant to be a pre-enforcement reminder letter to the property owner that informs them of their requirements associated with the ETPS unit through their septic permit. Contact information for their O&M Entity and service provider is included in the letter.

Motion: Michael Reno moved that the TGC recommend preliminary approval of Letter 1 with the changes added today and that DEQ issue the revised letter for public comment.

Second: Joe Canning.

Voice Vote: Motion carried unanimously. See **Appendix D** and provide public comment to Tyler Fortunati at 208-373-0140 or by email at tyler.fortunati@deq.idaho.gov.

Letter 2 – Voluntary Deadline to Comply

Letter 2 is meant to be sent out by the regulatory authority if there is no response or action initiated after a property owner's receipt of Letter 1. This letter is meant to be issued after 30 days of no response or action from Letter 1. The letter is more regulatory in tone and includes the IDAPA citations that the property owner is in violation of. It also includes a voluntary compliance date for the property owner to meet their responsibilities, and the notification that if the responsibilities are not met that the regulatory authority may pursue legal action against the property owner. This letter is copied to the O&M Entity and the County Prosecutor's office.

Motion: Joe Canning moved that the TGC recommend preliminary approval of Letter 2 with the changes added today and that DEQ issue the revised letter for public comment.

Second: George Miles.

Voice Vote: Motion carried unanimously. See **Appendix E** and provide public comment to Tyler Fortunati at 208-373-0140 or by email at tyler.fortunati@deq.idaho.gov.

1.4.2.2 Extended Treatment Package System Approvals

This proposed guidance addition was added to the agenda based on the TGC request from the July 18, 2013 TGC meeting. This section addresses a formal policy on ETPS product approvals in the State of Idaho. Discussion was held on how new systems will be evaluated and approved in the State of Idaho. James Bell provided background on the NSF/ANSI 360 standard.

Motion: Bob Erickson moved that the TGC recommend preliminary approval of Section 1.4.2.2 Extended Treatment Package System Approvals with the changes added today, and that DEQ issue the revised sections for public comment.

Second: Joe Canning.

Voice Vote: Motion carried with 4 ayes and 1 abstained. See **Appendix F** and provide public comment to Tyler Fortunati at 208-373-0140 or by email at tyler.fortunati@deq.idaho.gov.

2:20 p.m. Break

3:00 p.m. Meeting resumed.

Presentation of Drainfield to Surface Water Setback Determination Guidance

A.J. Maupin provided an overview of the guidance developed by DEQ that is to be used to determine acceptable site-specific drainfield setbacks to surface water. This guidance is used when an applicant is seeking a setback to surface water that is less than what is

allowed by rule or guidance for a site based upon the native site soils. To pursue a reduced setback to surface water through this guidance an applicant would have to apply for a variance. The variance would be supported by the model results produced through use of the guidance. The reduction limitations of the model are based off of phosphorous impacts to the nearby surface water. Prior to utilizing this guidance an applicant would have to successfully pass a Nutrient Pathogen (NP) Evaluation. The minimum allowable setback to surface water will not be less than 100 feet regardless of site soils under this guidance. Drainfields are limited to pressurized designs, with both drainfields installed before the permit is finalized. These dual drainfields must be installed in the upper soil profile horizons which limits the system type to a drip-distribution system or a pressurized cap and fill design with maximum installation depths of 12 inches. DEQ will review the NP Evaluation and the Drainfield to Surface Water Setback model and will send recommendations to the appropriate health district for their use in consideration of the variance approval.

A condition of the phosphorous guidance and model is that the site and soils will have an associated lifespan for the effective mitigation of phosphorous discharges in the septic system effluent. This results in a drainfield only functioning effectively for a guaranteed timespan. The model is conservative in its evaluation and lifespans may very but could be expected between 100-1000 years. The committee raised the question as to what happens once the drainfield life is reached on the combined primary and replacement areas. There was concern regarding the sites with limited space that would not have space for more than two drainfields and what is to be done after the point in time that both drainfields had reached their effective lifespan. AJ Maupin provided clarification that the mineralization of phosphorous in the soils would be expected to free up some additional sorption capacity over time. This would be expected to extend the useful life of the drainfield site beyond the model's conservative estimate.

Motion: Michael Reno moved that the TGC recommend preliminary approval of On-site Setback Distance Determination: Modeling Phosphorous in the Environment as the Critical Constituent and that DEQ issue the document for public comment.
Second: David Loper.
Voice Vote: Motion carried with 4 ayes and 1 nay. See **Appendix G** and provide public comment to Tyler Fortunati at 208-373-0140 or by email at tyler.fortunati@deq.idaho.gov.

NEXT MEETING:

The next committee meeting is scheduled to be on October 31, 2013, 9:15 a.m. – 4:30 p.m. at the DEQ State Office building.

Motion: Michael Reno moved to adjourn the meeting.
Second: Bob Erickson.
Voice Vote: Motion carried unanimously.
The meeting adjourned at 3:45 p.m.

Appendix C

4.2 Nonprofit Corporations

Revision: ~~November 21, 2000~~October 31, 2013

Nonprofit Corporations (Entities) to manage large soil absorption systems, extended treatment, ~~or~~ experimental systems, ~~clustered systems,~~ or any other ~~more~~ complex system~~s~~ the Director deems a maintenance entity is required to manage must guarantee that they will be responsible for the system and be available to provide operation and maintenance (O&M). The following guidance provides for a nonprofit corporation which can do that.~~:~~ If an O&M Entity is setup to provide operation and maintenance for Extended Treatment Package Systems (IDAPA 58.01.03.009.02 and 58.01.03.009.03) or Large Soil Absorption Systems (IDAPA 58.01.03.013.07.c) according to the following minimum elements, the maintenance entity will likely be approved by the Director. These minimum elements provide assurance that operation and maintenance, as conditioned for these particular systems by the Director, occurs. Other O&M Entity elements may be acceptable on a case-by-case basis depending upon the maintenance needs of an Entity. Other elements not included within this guidance section will be evaluated on a case-by-case basis.

4.2.1 Required Incorporation Elements

The following elements must be included within the Entity's Articles of Incorporation or Bylaws:

1. The nonprofit organization should be incorporated according to Idaho Code 30-3.
2. The Articles of Incorporation shall include a requirement that any changes to the Entity's Articles of Incorporation or Bylaws shall be approved by the Department of Environmental Quality's Water Quality Division Administrator (Director) or his/her designee per Idaho Code 30-3-99.
    a. The Director shall provide the Nonprofit Entity approval in writing of any changes to the Articles of Incorporation or Bylaws that are not in conflict with section 4.2 or 4.10 of the Technical Guidance Manual.

~~2.~~3. Membership should be limited to property owners only.

~~3.~~4. Voting should be limited to one parcel/one full membership/one vote.

~~4.~~5. Voting rights should be restricted to members with improved property.

6. Voting rights should not be cancelled.
    a. Exception to this is allowed in the event that an extended treatment package system is disconnected and removed from the property as approved by the Director.

7. Purposes of the organization should be clearly defined in the Articles of Incorporation.

~~5.~~8. The Nonprofit Entity should hold an annual meeting of the membership.

9. Funds generated are to operate specific functions and should be restricted for use to the specific purpose. Those purposes should be defined in the Bylaws or associated Membership Agreement.

   a. Annual financial reports should be made available to the membership upon request by individual members and through the annual membership meeting.

~~6.~~10. Multiple-purpose organization funds generated are to be separately maintained, and funds from one account should not be available for another account's use.

11. The ~~organization~~ Nonprofit Entity should either own the system(s) it intends to maintain or have an access easement in place.

   a. Access easements for extended treatment package systems should be executed through a membership agreement as outlined in section 4.2.3.

~~7. Mutually agreeable access to those systems owned by the entity should be provided by the property owner.~~

~~8.~~12. Membership (and shares) in the ~~entity~~ Nonprofit Entity must run with the land, and successive owners must acquire the preceding owner's membership or voting share(s).

~~9.~~13. The purchaser ~~or~~ and any new member should be provided by the Nonprofit Entity with a copy of the Articles of Incorporation, By-Laws, Covenants, and Contracts (i.e., membership agreement, etc.) with the ~~entity~~Entity.

~~10.~~14. There should be no provisions restricting ownership of improved property.

15. The ~~entity~~ Nonprofit Entity should be capable of raising revenue by ~~fixing~~ setting and collecting user charges.

16. Board of Director Requirements:

   a. For Extended Treatment Package System Nonprofit Operation and Maintenance Entities the Board of Directors should contain one permanent position required to be filled by a corporate officer, general partner, or owner of the manufacturer of the treatment technology.

      i. The only exemption to this requirement shall be for cases where manufacturers are no longer in business. In this case the existing Board Members and associated membership shall vote in a new Board Member to ensure that item 16.b is fulfilled.

b. The Board of Directors should include a minimum of three Board Member positions.

~~11.~~17. The Board of Directors should be able to raise revenue for emergency operation and maintenance of community owned systems without majority vote.

18. The ~~organization~~ Nonprofit Entity must be capable of suing and of being sued, maintain the capability to impose liens on those members (shareholders) who become delinquent in user charges, and suspend services, providing such suspension will not jeopardize other members' use.

~~12.~~19. The Nonprofit Entity should provide an operation and maintenance manual that shall be approved by the Director.

a. ~~An~~ The operation and maintenance manual ~~shall~~ should be ~~approved by the Director~~provided to all new members for extended treatment package systems and shall include the monitoring requirements as outlined in ~~the~~ Section 4.10.2 "Extended Treatment Package System" ~~Operation, Maintenance and Monitoring~~ Conditions for Approval.

~~13.~~20. Conditions for dissolution of the ~~organization~~ Nonprofit Entity should be specified. Dissolution should be limited to connection to a municipal wastewater treatment facility or merger with another approved ~~nonprofit~~ Nonprofit ~~corporation~~ Entity having management capability.

~~14.~~21. Except as provided in item ~~18~~20, the ~~entity~~ Nonprofit Entity should not be able to vote itself out of existence.

22. ~~A~~ For Nonprofit Entities a third party (i.e., maintenance entity, service provider, etc.) should be identified to execute the specified operation and maintenance functions. ~~in the event the operating entity is incapable of performance.~~

a. Service Providers for Nonprofit Entities overseeing extended treatment package systems should be certified in writing by the manufacturer for the servicing of their technology. The certification should be provided to the Director prior to approval.

~~15.~~23. The ~~entity~~ Nonprofit Entity should be able to plan and control how and at what time additional service functions will be extended or added.

~~16.~~24. The Articles of Incorporation and/or By-Laws should provide for proxy voting.

~~17.~~25. Proxies should not be binding on new purchasers.

~~18.~~26. ~~The~~ For community systems the developer of the project should be required to contribute to the operation and maintenance until such time as the ~~nonprofit~~ Nonprofit ~~corporation~~ Entity is self-sustaining. Consider either a specified period of time or when a specified number of lots ~~has~~ have been sold.

27. The ~~organization~~ Nonprofit Entity should have a defined service area boundary.

4.2.2 Notification Requirements

The Nonprofit Entity shall notify the Director for any of the following reasons:

1. Any content changes that occur to the Articles of Incorporation, Bylaws, or Membership Agreements that occur after initial approval by the Director shall be provided to the Director for review and approval prior to their implementation. Any changes that conflict with any portion of section 4.2.1 should not be approved.
2. Changes occur to the Board of Directors.
3. Service provider(s) are changed.
4. Sampling plan changes or adjustments are necessary.

4.2.3 Membership Agreements for Extended Treatment Package Systems

The membership agreement is separate from the Articles of Incorporation and Bylaws for the Nonprofit Entity but is a required element for membership in the Nonprofit Entity and to ensure that proper operation and maintenance will be performed (IDAPA 58.01.03.009.03). Membership agreements should contain the following elements:

1. Title of the membership agreement should include the words *lien notice, access easement, member agreement, and the name of the Nonprofit Entity*.
2. Contact information for the Nonprofit Entity should be listed including a mailing address and phone number.
3. A statement that annual fees will be assessed for services rendered by the Nonprofit Entity should be included.
4. The agreement should describe the exact services that are and are not included within the agreement (e.g., service, maintenance, annual testing, repairs, annual report submission, etc.).
5. The access easement language should be included.
6. A description of the lien process should be included.
7. The legal description of the property should be included.
8. A requirement that upon each sale of the property the buyer will sign an acknowledgement that they have reviewed the membership agreement and understand its requirements.

~~1.~~9. The agreement should state that the current property owner must disclose the terms of the membership agreement prior to any sales transaction of the property.

4.2.4 Sampling Plans for Extended Treatment Package Systems

Nonprofit Entities formed for the purpose of maintaining, servicing, and testing Extended Treatment Package Systems shall develop a sampling plan for the testing of effluent (IDAPA 58.01.03.009.03). Sampling plans should contain the following elements:

1. A signed letter from the manufacturer of the treatment technology certifying that the sampling method provided is acceptable for their technology.
2. A sampling location and design that is located after the secondary treatment unit for both gravity and pressurized systems.
3. Sample collection, preservation, and transportation techniques and methods that are in conformance with the latest edition of *Standard Methods for the Examination of Water and Wastewater*.
4. A way to collect all samples from a free flowing effluent pipe. Hose or portable water sources may be used to induce flowing condition but should be used as an option of last resort when access to a water source within the home is not available. If a hose or portable water source is used to induce a flowing condition the water source should discharge into the cleanout between the structure and primary septic tank. Cross connection and backflow prevention should be considered if hoses are used to induce flow.
5. Sample point cleaning and flushing procedures prior to sample collection.
6. Any necessary sampling device calibration techniques, equipment, and reagents.
7. Effluent field sample indicators that may be recommended for evaluation prior to collection of a grab sample. These indicators should provide indication that the treatment unit is operating properly.

Appendix D

4.10 Extended Treatment Package System

Revision: ~~January 4, 2011~~October 31, 2013

4.10.1 Description

Manufactured and *packaged* mechanical treatment devices that provide additional biological treatment to septic tank effluent. Such units may use extended aeration, contact stabilization, rotating biological contact, trickling filters, or other approved methods to achieve enhanced treatment after primary clarification occurs in an appropriately sized ~~primary clarifier (~~septic tank~~)~~. These systems provide secondary wastewater treatment capable of yielding high-quality effluent suitable for discharge in environmentally sensitive areas.

Extended Treatment Package Systems (ETPS) are required to have annual maintenance and effluent quality testing performed and reported to the Director as described within section 4.10 of the TGM (IDAPA 58.01.03.005.14). This maintenance is to be performed by an approved Operation and Maintenance Entity (O&M) (IDAPA 58.01.03.009.03). Property owners that install an ETPS unit must choose an O&M Entity capable of meeting their maintenance and effluent testing needs. Verification of the chosen O&M Entity shall be submitted with the subsurface sewage disposal permit application ensuring that the operation, maintenance, and monitoring (effluent quality testing) will occur (IDAPA 58.01.03.005.04.k). Property owners that do not want to meet these O&M requirements must meet the requirements of section 4.10.2(2) or choose another alternative system that will meet the conditions required for subsurface sewage disposal permit issuance.

4.10.2 ~~Operation, Maintenance, and Monitoring~~ Conditions for Approval

~~Procedures relating to operation, maintenance, and monitoring are required by IDAPA 58.01.03 (section 8.1) or may be required as a condition of issuing a permit, per IDAPA 58.01.03.005.14 (section 8.1) to ensure protection of public health and the environment.~~

1. A maintenance entity will be available to provide continued device operation and maintenance (O&M). Approval of the O&M Entity will be made by the Director ~~before~~ prior to the issuance of a permit. Approvable entities may include, but are not limited to, the following:

   a. Municipal wastewater treatment departments
   b. Water or sewer districts
   c. Nonprofit Corporations (see section 4.2)

   An O&M ~~Agreement~~ Entity membership agreement and an accompanying general access easement should be entered into between the property owner and the ~~Nonprofit~~ O&M Entity, as a necessary condition for issuing an installation permit (IDAPA 58.01.03.005.04.k). This agreement and the easement will be recorded with the County as a condition for issuing an installation permit.

2. Extended Treatment Package Systems (ETPS) may be used for ~~single-family dwellings~~properties without an approved ~~maintenance e~~O&M Entity **only under all of the following conditions**:

   a. The site is acceptable for a standard system. All separation distances from ground water, ~~and~~ surface water~~s~~, and limiting layers~~, and soil types~~ shall be met.

   b. Enough land is available, and suitable, for two full-size drainfields. One complete full-size drainfield shall be installed.

   ~~c. A state-approved effluent filter shall be used at the outlet of the package treatment system and before the drainfield.~~

3. Final effluent disposal through subsurface discharge will meet the following criteria:

   ~~d. Surface discharge. System owner will apply for a National Pollution Discharge Elimination System Permit (NPDES) from the United States Environmental Protection Agency (EPA). Effluent quality will meet the applicable requirements of the "Water Quality Standards" (IDAPA 58.01.02), "Wastewater Treatment Requirements" (IDAPA 58.01.16), and all other applicable regulations.~~

   ~~e. Ground water discharge. Effluent quality will meet the applicable requirements of the "Ground Water Quality Rule" (IDAPA 58.01.11), "Wastewater Rules" (IDAPA 58.01.16), and all other applicable regulations. Total Nitrogen discharge shall not exceed that specified in the development's Nutrient-Pathogen (NP) Study in order to prevent the ground water from exceeding the "Ground Water Quality Standard" for nitrates (IDAPA 58.01.11.200.01.a) and to maintain and protect the existing and projected future beneficial ground water uses (IDAPA 58.01.11.006.02).~~

   a. ~~Subsurface discharge.~~ If an 85% reduction or better in Carbonaceous Biological Oxygen Demand ($CBOD_5$) and Total Suspended Solids (TSS) can be achieved, then the effluent may be discharged to a drainfield satisfying the Intermittent Sand Filter (section 4.23.5) ~~or the Recirculating Gravel Filter Gravity Disposal Trenches (section 4.22.5)~~ application rate criteria and vertical setback requirements.

      i. Otherwise, the effluent must be discharged to a standard drainfield, sized as directed in IDAPA 58.01.03.008 (section 8.1) and meeting the required effective soil depth for standard drainfields as directed in IDAPA 58.01.03.008.02.

      ~~i.~~ii. Additional drainfield sizing reduction granted for use of gravelless trench products is not allowed.

   ~~f.~~b. ~~The 85% reduction is a qualitative criterion.~~ The 85% reduction will be accepted as being met if the effluent exhibits a quantitative value obtained from laboratory

analysis not to exceed 40 milligrams per liter (mg/L) (40 parts per million [ppm]) $CBOD_5$ and 45 mg/L (45 ppm) TSS.

~~g.~~c. Total Nitrogen (TN) reduction may be required for ETPS units located in an area of concern as determined through a Nutrient-Pathogen (NP) Evaluation. Permit specific TN reduction levels will be determined through the NP Evaluation. Results for TN are determined through the addition of TKN and Nitrate-Nitrite Nitrogen (TN = TKN + [NO_3+NO_2-N]). TN reduction will be accepted as being met if the effluent exhibits a quantitative value obtained from laboratory analysis not to exceed the TN level stipulated on the subsurface sewage disposal permit.

4.10.3 Operation, Maintenance, and Monitoring

Procedures relating to operation, maintenance, and monitoring are required by IDAPA 58.01.03.009.03 (section 8.1) or may be required as a condition of issuing a permit, per IDAPA 58.01.03.005.14 (section 8.1) to ensure protection of public health and the environment.

1. Operation and Maintenance

   a. Annual maintenance shall be performed on the ETPS unit as described in the ETPS manufacturer's operation and maintenance manual for the ETPS model as submitted under section 4.2.19.

   b. Additional maintenance not specified in the operation and maintenance manual may be required to ensure the ETPS functions properly.

   c. Records of each maintenance visit shall be kept and should include the following information for the primary maintenance visit:

      i. Date and time.

      ii. Observations for objectionable odors.

      iii. Observation for surfacing of effluent from the treatment unit or drainfield.

      iv. Notation as to whether the system was pumped since the last maintenance visit including the portions of the system pumped, pumping date, and volume.

      v. Sludge depth and scum layer thickness in the primary septic tank and treatment unit.

      vi. If responding to an alarm event provide the cause of the alarm and any maintenance necessary to address the alarm situation.

      ~~i.~~vii. Filed testing results for any system effluent quality indicators included in the approved sampling plan as submitted under section 4.2.4 or as recommended in section 4.10.3.2.b.

viii. Record of any cleaning and lubrication.

ix. Notation of any adjustments to control settings or equipment.

x. Test results for pumps, switches, alarms, blowers, etc.

xi. Notation of any equipment or component failures.

xii. Equipment or component replacement including reason for replacement.

xiii. Any recommendations for future service or maintenance and reasoning.

d. Any maintenance visit occurring after the primary annual maintenance visit should only record and address the reason for the visit and the associated activities that occur.

2. Monitoring

a. Annual effluent monitoring will be required for all ETPS units that discharge to a reduced size drainfield, to a drainfield with a reduced separation distance to ~~ground water~~limiting layers, and/or to a drainfield located in an environmentally sensitive area (area of concern).

i. Annual monitoring included in the Annual Report must occur within the reporting period.

b. It is recommended that prior to collecting effluent samples from the treatment unit for laboratory analysis that effluent quality indicators be field tested as described in the approved sampling plan for the O&M Entity. All recommendations included in 4.10.3.2.b are recommendations only and should be verified with the treatment technology manufacturer as acceptable with their field sampling plan and as suitable effluent quality indicators. Field testing is recommended to include, but may not be limited to:

i. Visual examination for wastewater color, odor, and effluent solids.

ii. The following constituents:

Constituent	Acceptable Range
pH	6 to 9
Dissolved Oxygen (DO)	≥ 2 mg/L
Turbidity	≤ 40 NTU

Table 4-5. Recommended field testing constituents for effluent quality indication.

c. Monitoring samples provided to a laboratory will analytically quantify that the units are operating in compliance, provided samples do not exceed 40 mg/L (40 ppm) for $CBOD_5$ and 45 mg/L (45 ppm) for TSS.

i. Results for $CBOD_5$ and TSS that exceed these levels indicate the ~~pretreatment device~~ ETPS unit is not achieving the required reduction levels. ~~*$CBOD_5$ monitoring will replace Biological Oxygen Demand (BOD_5) monitoring effective January 1, 2008.*~~

~~b.~~d. For those systems installed in areas of concern, including nitrogen sensitive areas, or are used to fulfill NP ~~Study~~ Evaluation results and requirements, the following additional constituents may be monitored as stipulated on the permit:

i. ~~a)~~ Total Kjeldahl Nitrogen (TKN)
ii. ~~b)~~ Nitrate-Nitrite nitrogen (NO3+NO2-N)
iii. ~~c)~~ Results for Total Nitrogen (TN = TKN + [NO3+NO2-N]) that exceed the levels stipulated on the installation permit, in the subdivision approval for sanitary restrictions release, or the approved NP ~~Study~~Evaluation, indicate that the device is failing to achieve the required reductions

~~c. Laboratory results that exceed the numerical Total Nitrogen values specified in the Total Nitrogen column of Table 8-1 (section 8.6) indicate that the treatment device is not achieving the required percent nitrogen reduction, specified in the Total Nitrogen Reduction (%) column of Table 8-1.~~

e. Samples will be collected, stored, transported, and analyzed according to the latest version of *Standard Methods for the Examination of Water and Wastewater* ~~(Rice et. al 2012)~~ and other acceptable procedures.

i. Each sample will have a Chain-of-Custody sheet, identifying, at a minimum, the sample's source (street address or installation permit number), date and time of collection, and the person who extracted the sample(s).

ii. The Chain-of-Custody sheet should also specify the laboratory analyses to be performed on the sample(s).

~~i.~~iii. Sample storage and transport will take place in appropriate containers under appropriate temperature control.

~~d.~~ Samples will be required to be analyzed by a certified laboratory capable of analyzing wastewater according to the acceptable standards identified below, and the monitoring results will be submitted as part of the Annual Report to the local health district. ~~The annual report shall be submitted no later than July 31 of each year for the preceding 12-month period. Reporting period is from July 1 of the preceding year through June 30 of the reporting year.~~

i. Analysis of ETPS effluent shall be performed using the following standards from the *Standard Methods for the Examination of Water and Wastewater* (NSF utilizes the same standards in their Standard 40 and 245 evaluations):

Analysis	Standard Method Number
Total Suspended Solids (TSS)	SM 2540 D
Carbonaceous Biological Oxygen Demand ($CBOD_5$)[a]	SM 5210 B
Total Kjeldahl Nitrogen (TKN)	SM 4500-NH_3 C
Nitrate-Nitrite Nitrogen (NO_3 + NO_2-N)	SM 4500-NO_3^- F

a – Person requesting the analysis from the lab must specify the $CBOD_5$ on the Chain-of-Custody paperwork.

Table 4-6. Standard methods required to be utilized for the analysis of ETPS effluent in annual testing.

ii. Annual reports submitted with laboratory analysis results differing from these standard methods will be rejected.

g. Samples failing to achieve the required effluent constituent levels shall require:

i. Additional operations and maintenance ~~will be required~~ for devices that fail to achieve the above reductions.

ii. Additional sampling ~~will be required~~ to demonstrate the operation and maintenance performed successfully restored the treatment system to proper operation.

1. Sample extraction and analysis should occur within 30 days after servicing the system.

~~1.~~2. A maximum of three ~~servicing and subsequent monitoring~~sampling events, within 90 days, will be allowed to return the system to proper operation. Failure to correct the system within this time frame will result in the system being classified as a *failing system* (Figure 4-8).

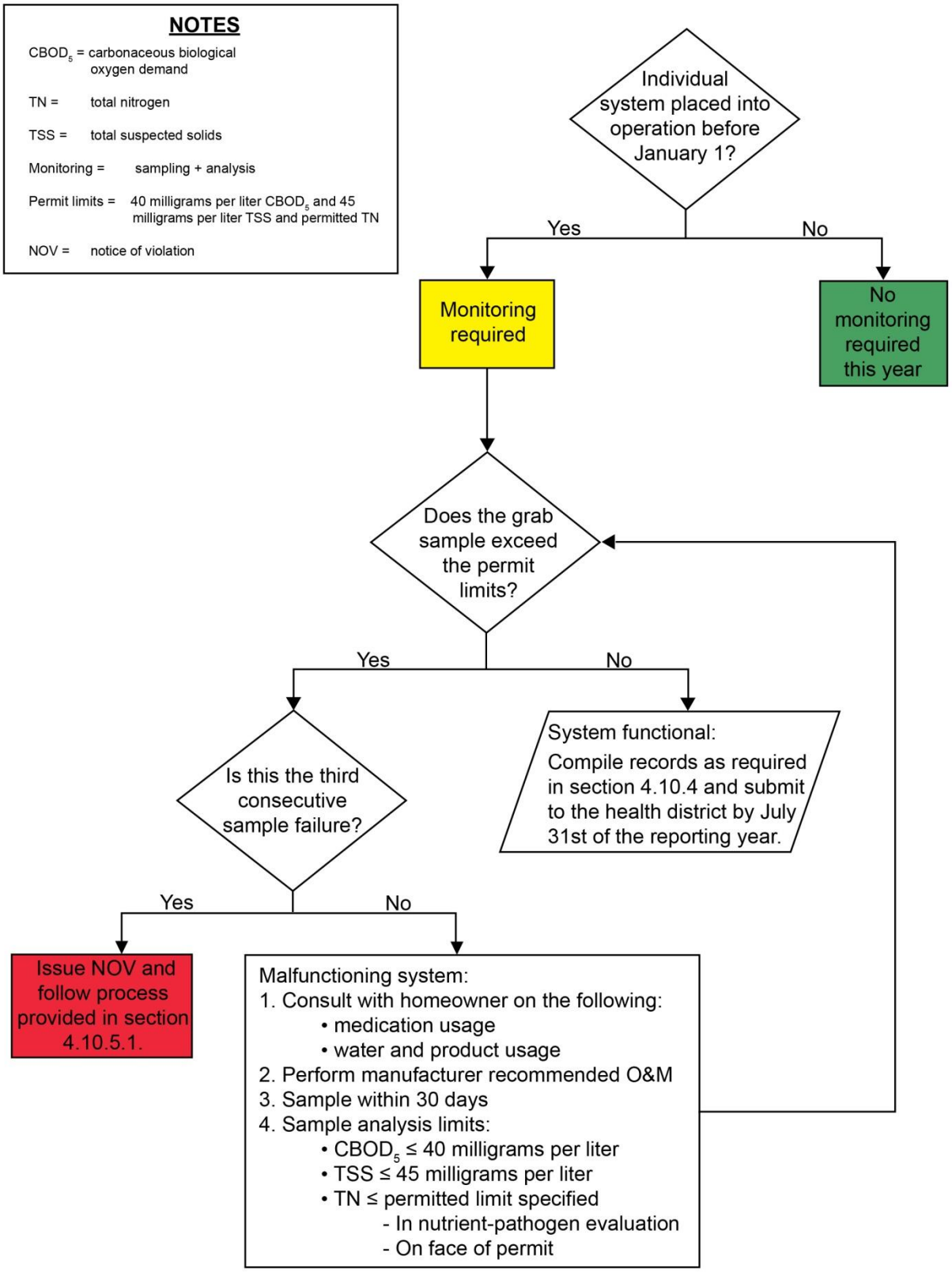


Figure 4-8. ETPS unit individual system sampling process.

4.10.4 Annual Report

The reporting period is from July 1 of the preceding year through June 30 of the reporting year. Annual reporting is the responsibility of the property owner (member), it is recommended that the property owner have their O&M Entity compile and submit their annual report. The property owner responsible under the Individual/Subsurface Sewage Disposal Rules for the ETPS unit shall ensure that the following annual reporting requirements are met:

1. The Annual Report for each property owner shall include the following items:
    a. A copy of all maintenance records for the reporting period as required under section 4.10.3.1.
    b. A copy of all certified laboratory records for effluent sampling.
    c. A copy of each Chain-of-Custody record associated with each effluent sample.
2. If the O&M Entity is fulfilling annual reporting requirements for their members it is recommended that the following additional information be included within the annual report:
    a. A current list of all members of the O&M Entity within the health district to which the Annual Report was submitted.
    b. The member list should clearly identify which members the O&M Entity is contracted with for annual reporting requirements and the status of each member in regards to completion of the Annual Reporting requirements.
    c. If Annual Reporting requirements are not complete for any given member for whom the O&M Entity is responsible for providing the Annual Report an explanation should be included with that member's records within the Annual Report.
3. Annual Report Exemptions:
    a. A member may be exempt from effluent testing based upon extreme medical conditions.
        i. Annual service and maintenance on the member's ETPS unit shall not be exempt due to medical conditions and record of annual service and maintenance shall still be submitted with the member's Annual Report.
    b. An O&M Entity contracted by a member to fulfill Annual Reporting requirements may be exempt from reporting annual service and testing results for individual members if that member's activities fall under section 4.10.6 of this manual.
        i. The O&M Entity should still report the activities described under section 4.10.6 of this manual for each member exempt from annual reporting through this section.

4. The annual reporting process:

    a. The annual report shall be submitted by the property owner or the O&M Entity on behalf of their member no later than July 31 of each year for the preceding 12-month period to the local health district.

        i. The Annual Reports shall be submitted to the local health district that issued the subsurface sewage disposal permit for, and has jurisdiction over, the ETPS unit.

    b. The local health district shall provide the O&M Entity a written response within 30 days of receipt of the Annual Report detailing compliance or non-compliance with septic permit requirements.

        i. The O&M Entity should inform individual members of their compliance status.

        ii. All correspondence from the health districts regarding a noncompliant Annual Report shall be copied to DEQ.

5. Delinquent Annual Reports:

    a. If the property owner or their O&M Entity contracted to submit the member's Annual Report does not submit the Annual Report by July 31st of the reporting year the local health district shall send the property owner, or O&M Entity contracted to submit the member's Annual Report, a reminder letter providing a secondary deadline for annual report submission of August 31st of the reporting year. The reminder letter shall detail the report requirements and that failure to submit the Annual Report by the secondary deadline will result in the district forwarding a notice of non-report to DEQ. DEQ may seek any remedy available under the Individual/Subsurface Sewage Disposal Rules, including without limitation requiring the property owner to replace the ETPS unit with another system, as outlined in section 4.10.5.

        ~~ii.~~i. All correspondence from the health district regarding delinquent Annual Reports shall be copied to DEQ.

4.10.5 ETPS System Failure, Disapproval, and Reinstatement

Commercially manufactured wastewater treatment components must be approved by DEQ (IDAPA 58.01.03.009.01). Manufactured ETPS units are subject to this approval. In addition, the installation of an ETPS unit requires a subsurface sewage disposal permit pursuant to IDAPA 58.01.03.005. ETPS units are alternative systems that must be approved by the Director pursuant to IDAPA 58.01.03.004.10. As part of the alternative system approval for ETPS units DEQ defines the specific circumstances under which the ETPS units may be installed, used, operated, and maintained within section 4.10 of the TGM (IDAPA 58.01.03.009.03 and 58.01.03.005.14).

If an ETPS product is not shown to be installed, used, operated, or maintained as described within section 4.10 of the TGM DEQ may pursue enforcement against a property owner and seek

those remedies available under IDAPA 58.01.03. Enforcement and remedies against a property owner may include a determination that the ETPS system has failed and the requirement that the property owner replace the ETPS unit with a different system authorized by DEQ. This may include the installation of another ETPS unit approved by DEQ or the engineering and installation of another alternative system that is capable of meeting the requirements of the property owner's subsurface sewage disposal permit. If an ETPS product is not shown to be in compliance or to consistently function in compliance with IDAPA 58.01.03 and the operation and maintenance requirements outlined in section 4.10 of the TGM, DEQ may disapprove the ETPS unit. Reasons for DEQ enforcement, which may include seeking remedies against a property owner or disapproval of an ETPS manufacturer's technology as outlined herein, but are not limited to, the following:

1. Failure to submit an Annual Report by the secondary deadline of August 31st.
2. If ~~an O&M Entity's~~the Annual Reports for a particular ETPS technology identifies a malfunctioning system rate~~s~~ of 10% or more.~~,~~
    a. Malfunctioning systems are defined as any system that fails to receive annual maintenance or exceeds the effluent reduction levels for any constituent required as part of the septic permit (i.e., TSS, $CBOD_5$, or TN).
3. If a property owner's ETPS unit has been determined to be a failing system.
    a. Failing ETPS units are defined in section 4.10.3(2)(g).

4.10.5.1 Failing System Enforcements

The regulatory authority shall follow the following procedures upon determination that an ETPS unit is a failing system (Figure 4-9):

1. When the regulatory authority is notified that a system is failing a Notice of Violation (NOV) shall be issued to the property owner. The property owner shall have the opportunity to hold a compliance conference with the regulatory authority to enter into a consent order.
2. Consent orders should allow a property owner a 12 month period in which to return the system to proper operation or replace the failing system.
    a. Over this 12 month period the property owner should have their O&M Entity service the ETPS unit at least monthly.
    b. Monthly effluent samples should be required to be taken by the O&M Entity until the ETPS unit passes 3 consecutive monthly samples.
        i. Three consecutive passing monthly samples taken one month apart from one another would be cause for the regulatory authority to terminate the consent order and NOV, and reclassify the system as compliant.
    c. Operation and Maintenance records as described in section 4.10.3.1, certified laboratory records, and Chain-of-Custody records for each sample should be

submitted to the regulatory authority on a monthly basis as part of the consent order.

d. If the ETPS unit is not capable of producing 3 consecutive monthly samples over the 12 month period the system shall be replaced with another alternative system capable of meeting the effluent quality requirements based upon applicable site conditions.

~~a.~~e. Appropriate replacement systems may include a sand mound with 24 inches of sand beneath the absorption bed, intermittent sand filter, recirculating gravel filter, or a different ETPS unit that is approved and has an active O&M Entity.

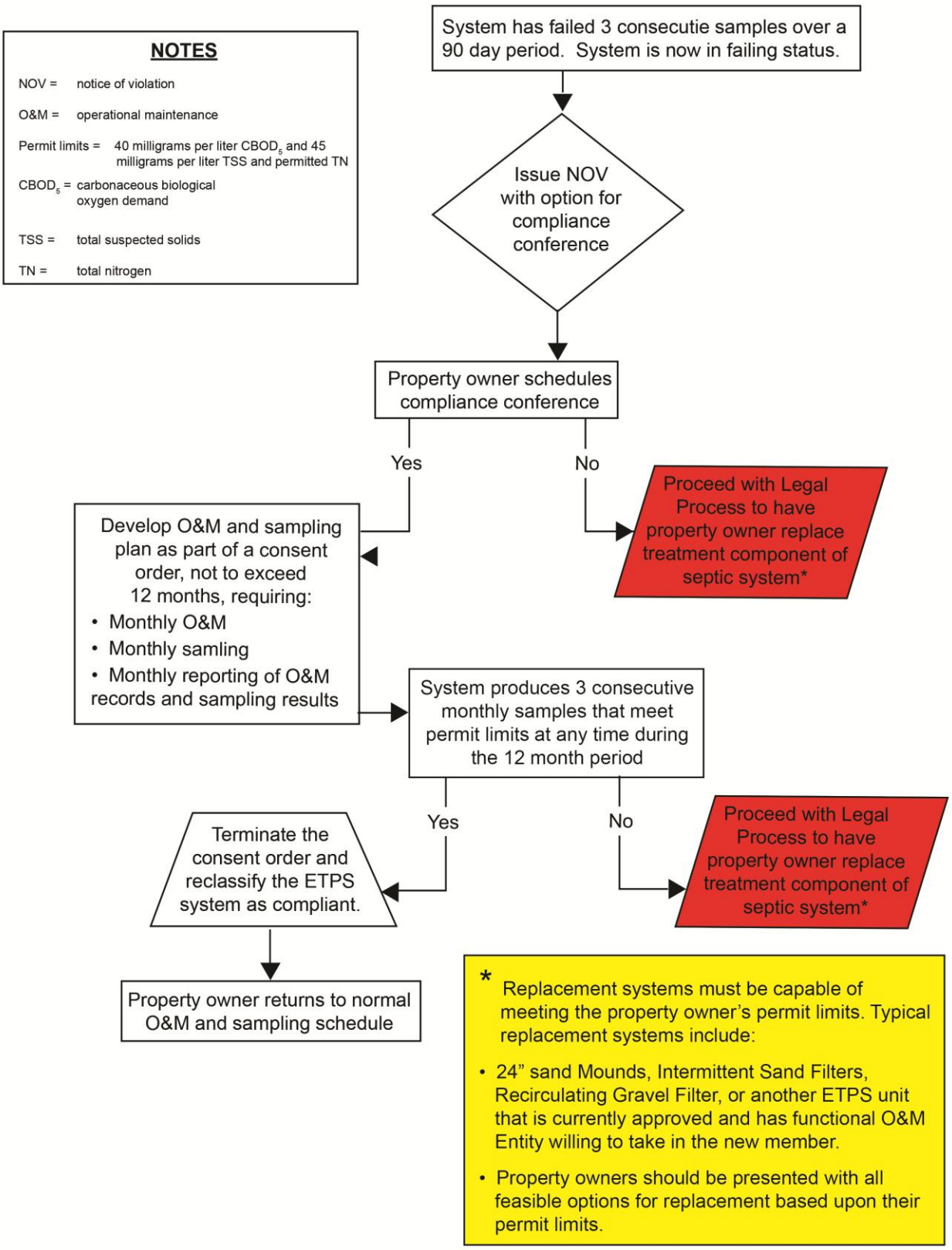


Figure 4-9. ETPS failing system enforcement flowchart.

4.10.5.2 ETPS Product Disapproval

In addition to determining a particular system is a failing system as set forth in section 4.10.5.1, if DEQ determines that an ETPS unit cannot consistently function in compliance with IDAPA 58.01.03, DEQ may disapprove the product (IDAPA 58.01.03.009.04). A notice of DEQ's intent to disapprove the product will be detailed in writing following Idaho Code, title 67, chapter 52, and sent to the ETPS product manufacturer, O&M Entity, and the health districts. The ETPS manufacturer will be allowed an opportunity to respond prior to product disapproval. Upon disapproval of an ETPS product the health districts shall not issue septic system permits on new applications for ETPS systems from the disapproved product manufacturer supplied by a specific O&M Entity. Monitoring, reporting, and servicing requirements of existing ETPS unit installations will not be affected by the product disapproval (Figure 4-10).

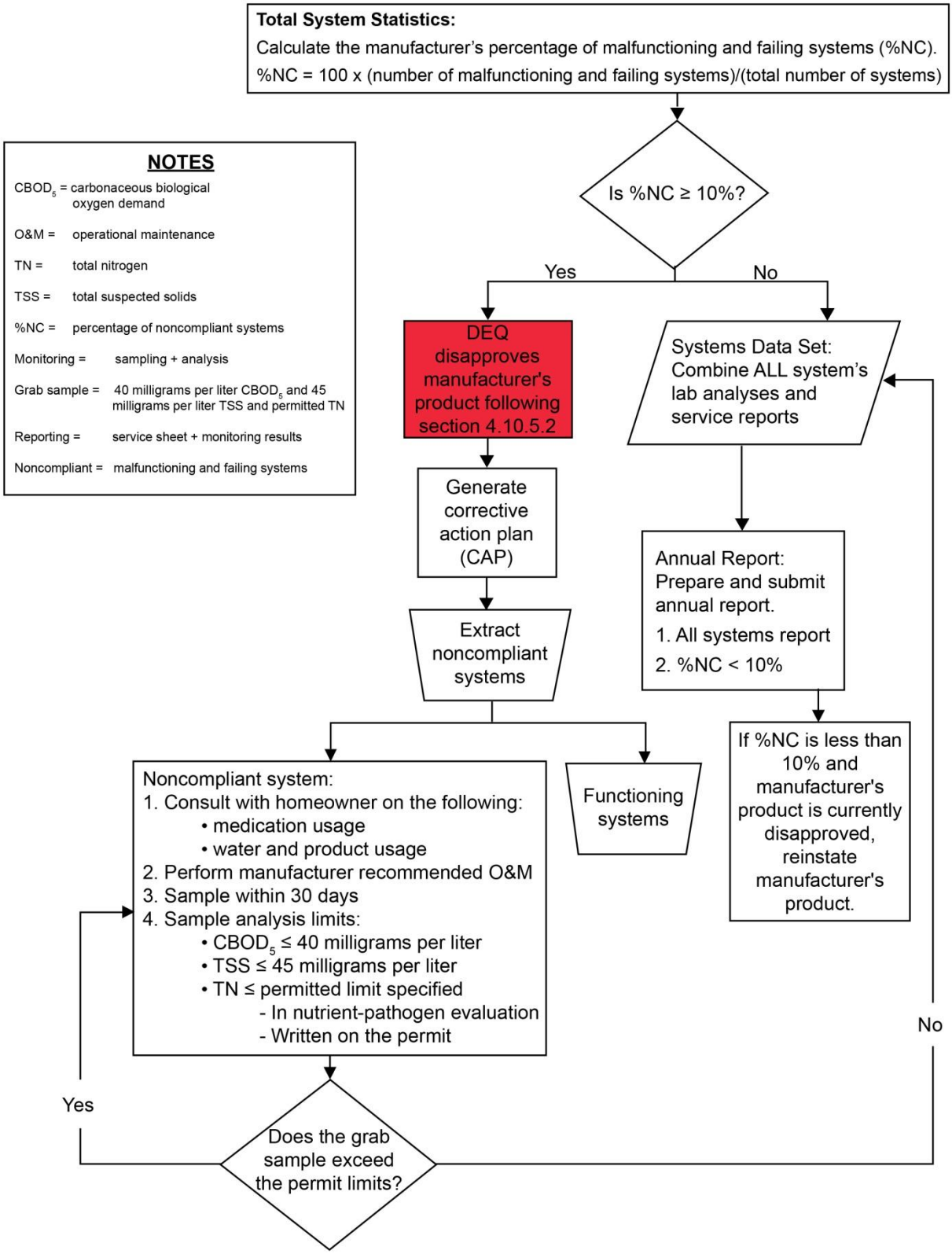


Figure 4-~~9~~10. ETPS product disapproval process based upon annual reports.

4.10.5.3 ETPS Product Reinstatement

Upon ETPS product disapproval DEQ will provide the opportunity for the ETPS product manufacturer to enter into a Corrective Action Plan (CAP) for the purposes of product reinstatement. The CAP should establish the time frame to return the noncomplying or failing systems to proper operation. The ~~suspension~~product disapproval will remain in effect until the malfunctioning and failing system rate for the ETPS manufacturer's technology is below 10%.

4.10.6 Member Refusal of Maintenance or Testing Requirements

It is the responsibility of the individual Nonprofit O&M Entity members (property owners) to ensure the O&M Entity is capable of performing the necessary annual maintenance and effluent testing required for their ETPS unit. Failure of an individual member to permit the O&M Entity from carrying out the required services is considered a violation of IDAPA 58.01.03.012.01. The following activities from a property owner toward their O&M Entity may be considered as refusal of service actions by a member, and may not be limited to:

1. Refusal to allow annual maintenance or effluent quality testing (e.g., refusal to pay annual dues preventing the financial capability of service, denial of property access, etc.).
2. Refusal to maintain the ETPS unit in operating condition (e.g., refusal to replace broken components, refusal to provide electricity to the unit, etc.).
3. If the refusal of service continues through the Annual Reporting Period the Nonprofit O&M Entity should substitute the following documents in the Annual Report for members refusing service that the O&M Entity is contracted with to submit their Annual Report:
    a. Copies of all correspondence and associated certified mail receipts documenting the property owner's receipt of the correspondence regarding the refusal of service. Refusal of service by a member through non-payment should include documentation of a lien being placed on the member's property.
        i. If the documentation is not included within the Annual Report, there will be insufficient documentation of the property owner's refusal to allow maintenance and monitoring, and therefore, the lack of maintenance and monitoring may count against the malfunctioning rate for the ETPS technology.

4.10.6.1 Refusal of Service Enforcement Procedures

Upon receipt of an Annual Report that shows that individual O&M Entity members have refused to allow maintenance and monitoring as set out in section 4.10.6 of this guidance the following guidelines shall apply:

1. The regulatory authority shall issue Letter 1 and the associated enclosure that was provided in the DEQ Program Directive dated xxxx.

a. This letter shall be sent to the property owner via certified mail and copied to the associated O&M Entity.

b. It is the property owner's responsibility to work with the regulatory authority and their O&M Entity to address their delinquent responsibilities. The O&M Entity should contact the regulatory authority and associated property owner 30 days after receipt of Letter 1 informing the regulatory authority of the property owner's voluntary compliance status.

2. If the property owner fails to voluntarily comply within the 30 day timeframe the regulatory authority shall issue Letter 2 that was provided in the DEQ Program Directive dated xxxx.

a. This letter shall be sent to the property owner via certified mail and copied to the associated O&M Entity.

b. It is the property owner's responsibility to work with the regulatory authority and their O&M Entity to address their delinquent responsibilities. The O&M Entity should contact the regulatory authority and associated property owner by the voluntary compliance date provided within Letter 2 informing the regulatory authority of the property owner's voluntary compliance status.

3. If the property owner fails to voluntarily comply by the date provided in step 2 of this process the regulatory authority shall issue a Notice of Violation to the property owner to ensure compliance with the property owner's subsurface sewage disposal permit requirements in regards to the ETPS unit.

~~1. DEQ will suspend the O&M Entity and require that the O&M Entity, affected homeowners, and service provider, in cooperation with the local health district, enter into a Corrective Action Plan (CAP). The CAP should establish the time frame to return the noncomplying systems to proper operation. The suspension will remain in effect until the malfunctioning system rate is below 10%. Suspension will only prevent issuing additional O&M agreements. Existing system monitoring, reporting, and servicing requirements will not be affected by a suspension (Figure 4-9).~~

~~4. If the system is experimental, the system owner will provide a waiver of liability absolving the Department and the health districts of any liability arising from operation or malfunction of the system.~~

~~4.10.3~~4.10.7 Design of ETPS Units

Procedures relating to design are required by IDAPA 53.01.03 (section 8.1) or may be required as permit conditions, as appropriate, to ensure protection of public health and the environment.

1. All materials will be durable, corrosion resistant, and designed for the intended use.
2. All electrical connections completed on site shall comply with the National Fire Protection Association (NFPA) Standard NFPA 70, National Electrical Code, as required by the Idaho Division of Building Safety, Electrical Bureau.
3. Design for each specific application should be provided by a PE licensed in the State of Idaho ~~specializing in environmental or sanitary engineering~~.
4. The system's aerobic treatment section will be preceded by ~~a primary clarifier~~an appropriately sized septic tank. The ~~primary clarifier~~septic tank may be either a separate septic tank, a volume integral with the system's package, or a combination of internal clarifier volume coupled with an external tank. The ~~primary clarifier~~septic tank shall provide the minimum tank capacity for residential facilities as specified in IDAPA 58.01.03.007.07.a, or for nonresidential facilities a minimum of 2-days hydraulic residence time (HRT) as stipulated in IDAPA 58.01.03.007.07.b. Timed dosing from the clarifier to the aerobic treatment unit is preferred, and highly recommended, to maintain a constant source of nutrients for the system's aerobic microbes.

~~4.~~5. Manufactured and *packaged* mechanical treatment devices will be required to prove that the specified equipment model~~:~~ meets the ETPS product approval policy outlined in section 1.4.2.2

   ~~a. Has successfully completed National Sanitary Foundation (NSF) standard 40 testing, or~~

   ~~b. Has successfully completed an EPA-sanctioned Environmental Technology Verification (ETV) test, or~~

   ~~c.~~d. ~~Was designed by a PE licensed in the State of Idaho specializing in sanitary or environmental engineering~~.

~~4.10.4~~4.10.8 Construction

Procedures relating to construction are required by IDAPA 58.01.03 (section 8.1) or may be required as permit conditions, as appropriate, to ensure the protection of public health and the environment.

1. Installation

   a. ~~The system shall be installed by an appropriately qualified installer. IDAPA 58.01.03.003.35 defines system as "Beginning at the point of entry~~

~~physically connected piping, treatment devices, receptacles, structures, or areas of land designed, used or dedicated to convey, store, stabilize, neutralize, treat, or dispose of blackwaste or wastewater." Consequently, the system includes the drainfield.~~

a. A licensed complex system installer shall be required to install an ETPS unit and all other portions of the septic system connected to the ETPS unit, or that the ETPS unit discharges to (IDAPA 58.01.03.006.01.b).

b. A public works contractor may install an ETPS unit if they are under the direct supervision of a PE licensed in the State of Idaho.

c. Licensed plumbers and electricians will be required to install specific devices and components for proper system operation. If the device requires any on-site fabrication or component assembly, a public works contractor should be used.

~~e.~~d. A sample port will be installed in the effluent line after the aerobic treatment unit.

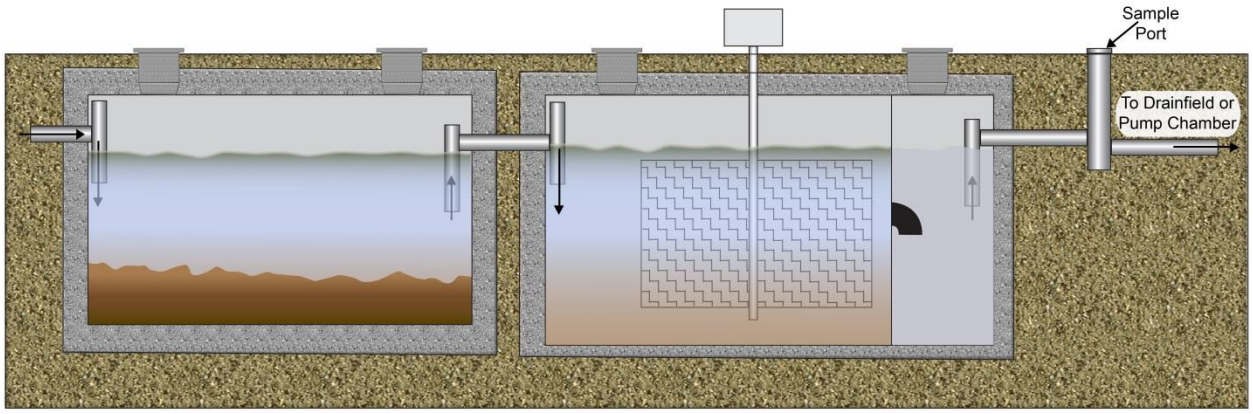
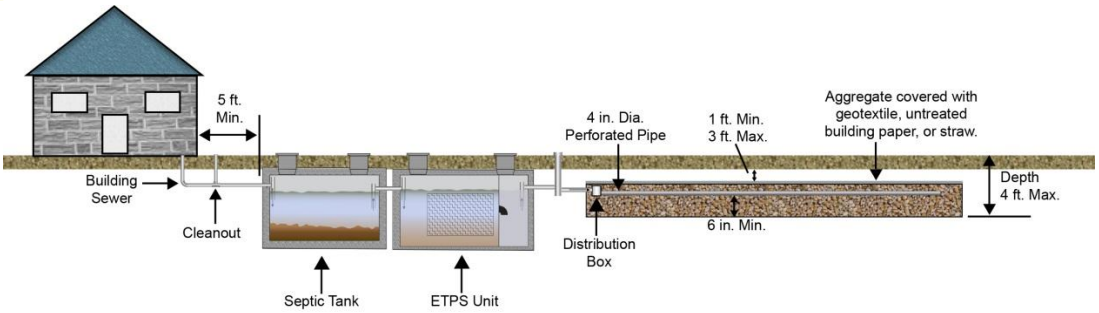


Figure 4-11. Sampling port example.



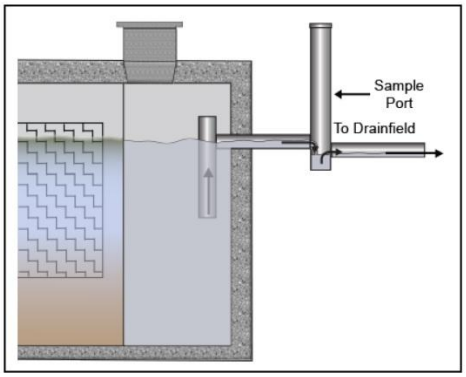


Figure 4-12. Sampling port and drainfield.

2. Within ~~90~~ 30 days of completing the installation the property owner shall provide certification to the regulatory authority, from their O&M Entity, that the system has been installed and is operating in accordance with ~~design and/or~~ the manufacturer's recommendations (IDAPA 58.01.03.005.15).

   a. A statement requiring the submission of the installation verification form described above shall be written on the face of the subsurface sewage disposal permit.

   ~~a.~~b. The regulatory authority shall hold the finalization of the subsurface sewage disposal permit until the certification of proper installation and operation is received.

~~*Note*: If a health district has questions regarding application of this guidance document to a proposed system, contact DEQ.~~

Figure 4-8 shows the ETPS sampling process for an individual system, ~~and~~ Figure 4-9 shows the ~~reporting~~ enforcement process for ~~an O&M Entity~~a failing system, Figure 4-10 shows the ETPS product disapproval process, Figure 4-11 shows the placement of a sampling port after the ETPS unit, and figure 4-12 shows the sample port and drainfield after the septic and treatment tank.

Appendix E

Dear Extended Treatment Package System Owner,

The Department of Environmental Quality (DEQ) would like to take this opportunity to provide some information about the treatment component of your septic system and remind you of the annual service and testing of the treatment unit that is vital to your systems overall functionality and required as a condition of your septic permit. The issuance of the septic permit for your property required a treatment component in order to install the drainfield. Without the septic permit the construction of buildings necessitating sewer connections on your property would not be possible.

Extended Treatment Package Systems provide pretreatment to your wastewater prior to its discharge to the drainfield portion of your septic system. These treatment units reduce waste strength and nutrients (particularly nitrogen) in wastewater. For more information on these systems and your drainfield please view the *Aerobic Treatment Systems and Drainfields: What You Need to Know* brochure on the DEQ website located at http://www.deq.idaho.gov/media/657393-aerobic_treatment_systems_and_drainfields_brochure.pdf.

Per your member agreement contract you are required to work with your Operation and Maintenance Entity and Service Provider to ensure that annual servicing and testing of your treatment unit is scheduled. Protection of public health and the environment is a team effort. Your participation in this program is a critical aspect to its success and is a requirement of the septic system permit for your property.

Thank you for your cooperation.

Sincerely,

The Idaho Department of Environmental Quality

Appendix F

October 31, 2013
[Certified Mail No.]
[Name]
[Address]
[City, State]

Re: Refusal of Service for Extended Treatment Package System

Dear [Name],

It has come to our attention that you have not had your extended treatment package system (ETPS) [maintained and/or tested] for this reporting year. The subject property is located at [address or legal description]. It is a requirement of the septic permit issued for your property that the ETPS unit has annual maintenance performed and the effluent quality tested through your Operation & Maintenance Entity (O&M Entity) and the O&M Entity's associated Service Provider. According to our records your O&M Entity and Service Provider contacts are:

O&M Entity:	Service Provider:
Entity Contact Name	SP Name
Entity Business Name	SP Business
Entity Address	SP Address
Phone Number	Phone Number

Your ETPS unit is under contract with this O&M Entity through a Member Agreement. This agreement is recorded with your County. It is the homeowner's responsibility to ensure the ETPS unit is provided with maintenance, and that the effluent quality discharged from the unit is tested annually. Failure to have annual maintenance performed and effluent quality tested for your ETPS unit places you in violation of the Subsurface Sewage Disposal Rules. Please work with your O&M Entity to schedule your annual maintenance and effluent quality testing. If you have any questions regarding your Member Agreement or the necessary requirements to schedule your maintenance and testing appointment please contact your O&M Entity. If you have questions concerning regulatory requirements regarding your ETPS system please contact [insert department name] at [insert phone number]. Your cooperation in meeting the requirements of your septic permit is appreciated.

Sincerely,

[Regulator Name]
[Regulator Title]

c: [O&M Entity]
enclosure

Dear Extended Treatment Package System Owner,

The Department of Environmental Quality (DEQ) would like to take this opportunity to provide some information about the treatment component of your septic system and remind you of the annual service and testing of the treatment unit that is vital to your systems overall functionality and required as a condition of your septic permit. The issuance of the septic permit for your property required a treatment component in order to install the drainfield. Without the septic permit the construction of buildings necessitating sewer connections on your property would not be possible.

Extended Treatment Package Systems provide pretreatment to your wastewater prior to its discharge to the drainfield portion of your septic system. These treatment units reduce waste strength and nutrients (particularly nitrogen) in wastewater. For more information on these systems and your drainfield please view the *Aerobic Treatment Systems and Drainfields: What You Need to Know* brochure on the DEQ website located at http://www.deq.idaho.gov/media/657393-aerobic_treatment_systems_and_drainfields_brochure.pdf.

Per your member agreement contract you are required to work with your Operation and Maintenance Entity and Service Provider to ensure that annual servicing and testing of your treatment unit is scheduled. Protection of public health and the environment is a team effort. Your participation in this program is a critical aspect to its success and is a requirement of the septic system permit for your property.

Thank you for your cooperation.

Sincerely,

The Idaho Department of Environmental Quality

Appendix G

October 31, 2013
[Certified Letter No.]
[Name]
[Address]
[City, State]

Re: Voluntary Deadline to Comply with ETPS Maintenance and Effluent Testing Requirements

Dear [Name],

[Regulatory Agency Name] has been informed that you are refusing to meet your responsibility and requirements surrounding your extended treatment package system (ETPS). As described in this Department's letter sent to you dated [insert letter 1 date] you are responsible for having annual maintenance performed on your ETPS unit and for annual testing of effluent quality discharged by the unit. Per *IDAPA 58.01.03.002.04.a.i* it is the responsibility of the property owner to treat and dispose of wastewater generated on their property in accordance with their subsurface sewage disposal permit.

You are responsible for the completion of your unit's annual maintenance and effluent quality testing. The results of the annual maintenance and testing are required to be submitted to this Department by July 31st of each year. As of the issuance of this letter you are delinquent in meeting these requirements by [insert number of days past July 31st]. This Department is providing you a 30 day window to voluntarily meet the requirements and responsibilities of your septic permit (see enclosure). You have until [insert voluntary compliance date] to accomplish your required annual maintenance and effluent quality testing. After this date this Department may issue a Notice of Violation to you for failure to meet the requirements of *IDAPA 58.01.03.002.04.a.i, 58.01.03.004.01, 58.01.03.005.14, and 58.01.03.012.01-03*. To view the requirements of these Rules please reference the Individual/Subsurface Sewage Disposal Rules located at http://www.deq.idaho.gov/water-quality/wastewater/septic-systems.aspx.

Please contact your O&M Entity to schedule your required annual maintenance and testing of effluent quality.

O&M Entity:

Entity Contact Name
Entity Business Name
Entity Address
Phone Number

Your O&M Entity will be required to report the status of the completion and compliance of these activities on [insert voluntary compliance date]. Your cooperation in meeting the requirements of your septic permit is appreciated.

Sincerely,

[Regulator Name]
[Regulator Title]

c: [O&M Entity]

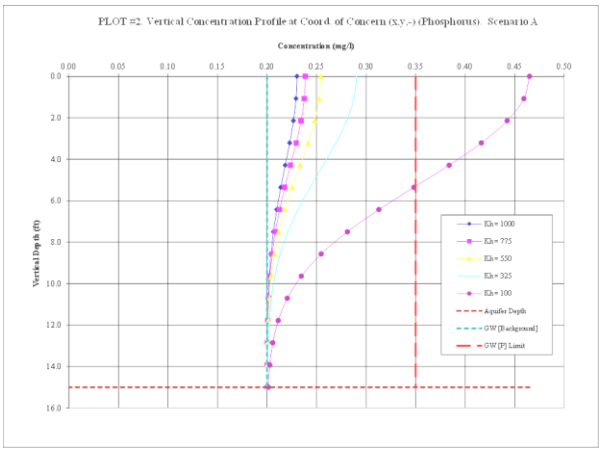
enclosure (septic permit)

Appendix H

See subsequent pages prior to appendix I.

On-Site Setback Distance Determination

Modeling Phosphorus in the Environment as the Critical Constituent



State of Idaho
Department of Environmental Quality
Technical Services Division

June 2013

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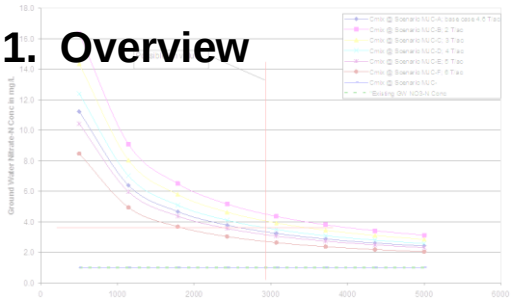
1. Overview



1.1 Synopsis

The *Phosphorus-Based On-Site Setback Determination Model* (POSDM) is a technical and scientific means to determine setback distances from surface water for domestic subsurface sewage disposal (SSD) systems. This software tool takes into account effluent quality, drainfield characteristics, aquifer characteristics, ground water quality, and surface water body characteristics to calculate an appropriate setback distance from surface water. The model only addresses phosphorus (P) as the constituent of concern. Prior to using this model, landowners and/or their consultants must consider other wastewater constituents, such as nitrate and pathogens, and obtain a determination from the Idaho Department of Environmental Quality (DEQ) that the other wastewater constituents are deemed insignificant.

The model consists of three *stages* corresponding to the effluent (and thus the contaminate transport) flow path:

1. Effluent application to the drainfield and soil sorption (removal) of P from effluent
2. Mixing of percolate discharging from the drainfield with ground water, and the subsequent transport along the ground water flow path
3. Mixing of ground water discharging into the receiving surface water body.

The first stage of the model predicts how much P can be sorbed to the soils beneath the distribution field before the soil P sorption capacity is fully utilized. The model also estimates the P concentration and volume of percolate discharging to ground water. The higher the P fixing capacity of the soil, the longer the site can be utilized.

The second stage of the model predicts resulting P concentrations as ground water and percolate from the drainfield mix. As ground water travels downgradient from the drainfield, P concentrations change both with distance and depth.

The resulting P concentration in ground water as it encounters a surface water body is used for the third stage of the model. The third stage of the model consists of estimating the resulting P impacts to the surface water body as ground water discharges into, and mixes with, the surface water body.

Several possible compliance points can be considered with this model. These include (a) a drainfield site life based on the P sorption capacity of the soils; (b) a maximum P concentration

of percolate discharging from the drainfield; (c) a maximum ground water P concentration a specified distance downgradient of the drainfield; (d) a mass discharge amount into a surface water body; or (e) a maximum P concentration in a surface water body after mixing with discharging ground water.

The POSDM design is a series of user-friendly spreadsheets where the required information can be easily entered, and determination of appropriate setback distances to surface water calculated and clearly displayed. The theory behind the model is complex. Consequently, parameter selection and model use should only be pursued by environmental professionals (such as a professional engineer or geologist) with expertise in environmental system modeling.

1.2 Introduction

Many properties in Idaho that are adjacent to surface water are not near municipal wastewater collection and treatment facilities. Furthermore, some of these properties may not be large enough to place an on-site wastewater drainfield the required distance away from the surface water. This situation hinders installation of, or access to, suitable wastewater treatment facilities, which prohibits building a structure supplied with pressurized water. It may be possible, however, to utilize shorter setbacks that still appropriately protect public health and water quality.

Recognizing the ever-advancing technology related to sewage disposal, the "Individual/Subsurface Sewage Disposal Rules" (Idaho Administrative Procedures Act (IDAPA) 58.01.03) state that alternative systems may be permitted if in accordance with the Technical Guidance Committee's recommendation and approved by the Director. (IDAPA 58.01.03.004.10.) Disposal via a pressurized drainfield is an approved alternative system under the Individual/Subsurface Sewage Disposal Rules. The Director may grant a variance from the dimensional or construction requirements for a system in certain circumstances, e.g., where the variance will not have an adverse impact on the public health or the environment (IDAPA 58.01.03.010.06(c)). This guidance document therefore assists real property owners and/or their consultants in complying with the requirements for seeking a variance from the Individual/Subsurface Sewage Disposal Rules' separation distances (IDAPA 58.01.03.008.02(d)) for a system utilizing a pressurized drainfield. (IDAPA 58.01.03.010.) The modeling results will help inform DEQ's setback determinations based on site specific information.

The site and proposed system must not adversely impact the adjacent surface water. This requires that the facility and wastewater system adequately address the following wastewater constituents:

1. Total nitrogen
2. Pathogens
3. Phosphorus

Current permitting procedures adequately address nitrogen and will not be addressed in this document. Refer to the current revision of the Nutrient-Pathogen (NP) Evaluation Program for On-Site Wastewater Treatment Systems (DEQ 2002) for these topics. Be aware that an NP evaluation, required to assess a system's impact on ground and surface waters, may identify site

limitations that require a nitrogen-reducing system be installed. Nitrogen-reducing systems do not reduce P in the wastewater stream.

This model will address P sorption in the soils beneath an appropriately sized pressurized drainfield. An appropriately sized drainfield is one that adheres to IDAPA 58.01.03.008.03 specified sizing, without drainfield reduction. This guidance is not intended to be used to establish reductions in drainfield size, but rather to assess the capacity of the soil beneath the drainfield to sequester P, so that any potential reduction in setback distance to surface water can be realized. Drainfields may be configured with capping fill trenches, or drip distribution fields, and must be pressure dosed. The intent for using pressurization is to place the effluent as near to the soil's surface as possible, in order to use all available soil sorption sites, and to evenly distribute the effluent over the entire drainfield. Application of this model should be preceded by a thorough site evaluation performed in conjunction with the local health district. Appropriate soil sampling protocols (Appendix A) and soil P sorption analytical methods (Appendix B) must be used. The physical system modeled is shown in Figure 1-1.

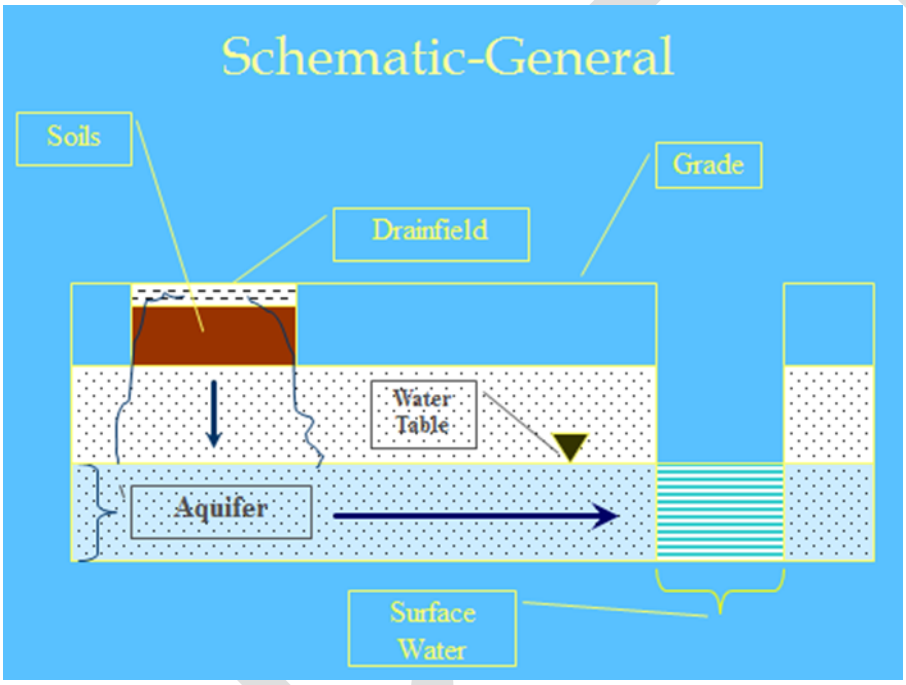


Figure 1-1. General schematic of the modeled flow path.

Three contaminant pathways are modeled as shown in Figure 1-2:

1. Phosphorus (P) movement through, and sorption in soils and resulting generation of P-bearing percolate
2. Mixing of percolate with ground water and subsequent P advection and dispersion during aquifer transport
3. Ground water mixing with surface water (either stream/river or lake/reservoir).

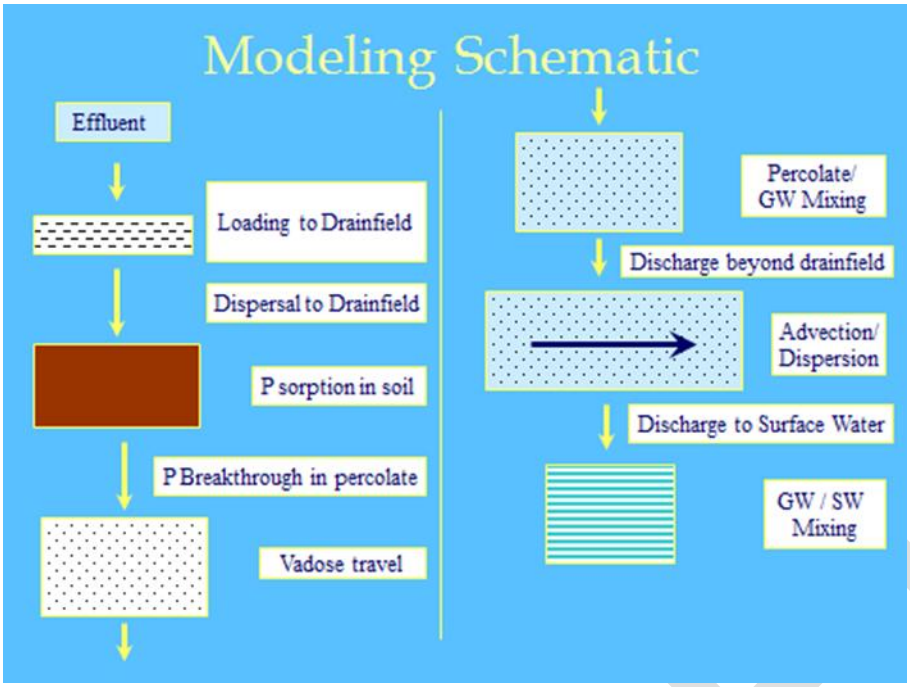


Figure 1-2. Schematic of the modeling steps.

The regulatory role is to (1) determine the point(s) of compliance, (2) set qualitative and quantitative criteria at the point(s) of compliance, (3) evaluate numerical model outputs to determine compliance with the established criteria, and (4) determine acceptability of a proposed project. Points of compliance may include but may not be limited to the following:

a. A site life (years) of a drainfield given its sorption capacity, P loading rate, and number of years to reach its capacity.
b. A threshold percolate concentration exiting the drainfield soil profile, in milligrams of P per liter (mg-P/L), that the system can reach before exceeding this threshold.
c. A threshold ground water concentration (milligrams per liter [mg/L]) at a distance from the drainfield that the installation must meet.
d. A mass discharge (pounds per year [lb/yr]) limit into a surface water body
e. A surface water mixing concentration limit (mg-P/L) that must not be exceeded.

1.3 Preliminary Considerations

This section describes appropriate uses of the model, expertise required to run the model, the *Tier I* nature of this simple model, and considerations for more complex *Tier II* modeling. Additionally, system compliance criteria will be presented.

1.3.1 Appropriate Uses of the Model

Until further notice, any use of this model for satisfaction of regulatory requirements, whether for characterization, design, or estimation of impact as a result of ongoing operation of a facility, for which output is submitted to the DEQ for review and approval, shall be preapproved by DEQ before use. Submittals to DEQ including nonapproved uses of this model shall not be accepted.

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1.3.2 Tier I (Conservative) Model

As with any tool, there are limitations and appropriate uses. This model is what we will term a *Tier I* model, meaning it is *relatively* simple mathematically, and it has internally set defaults that are meant to yield conservative estimations and predictions of P impacts to the environment. If a site-specific application of the model yields acceptable values that meet DEQ compliance criteria, the acceptability of the project should be reasonably assured.

The Tier I model is applicable for relatively straightforward scenarios. Increasing nonconformance to existing rule, guidance, or technology may necessitate more than a Tier I analysis (section 1.3.3). This model would be inapplicable for use in hydrogeologic scenarios that are inadequately characterized and do not present extremely limiting or unusual conditions. Such conditions may be cause for DEQ *to deem as inapplicable* the use of this model. Such conditions as generally described in this paragraph must be determined on a case-specific basis.

1.3.3 Approaches for a Tier II Analysis

If the Tier I outputs show predicted noncompliance at specified compliance points, more sophisticated, time-consuming approaches requiring additional expertise may be resorted to in order to conduct more detailed analyses. Such approaches will be called *Tier II* analyses. Tier II analyses may involve approaches that are outlined further in Appendix C.

1.3.4 Tier I Parameter Selection

Model output is only as good as the input parameters chosen. The modeler must have sufficient expertise, or access to such expertise, in parameter selection for the different media being modeled, such as the following:

- Drainfield design and operation
- Soils
- Hydrogeology
- Surface water hydrology
- Water quality issues

As discussed in detail below, documentation for all parameters selected must be provided to adequately document the modeling effort and the corresponding results. Documentation includes parameter sources and reasons why particular values were chosen.

The data utilized as inputs to the model should meet reasonable standards of quality. Contact DEQ for further guidance on data quality requirements and other details regarding quality assurance and quality control (QA/QC) that are pertinent for this application.

1.3.5 Compliance Criteria

Various site and system limitations must be taken into account prior to implementing this model to determine surface water setback reduction for drainfield placement. Some of these criteria and limitations include but are not necessarily restricted to the following:

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- Drainfields may not be placed closer than 100 feet from surface water.
- Soil horizons that encounter seasonally high ground water are not suitable for evaluation.
- Drainfields that are increased in size to utilize the P sequestering capacity of the extra soil to justify placement closer to surface water than IDAPA 58.01.03.008.02.d allows, does not justify future wastewater flow increases (adding bedrooms, increasing commercial wastewater flows).

1.4 Model Description

As discussed in section 1.2, the model incorporates three pathways and their corresponding removal/attenuation mechanisms Figure 1-1:

1. P movement through and sorption in soils, and resulting generation of P-bearing percolate
2. Mixing of percolate with ground water and subsequent P advection and dispersion during aquifer transport
3. Ground water mixing with surface water (either stream/river or lake/reservoir).

How these mechanisms are built into the model is discussed in this section. The general structure of the tool uses several Excel spreadsheets in one workbook. Each spreadsheet deals with a particular media that is being modeled, and inputs are placed on the top of the sheet, while outputs of the particular sheet are below the inputs. The sheets and their function are described below. Their interrelationships are shown in Figure 1-3.

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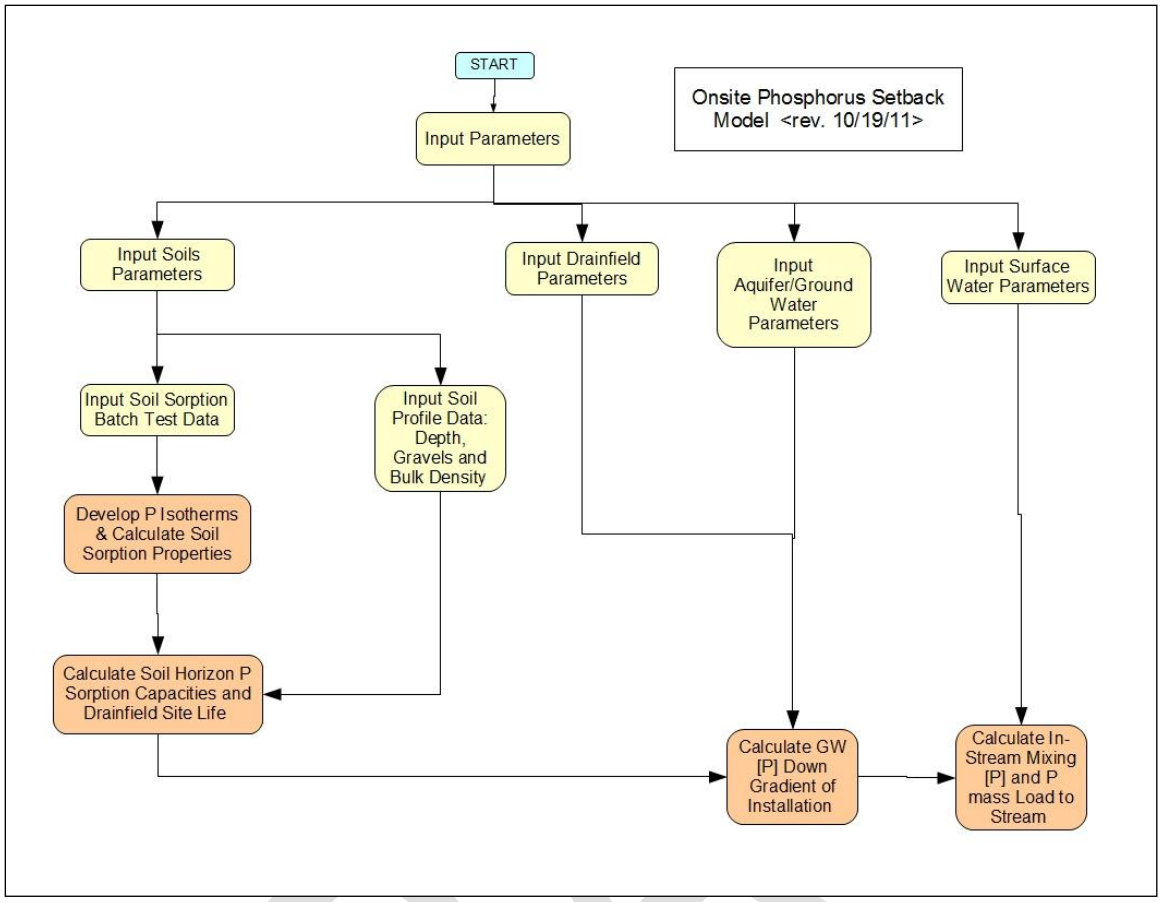

Figure 1-3. Model data input flow and subsequent output calculations.

Isotherm sheet—This sheet is where data from P sorption isotherm batch testing of soils is entered. Sorption isotherms are plotted and P sorption capacities of soils are calculated.

Sorption sheet—Soil horizon information is entered here, in addition to wastewater P concentrations [P]. Soil P sorption of the drainfield is calculated, along with a projected site-life.

Drainfield sheet—Soil class, number of bedrooms, wastewater flow, drainfield dimensions and orientation along ground water flow path, and proposed setback distance to surface water are entered.

Surface Water Mixing sheet—River or lake is entered, depth of water body, stream flow and other parameters related to mixing of ground water and surface water are entered.

GW Transport sheet—Ground water quality information, aquifer parameters, and model domain information are entered.

All Plots tab—All the graphics generated from the model appear in this tab.

Plot Data sheet—Most of the data utilized to create graphics in the All Plots tab are in this sheet. This sheet is protected and not available for modification by the user.

Utility Sheets tab—This tab indicates that the sheets beyond this tab relate to the inner workings of the model. No inputs are in these sheets, and only intermediate outputs that do not need to be displayed to the general user of the model are shown. These sheets are protected and not available for modification by the user.

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2. Isotherm Sheet

2.1 Description

The Isotherm sheet, shown in Figure 2-1, is where soil P sorption batch test data are entered, and where sorption isotherms are in turn generated from the data. This sheet has capacity to enter five sets of data, presumably enough data sets to accommodate up to five soil horizons being considered as the drainfield's sorptive matrix (adsorbent). Figure 2-1 shows both the inputs and outputs for one soil horizon. In brief, inputs of analytical data are shown in the yellow-colored columns to the center left of the table. Calculations based upon those data appear in the blue columns of the table. These calculations are used to create the four plots seen in the upper right and along the bottom of Figure 2-1. As described below, these plots represent various forms of two sorption isotherms—the Langmuir and Freundlich types (Bohn et al. 1979). The data, it is hoped, will fit one or the other of these isotherm types. Estimates of sorption capacity from the best fitting isotherm can then be made. The data inputs and outputs are described below:

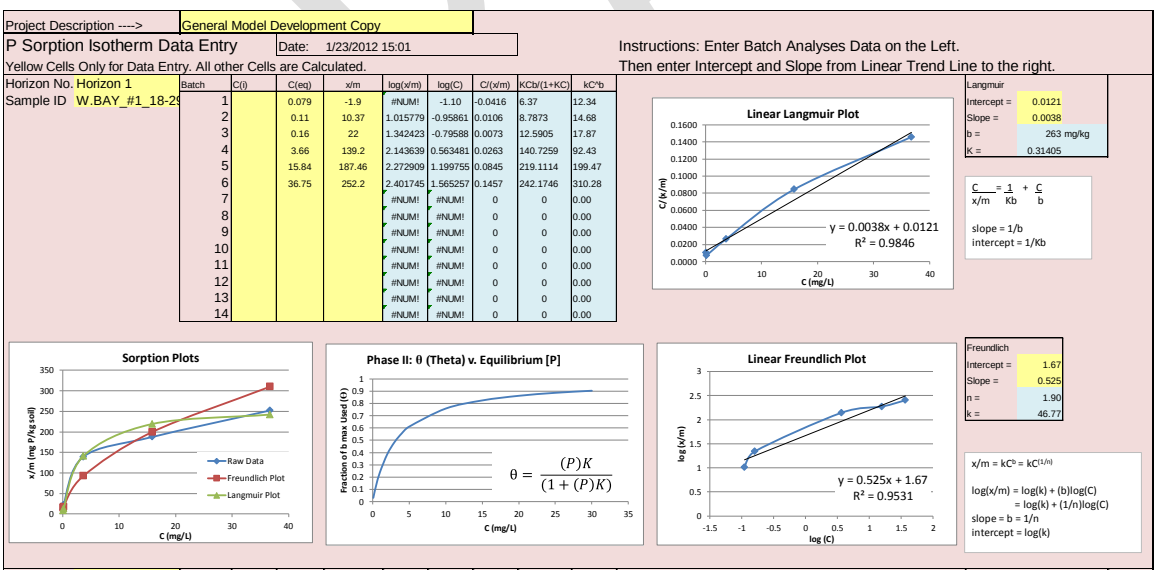

Figure 2-1. Soil sorption data input and P Isotherm generation sheet.

2.2 Instructions for Use

2.2.1 Isotherm Sheet Inputs

The following describes the input parameters for this sheet. As with the other sheets, cells used for inputs are colored yellow with red font.

1. **Project Description**: Enter a brief description of the project or scenario being modeled.
2. **Horizon No. (upper left of Figure 2-1):** The number or other designation of the horizon in the soil profile from which the sample was taken is entered here.
3. **Sample ID:** The unique sample ID, as given by the sampler or the analytical laboratory, is input below the Horizon No. input.
4. **Batch (number):** The batch number is pre-entered in the first column of the data/calculation table (appearing in the upper left of Figure 2-1) in the column labeled Batch. The batch represents a particular soil sorption test with a given aliquot containing a specific predetermined initial concentration (C_i) of phosphorus (P) (the adsorbate). Depending on the method used, and the initial aliquot concentration ranges to be employed, a variable number of batches may be analyzed. Utilization of five or more batches is common (Appendix B), but academic studies may employ numerous batches (Leytem and Westermann 2003).
5. **Initial Aliquot P Concentration (C_i) (mg/L):** In this column, enter the initial P concentration (C_i) (mg/L) (the adsorbate concentration) of the aliquot for each batch. These cells are not currently involved in any calculations, but minor spreadsheet modification may be employed to calculate the term, x/m, described in section 2.2.1(7). This is not anticipated to be necessary because the laboratory normally does this calculation and typically reports x/m to the client.
6. **Final (Equilibrium) Aliquot P Concentration (C_{eq} or C):** In this column, enter the final (equilibrium) P concentration (C_{eq}) (mg/L) of the aliquot for each batch. These cells are involved in this sheet's calculations for the linearized Langmuir plot as well as for plotting raw sorption data. These two plots are described in section 2.2.3.
7. **Phosphorus Sorbed onto the Soil (x/m) (mg/kg):** In this column, enter the amount of P sorbed onto the soil sample (the adsorbent). The variables are defined as follows: x is the mass of P (mg) sorbed onto the mass of soil (adsorbent) in kilograms (kg). The resulting ratio, x/m, is reported in units of mg P/kg soil.
8. **Langmuir Intercept (1/Kb):** The y intercept of the linear trendline plotted in the linearized Langmuir plot (Figure 2-2) is entered in the upper right input area. The Langmuir K is a constant related to the binding strength (Bohn et al. 1979). For further discussion of the Langmuir equation and its linear form, see Bohn et al. 1979 and the inserted text box in the upper right of Figure 2-1.
9. **Langmuir Slope (1/b) (kg soil/mg P):** The slope of the linearized Langmuir trendline is entered below the Langmuir intercept. The reciprocal of the Langmuir slope (b) is the maximum amount of adsorbate that can be adsorbed onto the soil (the adsorbent) (Bohn et. al 1979).
10. **Freundlich Intercept (log(k)):** the y intercept of the linear trendline plotted in the linearized Freundlich plot (Figure 2-4) is entered in the lower right input area. The value k is an empirical Freundlich constant. For further discussion of the Freundlich

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equation and its linear form, see Bohn et al. 1979, as well as the inserted text box in the lower right of Figure 2-1.

11. **Freundlich Slope (b or 1/n):** The slope, b, of the linearized Freundlich trendline is the reciprocal of the Freundlich empirical constant, n (Bohn et al. 1979). The slope, b, is entered below the Freundlich intercept.

2.2.2 Isotherm Sheet Calculated Outputs

1. **Calculation: Log(x/m)**—A calculation whose values are plotted against Log(C) so that a linearized Freundlich isotherm may be plotted (Figure 2-4).
2. **Calculation: Log(C)—**A calculation whose values are plotted against Log(x/m) so that a linearized Freundlich isotherm may be plotted (Figure 2-4).
3. **Calculation: C/(x/m)—**A calculation whose values are plotted against C so that a linearized Langmuir isotherm may be plotted (see Figure 2-2 below). This expression is actually the reciprocal of the solution/solid partition coefficient, K_d (K_d being (x/m)/C).
4. **Calculation: KCb/(1+KC)—**A calculation whose values are plotted against C so that a Langmuir isotherm for the particular soil sample analyzed may be plotted (see Figure 2-5 below).
5. **Calculation: kC^b—**A calculation made so that a Freundlich isotherm may be plotted (Figure 2-5).

2.2.3 Isotherm Sheet Graphical Outputs

1. **Linearized Langmuir Plot:** This plot (Figure 2-2) is semiautomatically generated by plotting C versus C/(x/m). See the linearized equation on the middle right of Figure 2-1. The user must decide what data to utilize and then select the data set (i.e., the x and y coordinate pairs) by editing the data set information. It is recommended that P desorption data pairs (i.e., those with negative x/m values) be omitted. It is also recommended that data pairs having initial P concentrations (C_i) greater than 200 mg/L not be used (Appendix B). The reason for this is to standardize the allowable concentrations employed when plotting the linearized Langmuir isotherm. This is important because the calculated sorption maximum (section 2.2.3(3)) will often increase when higher C_i batch test values are used.

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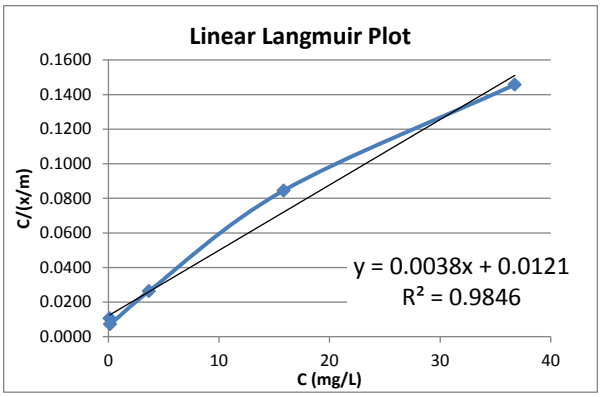

Figure 2-2. Linearized Langmuir isotherm [C/(x/m) versus C] with best fit trendline.

2. **Linearized Langmuir Plot Trendline – R^2 Value:** A linear trendline and its equation are automatically plotted along with the data as shown in Figure 2-2. Take note of three items: R^2 value, slope, and intercept. The R^2 associated with *goodness of fit* of the data to a linear trendline will appear in the plot area. It is often the case that the closer the goodness of fit parameter is to 1.0, the better the linear trendline matches the isotherm derived from the data, which increases one's confidence in using the linear trendline. In Devore (1995) correlation is considered strong, moderate, and weak where the R^2 is 0.8–1, 0.5–0.8, and <0.5 respectively. This is not always the case however, and other diagnostics may be necessary. See the important discussion in Helsel (1992). If the Langmuir isotherm is not an adequate fit, try another isotherm such as the Freundlich.
3. **Linearized Langmuir Plot Trendline – b_{max} or Reciprocal Intercept:** The y intercept (1/b) of the trendline appears in the equation in the plot area. The value b or b_{max} calculated is the Langmuir b_{max} or the sorption maximum of the analyzed soil matrix. It is the reciprocal of the y intercept and is expressed as mg-P/kg. The calculated value appears in the upper right of Figure 2-1. This parameter is an important input into the Phase I P sorption model in the Sorption sheet (section 3.2).
4. **Linearized Langmuir Plot Trendline – K or Affinity of the Sorption Matrix:** The K value is a constant related to the binding strength of the adsorbate (P in this case) to the adsorbent (the soil matrix) (Bohn et al. 1979). It is equal to the slope (1/b) divided by the intercept (1/Kb). The slope of the trendline is calculated and appears in the linear equation in the plot area. The K value is utilized in the Sorption sheet to generate a theta versus. [P]eq curve, which is a *normalized* curve constructed by plotting C versus. KC/(1+KC) as shown in Figure 2-3. The y axis is the fraction of soil P sorption capacity utilized (a proportion) and the x axis is C (i.e., the equilibrium P concentration). The significance of this plot will be explained in the Sorption sheet documentation in section 3.4.

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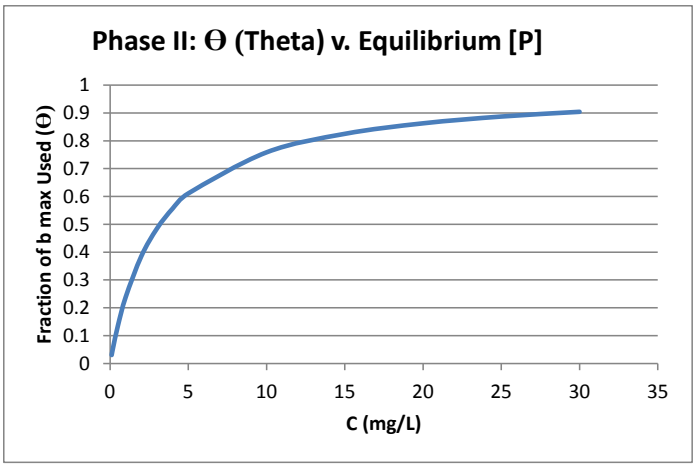


Figure 2-3. Normalized Langmuir isotherm [Theta (θ) versus C].

5. **Linearized Freundlich Plot:** This plot (Figure 2-4) is semiautomatically generated by plotting the log(C) versus. log(x/m). See the linearized equation on the lower right of Figure 2-1. The user must decide what data to utilize and select the data set (i.e., the x and y coordinate pairs) by editing the data set information. Phosphorus desorption data pairs (i.e., those with negative x/m values) cannot be used (the log of a negative number is undefined). It is recommended that data pairs with initial P concentrations (C_i) greater than 200 mg/L be omitted from the data to be plotted. The reason for this is twofold. First, such a limit serves to keep initial concentrations no more than an order of magnitude higher than expected in effluent concentrations. Raw wastewater effluent [P] ranges from 4–15 mg P/L (Lombardo 2006). Secondly, this limit serves to standardize the allowable concentrations employed when plotting the linearized Freundlich isotherm.

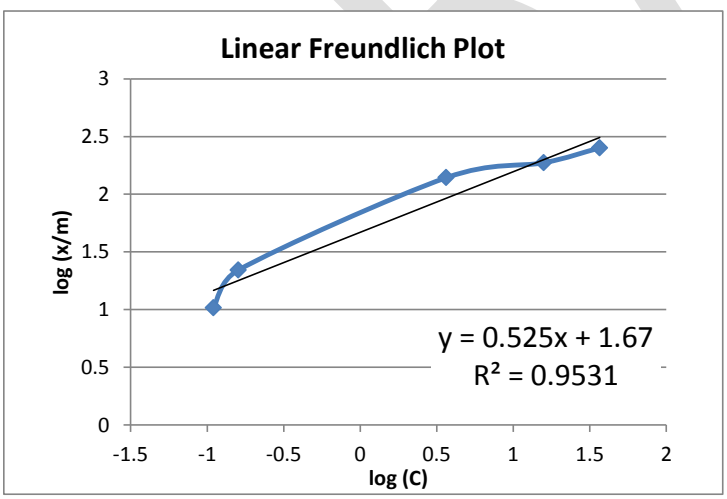


Figure 2-4. Linearized Freundlich isotherm [log(x/m) versus log(C)] with best fit trendline.

6. **Linearized Freundlich Plot Trendline – R^2 Value:** The trendline is automatically plotted along with the data. Take note of three items: R^2 value, slope, and intercept. The R^2 associated with *goodness of fit* of the data to a linear trendline will appear in the plot area. It is often the case that the closer the goodness of fit parameter is to 1.0,

the better the linear trendline matches the isotherm derived from the data, which increases one's confidence in using the linear trendline. In Devore (1995), correlation is considered strong, moderate, and weak where the R^2 is 0.8–1, 0.5–0.8, and <0.5 respectively. This is not always the case however, and other diagnostics may be necessary. See the important discussion in Helsel (1992). If the Freundlich isotherm is not an adequate fit, another isotherm such as the Langmuir should be chosen. One thing to note when comparing R^2 values of linearized Langmuir and Freundlich plots is that the Freundlich is a log/log plot and may result in better fits all other things being equal.

7. **Linearized Freundlich Plot Trendline – Intercept (b or 1/n):** The y intercept of the trendline appears in the equation in the plot area and is b or 1/n.
8. **Linearized Freundlich Plot Trendline – k:** The slope of the linearized Freundlich plot is log(k) from which the value of k is derived.
9. **Sorption Plots:** In the lower left corner of Figure 2-1, a graphic contains three sorption plots. This plot is reproduced below in Figure 2-5. The plots are semiautomatically generated. The raw data sorption curve plots equilibrium P concentration versus the amount of P sorbed onto the soil (C versus. x/m) (i.e., the data as are generally reported from a laboratory). The Freundlich curve plots C versus kC^b (an expression of x/m with the data fitted to the Freundlich isotherm). The Langmuir curve plots C versus KCb/(1+KC). The latter term is an expression of x/m with the data fitted to the Langmuir isotherm. Notice the additional b term in the numerator, which makes this curve a sorption curve rather than the *normalized* curve discussed in section 2.2.3 (Figure 2-3) and section 3.4. Plotting all three curves here enables the user to not only utilize the R^2 values in determining a best fitting isotherm, but enables the user to visually see which isotherm best fits the *raw data*. In certain cases, the user will be looking at what part of an isotherm appears to be fitting best with the raw data, such as in the case where a particular P equilibrium concentration is selected and calculations of the sorption capacity at that concentration are being estimated.

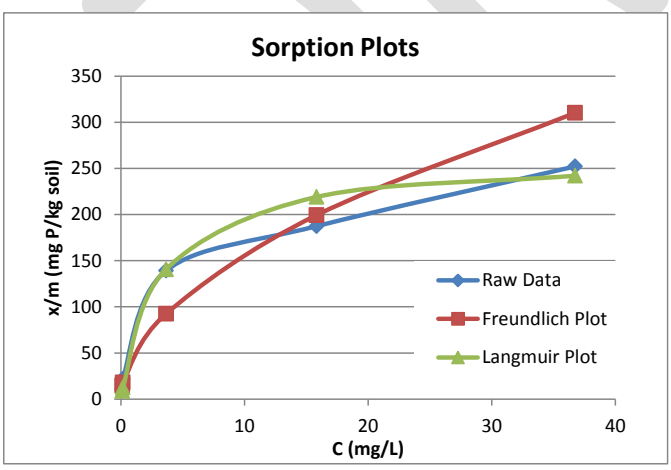
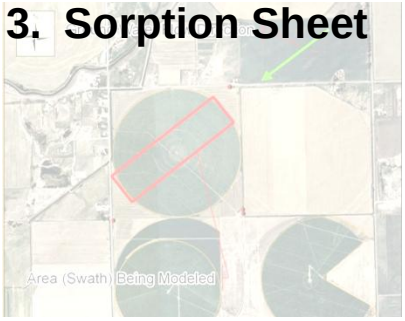


Figure 2-5. Sorption plots of soil sorption data, Langmuir and Freundlich isotherms [x/m versus C].

3. Sorption Sheet



3.1 Description

The Sorption sheet takes soil P sorption capacities calculated in the Isotherm sheet and determines P sorption capacities for soils in a drainfield and adjacent soils. Several subparts in this sheet have different functions. These subparts are discussed separately. In brief, they are

1. **Phase I: Site-Life P Sorption Maximum Tool.** This tool utilizes P sorption Langmuir maximums (b_{max}) calculated for each soil horizon in the Isotherm sheet, as well as the wastewater P loading rate to calculate a drainfield 'site-life'. This site-life is the time it takes to use up the P sorption capacity at the rate of P addition to the system.
2. **Phase II: Sorption/Percolate-P C_{eq} Estimator for On-Site Drainfields Tool.** This tool estimates percolate P concentrations (C_p) throughout the operation period of the drainfield. The longer the drainfield is in use the closer the C_p approaches wastewater phosphorus concentration (C_{ww}). Percolate P concentrations change in response to the amount of P that is sorbed, such that a given soil having little sorbed P, will have a low equilibrium P concentration exiting the soil profile. As the amount of P sorbed increases, the soil will exhibit increasingly a higher C_p. Eventually the soil reaches that P sorption capacity which is at an equilibrium concentration equal to the C_{ww}. Since the percolate concentration changes over time, the time-weighted average percolate concentration is calculated and that value is used for ground water mixing and contaminant transport calculations described in section 6.1 and following.
3. **P Desorption Capture Tool.** This tool calculates an estimated mass of P that will be desorbed from the soil matrix in a given number of years after drainfield abandonment, assuming a given percolate volume and P concentration. This estimated mass of desorbed P can be utilized in the model in one of three ways:
   a. This mass may be added to the mass of P calculated to be sorbed onto the soil in the Phase I analysis.
   b. This mass of P may be added to the mass of P calculated to be sorbed onto the soil in the Phase II analysis.
   c. This mass of P may be ignored and not added to either Phase I or Phase II sorption estimates.

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3.2 Phase I: Site-Life P Sorption Maximum Tool—Instructions for Use

As summarized above, this tool utilizes P sorption maximums (b_{max}) calculated for each soil horizon in the Isotherm sheet, as well as the wastewater P loading rate to calculate a drainfield *site-life*. This site-life is the time it takes for the drainfield and adjacent area to exhaust (use up) the predicted P sorption capacity at the given rate of P addition to the system. Three important simplifying assumptions of the Phase I tool are

1. It assumes that the Langmuir isotherm fits the soil data analyzed, which is necessary because only the Langmuir isotherm yields a b_{max}.
2. It assumes that all P applied to the system is sorbed and no P exits the system with percolate until the maximum sorption capacity (b_{max}) is exceeded.
3. Once b_{max} is exceeded, it is assumed that the system at that point has failed and the percolate P concentration ([P]) is assumed to be equal to the septic tank effluent [P] being discharged to the drainfield.

A critical limitation of the Phase I tool is its inability to calculate a percolate P concentration ([P]), and subsequently to calculate mixed ground water [P] downgradient. This prevents the Phase I tool from estimating a setback distance to surface water. Yet, the Phase I tool is able to provide an estimate for the soil's P sorption life, that is, how long the site will be able to be used to sorb P discharged at the rate specified concentration in the effluent (C_{ww}) assuming no percolate P losses.

This is not a besetting limitation if the Phase I tool is utilized in concert with the Phase II tool by allowing a b_{max} sorption capacity for only a portion of the total soil profile, and then reverting to the Phase II tool to set sorption capacities based on varying C_{eq} in the percolate. See Figure 3-1 and section 3.4 for further discussion.

Phase I: Site-Life P Sorption Max Tool for On-site Drainfields

Wastewater [P] (mg/L) [same for Phases I and II]	8.6		Sorption Multipliers		
P removal (precipitation) in Septic Tank (20 - 30 %)	0%		1.5	Estimate 5 d results from 1 d test	
WW vol/yr (million gallons/yr)	0.110			(1.5 recommended)	
WW vol/yr (million gallons/ac-yr)	3.407		1.5	Est of long term sorption from 5 d test	
Drainfield & Adjacent Area (acres)	0.032			(1.5 recommended)	
Regulatory Site life Min (yr) [set @ 0 to bypass Phase I]	10		2.25	Composite Sorption Multiplier	
P loading from WW/yr (lb/ac-yr) [both Phases I and II]	244.4				
Soil Parameters	Horizon 1	Horizon 2	Horizon 3	Horizon 4	Horizon 5
(Db) Soil bulk density (g/cm3	1.45	1.45	1.45	1.45	1.45
Rock fragment content - > 2 mm by volume (a proportion)	0	0	0	0.2	0.4
(d) horizon depth (inches)	8	32	30	25	5
(d) Corrected horizon depth (inches)	8.0	32.0	30.0	20.0	3.0
(b) P Sorption max (mg/kg)	592	1500	900	1184	726
P Sorption Capacity per acre (lb/ac)	1545	15660	8809	7727	710
P Sorbed lb/ac at Regulatory Site Life	1545	898	0	0	0
Depth of Horizon Used (in) Reg Site Life	8.0	1.8	0.0	0.0	0.0
Total P Sorption (lb/ac)	34452				
Site life (years)	141.0				
Are Regulatory Site Life Criterion Satisfied?	Yes				

Figure 3-1. Phase I site life P sorption maximum calculation tool.

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3.2.1 Sorption Phase I Sheet Inputs

The following describes the input parameters for this sheet. As with the other sheets, cells used for inputs are colored yellow.

1. **Wastewater Phosphorus Concentration (C_{ww}) (mg/L):** Enter the P concentration ([P]) of the wastewater effluent being discharged to the drainfield. Typical values for C_{ww} to septic tanks range from 1.2 to 16 mg-P/L according to Lombardo (2006) and from 6 to 12 mg-P/L according to the Technical Guidance Manual (TGM) (section 3.2.1, Table 3-1) (DEQ 2013). Idaho's Domestic Wastewater Phosphorus Concentration Report (DEQ 2012) identified the upper confidence limit, at the 95% confidence level, for the average total phosphorus concentration discharging from a septic tank to the drainfield as 8.6 mg-P/L. This input is used for both Phase I and Phase II analyses.
2. **P Removal (Precipitation) in Septic Tank (typically 20%–30%) (percent):** Enter an estimate for the percentage of effluent P that is precipitated in the septic tank prior to distribution in the drainfield. Typical values range from 20% to 30% (Lombardo 2006). This field should only be used where the data are from raw wastewater entering the septic tank. For cases where the model input utilizes data representing clarified effluent post septic tank (8.6 mg-P/L), this value must be set to zero (0).
3. **Regulatory Site Life (years):** This input reflects the regulatory agency's expectation of how long the drainfield installation should effectively sorb effluent P loading. Since SSD permits are permits to construct, and not operating permits, site-life issues must be characterized during permitting, and the regulatory expectations for site life must be established and stipulated as a criterion by the regulatory agency. Since regulatory controls are only implemented prior to and during construction, it is here that design criteria must demonstrate site-life capabilities with respect to P sorption. If site-life criterion cannot be demonstrated, this would be grounds for permit denial to construct.

   If the modeler wants to by-pass the Phase I tool in order to use the Phase II tool, zero should be set for this input. If the modeler wishes to allow maximum sorption for a portion of the soil profile, the site life can be set at a desired time for which this is to be allowed. The *excess* P not sorbed via the Phase I conditions passes to the Phase II tool for sorption at an attenuated rate.

4. **Soil Bulk Density (D_b) (g/cm^3):** Enter the soil bulk density here. Consult Natural Resources Conservation Service (NRCS) soil databases such as the NRCS Web Soil Survey (WSS) for typical values for the soil series represented at the installation site. See the following website: http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm.

   Soil bulk densities can also be determined by laboratory analysis. The D_b value is necessary to convert soil volume into soil mass, since it is on a mass basis that P sorption is calculated from isotherm batch analyses.

5. **Rock Fragment Content (a proportion):** Enter the rock fragment content of the soil horizon here. The rock fragment content is that fraction of the soil that does not pass a #10 mesh sieve (i.e., materials >2 mm in diameter [NRCS 2002]). This is estimated on a volume basis, and the fraction includes coarse sand, gravel, cobbles, stones, and

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boulders. It is estimated on a volume basis as observed in the soil profile (NRCS 2002). For example, if half the volume of the soil is gravel, enter a value of 0.5. If the coarse fragment content is determined by weighing what passes and does not pass through a #10 sieve, this will be on a weight basis and can be converted to a volume basis using NRCS guidance designed for that purpose (USDA-SCS no date).

6. **Soil Horizon Depth (inches):** Enter the soil horizon depth for each horizon being considered in this analysis. Horizon depth information is obtained from measurements done in the test pit(s).
7. **Sorption Multiplier—estimating 5-day results from 1-day test:** The sorption values obtained from a 5-day isotherm batch test are generally greater than those obtained from a 1-day test (Tofflemire and Chen 1977). Furthermore, values for P sorption over a 14-month period including wet/dry cycles and time, are considerably greater than those of the 5-day test. DEQ is adopting a method utilizing a 1-day test (Graetz and Nair [2000] and University of Idaho [no date]) (Appendix B) since this test is commonly done at many commercial laboratories. It is therefore important to convert 1-day test values to 5-day test values, so that, in turn those extrapolated 5-day values can be further converted to longer-term (14 month) estimates discussed in Tofflemire and Chen (1977). From limited data available, it is estimated that a factor around 1.5 is appropriate to convert 1-day test values into 5-day test values (Tofflemire and Chen 1977).
8. **Sorption Multiplier—estimating long-term sorption values from a 5-day test:** The sorption values obtained from long-term (14 month) studies are significantly greater than a 5-day isotherm batch test. As mentioned above, this is due to slow mineralization of the rapidly sorbed P due to wet/dry cycles, time, and other factors. Five-day test values can be used to derive longer-term estimates as these latter values reflect more of the reality of P sorption than do 5-day tests. Column studies for a limited number of soils having varying pHs and clay contents were conducted in Tofflemire and Chen (1977). From these limited data, *mineralization factors* appear to increase with increasing pH and silt plus clay content, as shown in Table 3-1.

Table 3-1. Soil properties summary and P mineralization factors.

Soil Property	Soils A and B	Soil C
pH	5.5–6.5	8
% course> 2 millimeters (mm)	2–20	16
% silt + clay < 0.62 mm	1–16	44
% clay < 0.002 mm	~1	7
Mineralization factor	1.9	5

A conservative *mineralization factor* (Tofflemire and Chen 1977) suggests a value of 1.90. Interpolation of these limited data must be done with caution.

3.2.2 Sorption Phase I Sheet Calculated Outputs

1. **Wastewater Vol (million gallons/year):** This calculation is the volume of wastewater applied per year to the drainfield system. This calculation comes from wastewater volume inputs entered in the Drainfield sheet as gallons/day.

2. **Wastewater Vol (million gallons/acre-year):** This calculation normalizes the wastewater loading rate on a per acre basis. The drainfield and adjacent buffer area (inches per square feet [in./ft^2]) comes from the inputs entered in the Drainfield sheet and depends upon the soil classification and the number of bedrooms in the proposed home.
3. **Drainfield and Adjacent Area (acres):** The drainfield and adjacent buffer area comes from the inputs entered in the Drainfield sheet as square feet in that sheet. Note that for pressurized drip systems no *adjacent area* and associated soil P sorption capacity are included.
4. **P Loading from Wastewater per Year**: A calculation based on the effluent volume per year and the wastewater P concentration (C_{ww}). This loading rate is used in both Phase I and Phase II analyses.
5. **Corrected Soil Horizon Depth (inches):** Each soil horizon depth is corrected for coarse fragment content on a volume basis utilizing horizon depth inputs and coarse fragment content. For example, if a soil volume is half course fragments and has a depth of 10 inches, only 5 inches of soil is present once coarse fragments are removed. Coarse fragments have negligible P sorption capacity necessitating this correction.
6. **P Sorption max (b or b_{max}) (mg P/kg soil):** This value is calculated for the soils in each horizon by taking the reciprocal of the linearized Langmuir isotherm slope to obtain the b_{max} (section 2.2.3(3)) and then applying the Composite Sorption Multiplier factor to the b_{max} (section 3.2.2(7)).
7. **Composite Sorption Multiplier:** This cell calculates the composite multiplier by combining the multiplier for the 1- to 5-day test (section 3.2.1(7)) and the multiplier of the 5-day test to the 14-month column study discussed in section 3.2.1(8) (i.e., long-term conditions). These are combined by multiplying them together. This composite multiplier is applied to the Langmuir b_{max} calculated in the Isotherm sheet, (section 2.2.3(3)). The resulting calculated P sorption max appears in the cells labeled, P sorption max, described in section 3.2.2(6).
8. **P Sorption Capacity per Acre (lb/acre):** This cell calculates a normalized value for maximum P sorption on a per acre basis for the entire depth of each soil horizon, using the P sorption max value (section 3.2.2(6)), acreage for the drainfield area (and adjacent buffer area if applicable) (section 3.2.2(3)), and soil bulk density (D_b) (section 3.2.1(4)) to convert soil horizon depth, a volume basis, to a mass basis. In other words, this cell calculates the maximum P sorption capacity for each soil horizon. These calculated values, as discussed below, are shown graphically, along with the P sorption capacity predicted to be utilized (section 3.2.3(1)).
9. **P Sorption at Regulatory Site Life (lb/acre):** This cell calculates how much of the maximum P sorption capacity (determined in section 3.2.2(8)) is utilized given the mass of P applied during the site life stipulated in section 3.2.1(3). These calculated values, as discussed in section 3.2.3(1), are shown graphically in Figure 3-2, along with the maximum P sorption capacity estimated in section 3.2.2(8).
10. **Depth of Horizon Used During Regulatory Site Life (inches):** This cell calculates the depth of each corrected soil horizon that has been filled to capacity with sorbed P during the stipulated regulatory site life (section 3.2.1(3)).

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11. **Total P Sorption (capacity) (lb/acre):** This cell calculates the total P sorption capacity (at b_{max}) by summing all soil horizon values (on a lb/acre basis) calculated as described in section 3.2.2(8).
12. **Site Life (years):** This cell calculates the site life of the system by dividing the total P sorption (capacity) (section 3.2.2(11)) by the annual P loading from wastewater (section 3.2.2(4)).
13. **Site Life Satisfy Regulatory Criterion? (Yes/No):** This cell compares the stipulated site life (section 3.2.1(3)) and calculated site life (section 3.2.2(12)). If the former is greater than the latter, this cell yields a No response. If the latter is greater than the former (i.e., that the calculated site life exceeds that required by regulatory interests), then the cell yields a Yes response.

3.2.3 Sorption Phase I Sheet Graphical Outputs

The Sorption Phase I sheet has two graphic outputs associated with it, the P sorption maximum site-life histogram (Figure 3-2) and the site life versus wastewater effluent P concentration C_{ww} plot (Figure 3-3).

1. **P sorption Maximum Site-Life Histogram:** This histogram (Figure 3-2) has two sets of bars on the x-axis. The blue bar on the left represents the maximum P sorption capacity for the particular soil horizon in lb/acre. The red bar on the right shows how much of each soil horizon's P sorption capacity has been utilized for the scenario modeled. Figure 3-2 shows five soil horizons ranging in capacity from approximately 1,750 lb/acre to approximately 3,750 lb/acre. It also shows that only the top four horizons are being utilized, the top three utilized to their capacity, and horizon four to less than half of its capacity.

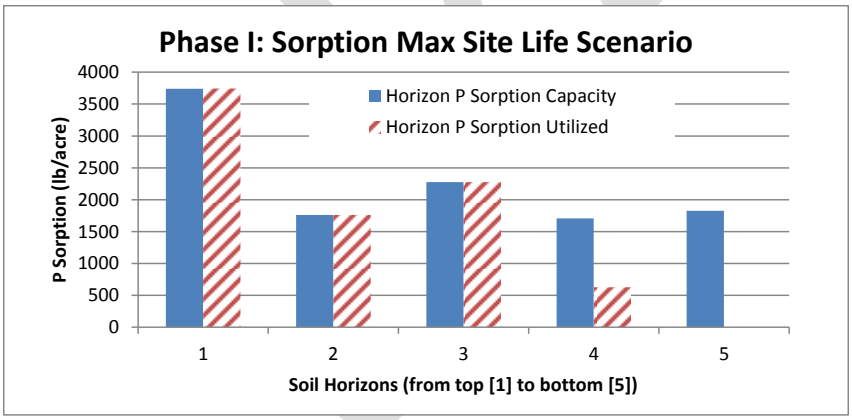

Figure 3-2. Phase 1 sorption capacity utilization histogram.

2. **Site Life Versus Wastewater Effluent Phosphorus Concentration C_{ww}:** This graph (Figure 3-3) is created from a data table function and shows how changes in wastewater effluent P concentration affect the predicted system site life. As C_{ww} increases, a higher P loading rate results and the maximum sorption capacity is filled sooner. This in turn results in a shorter site life.

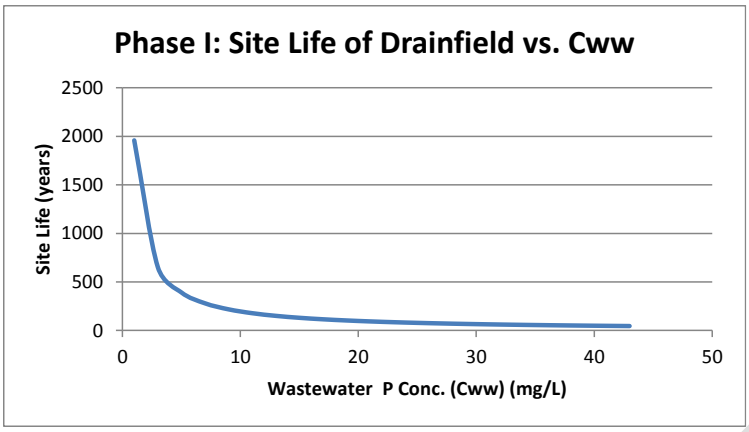

Figure 3-3. Phase I site life of drainfield versus wastewater P concentration (C_{ww}).

3.3 Desorption Tool—Instructions for Use

As summarized above and shown in Figure 3-4, this tool makes a rough estimate of the mass of P that might be desorbed from a drainfield after the installation has been decommissioned for a given number of years. This mass of P can be compared to the remaining sorption capacities of each lower soil horizon to determine how many inches of each horizon would be needed to capture (sorb) the soil P that is desorbing from upper horizons. As presented in section 3.1(3), this mass of P may be added to the sorbed P totals for either Phase I or Phase II analyses. Reasons for choosing to add or not to add are discussed in the footnote to section 3.3.1(4).

Capturing Desorbed P After Decommission of Drainfield		
Time After Decommissioning	50	yr
Est. Annual Percolation	14	inches/acre
Est. Desorption Perc [P]	1	mg/L
P Loss for Decom Period	158.5	lb/acre
Add Desorbed P to Total P Applied? (y/n)	No	
Which Phase to Add Desorbed P?	Phase II	
Reserve Depth for Phase I Perc P Capture	inches/acre	in avail. for desorp
Horizon 1	0.7	21.6
Horizon 2	0.5	0.9
Horizon 3	0.4	0.6
Horizon 4	0.3	0.8
Horizon 5	0.6	0.9

Figure 3-4. Phosphorus desorption estimating tool.

3.3.1 Desorption Tool Inputs

The following describes the input parameters for this sheet. As with the other sheets, cells used for inputs are colored yellow.

1. **Time After Decommissioning (years):** Enter the number of years after the drainfield decommissioning over which one wants to estimate the mass of P desorbed.

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2. **Estimate of Annual Percolation Rate (inches/acre):** Enter an estimate of the amount of percolate (leaching) that would be expected under *natural* or irrigated conditions as the case may be, after decommissioning. Such an estimate may be calculated by conducting a hydraulic balance for the area. See the instructions for the hydraulic/nutrient balance sheet in the spreadsheet model described in wastewater reuse system modeling instructions *(*DEQ 2009).
3. **Estimated Percolate P concentration [P] Perc (mg/L):** Enter an estimate of the P concentration of the percolate. This parameter depends on many factors including pH, soil texture and mineralogy, carbonate content, initial P content of the soil, infiltration rate, elapsed time since start of infiltration, and conditions under which a particular study was conducted. Zurawsky et al. (2004) studied drainfield P leachability in soils both near infiltration zones (zone soils) and in soils at depth (~3 feet) below the infiltration zones (deep soils). In *tension saturated* (field capacity) conditions, acid soils yielded [P] ~0.01 mg/L for both *zone* and *deep* soils; neutral soils varied from 1.5 mg/L (zone) to 0.38 mg/L (deep); and calcareous soils varied from 6.5 (zone) to 2.2 (deep). Since P accumulated in zone soils, it might be thought that desorption phenomenon at abandoned installations might yield [P] more reflective of deep soils. McDowell and Sharply (2001, Figure 5) show that lysimeter drainage waters vary in [P] from ~0 to 1.5 as soil test P (STP) varies from low to high (~10 to 600 mg-P/kg). Parkhurst et al. (2003, Figure 7) conducted column studies with contaminated drainfield sediments. As increased pore volumes of uncontaminated water pass through contaminated sediments, desorbed [P] in eluent decreases from an initial concentration of 0.77 mg/L to 0.15 mg/L and gradually decreases to <0.03 mg/L. Lentz and Westerman (2001) observed percolate [P] in an agricultural setting ranging from 0.1 to 2.0 mg/L, averaging 0.58 mg/L.
4. **Add Desorbed P to Total P Applied (Yes/No):** This input cell is a toggle switch, either enabling or disabling the *desorption function*. This function estimates the mass of P that would desorb over a given number of years after drainfield abandonment. This toggle switch allows the user, when choosing Yes, to add this mass of P as a *lump* quantity to the soil matrix so that it occupies a certain P sorption capacity of the final amount of P added to the system. If the user chooses No, this estimated P desorbed mass is not added to the total P applied to the system.[1]
5. **Which Phase to Add Desorbed P:** From the drop-down list, enter which operational phase the desorbed P will be added to; either Phase I or Phase II.

3.3.2 Desorption Tool Outputs

1. **Reserve Horizon Depths for Phase I Percolate P Capture (inches):** This calculation yields the number of inches in each soil horizon that would be necessary to capture the mass of P that is estimated to be desorbed during the decommissioned period. These calculations are based on calculated Langmuir b_{max} capacities.

1 The reason for not including desorbed P is to avoid double-counting applied and sorbed P. The desorbed P was applied once and sorbed on the soil matrix. That same P, via desorption, is solubilized and translocated elsewhere in (or below) the soil profile. The reason for including the desorbed P is determining whether enough sorption capacity is left in the soil matrix, below the depth where P sorption ceased during operation, which can sorb and thus capture the desorbed P mass after decommissioning.

2. **Available Horizon Depths for Phase I Percolate P Capture (inches):** The column to the right of *reserve horizon depths* shows how many inches of each soil horizon remain available for P sorption (i.e., that part of the soil horizon not having its sorption capacity exhausted). These values are calculated as the difference between corrected soil horizon depth (section 3.2.2(5)) and depth of horizon used (filled) during site life (section 3.2.2(10)).

3.4 Phase II: Sorption/Percolate P C_{eq} Estimator for On-Site Drainfields—Instructions for Use

As summarized above, the Phase II sorption/percolate-P C_{eq} estimator for the on-site drainfield tool estimates percolate P concentrations (C_p, or C_{eq}) throughout the operational period of the drainfield. The longer the drainfield is in use the closer the C_p approaches C_{ww}. Percolate P concentrations change in response to the amount of P that is sorbed, such that a given soil having little sorbed P, will have a low equilibrium P concentration. Increasing the amount of P sorbed, the soil will exhibit increasingly higher percolate equilibrium P concentrations until the soil reaches that P sorption capacity that is at an equilibrium concentration equal to the effluent P concentration (Figure 3-5). Since the percolate concentration changes over time, the time-weighted average percolate concentration is calculated, and that value is used for ground water mixing and contaminant transport calculations described in section 6.1 and following.

Changing percolate concentration as a result of increasing P sorption of the soil is best explained by examining Figure 3-5.

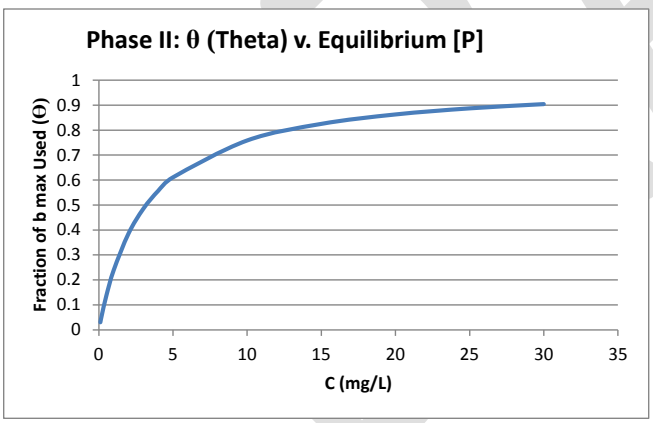

Figure 3-5. Normalized Langmuir isotherm [Theta (θ) versus C].

The x-axis in Figure 3-5 is the P concentration (C_{eq}) that is in equilibrium with a corresponding amount of P sorbed on the soil (y-axis). The y-axis is a normalized scale—from 0 to 1—that represents the fraction of the soil sorption capacity that is filled and is represented by the symbol theta (θ). If $\theta = 0.5$, this means 50% of the sorption capacity is filled. If $\theta = 1$, this means that 100% of the sorption capacity is filled—meaning that b_{max} has been reached. The curve on this plot shows that the fraction of the b_{max} that is occupied by sorbed P (y-axis) increases as the amount of P available for sorption increases. As the amount of P available for sorption increases,

the C_{eq}, after the sorption reaction takes place, will also be higher, and this increase in C_{eq} is what is seen on the x-axis. The theta curve in Figure 3-5 is calculated by utilizing Equation 3-1:

$$\theta = KC_{eq}/(1 + KC_{eq})$$

Equation 3-1. Normalizing the Langmuir isotherm.

As will be discussed in section 3.4.1(2), this plot will be used in determining the C_{eq} of the system during its operational life for purposes of determining a percolate concentration that will then serve as an input into the ground water mixing and contaminant transport part of the model. After the percolate mixes with ground water, the constituents in the mixed percolate/ground water subsequently undergo advection and dispersion along the ground water flow path and presumably attenuate to an acceptable ground water P concentration at distance downgradient from the source. The following is an example of how this plot would be used in a Phase II analysis.

A facility treats an effluent with a [P] of 9 mg/L, and it operates for 30 years. At, or sometime before, the end of its operational life, the percolate concentration (C_{eq} or C_p) comes to an equilibrium of 9 mg/L (in this case the same concentration as the effluent). Reading up from the value of 9 on the x-axis shows a θ value of ~ 0.75. If the b_{max} value is 100 mg-P/kg soil, then the sorption capacity at this equilibrium concentration is 0.75 * 100 = 75 mg-P/kg. *It is assumed—and this is the fundamental assumption in the Phase II analysis—that the operational site life will determine the amount of P sorbed (i.e., the fraction of b_{max} utilized) and the amount of P sorbed will in turn determine the eventual percolate concentration.*

Figure 3-6 provides the Phase II sorption/percolate-P C_{eq} estimator for on-site drainfields.

Phase II: Sorption / Percolate-P Ceq Estimator for On-site Drainfields

Operation Period under Phase II Assumptions (years)	20				
Operation Period under Phase II Assumptions (re-enter above value)	20		Sorption Multipliers		
Time-Weighted Percolate [P] (mg/L) over Op Period	0.21		1.5	Estimate 5 d results from 1 d test	
Maximum Percolate [P] (mg/L) over Op period	0.645			(1.5 recommended)	
Enter Time-Weighted or Maximum Percolate [P] ->	1.71		1.5	Est of long term sorption from 5 d test	
				(1.5 recommend)	
			2.25	Composite Sorption Multiplier	
Soil Parameters	Horizon 1	Horizon 2	Horizon 3	Horizon 4	Horizon 5
Isotherm Best Fit Choice	Langmuir	Freundlich	Freundlich	Freundlich	Langmuir
(d) corrected horizon depth avail (inches)	0.0	30.2	30.0	20.0	3.0
(C/(x/m) Langmuir y axis (L/mg)	0.014551	0.0088675	0.0142125	0.0063255	0.0172995
(b) P Sorption (Langmuir) (mg/kg)	100	164	102	229	84
(b) P Sorption (Freundlich) (mg/kg)	84	127	207	191	81
P Sorption Capacity per acre (lb/ac)	0	1247	2029	1249	82
P Sorbed lb/ac	0	1247	2029	1249	82
Depth of Horizon Utilized (inches)	0.0	30.2	30.0	20.0	3.0
Total P Sorption (lb/ac)	4607				
Operating Time (years) till Max Perc [P] is reached	18.9				

Figure 3-6. Phase II sorption/percolate P concentration (C_{eq}) estimating tool for on-site drainfields.

3.4.1 Sorption Phase II Sheet Inputs and Outputs

The following describes the input parameters for this sheet. As with the other sheets, cells used for inputs are colored yellow. It will be noted at the outset that all of the output cells in the Phase

II analysis have the same definitions as those in the Phase I analysis, and their calculated values are carried from the Phase I to the Phase II analysis. Certain cell values that are inputs to the Phase I analysis—effluent wastewater P concentration (C_{ww}), soil bulk density (D_b), coarse fragment content, and observed soil horizon depths—are utilized in the Phase II analysis since these parameter values do not change with Phase I or Phase II analyses.

Two input cells in the Phase I analysis—the sorption multipliers— remain as input cells in the Phase II analysis. This allows the modeler the flexibility to choose different multipliers for either Phase I or Phase II analyses, if necessary.

There are three additional input parameters in the Phase II analysis, Phase II operation period, percolate [P], and isotherm form. These parameters are described below:

1. **Operation Period under Phase II Assumptions (years):** Enter the expected time that this drainfield will be in operation. This input reflects the regulatory agency's expectation as to how long the drainfield installation should effectively sorb the P loading from wastewater under Phase II sorption conditions/capacities. It may be decided that the site life will be split between Phase I and Phase II operation. For example, it may be allowed for an installation to operate for 10 years under Phase I sorption capacities, and then for 20 years at Phase II capacities (totaling 30 years). If this is the case, then one would enter the remaining years (e.g., 20 years) that operation is expected under Phase II parameters. If Phase I is bypassed (by entering zero, see section 3.2.1(3)), then enter the regulatory site life here (e.g., 30 years). Re-Enter Operation Period under Phase II Assumptions (years): Re-enter the value entered in 1 above (in order to avoid a circular reference in data table functions).

2. **Percolate [P] (i.e., C_p) Selected for Ground Water Mixing and Contaminant Transport Calculations (mg/L):** Enter the percolate [P] (i.e., C_p) that will be used in ground water mixing and contaminant transport calculations as described in section 6.1 and following. Output cells (described below) provide two *recommended* values. The first is a time-weighted average percolate concentration value. This is an average of all the equilibrium percolate P concentrations that have been generated by the system for the operation period input above, based on the amount of time that the percolate was at a given concentration. The second value provided is the maximum percolate P concentration that resulted during the operation period. The time-weighted value may better express the dynamic nature of the percolate quality and *gives credit* to the sorptive capacity of the soil to mitigate and reduce P loss.

3. **Isotherm Best Fit:** Choose from the drop-down list either a Langmuir or a Freundlich isotherm to use in calculating P sorption capacity for each horizon under consideration. To make this choice, the modeler must examine the isotherm plots on the Isotherm sheet (section 2.2.3, Figure 2-2, Figure 2-4, and Figure 2-5) for each horizon being considered. Those plots will help determine which of the isotherms is the better fit to the raw data *at the particular C_{eq} range being considered*. The concentration range under consideration is typically governed by the effluent concentration. For example, if the effluent concentration is 9 mg-P/L, the range under consideration would be from 0 to 9 mg-P/L. Note that for the Phase I analysis no

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isotherm choice is provided. This is because only the Langmuir isotherm with its ability to calculate a b_{max} is utilized.

3.4.2 Sorption Phase II Sheet Outputs

The Sorption Phase II sheet has two outputs associated with it, not otherwise defined in Phase I descriptions:

1. **Time-Weighted Percolate [P] (C_{eq}) over the Operational Life (mg/L):** This is the calculated time-weighted percolate [P] (C_{eq}) that will result over the operational life of the facility. See the explanation in section 3.4, introduction and in section 3.4.1(2).
2. **Maximum Percolate [P] (C_{eq}) over the Operational Life (mg/L):** This is the calculated maximum percolate [P] (C_{eq}) that will result over the operational life of the facility. See the explanation in section 3.4, introduction and in section 3.4.1(2).

3.4.3 Sorption Phase II Sheet Graphical Outputs

The Sorption Phase II sheet has two graphic outputs associated with it:

- The Phase II soil horizon P sorption capacities and utilization for the selected operational life (Figure 3-7)
- P percolate concentration (C_{eq}) maximums and time-weighted values throughout the site operational life (Figure 3-8).

1. **Phase II Soil Horizon P Sorption Capacities and Utilization for Selected Operational Life:** This histogram, like the Phase I graphic, has two sets of bars on the x-axis, the blue and red bar representing the P sorption capacity, and the P sorption capacity utilized respectively (in lb/ac). Both of these values are determined for each soil horizon for a selected operational life under Phase II assumptions. The operational life determines the particular C_{eq} that will develop over the operational life, and the C_{eq}, as discussed in section 3.4, introduction, will reflect the mass of sorbed P in the soil. That being the case, both the P sorption capacity (blue bar) and the P sorption capacity utilized (red hatched bar) will be identical (i.e., the predicted and utilized capacities are the same). Figure 3-7 shows five soil horizons ranging in capacity from ~950 lb/acre in the upper horizon to ~320 lb/acre in lower horizons.

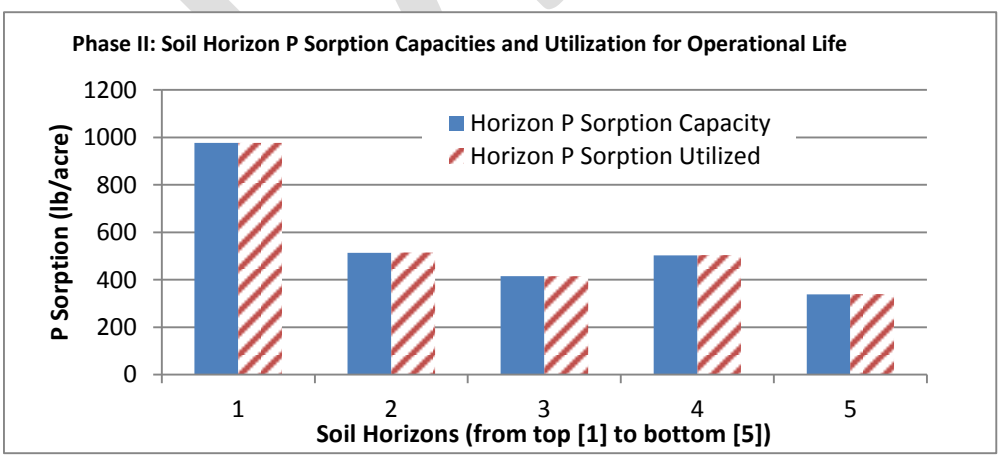


Figure 3-7. Phase II soil horizon P sorption capacities and utilization for selected operational life.

2. **Phosphorus Percolate Concentration (C_{eq}) Versus Operational Life:** This graphic (Figure 3-8) shows how the percolate P concentration (C_{eq}) changes during the operational life of the drainfield. This phenomenon is shown in Figure 3-5. As the proportion of the sorption capacity is filled, or as θ increases (y axis), the equilibrium concentration (C_{eq}) increases. Thus, as the facility is operated throughout its operational life, there is a calculated increase in C_{eq}, shown in the blue solid line in Figure 3-8. If the facility is operated long enough, there will come a time when the predicted equilibrium concentration (C_{eq}) will reach that of the effluent (C_{ww}). At that point, the C_{eq} cannot become greater than the C_{ww} , the amount sorbed to the soil will not increase, and the C_{eq} will plateau, as is seen in Figure 3-8.

   The red dashed line in Figure 3-8 is labeled *time-weighted* C_{eq}. For every year that the facility is in operation, a C_{eq} is calculated that will reflect—not the maximum as in the blue line—a value that consists of an average of the concentrations that the facility has been discharging, weighting them on a time basis. A time-weighted calculation is thought to be more representative than the maximum percolate concentration that the facility has been discharging over the operational life. The modeler may then select from either of these values to represent the percolate concentration in the ground water mixing/contaminant transport model.

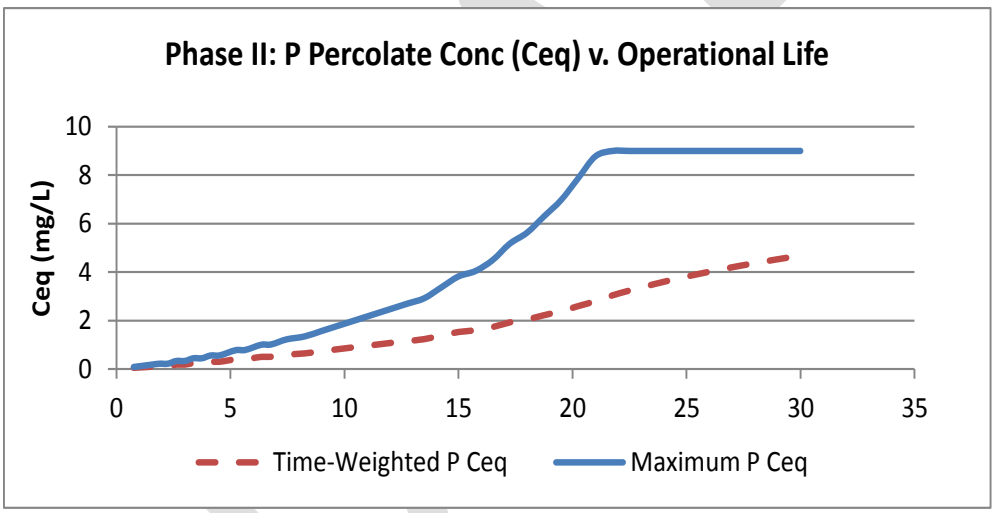
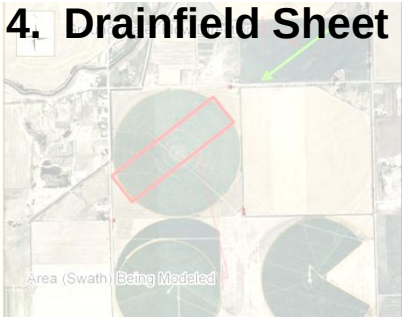


Figure 3-8. Phase II site life of drainfield versus maximum and time-weighted equilibrium [P] (C_{eq}).

4. Drainfield Sheet



4.1 Description

The Drainfield sheet is shown in Figure 4-1. It contains all the input parameters and outputs pertinent to the design and proposed operation of the on-site system being modeled. The inputs pertain primarily to wastewater flow, soil type, setback distances, and drainfield geometry and orientation. Certain critical outputs (i.e., outputs that are compared with allowable limits) include flow to drainfield, and ground water concentration at the discharge point to surface water.

Drainfield configurations are limited to pressurized dispersal areas installed as shallow as possible in the soil column. The two acceptable pressurized dispersal configurations include drip dispersal systems and capping fill trenches. Drip dispersal places the effluent in the plant's root zone, providing nutrient uptake to help limit phosphorus transport to the aquifer. It should be noted that no credit for nutrient uptake by plants is allowed in the model, or will be granted on the installation permit, because it is not feasible to regulate harvested vegetative materials above a residential subsurface disposal system (e.g., the homeowner may mulch the grass and DEQ cannot require lawn clipping removal from the property). Additionally, placement of the effluent this high in the soil column maximizes the soil available for sorption. Finally, using a pressurized dispersal system ensures that the effluent will be dispersed evenly over the entire drainfield during each dosing event. Capping fill trenches also provide these attributes but may not support plant nutrient uptake as well as drip dispersal systems can. Reference to one dispersal area configuration does not preclude use of the alternative configuration.

Drip dispersal systems are documented in the TGM, chapter 4. The area requirements depend upon the soil classification and the number of bedrooms in the home. Furthermore, to maximize the available soil and ensure that the drainfield undergoes periodic wetting and drying, which enhances the phosphorus sequestration, both primary and replacement dispersal fields will be required to be installed if a reduced separation distance to surface water is being assessed/requested. Additionally, primary and replacement dispersal fields may be increased in size to provide additional phosphorus sorption sites, since IDAPA 58.01.03.008.03 specified drainfield area is a minimum value. No matter what the proposed drainfield ends up looking like, the model must reflect the proposed system configuration.

A drip dispersal field for a 4 bedroom (300 gallons per day [gpd] wastewater) home located on a type B-1 soil (0.6 gpd/ft^2) will require 1,000 ft^2 for the distribution area. This amount of area is arrived at using Equation 4-1:

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$$Area = (300\ GPD) * (2\ dispersal\ fields)/(0.6\ GPD/ft^2\ ) \ = 1{,}000 ft^2$$

Equation 4-1. Calculation of drip dispersal field area.

Drainfield coverage is ensured due to the requirement that the drip lines are placed 2 feet on center across the entire drainfield. Drip dispersal field construction requirements are fully described in the TGM, Section 4.7, Drip Distribution System.

On-Site Drainfield Inputs Enter Inputs in Yellow Cells. 'Critical' Calculation Results Appear in Blue Cells Go to Transport Inputs and Enter Parameters			
Project Description ---------->	Martin Subdivision, Lot 5, Twin Falls ID		
Date ---------->	6/13/2013 15:44		
Parameter	Units	Value	Comments
Soil Class	none	B-2	Martindale 9/2011 (AJ Dwngrd from B-2)
Residential (select # of bedrooms) / Commercial (select 86)	none	4	Martindale 9/2011
Select System Type	none	Drip	Eligible for P setback reductions
WW flow to drainfield (Minimum Required)	gpd	300	Don't overwrite cell
WW flow to drainfield	gpd	300	per TGM
Required Setback to Surface Water	ft	200	Don't overwrite cell
Proposed Setback to Surface Water	ft	196	Assume this value
Minimum Drainfield Area (primary + replacement drainfields)	ft2	1333	Don't overwrite cell
Drainfield Area Proposed	ft2	1400	Martindale 9/2011 (AJ 20x30 -> 26x36)
For Drip Enter Zero in Cell D21	ft2	0	Adjacent area required for Cap and Fill
Width of Entire Drainfield Perpendicular to GW flow	ft	70	Site map geometry
Required WW Application Rate (gpd/ft2)	gpd/ft2	0.45	
Modeled WW Application Rate to Trench	gpd/ft2	0.21	
Flow Criteria Check gpd per ft2 trench ->	Meets gpd/ft2 Criterion		
Drainfield Area	ft2	1400	
Ground Water Setback Calculations			
Ground Water Velocity (mean Kh)	ft/d	2.4	
Grnd Water Time of Travel to Setback distance (yr)	yr	0.22	
Grnd Water Time of Travel to Setback distance (d)	d	80	
Ground Water [P] Selection: Max [P] gw or Depth Weighted	none	Max Conc	
Surface Water Type	none	stream/river	
Depth / Distance Weighted [P]	mg/L	0.070	
GW [P] Max Conc Disch to Surface Water -	mg/L	0.150	Use Mean Kh value
Selected $[P]_{gw}$ value	mg/L	0.150	
Ground Water [P] Acceptibility	Acceptible: [P] less than limit		

Figure 4-1. Drainfield data input sheet.

4.1.1 Drainfield Sheet Inputs

The following describes the input parameters for the Drainfield sheet. As with the other sheets, cells used for inputs are colored yellow with red font.

1. **Soil Class:** The soil class is entered from a drop-down list of choices that are limited to those soil classes defined and listed in the TGM, section 2.1.2, Table 2-4.
2. **Residential/Commercial:** Select the residence's number of bedrooms from the drop-down list, from 1 to 6 bedrooms. If the facility is a commercial operation, or a Large Soil Absorption System (LSAS), select 86.

3. **Select Drip/Cap and Fill/Gravity:** As discussed in section 4.1, only pressurized systems (drip or cap and fill) are considered for setback variances based on P loading. The *gravity* option is retained as a selection only for the evaluation of existing systems (i.e., for case-study purposes or other site-specific analyses). A *drip* selection directs one to insert a value of zero for recommended adjacent area. A *cap and fill* selection directs one to insert a value for required adjacent area. The minimum dispersal area for trenches includes only the trench bottom infiltrative area. Since trenches must be placed no closer than 6 feet apart, this additional area must be accounted for when a cap and fill drainfield configuration is selected. This adjacent area is typically two times the minimum dispersal area requirement.
4. **Wastewater Flow to Drainfield (Minimum Required) (gpd):** The value appearing in this cell is not entered but is retrieved from a lookup table based upon the number of bedrooms entered in section 4.1.1(2) (IDAPA 58.01.03.007.08). If commercial, numerical value 86, is chosen, a TBD appears in this cell. Commercial should also be selected if the system is a LSAS.
5. **Wastewater Flow to Drainfield (Proposed) (gpd):** Enter the proposed flow rate for the scenario being modeled. The recommended rate appearing in the cell above should be consulted when making this choice. Flow rates that deviate from IDAPA 58.01.03.007.07 specified minimums appearing in the cell above must be justified. All commercial and LSAS flows should be arrived at using the flows listed in IDAPA 58.01.03.007.08, unless justification is provided from flows that are significantly different. All flows differing from IDAPA 58.01.03.007 will be reviewed and approved/rejected by DEQ during the assessment of the model's results.
6. **Required Setback Distance to Surface Water (feet):** The value appearing in this cell is not entered but is retrieved from a lookup table based upon the soil class (TGM, section 2.2.2, Table 2-8) entered in section 4.1.1(1).
7. **Proposed Setback Distance to Surface Water (feet):** Enter the proposed setback distance for the scenario being modeled. The recommended distance appearing in the cell above (section 4.1.1(6)) should be consulted when making this choice. The distance entered should represent the shortest horizontal distance from the adjacent surface water to the distribution field's perimeter. In no instance shall the separation distance between the drainfield and the surface water be less than 100 feet.
8. **Minimum Drainfield Area (primary + replacement drainfields) (ft^2):** The value appearing in this cell is not entered but is calculated by dividing the proposed wastewater flow entered in 4.1.1(5) by the Long-Term Application Rate (LTAR) affiliated with the soil class entered in 4.1.1(1) and then doubling the area due to the requirement that both pressurized distribution fields are installed during initial construction. Both drainfields must be utilized upon placing the system into service. This use will allow the undosed areas within the drainfield a longer drying time between doses, which will assist with phosphorus adsorption.
9. **Drainfield Area Proposed (ft^2):** Enter the proposed trench area for the scenario being modeled. The recommended area appearing in the cell above (section 4.1.1(8)) is IDAPA 58.01.03.007 required minimum area to be designated for drainfield use. The proposed drainfield area must equal or exceed the recommended drainfield area in order to properly assess a suitable surface water setback reduction. Current IDAPA 58.01.03.007 requirements are minimum values. Increasing the drainfield size to

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obtain more phosphorus adsorbing soil in order to obtain a setback reduction is acceptable. Additional drainfield area, once designated for surface water setback distance reduction, cannot be utilized to accommodate increases in future wastewater flow from the structure.

10. **Width of Entire Drainfield Perpendicular to Ground Water Flow (feet):** Enter the total width of the pressurized drainfield area perpendicular to ground water flow. A representative pressurized drainfield configuration designed for installation in a type A soil is provided in Figure 4-2. This input in part determines the cross-sectional area of ground water discharge and thus the flow of ground water (Q_{gw}) that is used in mixing and contaminant transport calculations. The lower this input is, generally the higher the calculated mixed ground water concentration (C_{mix}) is; so, if either the ground water flow direction or installation orientation is not known, the conservative assumption would be to input the lesser of length or width of the installation.

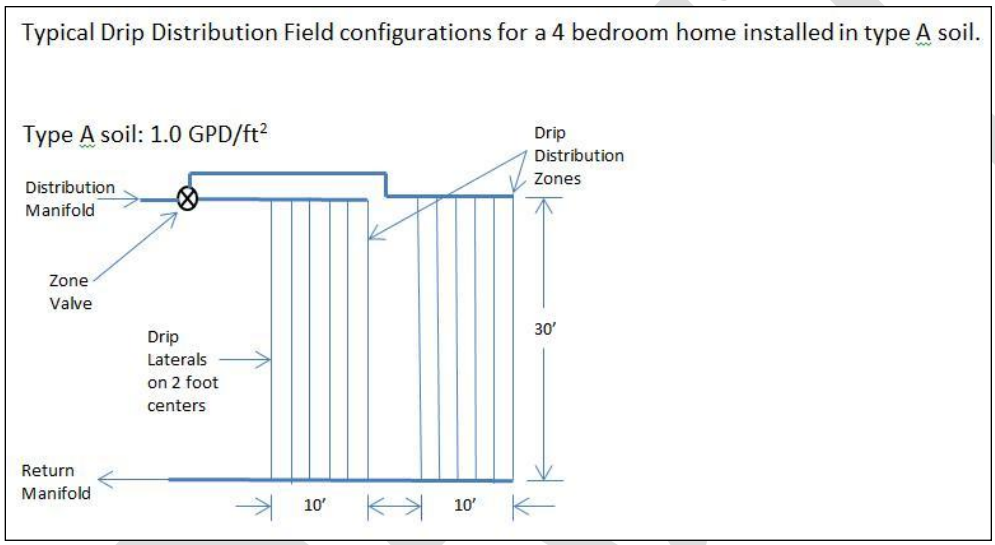

Figure 4-2. Typical drip distribution field geometry.

4.1.2 Drainfield Sheet Calculated Outputs

1. **Required Application Rate to Field (gpd/ft^2):** The value appearing in this cell is retrieved from a lookup table based upon the soil class (TGM, section 2.3, Table 2-9) entered in section 4.1.1(1).
2. **Modeled Application Rate to Field (gpd/ft^2):** This is a calculation based upon the entered effluent flow (section 4.1.1(5)) divided by the entered drainfield area (section 4.1.1(9)).
3. **Flow Criterion Check:** This output compares the required application rate (section 4.1.2(1)) to the calculated rate (section 4.1.2(2)) for the proposed scenario. If the calculated rate is equal to or less than the required rate, the adjacent cell format becomes green and the cell indicates that an acceptable rate is proposed. If the calculated rate is above the required rate, the adjacent cell format becomes red and the cell indicates that an unacceptable rate is proposed.
4. **Drainfield Area (ft^2):** This value is the sum of the Drainfield Area Proposed and the Adjacent Area Proposed. This area is used in the Ground Water Transport sheet

(section 6.1) to derive a length of the site along the ground water flow path that is in turn used in the calculation of the mixing zone depth.

5. **Ground Water Velocity (mean K_h) (ft/d):** This output is calculated using the mean K_h value of the range of K_h input in the GW Transport sheet (section 6.2.1.1(8)). This velocity is utilized to calculate aquifer travel times (in both years and days) to the proposed setback distance. The calculated time is used as one of the options in the selection of time elapsed from the commencement of drainfield operation. The other options, calculated in the GW Transport sheet (section 6.2.1.2(6)) include designated site life, infinite time, or *other* specified time span.
6. **Ground Water Time of Travel to Setback Distance (years):** This calculation is made by dividing the setback distance entered in section 4.1.1(7) by the ground water velocity calculated in section 4.1.2(5), and expressed in years.
7. **Ground Water Time of Travel to Setback Distance (days):** This calculation is made by dividing the setback distance entered in section 4.1.1(7) by the aquifer velocity calculated in section 4.1.2(5), and expressed in days.
8. **Ground Water P Concentration Selection—Maximum or Weighted:** This cell shows which ground water concentration was selected in the Surface Water Mixing sheet to be utilized in mixing calculations. See section 5.2.1(9) for further discussion.
9. **Select Surface Water Type:** This cell shows which surface water type was selected in the Surface Water Mixing sheet between one of the two choices: streams and rivers, or lakes and reservoirs. For further discussion, see section 5.2.1(9) and section 5.3.1(13).
10. **Depth/Distance Weighted [P]:** See explanation of this depth and distance weighting of the ground water P concentration in the cross-sectional area of discharge in section 5.2.1(9). The calculated value of the depth and distance-weighted P concentration appears here.
11. **Ground Water [P] Maximum Concentration Discharge to Surface Water (mg/L):** This calculation is made using Domenico equations. The calculation yields the value at the top of the water table at the point of concern specified in the GW Transp sheet (section 6.2.1.2(1)). The point of concern is (generally) set at x = setback distance, y = 0 (the plume centerline), and z = 0 (the top of the water table).
12. **Selected $[P]_{gw}$ Value:** The value of either the depth and distance weighted $[P]_{gw}$ or the maximum $[P]_{gw}$ appears here depending on what option was selected in the input described in section 5.2.1(9) or section 5.3.1(13)
13. **Ground Water [P] Acceptability:** This output compares the maximum ground water P concentration allowed (input in the GW Transport sheet, section 6.2.1.1(7)) to the modeled concentration at the setback distance for the proposed scenario. If the calculated concentration is equal to or less than the allowable concentration, the cell format becomes green and the cell indicates that an acceptable modeled concentration can be achieved at the setback distance. If the calculated concentration is above the allowable concentration, the cell format becomes red and the cell indicates that an acceptable modeled concentration cannot be achieved at the setback distance and the cell indicates that an unacceptable concentration is predicted.

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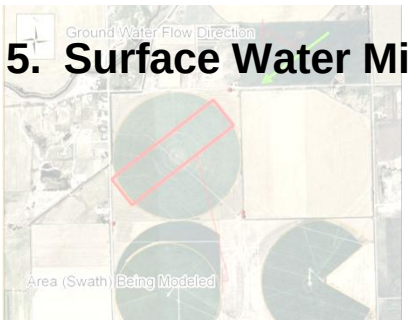

5. Surface Water Mixing Sheet

5.1 Description

The Surface Water Mixing sheet calculates both mass discharge of P from ground water into a surface water body as well as *instream* mixed concentration of P from ground water discharging into a surface water body. A limit for either a mass discharge or instream mixed concentration is set and the modeled output is compared to the set limit to determine acceptability of the modeled scenario. There are two areas on the sheet, one for rivers and streams, and another for reservoirs and lakes. This is due to the two types of water bodies each requiring different approaches and assumptions associated with discharge and mixing calculations.

5.2 Surface Water Mixing Sheet—Streams and Rivers

The following describes the input parameters for the Surface Water Mixing sheet—Streams and Rivers, which is shown in Figure 5-1. As with the other sheets, cells used for inputs are colored yellow with red font.

Project Description ---------->	General Model Development Copy		
Date ---------->	2/15/2012 14:14		
Select Surface Water Type ->	stream/river		
Surface Water Mixing - Stream /River			
Parameter	Abbreviation	Value	Comments/Notes
Surface Water Inputs - Stream / River		Spkn R.	USGS 12419000 SPOKANE RIVER NR POST FALLS ID
Depth of Stream (ft)	d	15	
Flow - [30Q5] or [M30D5Y] cfs	30Q5	844	
Optional Custom Flow (if needed)	--	345	
Upstream [P] (mg/L)	C(sw)	0.0090000	http://nwis.waterdata.usgs.gov/id/nwis/qwdata/?site_no=12419000&agency_cd=USGS&inventory_output=0&r
Allowable limit [P] to sw from this source	C(sw-allowed)	0.0090050	
Allowable mass flux from this source lb/yr	m(sw-allowed)	3	mjc value arbitrary
Mixing Zone Calculation			
GW Discharge Width (ft)	w	90	From inspection of plume width plot - calculated
GW Discharge Area (ft^2)	A	1350	
GW Flow (ft^3/d)	Qgw	4455	
GW Flow (cfs)	Qgw	0.0516	
Select Either the Max [P]gw or Depth Weighted	Selection	Weighted Conc	By selecting 'Weighted Conc', a [P]gw is calculated that is weighted by depth (see vertical profile plot) and by plume width profile at Setback
Depth / Distance Weighted [P]gw		0.208	
Selected [P]gw value	[P]gw	0.2082	
Mixing [P] - Flow [30Q5]	Cmix - 30Q5	0.0090122	Does not Meet [P] Limit
Mixing [P] - Optional Custom Flow	--	0.0090298	Does not Meet [P] Limit
Mass Loading (lb/yr)	M(sw)	0.83	Meets P Loading Limit

Figure 5-1. Surface water mixing data input sheet—streams and rivers.

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5.2.1 Streams and Rivers Inputs

1. **Select Surface Water Type:** Select from the drop-down list in the top center of the sheet (Figure 5-1) one of the two choices: streams and rivers, or lakes and reservoirs. Enter streams and rivers. The top area of this sheet will prompt the user to enter data and observe outputs from the Streams and Rivers portion of the sheet and ignore those in the Lakes and Reservoirs portion of the sheet.
2. **Surface Water Inputs—Stream/River:** Enter the name, or segment, of the stream or river being modeled. In the Comments cell to the right, enter documentation for the parameter selection, such as particular stream identification numbers, website locations of information obtained, etc. At the outset, it should be determined whether this water body is a gaining or losing stream (i.e., whether ground water is discharging into the stream, or whether the stream is discharging to ground water). Keep in mind this property of a stream may be seasonal. If the stream is a losing stream, there will be no mixing of ground water with surface water at any time of the year, and completion of the Surface Water Mixing Sheet is not necessary.
3. **Depth of Stream (feet):** Enter the maximum depth of the stream at low flow (30Q5) conditions (section 5.2.1(4)). The depth of the stream defines the depth dimension of the portion of the discharging ground water plume to be used in mixing calculations. For example, if the ground water contaminant plume is 22 feet deep at the surface water boundary, but the stream is only 15 feet deep, only the upper 15 feet of the discharging ground water plume will be used in mixing calculations. The remainder of the plume is assumed to bypass the surface water body and is not used in mixing calculations. It must be noted that ground water flow to a stream described here is greatly simplified and is likely much more complicated and beyond the scope of this document to discuss. A site visit during low flow conditions may be required to determine the appropriate depth.
4. **30 Q5 Flow cubic feet per second (cfs):** Enter the low annual stream flow rate for the period of record that is representative of the scenario being modeled. The 30Q5 flow rate represents the 30-day average low flow based upon a 5-year recurrence period. This flow rate will be used in calculating the instream ground water/surface water mixing P concentration and will (most likely) yield more conservative (higher) mixed concentration values than average flows. Generally, but not always, 30Q5 conditions occur in the late summer or fall. Values for 30Q5 flows may be found by utilizing the United States Geological Survey (USGS) StreamStats utility (Hortness 2006) found at the following website: http://water.usgs.gov/osw/streamstats/

   The United States Environmental Protection Agency (EPA) program DFlow will generate other flows such as 30Q10 (which may be close enough for modeling purposes) at a stream gage site but does not generate 30Q5 flow statistics. See the following website: http://water.epa.gov/scitech/datait/models/dflow/index.cfm

5. **Optional Custom Flow (cfs):** If another flow scenario besides the 30Q5 scenario is desired, this flow can be entered here. Provide justification and information source in the Comments/Notes cell.
6. **Upstream P concentration (mg/L):** Enter an estimate of the upstream P concentration for low (30Q5) flow conditions and for the period of record that represents the scenario being modeled. Sources of these data include EPA Storet

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Database at http://www.epa.gov/storet/dbtop.html, USGS National Water Information System (NWIS) at http://waterdata.usgs.gov/nwis, and local data that may not be in a database or accessible online, including discharge monitoring reports and consultant reports. Document the source of this information in the Comments/Notes cell.

7. **Allowable Instream Mixed [P] (mg/L):** Enter the instream P concentration limit that is allowed during the time period of the low-flow conditions specified in section 5.2.1(4) (e.g., late summer or fall, growing season, etc.). This value will be compared to the mixed concentrations modeled to determine whether the limit would be met in the modeled scenario. For narrative criteria for excess nutrients and oxygen-bearing materials, see IDAPA 58.01.02.200.06 and 07.
8. **Allowable Mass Flux (Mass Loading) of P into Stream (lb/year):** Enter the allowable mass flux (mass loading) of P that is allowed during the time period of the low-flow conditions specified in section 5.2.1(4) (e.g., late summer or fall, growing season, etc.). This value will be compared to the mass loading values modeled (section 5.2.2(9)) to determine whether the limit would be met in the modeled scenario. The basis for this limit may be derived from a total maximum daily load (TMDL) completed for the water body, or other basis.
9. **Ground Water P Concentration Selection—Maximum or Weighted:** This drop-down list allows the user to specify which ground water concentration to be utilized in mixing calculations. By selecting Maximum Conc, the maximum ground water concentration at the point of discharge to surface water is used. This concentration is that at the top of the water table and on the plume centerline. By selecting Weighted Conc, a concentration is calculated that attenuates the maximum concentration in two ways. First, the concentration is *depth-weighted*, meaning an *average* concentration (rather, an attenuation factor) is calculated for the entire vertical gradient from the top of the water table to the depth of the stream. Second, since the ground water concentration decreases as a function of the distance away from the plume centerline, an attenuation factor is calculated for this also. The maximum concentration is modified by these factors in order to arrive at an estimate of the concentration in the entire cross-sectional area of the ground water plume that is discharging to surface water.

5.2.2 Streams and Rivers Outputs

1. **Ground Water Plume Discharge Width (feet):** The width of the P plume at the ground water discharge point to surface water is calculated and the value appears here. This width can be visually determined by inspecting Plot #3 in the All Plots sheet (Figure 5-2). This plot shows the ground water P concentration from the plume centerline laterally until it reaches background levels. The lateral distance calculated is doubled since the plume is on both sides of the plume centerline.

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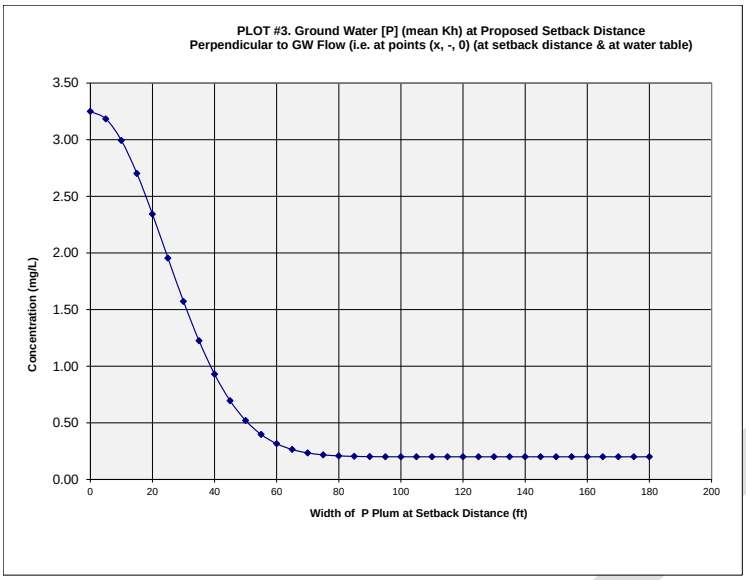

Figure 5-2. Ground water plume discharge width at setback distance.

2. **Ground Water Discharge Area (ft^2):** The value appearing in this cell is the product of the ground water plume width (section 5.2.2(1)) and the stream depth (section 5.2.1(3)). This is the cross-sectional area of ground water discharging into the stream.
3. **Ground Water Flow (Q_{gw}) into Surface Water (ft^3/day):** This calculation is the product of the mean hydraulic conductivity (K_h), the hydraulic gradient (i), and the cross-sectional area (A), or, $Q_{gw} = K_h iA$.
4. **Ground Water Flow (Q_{gw}) into Surface Water (cfs):** This is the same as section 5.2.2(3) except expressed in cubic feet per second.
5. **Depth/Distance Weighted Ground Water P Concentration (mg/L):** See explanation of this depth and distance weighting of the ground water P concentration in the cross-sectional area of discharge in section 5.2.1(9). The calculated value of the depth and distance weighted P concentration appears here.
6. **Selected Ground Water P Concentration (mg/L):** Depending on whether Maximum or Weighted was selected in section 5.2.1(9), the maximum ground water P concentration value, or the weighted value (section 5.2.2(5)) appears here and is used for further mixing and mass discharge calculations.
7. **Instream Mixing P Concentration—Low Annual [30Q5] Flow (mg/L):** Appearing here is the calculated mixed concentration of the low annual stream flow and concentration with the discharging ground water flow and concentration. The cell to the immediate right shows the result of the comparison with the P concentration limit set in section 5.2.1(7). If the calculated value is less than or equal to the limit, the cell format turns green and the statement, Meets [P] Limit, appears. If the calculated value exceeds the limit, the cell format turns red and the statement, Does not Meet [P] Limit, appears.
8. **Instream Mixing P Concentration—Custom Flow Conditions (mg/L):** Appearing here is the calculated fully mixed concentration of the high annual stream flow and concentration with the discharging ground water flow and concentration. The cell to the immediate right shows the result of the comparison with the P concentration limit set in section 5.2.1(7). If the calculated value is less than or equal to the limit, the cell

format turns green and the statement, Meets [P] Limit, appears. If the calculated value exceeds the limit, the cell format turns red and the statement, Does not Meet [P] Limit, appears.

9. **Mass Loading of P to Stream (lb/year):** This value is the mass of P discharging into the stream from ground water through the cross-sectional area previously determined (section 5.2.2(6) and section 5.2.2(2)). The cell to the immediate right shows the results of the comparison with the P mass loading limit set in section 5.2.1(8). If the calculated value is less than or equal to the limit, the cell format turns green and the statement, Meets [P] Loading Limit, appears. If the calculated value exceeds the limit, the cell format turns red and the statement, Does not Meet [P] Loading Limit, appears.

5.3 Surface Water Mixing Sheet—Lakes and Reservoirs

The following describes the input parameters for the Surface Water Mixing sheet—Lakes and Reservoirs, which is shown in Figure 5-3. As with the other sheets, cells used for inputs are colored yellow with red font.

Surface Water Mixing - Lake / Reservoir			
Parameter	Abbreviation	Value	Comments/Notes
Surface Water Inputs - Lake/Reservoir		Lakewood Cove	Martindale 9/2011
Shoreline Gradient into Lake/Reseroir	degrees	12	mjc - assumed
Depth of Lake/Res - Recommended	ft	23.4	<----Recommended Value. Do not overwrite.
Depth of Lake/Res in Mixing Area (ft)	d	1.6	http://www.fyinorthidaho.com/lake_river_facts
Area of Lake/Reservoir (acres)	A(L/R)	150	assume S. half of Windy Bay is 700' x 9,300' = 6,510,000 = 150 acres
Fraction of Lake/Res Area for Mixing	A(f)	0.10	0.10 required value by DEQ rule
Approx # of Onsite Systems near Lake	Syst(os)	33	Martindale map shows ~20 systems on 1,500' shoreline; 124 systems along 9,300 ft
Lake/Res Annual Turnover Rate	R(t)	1	i.e. number of lake volumes displaced per year
Lake/Res Mixing Volume (ft3)	Q(sw)	31680	
Lake/Res [P] (mg/L)		0.0155	DEQ, Nov 22, 2000, p. 42 (for Lower Twin Lk; need to locate source for Lake CDA data)
Allowable limit [P] to sw from this source	C(sw-allowed)	0.020	mjc arbitrary
Allowable mass flux from this source lb/yr	m(sw-allowed)	2	mjc arbitrary
Mixing Zone Dimensions in Lake / Res (areal)			
Distance into Lake / Res (ft)	L	220	
Mixing Zone Calculation			
GW Discharge Width (ft)	w	90	Also assumed to be the Shoreling Width (ft)
GW Discharge Area (ft^2)	A	144	
GW Flow (ft^3/d)	Qgw	4455	
GW Flow (ft3/yr)	Qgw	1626075	
Select Either the Max [P]gw or Depth Weighted	Selection	Weighted Conc	By selecting 'Weighted Conc', a [P]gw is calculated that is weighted by depth (see vertical profile plot) and by plume width profile at Setback
Depth / Distance Weighted]P]	[P]gw	0.222	
Selected [P]gw value	[P]gw	0.222	
Mixing [P]	Cmix	0.21792	Does not Meet [P] Limit
Mass Loading to Lake / Res (lb/yr)	M(sw)	2.22	Does not Meet P Loading Limit

Figure 5-3. Surface water mixing data input sheet—lakes and reservoirs.

5.3.1 Lakes and Reservoirs Inputs

1. **Select Surface Water Type:** Enter from the drop-down list in the top center of the sheet (section 5.2.1(1) and Figure 5-1) one of the two choices: streams and rivers, or lakes and reservoirs. Enter lakes and reservoirs. The top area of this sheet will prompt the user to enter data and observe outputs from the Streams and Rivers portion of the sheet and ignore those in the Streams and Rivers portion of the sheet.
2. **Lake or Reservoir:** Enter the name, or subarea such as a bay, of the lake or reservoir being modeled. In the Comments cell to the right, enter any other documentation for the parameter selection, such as particular identification numbers, website locations etc. At the outset, it should be determined whether this water body (hereafter referred to as *lake* for convenience) is a gaining or losing water body (i.e., whether ground water is discharging into the lake, or whether the lake is discharging to ground water). If the lake is a losing body, there will be no mixing of ground water with surface

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water and the basic assumption of the Surface Water Mixing Sheet is not satisfied, and no ground water/surface water mixing or mass loading can be calculated. Do not use this sheet.

3. **Shoreline Gradient into the Lake/Reservoir (degrees):** Enter the angle (θ, slope) at which the lake bottom makes with the water surface in degrees (Figure 5-4). The depth of the lake/reservoir mixing zone is determined by the formula
   $d = (L/2)*\tan\theta$,
   where:
   a. d is depth of the lake along the shoreline where mixing will be calculated
   b. L is the length of the surface area of the mixing zone obtained by calculation from the ground water plume discharge width (sections 5.2.2(1) and section 5.3.2(3)). Dividing L by 2 yields an average depth of the mixing zone. If the lake bottom is steep and abrupt, this calculation may not be appropriate. Both this calculation and the recommendation in section 5.3.1(4) may be ignored and a custom depth entered in section 5.3.1(5).

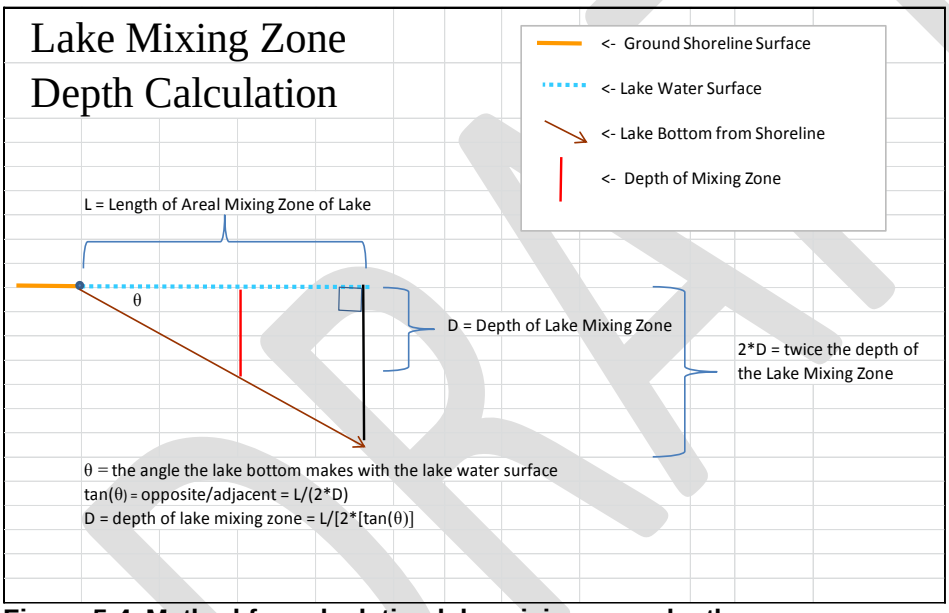

Figure 5-4. Method for calculating lake mixing zone depth.

4. **Depth of Lake/Reservoir—Recommended (feet):** The result of the calculation $d = (L/2)*\tan\theta$, appears here as a recommended value to enter into section 5.3.1(5) input described below.
5. **Depth of the Lake/Reservoir in the Mixing Area (feet):** Enter the depth of the lake calculated in section 5.3.1(4) or other estimate as appropriate (Figure 5-4). The manner in which this area is determined is discussed in section 5.3.1(6), (7) and (8) below. The depth of the lake defines the depth dimension of the portion of the discharging ground water plume to be used in mixing calculations. For example, if the ground water contaminant plume is 22 feet deep at the point of surface water discharge and if the lake is 5 feet deep, only the upper 5 feet of the discharging ground water plume will be used in mixing calculations. The remainder of the plume is assumed to bypass the surface water body and is not used in mixing calculations. It must be noted that ground water flow to a lake described here is greatly simplified

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and is likely much more complicated and beyond the scope of this document to discuss.

Note: Stratification of the water column in lakes often takes place, and such stratification may change seasonally. This seasonal stratification may result in restricted mixing of the water column. No attempt has been made to incorporate this phenomenon into mixing calculations.

6. **Area of the Lake/Reservoir (acres):** Enter the acreage of the lake here. If a subarea (such as a bay) of a larger lake like Lake Coeur d'Alene is being modeled, enter the bay's acreage.
7. **Fraction of the Lake/Reservoir (Surface) Allowed for Mixing:** Enter the fraction of the surface area of the lake that is allowed for mixing. A value less than or equal to 0.10 is required (IDAPA 58.01.02.060.01.f(i)).
8. **Approximate Number of On-Site Systems on the Lake:** Enter an estimate of the number of on-site systems that are near the lake's shore, or are planned to be installed along the shoreline of the lake. The reason for this input is to mathematically split the lake up into several smaller parts so that each on-site system is associated with its own *virtual lake*, not comprising the entire lake, but rather comprising its *share* of the lake.
9. **Lake/Reservoir Annual Displacement Rate (number):** Enter an estimate of the number of lake volumes displaced per year for the period of record of interest. This is calculated by dividing lake volume by annual discharge rate: V_{lake}/Q_{disch}. A rough estimate of the volume of a lake can be made by taking the area of the lake, assuming a circular shape and deriving the radius. Then assume an hemispherical three-dimensional shape and, using a maximum depth, find the volume of the hemisphere. A value for the discharge from a lake may be obtained in many cases from stream gaging stations. An example of a lake displacement calculation is as follows: given a lake volume of 200 million gallons (MG) and its annual discharge of 100 MG/year, the displacement rate is 200 MG/100 MG/year = 2 years. As a rough rule of thumb, displacement rate of most lakes is less than 1 year, larger lakes (such as Lake Coeur d'Alene) are greater than 1 year. It must be noted that the displacement rate of a reservoir can be highly variable, depending upon how they are managed from year to year. DEQ has a database containing certain information on several lakes in Idaho that is only available internally. Larger lakes will have USGS gages to measure discharge but most other lakes will not.
10. **Lake/Reservoir P Concentration ([P]) (mg/L):** Enter an estimate of the lake P concentration for the period of record and season (if applicable) that represents the scenario being modeled. If the lake is thermally stratified, one may want to restrict this mixing analysis to the upper mixed layer (epilimnion).
11. **Allowable Lake/Reservoir Mixed P Concentration ([P]) (mg/L) from this Source:** Enter the lake P concentration limit that is allowed. This value will be compared to the mixed concentrations modeled to determine whether the limit would be met in the modeled scenario. This might be a seasonal (i.e., summer) limit when septic usage is high and temperatures are warmer.

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12. **Allowable Mass Flux (Mass Loading) of P into Lake (lb/year):** Enter the mass flux (mass loading) of P that is allowed. This value will be compared to the mass loading values modeled to determine whether the limit would be met in the modeled scenario.
13. **Ground Water P Concentration Selection—Maximum or Weighted:** This drop-down list allows the user to specify which ground water concentration to be utilized in mixing calculations. By selecting Maximum Conc, the maximum ground water concentration at the point of discharge to surface water is used. This concentration is that at the top of the water table and on the plume centerline. By selecting Weighted Conc, a concentration is calculated that attenuates the maximum concentration in two ways. First, the concentration is *depth-weighted,* meaning an *average* concentration (rather, an attenuation factor) is calculated for the entire vertical gradient from the top of the water table to the depth of the lake. Second, since the ground water concentration decreases as a function of the distance away from the plume centerline, an attenuation factor is calculated for this also. The maximum concentration is modified by these factors in order to arrive at an estimate of the concentration in the entire cross-sectional area of the ground water plume that is discharging to surface water.

5.3.2 Lakes and Reservoirs Outputs

1. **Lake/Reservoir Mixing Volume (cubic feet per year [ft^3/year]):** This volume is calculated by dividing the lake acreage (section 5.3.1(6)) by the number of on-site systems on the lake (section 5.3.1(8)), then multiplying this value by the fraction of the lake surface allowed for mixing (section 5.3.1(7)). Then, this value is multiplied by the depth of the mixing zone area (section 5.3.1(5)) to obtain a preliminary mixing volume. Lastly, the value is multiplied by the lake turnover (displacement) rate calculated in section 5.3.1(9) to obtain the mixing volume.
2. **Mixing Zone Dimensions (Shoreline)—Width (Ground Water Discharge Width) (feet):** The width of the P plume at the ground water discharge point to the lake is calculated and the value appears here. As discussed for streams, this width can be visually determined by inspecting Plot #3 in the All Plots sheet (Figure 5-2). This plot shows the ground water P concentration from the plume centerline laterally until it reaches background levels. The lateral distance calculated is doubled since the plume is on both sides of the plume centerline.
3. **Mixing Zone Dimensions (Distance into Lake) (feet):** This cell is calculated by first dividing the lake area (section 5.3.1(6)) by the number of other on-site systems on the lake (section 5.3.1(8)). This value is multiplied by the fraction of the lake allowed for mixing (section 5.3.1(7)). The resulting value is multiplied by 43,560 to convert acres to ft^2. Then the value is divided by the shoreline width (ground water discharge width) (section 5.3.2(2) to yield length.
4. **Ground Water Discharge Area (ft^2):** The value appearing in this cell is the product of the ground water plume width (section 5.3.2(2)) and the lake mixing zone depth (section 5.3.1(5)). This is the cross-sectional area of ground water discharging into the lake.
5. **Ground Water Flow (Q_{gw}) into Surface Water (cubic feet per day [ft^3/d]):** This calculation is the product of the mean hydraulic conductivity (K_h), the hydraulic gradient (i), and the cross-sectional area (A), or, $Q_{gw} = K_h iA$.

6. **Ground Water Flow (Q_{gw}) into Surface Water (ft^3/year):** This is the same as section 5.3.2(5) except expressed in cubic feet per year.
7. **Depth- and Distance-Weighted Ground Water P Concentration (mg/L):** See explanation of this depth and distance weighting of the ground water P concentration in the cross-sectional area of discharge in section 5.3.1(13). The calculated value of the depth- and distance-weighted P concentration appears here.
8. **Selected Ground Water P Concentration (mg/L):** Depending on whether Maximum or Weighted was selected in section 5.3.1(13), the maximum ground water P concentration value, or the weighted value (section 5.3.2(7)) appears here and is used for further mixing and mass discharge calculations. Repeat the selection made on the Drainfield Sheet here.
9. **Lake Mixing P Concentration ([P]) (mg/L):** Appearing here is the calculated mixed concentration of the lake mixing volume (section 5.3.2(1)) and concentration (section 5.3.1(10)) with the discharging ground water flow (section 5.3.2(5) and (6)) and concentration (section 5.3.2(8)). In the cell to the immediate right, compare the cell value with the P concentration limit set in section 5.3.1(11) above. If the calculated value is less than or equal to the limit, the cell format turns green and the statement, Meets [P] Limit, appears. If the calculated value exceeds the limit, the cell format turns red and the statement, Does not Meet [P] Limit, appears.
10. **P Mass Loading to Lake/Reservoir (lb/yr):** The value appearing is the mass of P discharging into the lake carried by ground water (section 5.3.2(4) and section 5.3.2(8)). The cell to the immediate right compares the cell value with the P mass loading limit set in section 5.3.1(12). If the calculated value is less than or equal to the limit, the cell format turns green and the statement, Meets [P] Loading Limit, appears. If the calculated value exceeds the limit, the cell format turns red and the statement, Does not Meet [P] Loading Limit, appears.

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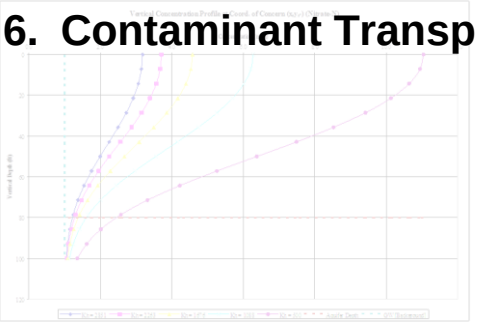
6. Contaminant Transport Module



6.1 Description

This spreadsheet module is an adaptation of the *Nutrient-Pathogen Evaluation Program for On-Site Wastewater Treatment Systems* (DEQ 2002), which in turn is an adaptation of the Pennsylvania Department of Environmental Protection (2002) *Quick Domenico.xls* implementation of the Domenico (1987) analytical solution for multidimensional transport of a decaying contaminant species. Adaptations include the following:

1. Inclusion of a procedure to estimate the mixing zone depth in ground water of contaminants beneath the wastewater land treatment source area. This procedure is taken from Equation 38 in the EPA Soil Screening Guidance, Technical Background Document (EPA 1996). This mixing zone depth, along with the estimated width of the source perpendicular to ground water flow, provides the dimensions of the rectangular patch source used in the Domenico solution.
2. Inclusion of a mass-balance mixing calculation to estimate the source zone chemical concentration in ground water resulting from the mixing of site percolate and upgradient ground water. The chemical concentration of the upgradient ground water is assumed to be zero. This provides a relative increase over the site-specific background value for the constituent of concern.
3. Inclusion of the Xu and Eckstein (1995) empirical equations for estimation of longitudinal dispersivity, as corrected by Al-Suwaiyan (1996).
4. Inclusion of charts plotting the vertical concentration profile at a specified distance downgradient from the source and the centerline concentration profile. The charts show the absolute concentration change with background chemical concentrations added in, and show five scenarios for K_h between the upper and lower ranges specified by the user.

The following describes the input parameters for the Ground Water Transport sheet, which is shown in Figure 6-1. As with the other sheets, cells used for inputs are colored yellow with red font.

INPUTS: GW Contaminant Transport Model: ADVECTIVE TRANSPORT				
WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY and RETARDATION <Rev 8/11/2010>				
Note: All Inputs are in Rows 6 - 54 and are in Cells with Red Font.				
Project Description:	Windy Bay Case Study; Pmt 92-28-77004			
Date:	5/15/2012			
Prepared by:	M. Cook			
Contaminant:	Phosphorus			
Mixing Zone Depth Calculation Inputs	**Symbol**	**Units**	**Input**	**Data Sources and Comments**
Onsite Installation Length Parallel to GW Flow	L	feet	51.00	From Drainfield Inputs Sheet
Onsite Installation Width Perpendicular to GW Flow	W	feet	36.00	From Drainfield Inputs Sheet
Percolate Volume	Qp	inches/ac	47.8	Calculated from Drainfield Sheet
Percolate Constituent Concentration:	Cp	mg/L	1.2	
Upgradient GW Concentration:	Cgw	mg/L	0.05	estimated
Allowable INCREASE above Bkgrd at Setback Distance	delta-Cgw	mg/L	0.1	mjc: arbitrary
Ground Water [P] Limit at Setback Distance	C(lim)	mg/L	0.15	
Aquifer Hydraulic Conductivity: Upper Range	K	feet/day	5	Stevens April 2011, p. 8, Tbl 6.
Aquifer Hydraulic Conductivity: Lower Range	K	feet/day	1	Stevens April 2011, p. 8, Tbl 6.
Aquifer Hydraulic Gradient	i	unitless	0.006	Stevens April 2011, p. 10
Aquifer Material	Driscoll, 1987 - Sand			
Aquifer Porosity (Suggested values, range in percent)	ne	unitless	25 – 40%	Suggested value. Don't overwrite
Aquifer Effective Porosity (enter suggested or other value as a perc	ne	unitless	43%	Stevens April 2011, p.9, Tbl 6.
Aquifer Thickness	da	feet	15	Stevens April 2011, p. 7, Tbl 4.
Model Domain & Other Spatial Inputs				
Spatial Coordinates of Concern (Origin is plume centerline at DG	discharge boundary			
X (longitudinal)	x	feet	100	X coord at required distance from surface water.
Y (latitudinal/transverse)	y	feet	0	
Z (depth)	z	feet	0	
Depth of Vertical Profile to Calculate and Observe	z	feet	25	Stevens April 2011, p. 7, Tbl 4.
Time that the Source is Discharging	d	days	Infinite	worse case
			15728	<------- Ignore This Entry
Selected Time that the Source is Discharging	d	days	1000000	Do not Overwrite Cell
AREAL Model Calculation Domain			2739.7	
(dinensions of area modeled)				
Length (ft)	L	feet	500	assumed mjc
Width (ft)	W	feet	200	assumed mjc
Alert: Significant Vertical Dispersion Below Actual Aquifer Depth in One or More P Scena				

Figure 6-1. Ground water contaminant transport data input sheet.

6.2 Contaminant Transport Module—Instructions for Use

6.2.1 Contaminant Transport Module Inputs

This section provides descriptions of the following:

- The required aquifer parameters
- Ground water quality
- Ground water impact analysis inputs

General instructions for inserting these parameters into the model are also provided.

1. **Data Sources and Comments:** The column titled, Data Sources and Comments, is a space where the user should document sources and rationale for input parameters chosen.
2. **Project Description:** The Project info appearing here is carried over from the Isotherm sheet (section 2.2.1(1)). This label should include a description of the scenario that is being run, and how a particular scenario may differ from other scenarios.
3. **Run Date:** The time/date stamp is automatically calculated for the particular model run.
4. **Prepared By:** Enter users name.
5. **Contaminant:** Enter contaminant being modeled.

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6.2.1.1 Mixing Zone Depth Calculated Inputs and Selected Outputs

1. **On-Site Installation Length Parallel to GW Flow (feet)—Calculated Cell:** The length of the on-site installation parallel to ground water flow is calculated by dividing the total drainfield area (section 4.1.2(4)) by the width of the on-site installation perpendicular to ground water flow (section 4.1.1(10)).
2. **On-Site Installation Width Perpendicular to GW Flow (feet)—Calculated Cell:** The value of this cell appearing here is brought from the Drainfield sheet (section 4.1.1(10)).
3. **Percolate Volume (Q_p) Calculated Cell (inches/acre-year):** The value of this cell is calculated using the daily flow to the drainfield (section 4.1.1(5)) and the total drainfield area (section 4.1.1(9)) entered in the Drainfield sheet, to calculate flow in inches/acre-year.
4. **Percolate Constituent (P) Concentration (C_p or C_{eq}) (mg/L):** The value of this cell is brought from the P equilibrium concentration assigned to the system in the Phase II analysis in the Sorption sheet (section 3.4.1(2)).
5. **Upgradient Ground Water Phosphorus Concentration (C_{gw}) (mg/L):** Enter a value for the upgradient ground water phosphorus concentration. The upgradient (background) concentration is shown on centerline and vertical plots for reference.
6. **Allowable Increase in Ground Water Phosphorus Concentration (mg/L):** Enter a value for the allowable increase above upgradient (background) ground water phosphorus concentration.
7. **Ground Water [P] Model Threshold Value at Setback Distance (mg/L)—Calculated Cell:** The value appearing here is the sum of the upgradient concentration plus the allowable increase (section 6.2.1.1(5) and (6)), thus yielding the model threshold value. The concentration limit is shown on centerline and vertical plots for reference.
8. **Aquifer Hydraulic Conductivity (K_h) (upper and lower range):** Enter these values in the next two cells in ft/d. Uncertainty exists when estimating this parameter. See the Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater (DEQ 2007) sections 2.5.3 through 2.5.8 and DEQ 2007 section 2.1.4.2.2 for further information on K_h values. See the DEQ 2007 section 7.7.5.2.2 for a detailed discussion of how aquifer parameters are used in mixing zone calculations. This model generates five different K_h scenarios, including those of the upper and lower range, as well as three intermediate values, and plots the results.
9. **Aquifer Hydraulic Gradient (i) (unitless):** Enter the aquifer gradient here. The gradient is derived from potentiometric maps or other sources. Document the source of the gradient value used in the Data Sources and Comments column.
10. **Aquifer Material:** From the drop-down list, select the aquifer material. A suggested porosity will appear below.
11. A**quifer Porosity (suggested values) (n)—Calculated Cell:** A suggested aquifer porosity value appears in this cell, which is based upon the aquifer material chosen in section 6.2.1.1(10). Values are based upon those found in Freeze and Cherry (1979), Driscoll (1987) and Domenico and Schwartz (1998).
12. **Aquifer Effective Porosity (n_e):** Enter an aquifer effective porosity here. See DEQ 2007, Sections 2.1.4.2.2 and 2.5.9 for further information on n_e values. Note that standard tables for aquifer parameters list porosities, not effective porosities. The

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modeler should use best professional judgment when using porosity values, or modifying them as needed to reflect effective porosity.

13. **Aquifer Thickness (b):** This is the thickness of the aquifer, *not* the mixing zone depth (which is calculated from various aquifer parameters and site geometry). Geological studies and/or well logs should be consulted for aquifer thickness information. Aquifer thickness is plotted on vertical profile plots (section 6.2.1.2(2)) for reference. If *aquifer thickness* is greater than the *depth of vertical profile to be observed* (section 6.2.1.2(2)), then aquifer thickness will set the scale of the vertical plots. If *aquifer thickness* is less than the *depth of vertical profile to be observed*, then depth of vertical profile to be observed will set the scale of the vertical plots.

    Note that at the bottom left of the Inputs area in this sheet there are two cells that alert the user if significant dispersion of the constituent of concern is occurring below the specified depth of the aquifer (which would represent an unrealistic scenario). In this model, depth of vertical dispersion cannot be limited so it must be *manually* checked. If the constituent dispersion exceeds aquifer thickness these cells will be displayed in red, and if the aquifer thickness exceeds the constituent dispersion, these cells will be displayed in green.

6.2.1.2 Ground Water Transport Calculated Inputs

On the Inputs worksheet, input parameters related to ground water contaminant transport modeling include the following:

1. **Spatial Coordinates (x,y,z) of Concern:** The user specifies a point in space (i.e., in the contaminant plume) by entering coordinates (x, y, z). Figure 6-2 shows the coordinate system of a contaminant plume. The coordinate system consists of the following:

    The x Axis—Calculated Cell: This cell has a value brought in from the Drainfield sheet (section 4.1.1(7)) and is the proposed setback distance from the on-site installation to a surface water body. The x axis is parallel to the direction of ground water flow through the center of the site, passing through the origin and is positive downgradient along the plume centerline (i.e., the x value specified refers to the distance downgradient from the source discharge boundary).

    The y Axis: This axis is perpendicular to ground water flow along the downgradient boundary of the wastewater land treatment site (i.e., the y value specified refers to the distance from the center of the source area in a horizontal direction perpendicular to the direction of ground water flow). Zero is located at the midpoint (center) of the site at the downgradient boundary.

    The z Axis: This axis is depth below the water table surface. The water table surface is at z = 0. Positive numbers represent depth below the water table.

    A constituent concentration at the selected (x, y, z) coordinate of concern is calculated in Domenico Outputs sheet (section 6.2.2.1). This may be a point of compliance or a location where ground water criteria should be met.

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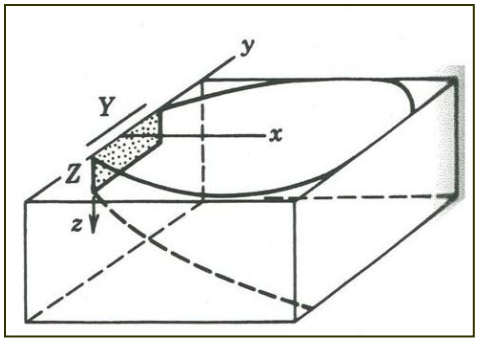

Figure 6-2. Coordinate system for a contaminant plume.

2. **Depth of Vertical Profile to Calculate and Observe:** This entry determines over what thickness of the aquifer, starting at the water table, the chemical concentrations will be calculated by the model. If *depth of vertical profile to be observed* is greater than *aquifer thickness* (section 6.2.1.1(13)), depth of vertical profile to be observed will set the scale of the vertical plots. If *depth of vertical profile to be observed* is less than *aquifer thickness,* then aquifer thickness will set the scale of the vertical plots. Initially, set the *depth of vertical profile to observe* slightly greater than the *aquifer depth.*
3. **Location and Time Information:** The location and time information inputs are used to calculate the predicted chemical concentration at a specific location away from the source at a specific time after source release begins. The time is specified in days from the start of chemical release. If steady-state conditions are to be simulated, the value for time should be set at an appropriately large value. Steady state conditions are reached when concentration profiles no longer change with increasing time. Other values of time should be input if certain time frames need to be considered.
4. **Time that the Source is Discharging:** The drop-down list allows many options for the user to select the length of time the source is discharging. All values except Other are automatically calculated from data already entered in other sheets. The options are as follows:
   a. Infinite, as discussed above, is reckoned as 1 million days and will yield the worst case scenario of the system achieving steady state conditions. Other options include the following:
   b. Setting the time to the regulatory site life allowed by the agency (Phase I plus Phase II operational lives)
   c. The installation site life as determined by the maximum (Phase I) P sorption capacity (section 3.2) determined in the Isotherm sheet (section 2) utilizing the Langmuir isotherm
   d. The time until P breakthrough where $C_p = C_{ww}$ under Phase II conditions (see section 3.4)
   e. The ground water travel time from the installation to the setback distance
   f. An Other time frame selected by the user.

5. **Field for Other Time Frame Entry:** If the Other drop-down list selection is chosen, in the cell below the list, a place to enter (in days) the time that the source is discharging appears. Enter the time where designated.

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6. **Selected Time that the Source is Discharging—Calculated Cell:** The value for the menu option chosen appears in this cell.
7. **AREAL Model Calculation Domain:** The planar (length and width) dimensions of the area to be modeled are input in these two cells. They are selected in relation to the center of the source and extend in both the x and y directions, as shown in Figure 6-2, delineating one-half of the symmetrical plume. The model performs contaminant transport calculates within this area. The length input determines the x scale dimension on the plume centerline profile plot. See Figure 6-3 and the discussion in section 6.2.2(1).

6.2.2 Contaminant Transport Module Graphical Outputs

All graphical outputs discussed in this section are found in the All Plots sheet. Data used to make the plots drawn from the various locations where they are generated and are shown in the Plot Data sheet.

1. **Centerline Profile Graph:** Provides graphical representations of the horizontal (x) distribution of the constituent of concerns' chemical concentration, including background ground water concentrations, for five K_h scenarios. See Figure 6-3 for an example of the Centerline Profile output. It shows concentration distributions for the centerline of the plume (y = 0) downgradient from the source to a distance determined by the length value input for the model domain. This concentration profile will be calculated at the z value chosen in the coordinate of concern; if z = 0, the concentrations will be calculated for the top of the water table. See Coordinate of Concern inputs in section 6.2.1.2(1). Notice in the plot the following *marker* lines:
   a. The green vertical dashed line representing the setback distance
   b. The red horizontal long-dashed line representing the ground water constituent limit
   c. The blue horizontal short-dashed line represents upgradient or background ground water quality.

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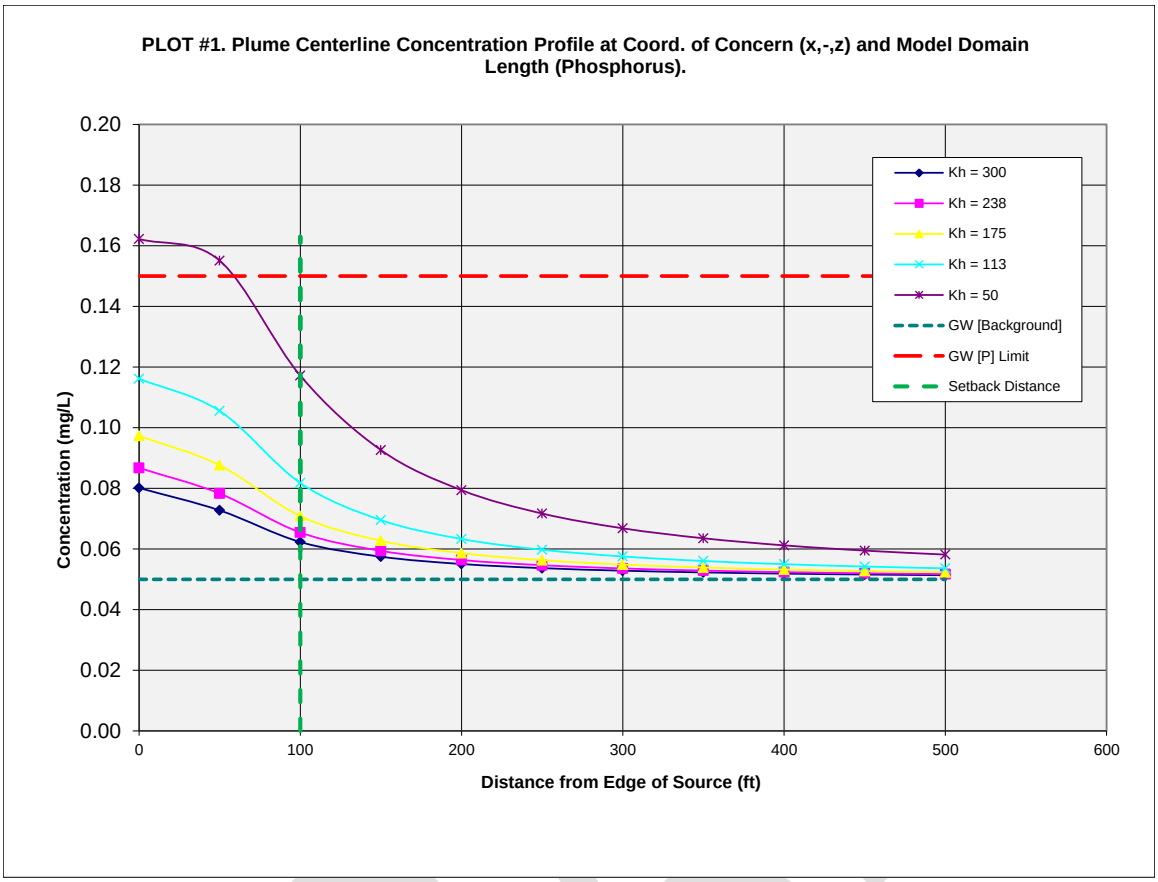

Figure 6-3. Plume centerline P concentrations downgradient of the source.

2. **Vertical Profile graph:** Provides graphical representation of the vertical distribution of the constituent of concern's chemical concentration, including background ground water concentration, for five K_h scenarios. See Figure 6-4 for an example of the vertical profile output. The vertical plot shows the concentration distribution from the water table (z = 0) to a specified depth at a (x, y) coordinate down-gradient of the source, specified in the Coordinate of Concern inputs in Section 6.2.1.2(1). Notice in the plot the following 'marker' lines:
    a. The brown horizontal dashed line represents the aquifer depth.
    b. The red vertical long-dashed line represents the ground water constituent limit.
    c. The blue vertical short-dashed line represents the up-gradient or background ground water quality.

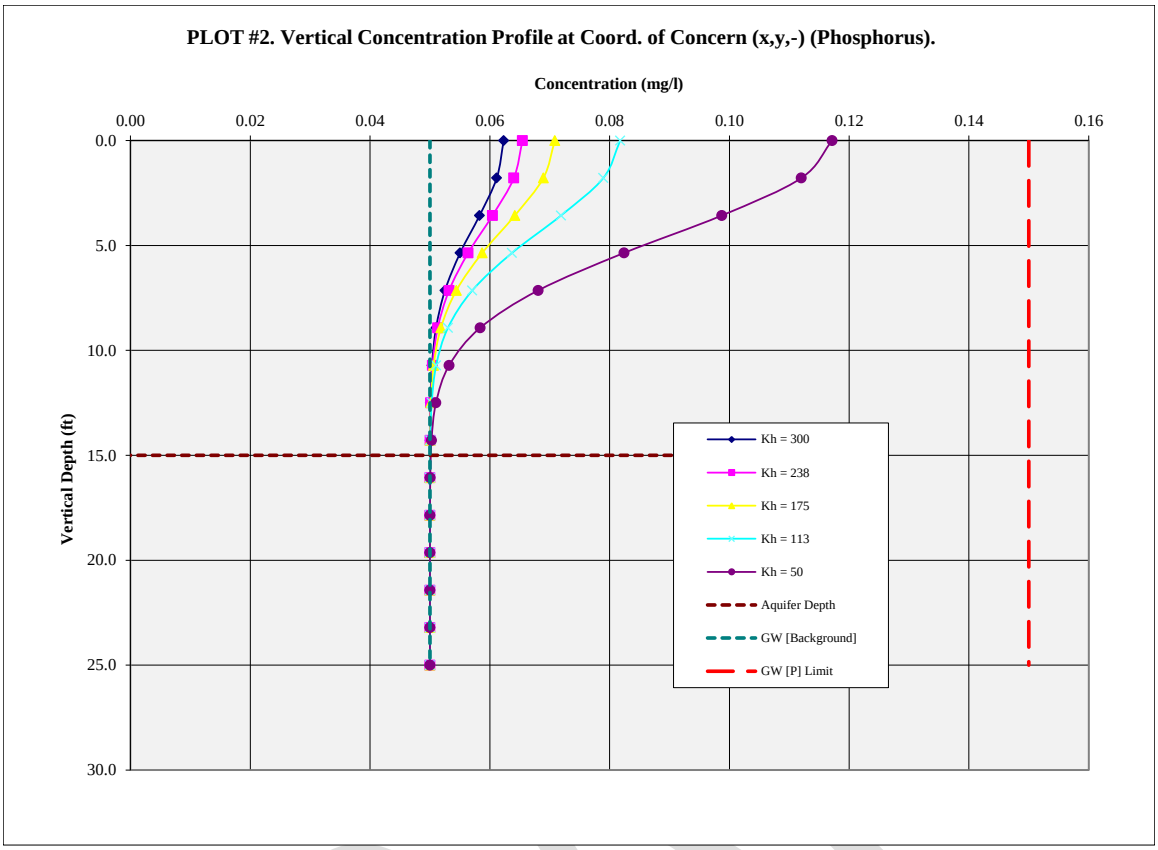

Figure 6-4. Vertical P concentration gradients at the setback distance.

6.2.2.1 Utility Sheets

There are 10 sheets to the right of the Utility Sheets tab. Five of them are labeled IP_N(1) through IP_N(5). These five sheets perform the ground water contaminant transport calculations. One sheet is utilized for each of the five K_h (hydraulic conductivity) values being evaluated. For our purposes the constituent is phosphorus.

The second set of five sheets are labeled IP_TDS(1) through IP_TDS(5). These five sheets also perform ground water contaminant transport calculations. One sheet is utilized for each of the five K_h values being evaluated.

Each of these nine sheets has an identical format (the sheet, IP_N(1), is arranged differently). Examining sheet IP_N(2) for example, there are several calculation areas that are delimited by black borders. These areas are discussed as they appear from the top to the bottom of the sheet.

1. The first area summarizes Mixing Zone Depth Calculation Inputs and Ground Water Transport Calculation Inputs. (Begin at cell B2.)
2. The second area shows various aquifer modeling calculation outputs. (Begin at cell B51.)
3. The third area shows Domenico dispersion calculation outputs for both the plume centerline and vertical profile (these are in the yellow shaded cells). (Begin at cell B74.)
4. The fourth area shows Mixing Zone Model Output Calculations. (Begin at cell B102.)

5. The fifth area has the Domenico Calculations (i.e., the advection/dispersion calculations). (Begin at cell B141.)
6. The sixth and last area contains Miscellaneous Calculations and Lists. These are the lookup tables from which drop-down list choices derive. (Begin at cell 205.)

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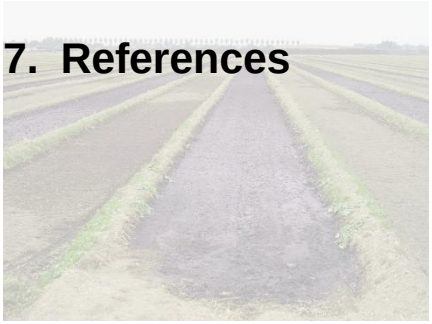

7. References

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Appendix A—Soil Sampling for P Sorption Characterization

Surface site characterization and subsurface site characterization of test pits for on-site septic systems will generally conform to the following American Society for Testing and Materials (ASTM) designations, except where rule or guidance indicate otherwise:

- Designation: D5879 – 95. Standard Practice for Surface Site Characterization for On-Site Septic Systems
- Designation: D5921 – 96. Standard Practice for Subsurface Site Characterization of Test Pits for On-Site Septic Systems

Sampling of soils for P sorption analysis should follow an approved quality assurance project plan to ensure adequate accuracy, precision, and representativeness of the samples. Contact The Idaho Department of Environmental Quality for further guidance.

Appendix B—Phosphorus Sorption Isotherm Methods

B.1 Graetz and Nair (2000) P Sorption Isotherm Method

From: Graetz, D.A. and V.D. Nair. 2000. Phosphorus Sorption Isotherm Determination. *In* Pierzynski, G.M. ed. 2000. *Methods of Phosphorus Analysis for Soils, Sediments, Residuals, and Waters*. Southern Cooperative Series Bulletin No. 396. http://www.soil.ncsu.edu/sera17/publications/sera17-2/pm_cover.htm

URL http://www.sera17.ext.vt.edu/Documents/P_Methods2ndEdition2009.pdf

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Phosphorus Sorption Isotherm Determination

D.A. Graetz, University of Florida
V.D. Nair, University of Florida

Introduction:

Phosphorus (P) retention by soils is an important parameter for understanding soil fertility problems, as well as for determining the environmental fate of P. The P adsorption capacity of a soil or sediment is generally determined by batch-type experiments in which soils or sediments are equilibrated with solutions varying in initial concentrations of P. Equations such as the Langmuir, Freundlich and Tempkin models have been used to describe the relationship between the amount of P adsorbed to the P in solution at equilibrium (Berkheiser et al., 1980; Nair et al., 1984).

Advantages of the batch technique include: the soil and solution are easily separated, a large volume of solution is available for analysis, and the methodology can be easily adapted as a routine laboratory procedure. Disadvantages include difficulties in measuring the kinetics of the sorption reaction and optimizing the mixing of solution and soil without particle breakdown (Burgoa et al. 1990). Despite the disadvantages, the batch technique has been, and still is, widely used to describe P sorption in soils and sediments.

Nair et al. (1984) noted that P sorption varies with soil/solution ratio, ionic strength and cation species of the supporting electrolyte, time of equilibration, range of initial P concentrations, volume of soil suspension to head space volume in the equilibration tube, rate and type of shaking, and type and extent of solid/solution separation after equilibration. Although most researchers use a similar basic procedure for measuring P adsorption, there is considerable variation observed among studies with regard to the above parameters. This variation often makes comparisons of results among studies difficult. Thus, Nair et al. (1984) proposed a standard P adsorption procedure that would produce consistent results over a wide range of soils. This procedure was evaluated, revised, tested among laboratories and was eventually proposed as a standardized P adsorption procedure. This procedure as described below is proposed as the standard procedure recommended by the SERA-IEG 17 group.

Equipment:

1. Shaker: End-over-end type
2. Filter Apparatus: Vacuum filter system using 0.45 or 0.2 μm filters
3. Equilibration tubes: 50 mL or other size to provide at least 50% head space
4. Spectrophotometer: Manual or automated system capable of measuring at 880 nm

Reagents:

1. Electrolyte: 0.01 *M* $CaCl_2$, unbuffered
2. Microbial inhibitor: Chloroform
3. Inorganic P solutions: Selected concentrations as KH_2PO_4 or NaH_2PO_4 (in 0.01 *M* $CaCl_2$ containing: 20 g/L chloroform)

Procedure:

1. Air-dry soil samples and screen through a 2 mm sieve to remove roots and other debris.
2. Add 0.5 to 1.0 g air-dried soil to a 50 mL equilibration tube.
3. Add sufficient 0.01 *M* $CaCl_2$ solution containing 0, 0.2, 0.5, 1, 5, and 10 mg P/L as KH_2PO_4 or NaH_2PO_4, to produce a soil:solution ratio of 1:25. The range of P values could vary from 0 to 100 mg P/L (0, 0.01, 0.1, 5, 10, 25, 50 and 100 mg P/L) and the soil/solution ratio could be as low as 1:10 depending on the sorption capacity and the P concentrations of the soils in the study.
4. Place equilibration tubes on a mechanical shaker for 24 h at 25 ± 1 °C.
5. Allow the soil suspension to settle for an hour and filter the supernatant through a 0.45 μm membrane filter.
6. Analyze the filtrate for soluble reactive P (SRP) on a spectrophotometer at a wavelength of 880 nm.

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Calculations and Recommended Presentation of Results:

Two of the often used isotherms are the Langmuir and the Freundlich isotherms; the Langmuir having an advantage over the Freundlich in that it provides valuable information on the P sorption maximum, S_{max} and a constant k, related to the P bonding energy.

The Langmuir equation

The linearized Langmuir adsorption equation is:

$$\frac{C}{S} = \frac{1}{kS_{max}} + \frac{C}{S_{max}}$$

where:
S = S' + So, the total amount of P retained, mg/kg
S' = P retained by the solid phase, mg/kg
So = P originally sorbed on the solid phase (previously adsorbed P), mg/kg
C = concentration of P after 24 h equilibration, mg/L
Smax = P sorption maximum, mg/kg, and
k = a constant related to the bonding energy, L/mg P.

The linearized form of the Langmuir equation, as presented herein, is the most commonly used procedure to determine the sorption parameters for P because of its ease of use. The Langmuir equation in its nonlinear form may provide more accurate sorption parameters but fitting this model to experimental data requires a "trial and error" approach which is relatively difficult to accomplish. However, recent development of optimization programs to solve the nonlinear equation provides an opportunity to more easily utilize the nonlinear equation in P sorption studies (Bolster and Hornberger, 2007; Schulthess, 2007).

The Freundlich equation

The linear form is:

$$\log S = \log K + n \log C$$

where:
K is the adsorption constant, expressed as mg P/kg,
n is a constant expressed as L/kg, and
C and S are as defined previously.

A plot of log S against log C will give a straight line with log K as the intercept, and n as the slope.

Previously adsorbed P (also referred to as native sorbed P)

Adsorption data should be corrected for previously adsorbed P (S_o). For the calculation of previously sorbed P, Nair et al. (1984) used isotopically exchangeable P (Holford et al., 1974) prior to calculations by the Langmuir, Freundlich and Tempkin procedures. Other procedures

used to calculate the previously adsorbed P include oxalate-extractable P (Freese et al., 1992; Yuan and Lavkulich, 1994), anion-impregnated membrane (AEM) technology (Cooperband and Logan, 1994) and using the least squares fit method (Graetz and Nair, 1995; Nair et al., 1998; Reddy et al., 1998). Sallade and Sims (1997) used Mehlich 1 extractable P as a measure of previously sorbed P.

Investigations by Villapando (1997) have indicated a good agreement among native sorbed P values estimated by the least squares fit method, oxalate extractions, and the AEM technology. At this point, it appears that selection of the method for determination of native sorbed P would depend on the nature of the soils in the study and reproducibility of the results. The procedure for calculation of S_o using the least square fit method is based on the linear relationship between S' and C at low equilibrium P concentrations. The relationship can be described by:

$$S' = K'C - S_o$$

where:

K' = the linear adsorption coefficient, and all other parameters are as defined earlier.

(Note: It is recommended that the linear portion of the isotherm have an r^2 value 0.95 or better).

Equilibrium P Concentration

The "equilibrium P concentration at zero sorption" (EPC_0) represents the P concentration maintained in a solution by a solid phase (soil or sediment) when the rates of P adsorption and desorption are the same (Pierzynski et al., 1994). Values for EPC_0 can be determined graphically from isotherm plots of P sorbed *vs.* P in solution at equilibrium. From the calculations given above, EPC_0 is the value of C when S' = 0.

Comments:

The above procedure was developed to provide a standardized procedure with a fixed set of conditions that could be followed rigorously by any laboratory. The procedure uses a low and narrow range of dissolved inorganic P concentrations because these are the concentrations likely to be encountered in natural systems and because higher concentrations may result in precipitation of P solid phases. However, higher concentrations of P (up to 100 mg/L) and/or lower soil:solution ratios (1:10) have been used for isotherm determinations on soils and sediments (Mozaffari and Sims, 1994; Sallade and Sims, 1997; Nair et al., 1998; Reddy et al., 1998). A 0.01 *M* KC1 solution may be used as the background electrolyte to avoid precipitation of Ca in neutral and alkaline soils.

Toluene and chloroform have been shown to increase the dissolved P concentration in the supernatant, apparently due to lysis of microbial cells, and thus, some researchers do not try to inhibit microbial growth (Reddy et al., 1998).

Most adsorption studies are conducted under aerobic conditions. However, with certain studies it is more appropriate to use anaerobic conditions, as they more closely represent the natural environments of the soils or sediments. Reddy et al. (1998) pre-incubated sediment/soil samples in the dark at 25°C under a N_2 atmosphere, to create anaerobic conditions. Adsorption

experiments were then conducted, performing all equilibrations and extractions in an O_2-free atmosphere.

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B.2 University of Idaho P Sorption Isotherm Method (University of Idaho (no date)

Abstract:

This procedure is used to determine the amount of phosphorus a soil can adsorb. Phosphate moves to plant roots by diffusion, and the concentration of phosphate in the soil solution is one factor that determines this movement. It has been found that the average plant sustains maximum growth at a solution phosphate concentration of 0.2 µg/mL. Soil tests can indicate a phosphorus deficiency, but are of limited value for predicting the actual amount of phosphorus a soil requires to maintain optimum P availability. This is due to the fact that standard soil tests do not account for P sorption by Fe, Al, and Ca soil constituents.

A phosphorus sorption isotherm can be used to describe the relationship between available and adsorbed P in soils. A known amount of soil is allowed to react with a succession of P solutions over a period of 24 h. The difference between the initial and final (equilibrium) P concentrations is used to calculate the amount of sorbed P. The final solution P concentration is plotted against the sorbed P. The resulting plot, known as the sorption isotherm, can be used to determine the amount of fertilizer P required for maximum growth. Approximately 10 g of dried and ground soil are needed for this procedure. Detection limits are not applicable in this procedure.

I. Equipment and Apparatus:

- **A.** Analytical balance (Mettler PC440 or equivalent)
- **B.** 50 mL plastic centrifuge tubes
- **C.** Reciprocal shaker
- **D.** Filter funnels: Polypropylene (Nagle 4252) 65 mm (Fisher catalog # 10-348A, or equivalent)
- **E.** 125 mL Wheaton bottles
- **F.** Filter paper: 15 cm pleated, grade 542, or equivalent
- **G.** ICP-AES

II. Instrument Operating Parameters

Optima 3200RL ICP-AES (see SOP.52.045.xx for more information)

- **A.** Instrument parameters, Table 1, are subject to change; see instrument method for current operating conditions. Load desired method. Select the desired elements by the enable/disable menu option.

Table 1: ICP-AES Operating Conditions
Plasma: 15 L/min
Auxiliary: 0.5 L/min
Nebulizer: 0.80 L/min
Power: 1300 W
Flow Rate: 1.5 mL/min
Wash Time: 60 sec
Wash Rate: 2.00 mL/min

B. Start the torch and allow the system to warm up for about 60 min. Note: Do not adjust the tension on the sample introduction line unless absolutely necessary.

C. Tune the ICP-AES by calibrating the instrument and checking the position of wavelength measurement against the actual emission peak (See Table 2). Adjust the position to best measure the peak (approximately the middle of the peak). Recalibrate before beginning analysis.

Table 2: Element for Optima 3200RL:

Element	Emission Wavelength (nm)
P	213.6

NOTE: The wavelength may vary slightly day to day due to instrument conditions.

D. Interelement Corrections (IEC) and background corrections: see IEC file under Model Builder.

III. Reagents

A. Calcium chloride (Granular, $CaCl_2 \cdot 2H_2O$, Organic Residue Analysis, USP/FCC Grade, VWR Order # JT1336-01 or Fisher Order # C70-500, or equivalent).

B. 0.01 M calcium chloride solution: Weigh 2.92 g $CaCl_2 \cdot 2H_2O$ and transfer to a 2 L volumetric flask. Mix and make to volume with Type I or II water.

C. Stock phosphorus solution, 1000 µg P/mL - Dissolve 4.3943 g oven dried KH_2PO_4 (Certified ACS, Fisher Order # P288-500 or Baker Analyzed Reagent, VWR Order # JT3252-1 or equivalent) in 500 mL of 0.01 M $CaCl_2$ solution. Make to 1 L volume with 0.01M $CaCl_2$ solution.

D. Working Phosphorus solutions: prepare according to the following table.

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Desired P Conc. (µg/mL)	Volume of 1000 mg/L Stock P Solution (mL)	Final Volume (L)
5	5	1
25	25	1
50	50	1
100	100	1
200	200	1

1 Adjust to final volume in a 1 L volumetric flask with 0.01 M $CaCl_2$ solution.

IV. Standards

Calibration standards:

A. Primary standard: 10,000 µg P /mL
ICP/AES grade (AESAR order #14415, or equivalent).

B. Typical calibration curve: 0, 10, and 100 µg/mL in 0.01 M $CaCl_2$.
A standard dilution worksheet is located at: P:\bench\inorgan\soil\piso.xls (tab: Dilution P) for assistance in preparing the standards.

Note: This calibration is a suggestion and is not necessarily used for the analysis. Record the actual calibration curve used on the dilution calibration worksheet.

V. Sample Preparation

A. Weigh 1.000 ± 0.003 g of dried and ground sample (see SMM.85.410.xx, Soil Drying and Grinding) into each of a set of ten 50 mL centrifuge tubes. (Five phosphorous concentrations will be run, each concentration in duplicate; therefore, a total of 10 centrifuge tubes will be needed for each sample.)

Note: Rock percentage needs to be taken into account for a drainage field sample. Calculate the decimal fraction of the soil to be weighed using the following formula (g soil / total g soil + rock). The number obtained is the amount of sample (g) to be weighed into the centrifuge tubes. A spreadsheet for calculating the amount of soil for the analysis is located at **P:\soil\spdshts\pisowt.xls**.

B. Add 25 mL of the working phosphorus solutions (5, 25, 50, 100 and 200 µg P/mL) to the centrifuge tubes.

C. Cap, wrap with Parafilm, and place the centrifuge tubes on a reciprocating shaker so that the sample is being shaken lengthwise in the tube.

D. Shake for 24 h.

E. Remove from the shaker and filter into 125 mL bottles with 15 cm filter paper.

F. Submit for analysis on the ICP.

NOTE: Samples may be kept up to one week if refrigerated.

VI. Sample Analysis

A. Determine equilibrium P concentration on the ICP.

B. Plot adsorbed P µg/g (Y) vs solution P µg/mL (X).

VII. Calculations

A. Use the Excel spreadsheet to calculate and plot the amount of phosphorus sorbed vs. the amount of phosphorus remaining in solution. The Excel spreadsheets are located at **P:\soil\spdshts\pisocalc.xls**, **pisoa.xlc**, **pisob.xlc**, **pisoc.xlc**, **pisod.xlc**, **pisoe.xlc**, **pisor.xlc**, and **pisorpt.xls**.

B. Plot X axis, amount of P remaining in solution in µg P/mL.

C. Plot Y axis, amount of P sorbed by soil in µg P/g:

$$\frac{\mu g\ P}{g\ soil} = \frac{\text{mL working standard}}{g\ soil} \times (\text{concentration of working standard} - \text{concentration of P remaining in solution})$$

VIII. Quality Control and Corrective Action

Note: at least 10% of each analytical batch will consist of QC samples. At a minimum, each batch will contain a set of reagent blanks, one check standard, and a reference material. Samples are run in duplicate (assuming there is sufficient sample quantity). Additional QC samples (i.e. matrix spikes) may be required by client request.

A. Reagent (working solution) blanks

Analyze "blank" working solutions (no soil), at each concentration used (5, 25, 50, 100, 200 µg P/mL). If a solution does not fall within 10% of the known concentration it does not pass QC.

B. Check standard

If the measured analyte concentration in a check standard differs from the known concentration by more than 10%, the check standard has not passed QC.

C. Reference material

House Reference Materials – if the measured analyte concentration falls outside the acceptance range (plus or minus 2 standard deviations of the average), the reference material has not passed QC.

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D. Duplicate

If the measured analyte concentration of the duplicates differs by more than 10%, the duplicates have not passed QC.

E. Corrective Action

1. Values of all QC samples are to be recorded on the Quality Control Report. Values outside of the acceptance range will be indicated.
2. Quality control results are to be considered as a package, rather than individual results. Hence, a single failure (i.e. a single QC sample not passing) may not constitute an overall failure of the analytical batch.
3. If, in the professional judgment of the Laboratory Director or Group Leader, the overall quality control is acceptable (i.e. meets both ASL and, if applicable, client data quality objectives), the QC Report will be initialed and dated indicating the results have been reviewed and are to be reported.
4. If, in the professional judgment of the Laboratory Director or Group Leader, the overall quality control is unacceptable, the chemist will be instructed to rerun all or part of the analytical batch. Unused data will be retained in the raw data packet, with an explanation regarding any actions taken.
5. In recognition of the variety of analytical tests conducted by ASL, and the unique challenges influencing the accuracy and precision of certain tests, chemists are permitted to exercise professional judgment when evaluating QC during an analytical run. However, unusual QC results should always be discussed with the Laboratory Director or Group Leader.

IX. Documentation Requirements

A. Instrument information for phosphorous isotherms is recorded in the ICP log book, which is located next to the ICP.

B. The in-house reference material results are recorded on the phosphorus isotherm QC sheet and the ICP computer printout.

C. The sample phosphorus isotherm values are recorded onto the ICP computer printout.

D. The phosphorus isotherm bench sheet can be found at **P:\bench\inorgan\soil\piso.xls**.

E. The phosphorus isotherm QC sheets can be found at **P:\qcsheets\inorgan\soil\piso.xls**.

X. Safety and Health

Consult Material Safety Data Sheets for information on reagents.

XI. References

Nair, P.S., Logan, T.J., Sharpley, A.N., Sommers, L.E. Tabatabai, M.A. and Yuan, T.L. 1984. Intralaboratory comparison of a standardized phosphorus procedure. J. Environ. Qual., Vol. 13 No. 4:571-593.

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XII. Validation

The phosphorus isotherm values have a long history of in-house reference material quality control.

Revision History

SMM.85.120.05	Two year review update. Revision History – Added. 18 MΩ•cm water replaced by Type I or II water. Removed Leeman ICP information and added Optima ICP information. Added standard dilution information.

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Appendix C—Ground Water Modeling: Considerations for Tier II Applications

From: Gary Stevens, P.G., Coeur d'Alene Regional Office, Idaho Department of Environmental Quality.

Water Quality Impact Evaluation Elements

This section describes the elements of a Water Quality Impact Evaluation (WQIE), the minimum data set required and guidelines to help determine how detailed an evaluation is required for the development.

General

The general steps in completing a WQIE involve;

- Data Collection
- Development of Conceptual Model
- Fate & Transport Model Selection
- Construction, Calibration and Simulations Using Fate & Transport Model
- Model Documentation

Data Collection

In order to characterize subsurface conditions all existing available information should be collected within the development boundaries and the surrounding areas. Typical sources of data include;

Geology/Hydrogeology

1. Idaho Department of Water Resources

   The IDWR is responsible for permitting new water wells in the State of Idaho. All drillers that complete new water wells must submit a Well Driller's Report that includes well construction, depth to water and a lithologic description. These are organized by location using a PLS system and are available at the local IDWR office or on-line at; http://www.idwr.idaho.gov/water/well/search.htm

2. National Resource Conservation Service

   The NRCS performs soil surveys mapping the soil types and characteristics for a given area. The soils are given a numeric rating regarding the limitations of the soils for use in various activities including subsurface wastewater disposal. The surveys are organized by county and are available at the local NRCS offices or on-line at; http://websoilsurvey.nrcs.usda.gov/app/

3. Idaho Geological Survey

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The IGS collects and interprets geologic and mineral data for areas within Idaho and publishes reports and maps using this data. The data is available at the IGS office at the University of Idaho in Moscow, Idaho or on-line at; http://www.idahogeology.org/

4. Idaho Department of Environmental Quality

   DEQ enforces various state environmental regulations and administers a number of federal environmental protection laws. As part of these activities DEQ also collects, compiles and interprets ground and surface water quality data throughout the state. These data are available to the public and can be accessed by contacting the local DEQ office or on-line at; http://www.deq.state.id.us/

5. Idaho State Department of Agriculture

   The ISDA role is to protect the public, animals, and environment through regulation and education. The Agricultural Water Quality Program implements agricultural monitoring and protection programs with public and private partners to protect ground and surface water quality. As part of these activities the ISDA collects, compiles and interprets ground water and surface water quality data as it relates to agriculture. These data are available to the public and can be accessed by contacting the ISDA office in Boise, Idaho or on-line at; http://www.agri.state.id.us/index.php

6. U.S. Geological Survey

   The USGS is a federal organization that collects, compiles and interprets geological and hydrogeological data as well as ground and surface water quality data. These data are available to the public and can be accessed by contacting the a USGS office or on-line at; http://www.usgs.gov/

7. Idaho Universities

   Idaho has a number of universities that conduct research regarding the geology and hydrogeology within the state. These data are available to the public and can be accessed by contacting the respective universities;

   a. University of Idaho – Moscow, Idaho
      http://www.uidaho.edu/
   b. Boise State University – Boise, Idaho
      http://www.boisestate.edu/
   c. Idaho State University – Pocatello, Idaho
      http://www.isu.edu/

Surface Water

1. The USGS is a federal organization that collects, compiles and interprets surface water flow and quality data. These data are available to the public and can be accessed by contacting the a USGS office or on-line at: http://waterdata.usgs.gov/id/nwis/current/?type=flow

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2. DEQ also collects, compiles and interprets surface water quality data throughout the state. These data are available to the public and can be accessed by contacting the local DEQ office or on-line at;
   Data:
   http://www.deq.idaho.gov/water/data_reports/surface_water/tmdls/sba_tmdl_master_list.cfm#region

Administrative Rules
http://adm.idaho.gov/adminrules/rules/idapa58/0102.pdf

If there is limited existing available data it may be necessary for the applicant to obtain site specific information from a site exploratory program. The types of site exploration methods may include test pit excavations, completion of borehole/monitoring wells, cone penetration tests (CPT) and surface geophysics. The reader is referred to the following for further information and guidance regarding the development and methods for developing an on-site subsurface exploratory program;

- ASTM D 5921 – 96 Standard Practice for Subsurface Site Characterization of Test Pits for On-Site Septic Systems.
- ASTM D 5979-96 Standard Guide for Conceptualization and Characterization of Ground-Water Systems
- ASTM D 1586 REV A Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
- ASTM D6151 - 08 Standard Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling
- ASTM STP 1101 Geophysical Applications for Geotechnical Investigations
- ASTM D6429-99 Standard Guide for Selecting Surface Geophysical Methods
- EPA, 2006. Characterization of Site Hydrogeology. State of Ohio, Environmental Protection Agency, Division of Drinking and Ground Waters. Technical Manual for Ground Water Investigations, Chapter 3.
- EPA. 1987. A Compendium of Superfund Filed Operations Methods, Volume 1.
- Michigan Department of Environmental Quality, May, 2006. RRD Operational Memorandum No. 4, Interim Final. Site Characterization and Remediation Verification – Attachment 7, Groundwater Modeling.
- USGS, 1987. A Conceptual Framework for Ground-Water Solute-Transport Studies with Emphasis on Physical Mechanisms of Solute Movement. USGS WRIR 87-4191.

Development of Conceptual Model

The conceptual model is a description of the relevant site-specific and regional subsurface conditions that may influence the results of the fate and transport model. The conceptual model should incorporate all the relevant site-specific information along with a description of any simplifying assumptions. The more complex the subsurface conditions or boundary conditions the more information will need to be incorporated into the conceptual model. The conceptual model will be used as the basis for deciding the type of fate and transport model that will be necessary to adequately incorporate the necessary complexities. The conceptual model may include some or all of the following;

1. Significant geologic/hydrogeologic units in the area

2. The location, along with the lateral and vertical extent of any aquifers that may be impacted by wastewater activities
3. The types of aquifers present; confined and/or unconfined.
4. The ground water flow rate and direction in each aquifer
5. Characteristics of the aquifers that include transmissivity, storativity, and porosity
6. Boundary conditions
7. Hydraulic connection to any surface water bodies

The conceptual model and all the relevant information is often shown as a geological/hydrogeological cross section(s). The reader is referred to the following for further information and guidance.

Fate and Transport Model Selection

The selection of the fate and transport model will be dependent on the conceptual model. Different fate and transport models have limitations associated with the level of complexity that each can accommodate. If the subsurface conditions exhibit complexities that need to be characterized, as shown in the conceptual model, the selected fate and transport model must have the ability to incorporate these complexities. The three types of models that will be discussed are: 1) mass balance model, 2) analytical model, and 3) numerical model.

Mass Balance Model

A mass balance model is the simplest model with the most limitations and assumptions. The mass balance model is also referred to as a single cell model or black-box model and is considered to have zero dimensions. The assumptions of a mass balance model are:

1. There is a single aquifer with constant thickness
2. The aquifer is homogeneous and isotropic
3. The boundary conditions are fixed for each stress period and independent of other model inputs and outputs.
4. Changes in water quantity and quality are distributed equally over the entire model domain for each stress period
5. Changes in water quantity and quality occur instantaneously over the entire model domain for each stress period
6. The model cannot incorporate any aquifer parameters such as hydraulic conductivity, transmissivity, flow rate, or direction.
7. The only model parameter that can be incorporated is storativity that is distributed equally over the entire model domain.

The mass balance model is useful in developing a conceptual model and identifying additional data needs. The mass balance model should not be used for determining regulatory compliance regarding proposed wastewater projects and potential down gradient water quality impacts. A mass balance model may be used to provide a general assessment on whether the proposed development may pose a threat to ground and surface water resources.

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Analytical Model

An analytical model can be used to describe flow and transport in a homogeneous aquifer with two-dimensional flow. The analytical model provides a mathematical solution to contaminant fate and transport problems that incorporate some aquifer parameters and boundary conditions. Properly configured analytical models can provide solutions for specific locations and times over the model domain. Analytical models can incorporate more complex conditions than the mass balance model described above. The assumptions of an analytical model are:

1. There is a single aquifer with constant thickness
2. The aquifer is homogeneous
3. Flow within the model domain is horizontal and both velocity and direction are constant
4. The boundary conditions are fixed for each stress period and independent of other model inputs and outputs.

The analytical model can incorporate the following:

1. Aquifer parameters such as hydraulic conductivity, storativity, flow rate, and direction
2. The duration of a stress period can be explicitly defined
3. The contaminant concentration can be determined at specific locations within the model domain

An analytical model can successfully be used for fate and transport problems regarding proposed wastewater projects if the subsurface conditions are suitable and the complexity can be reduced or simplified to meet the assumptions and limitations described above. Analytical solutions can be categorized into approximate and exact solutions. Approximate solutions are easier to solve mathematically but may result in errors due to the approximate nature of the solution. An example of an approximate solution is the Domenico solution (Domenico, 1982). Exact solutions are more difficult to solve mathematically but provide results with minimal mathematical error. The magnitude of error introduced by using an approximate solution as compared to the exact solution will be dependent on the subsurface conditions and the type of problem posed. Examples of exact solutions are described by Wexlar (1992) and Galya (1987).

The Domenico solution is available from DEQ and has been incorporated into a spreadsheet model. The Wexlar solution has similar model geometry to the Domenico of a vertical plane source, while the Galya solution assumes a horizontal plane source. *Please refer to the referenced documents for limitations and proper use*. Other computer software is available that solves for fate and transport problems using the analytical technique, such as Stanmod which is available through the U.S. Department of Agriculture, Salinity Laboratory. Commercial software is also available that provides an analytical solution. These software include, but are not limited to Solutrans and ATD123.

A more complicated type of model that incorporates analytical solutions is the analytical element model (AEM). The AEM uses separate analytical solutions for the distinct flow and transport processes (elements). The AEM then superimposes/combines the separate analyses to arrive at a solution. A discussion of AEM models is beyond the scope of this guidance and the applicant

should refer to a number of available references or consult an appropriate ground water professional for further information.

Numerical Model

A numerical model divides the model domain into a number of small cells (discretization). Each cell then is assigned flow and transport attributes. Boundary conditions are established by defining fluxes into or out of certain cells. The computer program then solves a set of algebraic equations that define ground water flow conditions. After the ground water flow direction and velocities are defined for each cell within the model domain and the fluxes into and out of the boundaries, a contaminant maybe introduced and similar computations are carried out. The entire process can be completed for discrete time steps. The ground water flow and contaminant conditions at the end of one time step are the initial conditions for the next. The entire process is repeated until the end of the simulation time period, defined by the modeler, is reached.

There are few limitations using the numerical method and thus it is ideally suited for complex subsurface conditions along with modeling flow directions, velocities, and boundary conditions that may vary over time. The construction of a numerical model may be simple and quick or complicated and timely depending on the conceptual model being represented. There are various types of numerical models based on model domain discretization, such as finite difference or finite element, and different mathematical solutions to solve the ground water flow and contaminant transport problems posed. It is beyond the scope of this guidance to describe these and the applicant should refer to a number of available references or consult an appropriate ground water professional for further information.

Construction, Calibration and Simulations Using a Fate & Transport Model

The construction of the fate and transport model is based on the conceptual model. The construction of an analytical model is facilitated by the number of underlying assumptions and resulting limited number of inputs. The construction of a numerical model is more difficult as the aquifer parameters and boundary conditions must be defined for each cell and time step across the entire model domain.

If ground water flow direction, gradient and levels are calculated over time as in a numerical model then calibration of the model should be conducted. Calibration consists of changing model parameters until the model output matches measured values. The modeled results are often displayed with measured values in a scattergram for comparison. In addition, residuals should be calculated and reported in a tabulated format.

A sensitivity analysis consists of varying selected input parameters and measuring the resulting changes in model output. The sensitivity analysis is performed to determine if the selected values of input parameters used in the model are adequate for the purpose of the model or need to be better defined and justified. The sensitivity analysis should be performed for both analytical and numerical models.

The reader is referred to the following for further information and guidance regarding the construction and use of fate and transport models;

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- ASTM D 5880 Standard Guide for Subsurface Flow and Transport Modeling
- ASTM D 5447 Standard Guide for the Application of a Ground-Water Flow Model to a Site-Specific Problem
- ASTM D 5490 Standard Guide to Comparing Ground-Water Flow Model Simulations to a Site Specific Problem
- ASTM D 5609 Standard Guide for Defining Boundary Conditions in Ground-Water Flow Modeling
- ASTM D 5610 Standard Guide for Defining Initial Conditions in Ground-Water Flow Modeling
- ASTM D 5611 Standard Guide for Conducting a Sensitivity Analysis for a Ground-Water Flow Model Application
- EPA Fundamentals of Ground-Water Modeling, Ground Water Issue. EPA/540/S-92/005.
- EPA, 2007. Ground Water Flow and Fate and Transport Modeling. State of Ohio, Environmental Protection Agency, Division of Drinking and Ground Waters. Technical Manual for Ground Water Investigations, Chapter 14.
- USGS, Guidelines for Evaluating Ground-Water Flow Models. Scientific Investigations Report 2004-5038—Version 1.01
- USGS**,** User's documentation for MODFLOW-96, an update to the U.S. Geological Survey modular finite-difference ground-water flow model. U.S. Geological Survey Open-File Report 96Ð485, 56 p.

Model Documentation

Because of the quantity of data used and assumptions and decisions made during the design and construction of a fate and transport model, it is imperative that the modeler document all the necessary information. The model documentation should at a minimum include:

- Introduction
- Data Collection
- Conceptual Model Description
- Model Description and Relation to Conceptual Model
- Model Construction
- Model Simulation and Results
- Summary and Conclusions

The data collection documentation should include all data used to develop the conceptual model and inputs used for the fate and transport model. If existing published data was used then the appropriate references should be included. If any information was used from water well logs to develop the conceptual model or used in calibration, then the Well Driller's Reports should be included in the report. Any data obtained as part of a subsurface exploratory program should be included along with the description of all methods, equipment and analysis.

The conceptual model and its relation to the site specific subsurface conditions as indicated by the existing data collected or obtained through site explorations should be included in the documentation. The conceptual model can be presented as a geologic/hydrogeologic cross section(s). Figures with the site and regional maps should be included with the following:

1. Development / property boundaries
2. Drain field locations
3. All water wells on the site and in the general vicinity. If pertinent the location and extent of capture zones
4. All compliance points or boundaries
5. A measured potentiometric map or maps with the direction of ground water flow indicated for each aquifer. All the monitoring and water wells that were used to generate the map should be located with the water elevation for each well shown. A justification of the model selection in relation to the conceptual model should be included. The model configuration/construction description can be short if an analytical model is used or very lengthy if a numerical model is constructed.

If a numerical model was used the following should be included:

1. A site/regional surface map with development boundary indicated along with the model grid or elements shown.
2. A site/regional surface map with all boundaries including drainfield(s).
3. A site/regional surface map containing aquifer parameters, such as hydraulic conductivity, storativity, and dispersivity. Additional plan view maps for various elevations may be necessary if these parameters vary with depth.
4. At least two cross sections orthogonal to each other showing model grid, aquifer parameters and boundary conditions.

The model simulations and results should include the model outputs, along with any calibration or sensitivity analysis, if completed. The model output documentation should include figures with the following;

1. A modeled potentiometric map(s) for each aquifer with ground water flow direction and velocity
2. A site/regional plan view map showing the contaminant plumes for each constituent of concern. The contaminant plumes should include areal extent and concentration gradients with at least five concentration divisions. The map should also include all the compliance points/boundaries that are being considered.
3. At least two cross sections orthogonal to each other showing model areal extent and concentrations gradient with at least five concentration divisions. The map should also include all the compliance points/boundaries that are being considered.

The simulation results should be discussed in relation to compliance with the WQIE. The reader is referred to ASTM D 5718 *Standard Guide for Documenting a Ground-Water Flow Model Application* for further information and guidance.

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Appendix I

1.4.2.2 Extended Treatment Package System Approvals

Manufacturers seeking approval of an Extended Treatment Package System (ETPS) technology shall submit product information to the DEQ On-Site Wastewater Coordinator for review by DEQ. In addition to product information (i.e., engineering designs and product manuals) manufacturers seeking approval on their ETPS units for reduction of Total Suspended Solids (TSS) and Carbonaceous Biological Oxygen Demand ($CBOD_5$) will need to submit National Sanitation Foundation (NSF)/American National Standards Institute (ANSI) Standard 40 and 360 approvals, reports, and associated data. Manufacturers also seeking approval on their ETPS units for reduction of Total Nitrogen (TN) will need to submit NSF Standard 245 approvals, reports, and associated data. Any additional third party standards evaluated for the ETPS unit will also need to be submitted including approvals, disapprovals, reports, and associated data.

DEQ will issue ETPS product approval in conjunction with associated reduction levels for TSS, $CBOD_5$, and TN. Reduction levels will be determined through statistical analysis of the data included in the third party standards. Third party reports average reduction values will not be accepted to establish system performance approvals. The third party data will be statistically evaluated to determine a resulting value that corresponds to the 95% upper confidence limit. The resulting value that corresponds to the 95% upper confidence limit will be used as the system's initial performance limit.

ETPS units that have not undergone third party testing and wish to be approved for reduction in TSS, $CBOD_5$ and TN must be permitted and installed under the Experimental System guidance in Section 4.9. ETPS units installed under the Experimental System guidance in an attempt to gain approval for effluent reduction levels shall follow the minimum operation, maintenance, and effluent testing procedures outlined in Section 4.10.3, and be installed in an area suitable for a standard system with no reduction in drainfield sizing or separation distance requirements. Operation, maintenance, and effluent testing requirements shall be written into the experimental system's permit.

To obtain approval for TSS, $CBOD_5$, or TN reduction without third party data, or to lower reduction levels from initial approval for any constituent, the manufacturer of the ETPS unit or their representative must submit data from their ETPS units installed in Idaho. Data from other states will not be considered under this approval process. Any data submitted must be specific to a particular ETPS make and model. Data submission must include information on 30 installations with a minimum of 3 full years of operational data on each system. All maintenance and effluent testing records, as described in Section 4.10.3, obtained over this period must be submitted for review. For adjustment in reduction levels of effluent constituents to be approved the data must show that 90% of the installed units have successfully maintained effluent reduction levels at or below the desired reduction approval level during the entire testing period.

Prior to product approval or the issuance of any non-experimental permits being issued for system installation manufacturers must have an Operation and Maintenance Entity setup for their ETPS units as described in section 4.2 of the TGM. The Operation and Maintenance Entity must be capable of fulfilling the requirements of section 4.2 and 4.10 of the TGM prior to product approval.

Appendix J

3.2.5 Equal Distribution

In equal distribution wastewater effluent is distributed to all trenches within the subsurface sewage disposal system thus providing the opportunity for utilization of the entire infiltrative surface of the disposal system. Equal distribution is the preferred method of wastewater discharge to any subsurface sewage disposal system on flat or slightly sloped site. The best way to accomplish this is through pressurization of the drainfield (see section 4.20). When gravity flow is utilized for wastewater discharge to the subsurface system equal distribution to each subsurface disposal trench can be accomplished through the use of a piping header or distribution box.

3.2.5.1 Piping Header

With a piping header system wastewater is conveyed to each disposal trench through the use of a network of solid piping. The discharge line from the septic tank should be split through the use of a T pipe fitting. The T should be offset equally from the distribution trenches. One-directional sweeping cleanouts should not be used in place of a bi-directional T. The T pipe fitting should be installed on a solid surface in a level position. It is recommended that the piping header only be utilized in installations involving two trenches. See figure 3-3 for an overhead view of this distribution setup.

3.2.5.2 Distribution Box

Distribution boxes (d-box) are used to divide wastewater effluent evenly among multiple subsurface distribution lines. D-boxes are typically made of concrete or wastewater grade plastics and are watertight with a single inlet set at a higher elevation in the box than the outlets. Outlets should be constructed at equal elevations to one another. The d-box should be constructed with an access lid. Access lids are recommended to be made accessible from grade. Distribution boxes should be installed level on a sound footing (e.g., properly bedded to prevent settling and heaving).

There are several devices available for installation on the distribution lines leaving the d-box to ensure that each line is receiving equal amounts of effluent if the piping or d-box becomes un-level. It is recommended that leveling devices be installed on the effluent lines leaving the distribution box at time of initial installation. Distribution boxes are highly recommended for situations where there are more than two trenches installed and gravity flow is desired. See figure 3-3 for an overhead view of this distribution setup on a level site. Figure 3-4 provides an overhead view of a distribution box setup on a sloped site.

Upon installation it is important that the distribution box is checked for level installation on all sides. It is also highly recommended that outlet lines from the d-box be checked for level installation within the d-box to one another. This is especially important when trenches are installed at different elevations from each other and the distribution box. Flow should be induced within the d-box, from a point prior to the d-box, after installation and prior to final cover to verify that each outlet line will receive effluent at similar flow rates. If flow rates differ it is

recommended that effluent outlet lines and/or flow equalization devices be adjusted and the flow rates retested after adjustment.

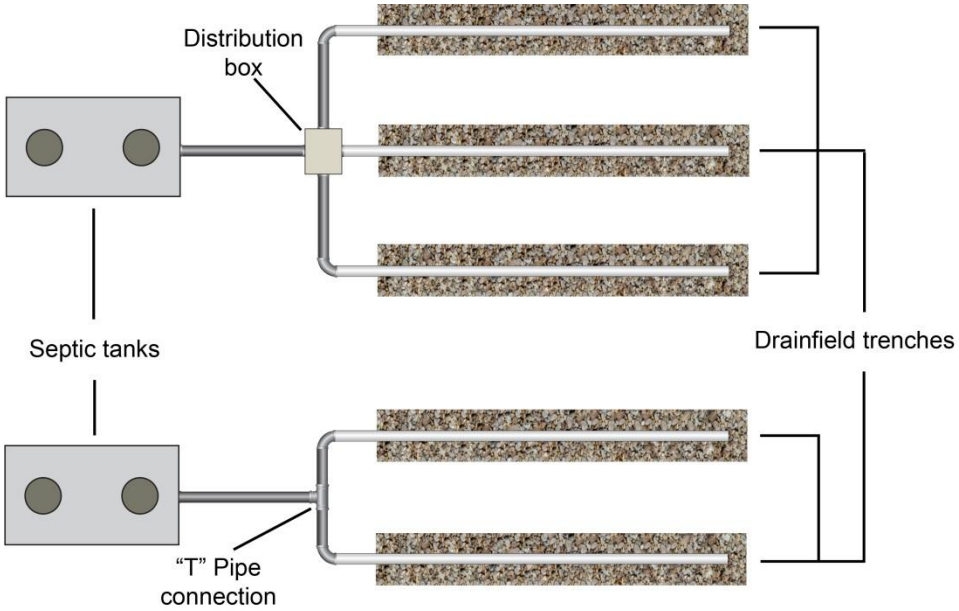


Figure 3-3. Overhead view of equal distribution methods for level sites.

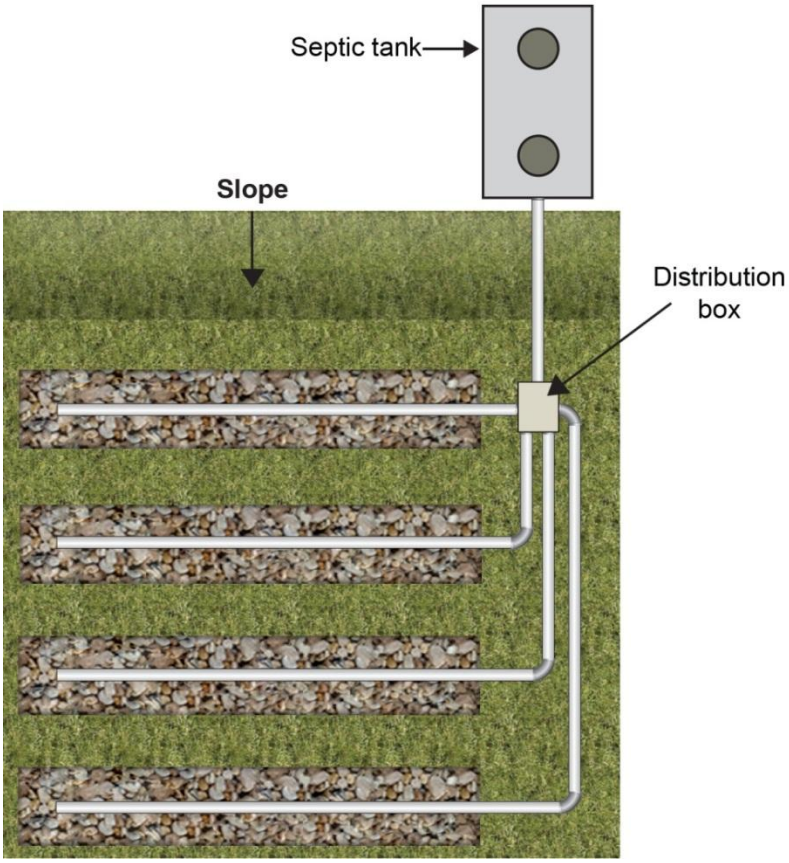


Figure 3-4. Overhead view of a distribution box layout on a sloped site.

3.2.6 Serial Distribution

~~Due to continuous ponding over the infiltrative surface serial distribution trenches suffer hydraulic failure more rapidly and progressively because the infiltrative surface cannot regenerate its infiltrative capacity. With this in mind serial distribution should only be used where equal distribution is not achievable. On sloped ground, it is preferable to use serial~~ Serial distribution~~, that is, distribution~~ functions so that each trench ~~in order~~ is ~~completely filled~~ loaded and completely flooded with effluent before effluent flows to the next ~~lower~~ trench in series. Serial distribution is typically utilized on sites with slopes in excess of 20%. In this distribution method it is not necessary to construct trenches at the same length but each trench must maintain a level installation by following a slope contour. ~~To maintain trenches between 2 to 4 feet below ground, it may be essential to use this kind of distribution.~~Serial distribution is accomplished either by installing relief lines or drop boxes between successive trenches. It is strongly recommended that serial distribution be accomplished through the use of drop boxes due to control and access aspects to the system.

3.2.6.1 Relief Lines

Relief lines are overflow lines that connect one trench to the adjacent lower trench in series. Relief lines are constructed of solid-wall piping and may be placed at opposite ends of successive trenches or anywhere within the trench line. If relief lines are installed in the middle of trenches successive relief lines should be offset by a minimum of 5 feet to avoid short circuiting the distribution system. Care must be exercised in excavating the ~~connecting~~relief line between trenches. Bleeding of effluent down this excavation is a common cause of surfacing effluent in serial distribution systems. The excavation of the connecting trench to the next downslope trench should be just deep enough to accept the solid connector pipe. See figure 3-5 for an overhead view of a relief line installation system network. See figure 3-6 for a cutaway view of relief line connection between trenches.

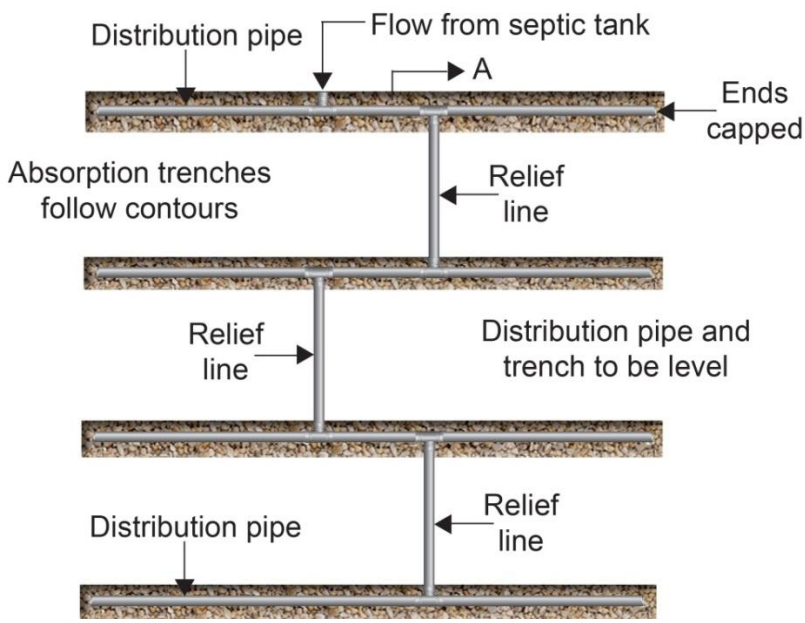


Figure 3-5. Overhead view of a relief line system network.

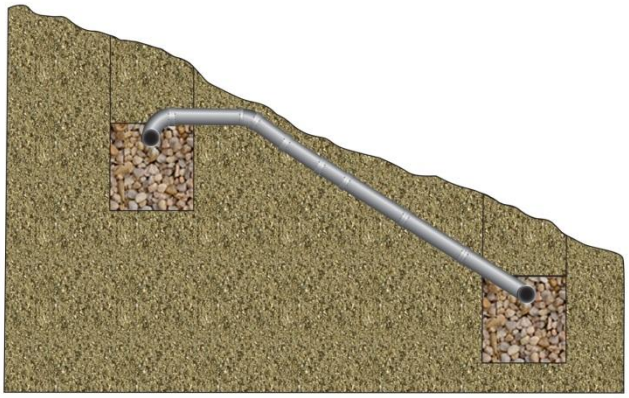


Figure 3-6. Side view of relief line installation between trenches.

3.2.6.2 Drop Boxes

Serial distribution may also be accomplished through the use of drop boxes. This method is commonly referred to as sequential distribution. Distribution boxes should not be substituted for drop boxes in this system design. The drop boxes are constructed so that each trench is completely flooded before the effluent flow runs to the next downslope trench in series. ~~Care must be exercised in excavating the connecting line between trenches. Bleeding of effluent down this excavation is a common cause of surfacing effluent in serial distribution systems. The excavation of the connecting trench to the next downslope trench should be just deep enough to accept the solid connector pipe.~~ The drop box consists of an inlet and outlet set at the same height that should be a minimum of 2 inches from the bottom of these ports to the top of the outlet ports for the trench at this location. There are typically two outlet ports to the disposal trench on opposite sides of the drop box to allow the trench to be extended on either side of the drop box. The trench outlets from the drop box should be set level with the distribution pipes in the disposal trench connected to the drop box. Solid-wall pipe should be used between drop boxes. ~~Figure 3-3~~ Figure 3-7 shows the detail of a drop box and the associated distribution system. Figure 3-8 shows an overhead view of drop box installation utilizing multiple trenches with one drop box.

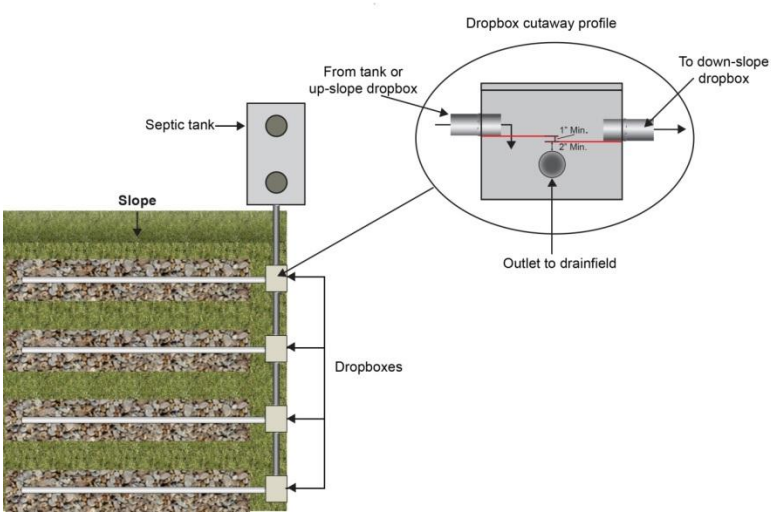


Figure 3-~~3~~7. Drop box and sequential distribution details.

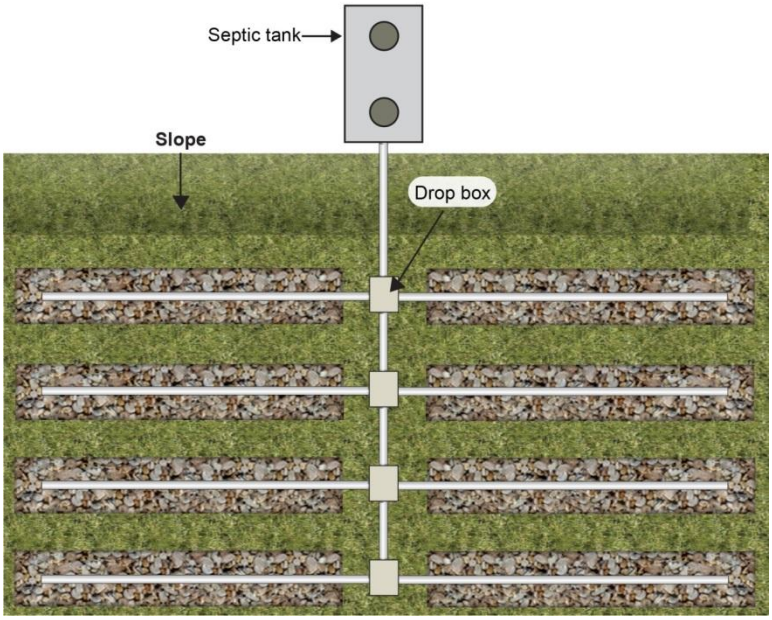


Figure 3-8. Overhead view of drop box installation utilizing multiple trenches with sequential distribution.

Appendix K

4.3 Vested Rights and Nonconforming Uses

Revision: ~~May 15~~April 18, 2013~~00~~

Failed system: Repair or replacement of an existing system.

1. Dwelling or structure unit served by the system must not be altered, remodeled, or otherwise changed, so as to result in increased wastewater flows (IDAPA 58.01.03.004.04).

2. Reason for failure should be determined if possible.

3. If failure is due to age, the system may be repaired or replaced with a similar system that shall be constructed as close as possible to current dimensional and setback requirements for standard systems (IDAPA 58.01.03.008.12).

4. If failure has occurred in less than 10 years and is due to increased wastewater flows or poor site characteristics, an alternative or larger system must be constructed as close as possible to current dimensional and setback requirements for alternative systems (IDAPA 58.01.03.008.12).

~~4.~~5. System replacement must follow the requirements of the subsurface program directive memorandum entitled "Failing Subsurface Sewage Disposal System" issued by DEQ on July 26, 1993.

Additions or alterations: Changes to an existing structure or dwelling~~, such as remodeling~~.

1. Addition or alteration will not cause the existing system to become unsafe or overloaded (IDAPA 58.01.03.004.04).

~~1.~~2. Enough reserve area for both the original and additional system shall be preserved (IDAPA 58.01.03.004.06).

~~5.Addition or alteration will not be additional or new dwelling units.~~

3. Wastewater flow will not be significantly increased (IDAPA 58.01.03.004.04). Significant increases shall be considered to be any increase in wastewater flow that exceeds the design flow of the system.

4. Area reserved for replacement cannot be used for the addition (IDAPA 58.01.03.004.06).

5. A subsurface sewage disposal permit may be required for system enlargement or adjustments based upon the addition or alteration plan.

    a. A permit may be required due to possible impacts on separation distances from the addition or alteration to the existing subsurface sewage disposal system or due to additional wastewater flows from the addition or alteration that exceeds the original design flow of the system.

~~a.~~b. Permit issuance shall be required in conformance with the subsurface program directive entitled "Permit Requirements for Increased Flows at Single Family Dwellings" issued by DEQ on April 15, 2010.

Abandoned system: An abandoned system is considered to be a system that has not received wastewater flows or blackwaste for 1 year or more due to the removal of a wastewater generating structure from the system. ~~(IDAPA 58.01.03.003.01)~~

1. An abandoned system may be used if the system was originally permitted and approved, and ~~wastewater or blackwaste characteristics are similar to former waste strengths and flow rate received by the system and,~~

2. ~~The system was originally permitted and approved and,~~Wastewater flows and blackwaste characteristics are similar to the system's original permit requirements for waste strength and flow rate received by the system, and

3. The site is inspected and approved.

4. If the system is not an approved ~~an unapproved~~ system (i.e., no issuance of previous subsurface sewage disposal permit regardless of installation date), it must be:

   a. U~~u~~ncovered by a permitted installer or the property owner (IDAPA 58.01.03.011.02) and,

      i. Uncovering includes exposure of the septic tank, effluent piping, and the front and back ends of each subsurface disposal trench.

   b. P~~p~~umped by a permitted septic tank pumper and, ~~and~~

   c. I~~i~~nspected by the health district while uncovered (IDAPA 58.01.03.011.02) and,~~.~~

   d. ~~The system must~~ Must meet all current requirements, including the ~~issuing~~ issuance of a permit (IDAPA 58.01.03.005.01).

      i. If the system does not meet all current requirements it must be brought into compliance with the current requirements prior to use according to the issued permit requirements.

      ~~i.~~ii. If the system, or any portion thereof, cannot be brought into compliance with the current requirement the system or portion of the system not in compliance must be abandoned and replaced in compliance with the current requirements and in accordance with the issued permit.

Appendix L

2.5 Ground Water Level

Revision: ~~June 5, 2000~~July 18, 2013

2.5.1 Description

Ground water is any water in the State of Idaho which occurs beneath the surface of the earth in a saturated geological formation of rock or soil (IDAPA 58.01.03.003.14). Ground water may be present near the ground surface at normal and seasonal high levels. Seasonal high ground water level is the highest elevation of ground water that is maintained or exceeded for a continuous period of one week per year (IDAPA 58.01.03.003.15.a). Normal high ground water level is the highest elevation of ground water that is maintained or exceeded for a continuous period of six weeks per year (IDAPA 58.01.03.003.15.b).

Subsurface sewage disposal systems and septic tanks must maintain vertical separation distances from the ground water to the bottom of the drainfield (IDAPA 58.01.03.008.02.c) and top of the septic tank (IDAPA 58.01.03.007.17). Ground water may be present year-round or seasonally. Permanent (year-round) ground water levels may fluctuate throughout the year or remain fairly constant. Seasonal ground water levels can fluctuate greatly and are typically affected by runoff or irrigation practices. To ensure separation distances as required by IDAPA 58.01.03 to permanent or seasonal ground water levels are met, determining the normal and seasonal high ground water levels is important.

High ground water levels may be established by the presence of low chroma mottles, historic records, or actual ground water monitoring (IDAPA 58.01.03.003.15). It is recommended and preferred that actual ground water monitoring be performed prior to the issuance of a subsurface sewage disposal permit if the proposed site of a new system is suspected to be effected by ground water levels. This provides insurance that adequate separation distances are maintained from subsurface sewage disposal systems and ground water as required by IDAPA 58.01.03.008.02.c and fulfills the intent of the State of Idaho's ground water policy as outlined in Idaho Code §39-102.3.a, and the intent of the Department of Environmental Quality's ground water policy as outlined in IDAPA 58.01.11.006.05 to prevent contamination of ground water from any source to the maximum extent practical.

In situations where a repair permit must be issued to replace a failing subsurface sewage disposal system it would be appropriate to utilize historic records or the presence of low chroma mottles to establish the normal and seasonal high ground water levels.

The following subsections provide guidance on when and how to utilize low chroma mottles, historic records, and how to perform and interpret actual ground water monitoring.

2.5.21~~From the Static Water Level~~Ground Water Monitoring

Ground water monitoring is the preferred method of determining ground water levels. Over a period of time, ground water levels can be established by recording elevation changes in the ground water's surface, observed through a ~~hole~~ permanent or temporary well.~~:~~

2.5.2.1 Monitoring Wells

During preliminary site investigations prior to subsurface sewage disposal permit issuance temporary monitoring wells are the most common type of monitoring well utilized. If continual ground water monitoring is required as a condition of the subsurface sewage disposal installation permit (e.g., Large Soil Absorptions Systems) then permanent monitoring wells are recommended to be installed after permit issuance. The recommended installation and design of both of these well types are provided below.

2.5.2.1.1 Permanent Monitoring Wells

It is recommended that permanent monitoring wells be installed by a professional well driller and that the Idaho Department of Water Resources be consulted to determine the need for a well permit and any required construction standards. Permanent wells should be cased, with perforations in the casing throughout the anticipated zone of saturation. An idealized permanent monitoring well for observing ground water of less than 18 feet deep is shown in Figure 2-3. If a permanent well will be used for water quality monitoring, then it should be:

~~2. Newly excavated holes or installed wells should be left undisturbed for 24 hours before observing and recording the ground water's surface elevation.~~

~~Permanent wells should be cased, with perforations in the casing throughout the anticipated zone of saturation. An idealized monitoring well for observing ground water of less than 18 feet deep is shown in Figure 2-3.~~

~~If a permanent well will be used for water quality monitoring, then it should be:~~

1. Purged or otherwise developed to eliminate installation contamination and silt buildup.

2. Provided with a ground water seal at the annular space between the casing and natural ground to prevent surface water from entering the ground water along the casing's exterior.

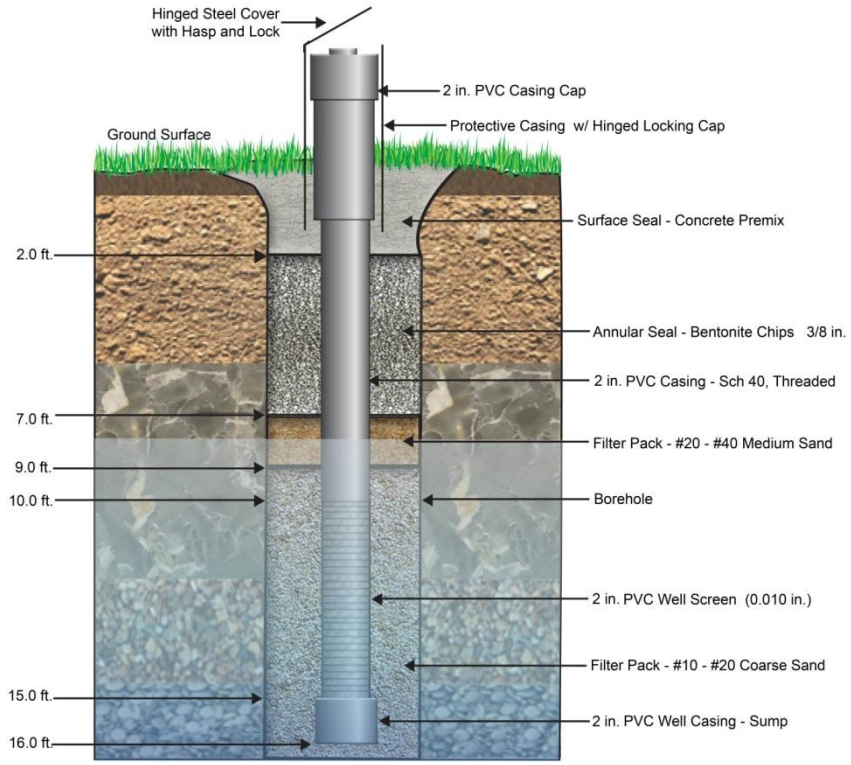


Figure 2-3. Permanent shallow ground water monitoring well design.

2.5.2.1.2 Temporary Monitoring Wells

Temporary monitoring wells are typically installed at the same time that test pits are excavated and evaluated. Monitoring wells are either placed in the excavated test pit or are placed in a separate hole near the test pit created by an auger. Temporary monitoring wells placed by auger should be no further than 10 feet from the evaluated test pit. More than one temporary monitoring well may be necessary at each site and are highly recommended. Each monitoring well should have an evaluated test pit associated with its placement.

Temporary monitoring wells are typically constructed of perforated or solid plastic pipe at least 1 inch in diameter. Solid plastic pipe should be manually perforated with holes or slits that extend up the pipe through the expected zone of saturation. Temporary monitoring wells should extend 10 feet below ground or to a known limiting layer less than 10 feet deep. Temporary monitoring wells placed to evaluate spring runoff influenced seasonal ground water should be extended above grade high enough to be found through snow pack during the early monitoring period. Removable caps are recommended to be placed on the top of each monitoring well. The bottom end of the monitoring well should not be capped. Geotextile fabric or a filter cloth/sock should be used to wrap the plastic pipe from the bottom of the pipe to a point above the perforations. When backfilling soil around the temporary monitoring well care should be taken to mound fill soil around the well so that a depression does not form in the ground's surface around the mound that will collect surface runoff and artificially raise the ground water level within the monitoring pipe. An idealized temporary monitoring well for observing ground water of less than 18 feet deep is shown in Figure 2-4.

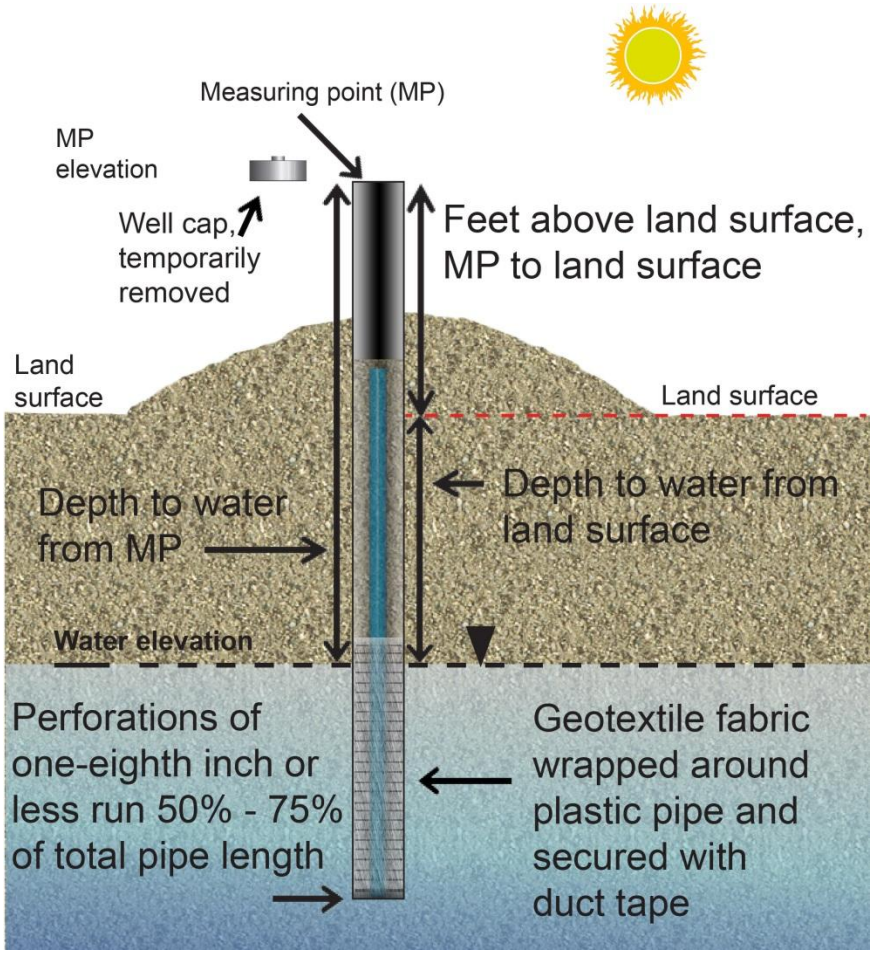


Figure 2-4. Temporary ground water monitoring well design.

2.5.2.2 Measuring the Seasonal Ground Water Level from a Monitoring Well

Seasonal ground water is typically influenced by seasonal runoff of snowmelt, spring rain events, and irrigation practices. The timeframe that these influences affect a property may vary due to location, climate, or agricultural practices. Due to this variability monitoring timeframes required prior to subsurface sewage disposal permit issuance may vary from permit to permit. Monitoring periods may overlap if all of these influences are expected to impact seasonal ground water levels at a proposed subsurface sewage disposal site. Typical timeframes for monitoring based upon ground water influences are as follows:

1. Seasonal runoff and spring rain events

    a. February 15th through June 30th

Irrigation

    b. April 15th through October 31st

Monitoring should be performed by the applicant on a weekly basis over the determined monitoring period. Concurrent monitoring at a proposed subsurface sewage disposal site should also be performed by the health district on a monthly basis for verification of ground water levels obtained by the applicant. The monthly verification by the health district also allows for the evaluation of any potential temporary or intermittent surface waters that may exist on the site.

Prior to recording ground water levels from a newly installed permanent or temporary monitoring well, the well should be left undisturbed for 24 hours before observing and recording the ground water's surface elevation. To record the ground water level a standardized location on the top rim of the monitoring well should be marked for the purpose of obtaining ground water measurements from. The following equipment should be utilized to obtain the ground water level below grade:

- A measuring tape that will fit inside the monitoring well
- Carpenter's chalk to coat the initial length of the measuring tape
- Ground water monitoring table that includes the following information:
    - Height of the monitoring well above the native soil surface
    - Total depth of the monitoring well from the top rim to its termination point below ground level
    - Date and time for each measurement
    - Location for recording ground water level from top rim of monitoring well
    - Location for recording the total depth of wetted chalk (indicates how far below the ground water level the measuring tape was inserted)
    - Location for recording the water level below ground surface (ground water level measurement minus the wetted chalk depth minus the height of the monitoring well above the native soil surface)
    - Location for date specific notes (e.g., weather, well conditions, recorder, etc.)

The following steps should be taken at each monitoring well to obtain the ground water level:

1. Coat the initial foot or two of the measuring tape with carpenter's chalk
2. Lower the measuring tape down the monitoring well with the tape against the identified measuring point on the top rim of the monitoring well
    a. This should occur at a rapid rate so it can be heard when the measuring tape encounters the top of the ground water level

3. Once it is verified that the tape has either encountered the top of the ground water level or the bottom of a dry monitoring well record the value on the measuring tape that is identified at the measuring point on the top rim of the monitoring well

4. Slowly remove the measuring tape from the monitoring well and obtain the total wetted chalk measurement

5. Determine the ground water depth below native ground level by subtracting the wetted chalk measurement and height of the monitoring well above native ground from the measurement obtained in step 3.

Care should be taken not to insert items of large diameter into the ground water through the monitoring well to obtain ground water level measurements. This may cause water displacement and artificially raise the ground water level. Ground water monitoring should continue throughout or past the expected monitoring period until it is determined that the seasonal and normal high peaks have occurred and will not be exceeded.

2.5.2.3 Determining Seasonal and Normal High Ground Water Levels

Seasonal and normal high ground water levels can be determined once the weekly monitoring for the designated monitoring period is completed. The seasonal high ground water level is the weekly measurement that is the highest level recorded during the monitoring period. The highest level is the measurement that equates to the shallowest depth from the native ground level to the ground water level.

The normal high ground water level is the highest elevation of ground water that is maintained or exceeded for a continuous period of six weeks per year. This determination may include the seasonal high ground water level week, but may fall outside of the seasonal high peak. If the determination of the normal high ground water falls outside of the seasonal high peak it is because the highest ground water level that is maintained or exceeded for a continuous period of six weeks falls within this time frame (IDAPA 58.01.003.15.a). A normal high ground water level that falls in a six week block of time that does not include the seasonal high ground water level will be more restrictive than what would be determined by the six week block of time that included the seasonal high ground water level. The determination is demonstrated in Table 2-11 and Table 2-12.

Monitoring Week	1	2	3	4	5	6	7	8	9
Ground Water Level (inches below native grade)	69	62	65	53	46	40	47	66	72

Table 2-11. Determination of seasonal ground water levels where the seasonal high ground water level and normal high ground water level occur within the same six week block of time.

In Table 2-11 the seasonal high ground water level occurs within the six week block of time that defines the normal high ground water level. The seasonal high occurs in week 6 and is 40 inches below native grade. The six week block of time that defines the normal high ground water level occurs from week 2 through 7. During this time the lowest ground water level

recorded from native grade occurs on week 3 so the normal high ground water level is 65 inches below native grade.

Monitoring Week	1	2	3	4	5	6	7	8	9
Ground Water Level (inches below native grade)	23	24	19	23	21	22	25	16	20

Table 2-12. Determination of seasonal ground water levels where the seasonal high ground water level occurs outside the six week block of time that determines the normal high ground water level.

In Table 2-12 the seasonal high ground water level occurs outside of the six week block of time that defines the normal high ground water level. The seasonal high occurs in week 8 asnd is 16 inches below native grade. The six week block of time that defines the normal high ground water level occurs from week 1 through 6. During this time the lowest ground water level recorded from native grade occurs on week 2 so the normal high ground water level is 24 inches below native grade. This meets the requirements of IDAPA 58.01.03.003.15.a in that 24 inches is the highest elevation of ground water this is maintained or exceeded for a continuous period of six weeks.

2.5.3~~2 From Soil Condition~~Low Chroma Mottles

If the static ground water level cannot be determined through ground water monitoring due to the time of year the soil profile is observed, but its presence at some time in the year is suspected, its level can be predicted by looking for the presence of the following soil conditions:

1. Reddish-brown or brown soil horizons with grey mottles that have a chroma of two or less and red or yellowish-red mottles.
2. Grey soil horizons that have a chroma of two or less, or grey soil horizons with red, yellowish-red, or brown mottles.
3. Dark-colored, highly organic soil horizons.
4. Soil profiles with soluble salt concentrations at or near the ground surface.

Exercise cCare should be exercised in interpreting soil conditions as an indicator of high ground water. Mottling may be the artifact of past ground water from geologic time. Some soils do not readily indicate mottling, especially those with high ferric (Fe^{+++}) iron content and in areas with newly-established water tables or where the brown color is from iron bacteria. ~~Figure 2-3 shows the typical design of a shallow ground water monitoring well.~~

2.5.4 Historical Records

Historical records are another method that may be used to determine seasonal and normal high ground water levels for a proposed subsurface sewage disposal system. Historical records should be those that evaluate unconfined aquifers or perched seasonal water tables. Well drilling records may not be suitable in all circumstances and must be evaluated on a case by case basis if

available. Historical records should be composed of ground water monitoring data as described in section 2.5.2 to be used for determination of ground water levels at a proposed site.

All historical records available for properties immediately surrounding the applicant's property should be utilized in the determination of ground water levels. Other records from nearby properties should also be evaluated in order to gain an understanding of ground water levels for the immediate area with an emphasis placed on records for properties closest to the applicant's property. A conservative approach should be utilized in this evaluation and the most restrictive ground water level record within those historical records should be used for permit issuance.

2.5.5 Low Water Years

Care should be taken when reviewing ground water monitoring records related to spring runoff during low water years. Snow-water equivalents of less than 75% of normal would be considered an extremely low water year. Ground water monitoring performed during these years may need to be repeated due to below normal ground water levels. Information regarding the snow-water equivalent reading is available through NRCS.

Appendix M

3.3 Wastewater Flows

Revision: July 18, 2013

Assigning wastewater flow projections to a proposed subsurface sewage disposal system is necessary to adequately design the system and is required as part of the permit application by IDAPA 58.01.03.005.04.j. The term *wastewater flow* refers to the amount of wastewater a structure will generate in gallons per day. These flow estimates provide the basis for determining the minimum septic tank volume and subsurface disposal system sizing (IDAPA 58.01.03.007.07.b and 58.01.03.008.03.a). For most proposed projects IDAPA 58.01.03.007.08 is used for providing the quantitative daily wastewater flow estimates necessary to design the proposed subsurface sewage disposal system.

Due to the limited number of commercial/industrial establishments and flow scenarios provided in IDAPA 58.01.03.007.08 not all proposed commercial or industrial projects will be capable of proposing daily wastewater flows based off of this rule. IDAPA 58.01.03.005.04.d provides the applicant the allowance to propose wastewater flows through other appropriate measures to adequately size the subsurface sewage disposal facility. Daily wastewater flow projections may be provided from other sources when a proposed commercial or industrial project is not covered by IDAPA 58.01.03.007.08, or when an applicant feels that the daily wastewater flow projections for a commercial or industrial facility provided in IDAPA 58.01.03.007.08 are higher or lower than actual daily peak wastewater use for similar facilities.

Other appropriate measures for daily wastewater flow estimation as described in IDAPA 58.01.03.005.04.d must include the nature and quantity of wastewater the system will receive. Adequate documentation must be submitted with the permit application detailing the basis for the estimate of the quantity of wastewater and its nature (IDAPA 58.01.03.005.04.j). Included in the adequate documentation should be a description of the commercial or industrial facility's proposed operation, referred to as a Letter of Intended Use. Letter of Intended Use ~~requirements~~ elements are described in section 3.3.1. Appropriate measures and documentation for the provision of empirical wastewater flow data that is not provided in IDAPA 58.01.03.007.08 is described in section 3.3.2.

3.3.1 Letter of Intended Use

As part of the permit application the applicant must provide information regarding the type of establishment served (IDAPA 58.01.03.005.04.c), the nature and quantity of wastewater the system will receive (IDAPA 58.01.03.005.04.j), and provide documentation that substantiates that the proposed system will comply with IDAPA 58.01.03 (IDAPA 58.01.03.005.04.o). This information should be included in a Letter of Intended Use that contains the following minimum ~~requirements~~elements:

- A description of the commercial/industrial processes that are occurring within the facility
    - The type of business that is to be discharging to the subsurface sewage disposal system and the processes involved in its operations.

- The maximum number of employees and customers within the facility at any given time now or in the future if expansion is to occur later.
- The estimated daily wastewater flow that may be produced by the domestic, commercial, and industrial uses occurring within the facility.
  - Estimated daily wastewater flow projections must either be supported by IDAPA 58.01.03.007.08 or follow the guidance regarding empirical wastewater flow data as provided in section 3.3.2.

- A completed copy of the non-domestic wastewater application checklist
  - The characteristics of the non-domestic wastewater should be supported with adequate documentation.

3.3.2 Empirical Wastewater Flow Data

Empirical wastewater flow data is collected from similar facilities as the one proposed in the subsurface sewage disposal permit application. The wastewater flow data is typically collected from facilities that are connected to a public water system or other water source that is capable of providing water meter data for daily, weekly, or monthly water use by the facility. The daily wastewater flow is estimated based upon the usage of the potable water being used by the facility as determined by the water meter data. It is often necessary to convert the data that is able to be obtained into gallons per day as most utilities and public water systems do not meter water by the gallon. The volume of water provided in a water usage history should be verified for the correct meter units.

Evaluated facilities should be located within the State of Idaho if possible, but may be from any region within the State. Unique facilities that may not be found elsewhere in the State may utilize similar facilities from other States. Facilities should be able to be compared to the proposed facility and be able to assign a daily wastewater flow estimate on a per unit basis. Units may include employees, meals, visitors, or any other quantifiable unit applicable to the proposed facility. If the proposed facility will produce non-domestic wastewater (i.e., wastewater from sources other than hand sinks, toilets, showers/bathtubs, non-commercial kitchens, and washing machines), then the wastewater data must also include the characterization of the proposed commercial or industrial wastewater to be discharged to the subsurface sewage disposal system in addition to the daily wastewater flow data.

The time of year that water usage data is collected and evaluated should be representative of the proposed facility's peak usage timeframe. If possible, it is recommended that water consumption devoid of irrigation flows be provided. This may be accomplished by locating facilities that do not have landscaping to irrigate or by eliminating the irrigation season from the evaluation. Eliminating the irrigation season from the water data evaluation should only be used for facilities that do not have their peak facility use occur over this timeframe. Water usage data that does not include the irrigation season typically occurs from November through February.

Adequate documentation of daily wastewater flows may vary on a case-by-case basis. The following list of water usage data will be considered adequate for most circumstances:

- Water usage data from a minimum of three facilities of similar operation should be provided for review.
    - The facilities should be connected to a public or private water system for which monthly water use records are kept that can be readily converted to average gallons per day flows.
        - Water usage data should be provided in writing by the water system operator.
    - Statistics should be provided on each facility's operation that are pertinent to the wastewater flow estimation (e.g., number of employees, number of children attending a childcare, number of meals served per day for restaurants, occupancy per day of a hotel or RV park, etc.).
        - Statistical data for each facility should be provided in writing by the facility providing the data.
- Water usage data should occur over an adequate timeframe to provide data that is applicable to the design flows for subsurface sewage disposal permit issuance.
- Wastewater characterization for non-domestic wastewater sources (including the non-domestic wastewater application checklist found on DEQ's website).
- Other facility specific data the Director feels is reasonable and necessary for daily wastewater flow estimation evaluation.

The Director shall evaluate the data provided and average the daily wastewater flow projections from each facility to determine an acceptable flow. If the Director determines that any data provided is inadequate for assessment, the facility the data applies to will not be included in the evaluation process. The provision of empirical wastewater flow data in lieu of utilizing the wastewater flows provided in IDAPA 58.01.03.007.08 does not guarantee that the daily wastewater flow projection will be less than what is provided by IDAPA 58.01.03.007.08.

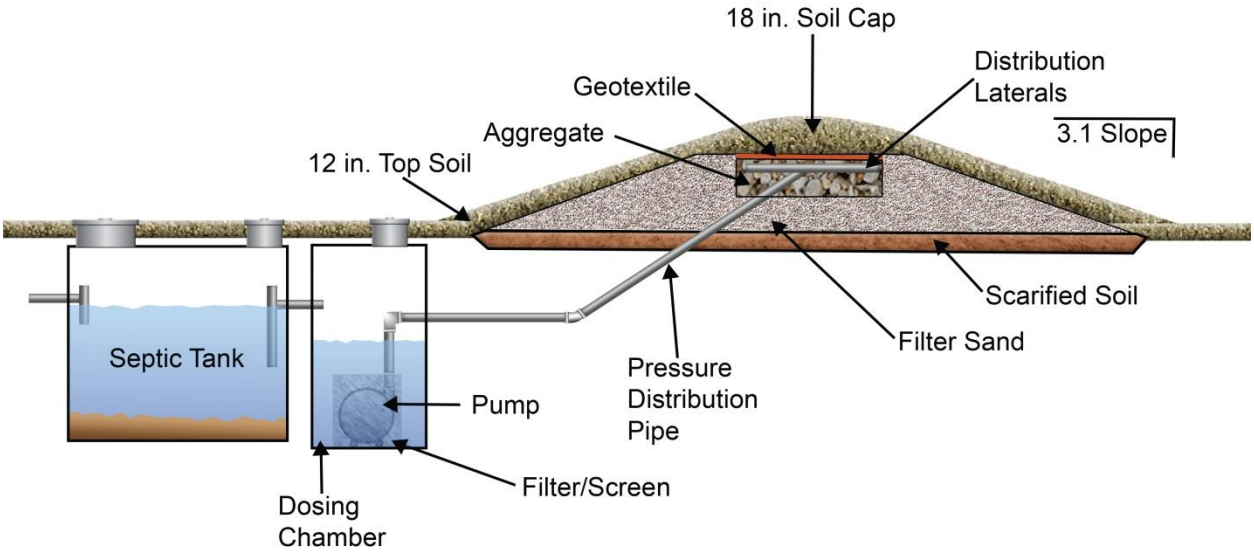
Appendix N

4.25 Sand Mound

Revision: ~~October 23~~July 18, 2013~~2~~

4.25.1 Description

A sand mound is a soil absorption facility consisting of a septic tank, ~~pumping~~ dosing chamber ~~or dosing siphon and chamber~~, mound ~~fill~~ constructed of ~~selected~~ medium sand, ~~with~~ a pressurized small-diameter pipe distribution system, ~~cap,~~ and topsoil cap. ~~Figure 4-26~~Figure 4-27 provides a diagram of a sand mound.



~~Figure 4-26~~Figure 4-27. Cross sectional view of sand mound.

4.25.2 Approval Conditions

1. Effective soil depth to limiting layers may vary depending upon thickness of filter sand beneath the absorption bed:

   a. If 12 inches of filter sand is placed beneath the absorption bed, then Table 4-21 lists the minimum depth of natural soil to the limiting layer.

   b. If 24 inches of filter sand is placed beneath the absorption bed, and the dosing recommendations in section 4.25.4 are met, then Table 4-19 in Section 4.23 "Intermittent Sand Filter," identifies the effective soil depth to limiting layers.

~~2.~~4. ~~For soil textural classifications of sandy clay, silty clay, clay, or coarser-textured soils with percolation rates from 60 to 120 minutes/inch, the minimum depth of natural soil to the limiting layer shall conform to soil design group C.~~

2. Table 4-22 shows the maximum slope of natural ground, listed by soil design group.

3. Sand mound must not be installed in flood ways, areas with large trees and boulders, in concave slopes, at slope bases, or in depressions.

4. Minimum pretreatment of sewage before disposal to the mound must be a septic tank sized according to IDAPA 58.01.03.007.07.

5. The maximum daily wastewater flow must be equal to or less than 1,500 GPD.

6. Design flow must be 1.5 times the wastewater flow.

Table 4-21. Minimum depth of natural soil to limiting layer.

Soil Design Group	Extremely Impermeable Layer (feet)	Extremely Permeable Layer (feet)	Normal High Ground Water (feet)
A, B	3	3	3
C	3	2	2

Table 4-22. Maximum slope of natural ground.

Design Group	A	B	C-1	C-2
Slope (%)	20	20	12	6

4.25.3 Design

1. Absorption ~~Bed~~ bed design:

   a. Only absorption beds may be used. The maximum absorption bed disposal area should be 2,250 ft^2 (A x B). Beds ~~in commercial or large systems~~ should be a maximum of ~~15 feet wide (B ≤ 15 feet), and beds for individual dwellings a maximum of~~ 10 feet wide (B ≤ 10 feet). Beds should be as long and narrow as practical, particularly on sloped ground, to minimize basal loading. It is recommended that beds be less than 10 feet wide if site conditions will allow.

   b. Application rate of effluent in the sand bed should be calculated at 1.0 gallon/ft^2 (sand HAR = 1.0 gallon/ft^2).

   ~~c. Absorption beds for commercial establishments that discharge other than normal strength domestic waste should be sized at 0.5 gallon/ft^2 or 40 pounds BOD/acre/day, whichever is greater.~~

   ~~d.~~c. Absorption bed must be filled with 9 inches of clean drainrock, 6 inches of which must be below the pressurized distribution pipes.

d. ~~Drainrock portion of the sand mound~~The absorption bed drainrock must be covered with a geotextile after installation and testing of the pressure distribution system.

e. Two observation ports should be installed extending from the drainrock/medium sand interface through the soil cap at approximately the ¼ and ¾ points along the absorption bed. The observation ports should contain perforations in the side of the pipe extending up 4 inches from the bottom of the port. Observation ports must be capped.

f. Absorption bed disposal area or dimensions may not be reduced through the use of extra drainrock, pretreatment, or gravelless drainfield products.

~~e.~~g. Pressurized laterals within the absorption bed should not be further than 24 inches from the absorption bed sidewall and should not be spaced farther than 48 inches between each lateral within the absorption bed.

2. Medium ~~Sand~~ sand fill design:

a. Filter Mound sand fill must conform to ~~ASTM C-33, with less than 2% passing the #200 sieve~~the medium sand definition provided in section 2.1.4 of this manual. ~~A manufactured sand is recommended.~~

b) Minimum depth of medium sand below the absorption bed shall be 1 foot.

c) Medium sand fill shall extend out a minimum of 24 inches level from the top edge of the absorption bed on all sides (medium sand fill absorption perimeter), and then uniformly slope as determined by the mound dimensions and the slope limitations as described in 4.25.3.2.f.

~~b)~~d) Flat sites: The effective area will be A x (C+B+D+2(H)).

~~c)~~e) Sloped sites: The effective area will be A x (B+D+H).

Equation 4-16 shows the calculation for the absorption bed area.

$$\frac{\text{Design Flow (GPD)}}{\text{Soil Application Rate } (\text{GPD}/\text{ft}^2)}$$

Equation 4-16. Effluent application area.

f) Slope of all sides must be 3 horizontal to 1 vertical (3:1) or flatter.

~~d)~~g) Sand fill area must be as long and narrow as practical, with plan view dimension G exceeding dimension F (Figure 4-27).

h) Slope correction factors as provided in Table 4-23 shall be used to determine the downslope width of the medium sand fill for sloped sites.

Table 4-23. Down slope correction factors for sloped sites.

Slope (%)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Correction Factor	1.03	1.06	1.10	1.14	1.18	1.22	1.27	1.32	1.38	1.44	1.51	1.57	1.64	1.72	1.82	1.92	2.04	2.17	2.33	2.50

Figure 4-27 can be used with Table 4-23 (sand mound design checklist) for flat and sloped sites.

3. Soil cap design:

a) Sand mound must be covered with a minimum topsoil depth of 12 inches. The soil cap at the center of the mound must be crowned to 18 inches to promote runoff.

~~e)~~b) Topsoil and soil cap must be a sandy loam, loam~~y sand~~, or silt loam. Soils meeting the soil design group classifications of A and C shall not be used for the topsoil and soil cap cover.

~~f)~~c) Mound should be protected to prevent damage caused by vehicular, livestock, or excessive pedestrian traffic. The toe of the mound must be protected from compaction.

~~g)~~d) Mounds on slopes should have design considerations taking surface runoff diversion into account.

e) ~~Sand fill area must be as long and narrow as practical, with plan view dimension G exceeding dimension F (Figure 4-27).~~

4.25.4 Dosing Recommendations

1. Timed dosing should be utilized.
   a. Surge capacity should be considered to be incorporated into the dosing chamber.
2. Dose time should be short and the frequency of the doses should be high
   a. Maximum dose volume reaching the bed should not exceed 20% of the daily design flow prior to the addition of the safety factor.
3. Distribution piping orifices should be closely spaced.
   a. Recommended spacing is 4 – 6 ft^2 of disposal area per orifice.

~~1.~~4. Dosing volume should be roughly 5 times the volume of the lateral pipe volume, but should not exceed 20% of the design volume.

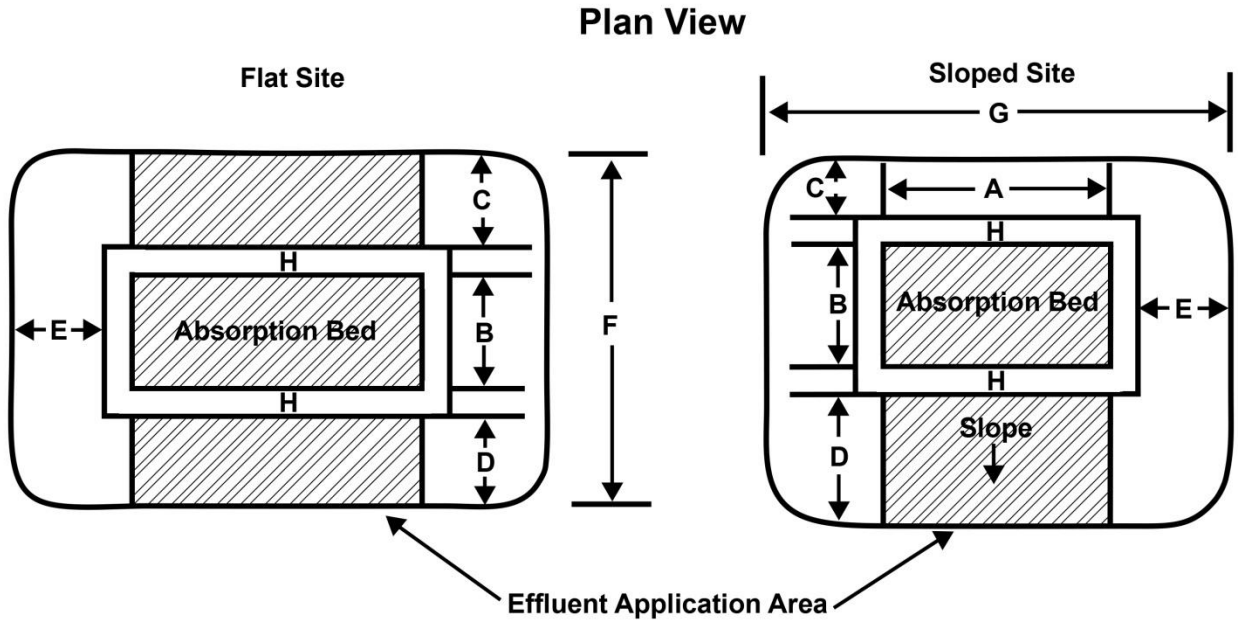


Figure 4-27. Design illustrations for sand mound installation on flat and sloped sites (use with sand mound design checklist).

Table 4-23. ~~Sample~~ Example sand mound design checklist.

	Sand Mound Design Checklist **(Example for a three-bedroom house on soil design subgroup B-2 soils, flat site, 12 inch medium sand fill depth below absorption bed)**	
1	Determine soil application rate (AR) (Example: B-2 soil)	AR = GPD/ft^2 (Example: 0.45 GPD/ft^2)
2	Determine daily flow rate (DFR) (Example: 250 GPD x 1.5 safety factor)	DFR = GPD x 1.5 (Example: 375 GPD)
	Absorption Bed Design	
3	$Area = \frac{Daily_Flow_Rate_GPD(\#2)}{Sand_Application_Rate_{}^{GPD}/_{ft^2}\left(1.0_{}^{GPD}/_{ft^2}\right)}$	Area = ft^2 (Example: 375 ft²)
4	Width (B): $Width_(B) = \sqrt{\frac{Area_(\#3) \times Soil_AR_(\#1)}{Sand_Application_Rate_\left(1.0\,{}^{GPD}/_{ft^2}\right)}}$ Maximum bed width: ~~Commercial = 15 feet~~ ~~Residential =~~ 10 feet *Beds may be designed narrower than determined by this equation if desired. Beds are recommended to be as long and narrow as site conditions allow.* Example: $Width_(B) = \sqrt{\frac{(\#3 \times \#1)}{1.0\,{}^{GPD}/_{ft^2}}} \approx 13\,ft$	Width (B) = feet (Example: 13 feet or 10 feet max) (Example: use 10 feet)
5	Length (A): $Length_(A) = Area_(\#3)/Width_(\#4)$ (Example: 375 ft²/10 feet)	(A) feet (Example: 37.5 feet)
	Sand Mound Design	
6	Total area (TA): $TA = DFR_(\#2)/soil_AR_(\#1)$ (Example: 375 gallon/0.45 gallon/ft^2)	TA = ft^2 (Example: 833 ft²)
7	Medium sand fill absorption bed perimeter area (SFAP): Flat Site: SFAP = 2 x [2 feet x length (#5)] Sloped Site: SFAP = 2 feet x length (#5) (Example: 2 x [2 feet x 37.5 feet])	SFAP = ft^2 (Example: 150 ft^2)
8~~7~~	Effluent application area (EAA) = Total area–(bed area + SFAP): EAA = TA (#6) – [Area (#3) + SFAP (#7)] = (Example: 833 ft^2 – [375 ft^2 + 150 ft^2] = ~~458~~ 308 ft^2)	EAA = ft^2 (Example: ~~458~~ 308 ft²)

98	Flat site perimeter (C,D): 0.5 x [EAA (#~~7~~8)/length (#5)] *Perimeter width must meet or exceed dimension meeting a 3:1 slope*	(C) = (D) = feet (5.25 feet minimum for 3:1 slope in 12 in. mound, 8.25 feet minimum for 3:1 slope in 24 in. mound)
	(Example: 0.5 x [~~458~~ 308 ft^2/37.5 feet] = ~~6~~4.1 feet)	(Example: ~~6~~4.1 feet, use default of 5.25 to meet minimum slope)
10~~9~~	Sloped site: Downslope length (D) = [EAA (#~~7~~8)/length (#5)] x DCF *Downslope width must meet or exceed the dimension meeting a 3:1 slope based on down slope height of the medium sand fill absorption bed perimeter*	(D) = feet
	(Example: D = [~~458~~ 383 ft^2/37.5 feet] x 1.0 = ~~12~~10.2 feet)	(Example: ~~12~~10.2 feet)
11~~0~~	Sloped site: Upslope (C) = (Bed depth + max. sand depth) x 3 *Upslope width must meet or exceed the dimension meeting a 3:1 slope based on upslope height of the medium sand fill absorption bed perimeter*	(C) = feet
	(Example: C = [0.75 feet + 1.0 foot] x [3] = 5.25 feet)	(Example: 5.25 feet)
12~~1~~	End slope (E) = (Bed depth + max. sand depth) x 3 *End slope width must meet or exceed dimension meeting a 3:1 slope based on the height of the medium sand fill absorption bed perimeter at the absorption bed ends*	(E) = feet
	(Example: [0.75 feet + 1.0 feet] x [3] = 5.25 feet)	(Example: 5.25 feet)
13~~2~~	Total width (F) = B + C + D + 2(H)	(F) = feet
	(Flat site example: 10 feet + 6.1 feet + 6.1 feet = 22.2 feet)	(Example: 22.2 feet)
	~~(Sloped site example: 10 feet + 5.25 feet + 12.2 feet = 27.45 feet)~~	~~(Example: 27.45 feet)~~
14~~3~~	Total length (G) = A+(2 x E) + 2(H) (G > F)	(G) = feet
	(Example: [G] = 37.5 feet + [2 x 5.25 feet] = 48 feet)	(Example: 48 feet)
	~~**Finished Mound Dimensions**~~	
~~14~~	~~Sand mound length + 6 feet min. (G + 6)~~	~~(G+6) = feet~~
	~~(Example: 48 feet + 6 feet = 54 feet)~~	~~(Example: 54 feet)~~
~~15~~	~~Sand mound width + 6 feet min. (F + 6)~~	~~(F+6) = feet~~
	~~(Flat site example: 22.2 feet + 6 feet = 28.2 feet)~~	~~(Example: 28.2 feet)~~
	~~(Sloped site example: 27.45 feet + 6 feet = 33.45 feet)~~	~~(Example: 33.45 feet)~~

Note: gallons per day per square foot (GPD/ft^2), downslope correction factor (DCF)

4.25.4 Construction

1. Pressure line from the dosing chamber should be installed first~~ and should be located upslope of the mound~~. The pressure line should slope down to the pump so that the pressure line will drain between discharges. If the sand mound is located downslope of the pump chamber, consider using anti-seep collars on the trench. ~~If a pump is to be used, the pressure line should slope down to the pump so that the pressure line will drain between discharges.~~

2. Grass~~,~~ and shrubs~~, and trees~~ must be cut close to ground surface and removed from the mound site.

   a. If extremely heavy vegetation or organic mat exists, these materials should be removed before scarification and replaced with filter sand (typically 3 or 4 inches of filter sand is added~~.~~).

   b. Larger than two inch caliper trees and large boulders are not to be removed. Trees should be cut as close to ground level as possible and the stumps left in place. If stumps or boulders occupy a significant area in the mound placement area, additional area should be calculated into the total basal area of the mound to compensate for the lost infiltrative area.

~~2.~~3. When the soil is dry, and site vegetation has been cut or removed the ground in the basal placement area of the sand ~~fill~~ mound should ~~then~~ be scarified or ripped to a depth of 6–8 inches. Scarification/ripping is important to provide vertical windows in the soil. ~~Tree stumps are not to be removed. If stumps are numerous, additional area should be calculated into the total sand area to compensate for the lost area.~~

~~3.~~4. Sand fill will then be placed and shaped before it freezes or rains. No vehicles with pneumatic tires should be permitted on the sand or ~~plowed~~ scarified area to prevent the soils from being compacted. For sloped sites, all work ~~is~~ should be done from the upslope side of the mound placement area if possible.

5. Absorption bed will be shaped and filled with clean drainrock.

~~4.~~6. Two observation ports should then be installed extending from the drainrock/medium sand interface through the soil cap at approximately the ¼ and ¾ points along the absorption bed. The observation ports should contain perforations in the side of the pipe extending up 4 inches from the bottom of the port. Observation ports must be capped.

~~5.~~7. After leveling the drainrock, the low-pressure distribution system manifold and laterals will be installed. The system should be tested for uniformity of distribution.

~~6.~~8. Geotextile must be placed over the absorption bed and backfilled with 12 inches of soil on the sides and shoulders, and 18 inches of soil on the top center. Soil types must be sandy loam, loam~~y sand~~, or silt loam.

~~7.~~9. Typical lawn grasses ~~and~~ or other appropriate low-profile vegetation should be established on the mound cap as soon as possible, preferably before the system is put into operation. Do not plant trees or shrubs on the mound, or within the mature rooting radius of the tree or shrub. Trees with roots that aggressively seek water ~~must~~ should be planted at least 50 feet from the mound (~~e.g.~~i.e., poplar, willow, cottonwood, maple, elm, etc.).

~~8. A standpipe must be installed within the bed, down to the fill sand, so that ponding water can be measured periodically.~~

4.25.5 Inspections

1. Site inspections ~~must be made by the Director before, during, and after construction~~shall be conducted by the Director at the following minimum intervals (IDAPA 58.01.03.011.01):~~.~~

   a. Pre-construction

      i. Recommended that pre-construction conference be conducted with the Director, design engineer, complex installer, and property owner (if available) present

   b. During construction as needed

      i. Scarification, pressure line installation, medium sand mound construction, absorption bed construction, pressure distribution piping

   c. Final construction inspection

      i. Pump drawdown/alarm check, pressure test of distribution network, soil cap material and placement

2. The d~~D~~esign~~er~~ engineer ~~or owner~~ must certify that the system has been installed according to the approved plans and provide as-built plans for the sand mound construction (IDAPA 58.01.03.005.15).

Table 4-23 is a sample sand mound design checklist, and Table 4-24 is a blank checklist for sand mound design.

Table 4-24. Sand mound design checklist.

	Sand Mound Design Checklist	
1	Determine soil application rate (AR)	AR = _____GPD/ft^2
2	Determine daily flow rate (DFR) DFR = GPD x 1.5	DFR = _____GPD
	Absorption Bed Design	
3	$Area = \frac{Daily_Flow_Rate_GPD(\#2)}{Sand_Application_Rate_{}^{GPD}/_{ft^2}\left(1.0_{}^{GPD}/_{ft^2}\right)}$	Area = _____ft^2
4	Width (B): $Width_(B) = \sqrt{\frac{Area_(\#3) \times Soil_AR_(\#1)}{Sand_Application_Rate_\left(1.0\,{}^{GPD}/_{ft^2}\right)}}$ Maximum bed width: ~~Commercial = 15 feet~~ ~~Residential =~~ 10 feet	Width (B) = _____ft
5	Length (A): $Length_(A) = Area_(\#3)/Width_(\#4)$	(A) _____ft
	Sand Mound Design	
6	Total area (TA): $EAA = DFR_(\#2)/soil_AR_(\#1)$	TA = _____ft^2
7	Medium sand fill perimeter area (SFAP) Flat site: SFAP = 2 x [2 feet x length (#5)] Sloped site: SFAP = 2 feet x length (#5)	SFAP = _____ft^2
~~7~~8	Effluent application area (EAA) = Total area – (Bed area + SFAP): EAA = TA (#6) – [Area (#3) + SFAP (#7)]	EAA = _____ft^2
~~8~~9	Flat site perimeter (C,D): 0.5 x [EAA (#~~7~~8)/length (#5)] (5.25 feet minimum)	(C) = (D) = _____ft
~~9~~10	Sloped site: Downslope length (D) = [EAA (#~~7~~8)/length (#5)] x DCF	(D) = _____ft
~~10~~11	Sloped site: Upslope (C) = (Bed depth + max. sand depth) x 3	(C) = _____ft
~~11~~12	End slope (E) = (Bed depth + max. sand depth) x 3	(E) = _____ft
~~12~~13	Total width (F) = B + C + D + 2(H)	(F) = _____ft
~~13~~14	Total length (G) = A+(2 x E) + 2(H) (G > F)	(G) = _____ft
	~~**Finished Mound Dimensions**~~	
~~14~~	~~Sand mound length + 6 feet min. (G + 6)~~	~~(G+6) = _____ft~~
~~15~~	~~Sand mound width + 6 feet min. (F + 6)~~	~~(F+6) = _____ft~~

Note: gallons per day per square foot (GPD/ft^2), downslope correction factor (DCF)

Appendix O

2.2.3 The Method of 72 to Determine Effective Soil Depths to Porous Layers and Ground Water

Often times effective soil depths as required by IDAPA 58.01.03.008.02.c are not achievable due to various site conditions. In response to this issue section 2.2.1 provides guidance for reducing separation distances to limiting layers based upon soil design subgroups. In some situations this guidance does not go far enough to address these site limitations, nor does it provide guidance on how to approach separation distances to limiting layers when the soil profile is variable and does not meet the minimum effective soil depths as described in IDAPA 58.01.03.008.02 or Table 2-6, or when the In-trench Sand Filter system design is utilized. To address ~~provide further guidance in~~ these situations the ~~Technical Guidance Committee has developed the~~ Method of 72 should be utilized.

The Method of 72 is based upon assigning treatment units to soil design subgroups. Treatment units assigned to soil design subgroups are extrapolated from the effective soil depths required by IDAPA 58.01.03.008.02.c. Based on this rule it can be determined that 72 treatment units are necessary from the drainfield-soil interface to the porous layer/ground water to ensure adequate treatment of effluent by the soil. Table 2-7 provides the treatment units assigned to each soil design subgroup.

Table 2-7. Treatment units assigned to each soil design subgroup per foot and per inch. ~~(*Medium sand receives an additional 6 treatment units for the sand-native soil interface)~~

Soil Design Subgroup	A-1 / Medium Sand*	A-2	B-1	B-2	C-1	C-2
Treatment Units Per 12 Inches of Soil	12	14.4	18	24	24	28.8
Treatment Units Per Inch of Soil	1	1.2	1.5	2	2	2.4

2.2.3.1 Native Soil Profiles and the Method of 72

When the soil profile contains multiple suitable layers, but no layer is thick enough to meet the separation guidance provided in IDAPA 58.01.03.008.02.c or table 2-6, an individual may utilize the Method of 72 to determine the suitable separation distance for the proposed drainfield site. The following example is based off of the soil profile identified in figure 2-3.

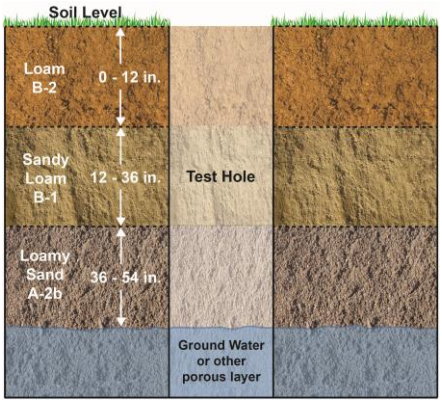


Figure 2-3. Test hole profile utilized in example 1.

Example 1:

Based upon the soil profile in figure 2-3 and the treatment units from table 2-7 the following treatment unit equivalent would be ascribed:

Treatment Units = 24 + 36 + 21.6 = 81.6

Since this is the treatment unit equivalent from grade to the porous layer or normal high ground water level the installation depth must still be determined. In this particular instance the soil profile has 9.6 treatment units more than the minimum necessary to be considered suitable for a standard alternative drainfield. To determine installation depth utilize the upper layer of the soil profile where the system will be installed and determine the treatment units per inch of soil. Once the treatment units per inch are known the depth of allowable installation can be determined.

24 treatment units / 12 inches of B-2 soil = 2 treatment units per inch

Installation depth = 9.6 excess treatment units / 2 treatment units per inch
Installation depth = 4.8 inches

In this example a standard basic alternative system can be permitted. The system design would be a capping fill trench with a maximum installation depth of 4.5 inches below grade.

2.2.3.2 In-Trench Sand Filters and the Method of 72

The Method of 72 may also be used in determining the necessary depth of medium sand required for installation between a drainfield and the native soils overlying a porous limiting layer or normal high ground water. Installation of medium sand may be necessary to access suitable soils below an unsuitable soil layer. ~~In this application an additional 6 treatment units are allotted for the medium sand and native soil interface. Medium sand is classified under the A-1 soil design subgroup providing 12 treatment units per foot of medium sand. Treatment units for native soils are provided in table 2-7.~~ The following example is based off of the soil profile identified in figure 2-4.

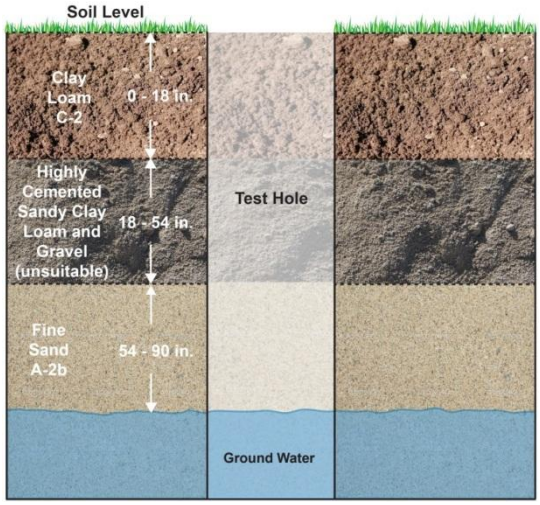


Figure 2-4. Test hole profile utilized in example 2.

Example 2:

In this example the site soils must be excavated down to 54 inches to access suitable soils. This leaves 36 inches of A-2b soils, providing 43.2 treatment units. ~~An additional 6 treatment units is then added for the medium sand – native soil interface, for a total of 49.2 treatment units.~~ The amount of medium sand required to be backfilled prior to system installation would be determined as follows:

Remaining treatment units = 72 – ~~49~~43.2 = ~~22~~28.8

Depth of medium sand required = ~~22~~28.8 treatment units remaining / 1 treatment unit per inch

Depth of medium sand required = ~~23~~ 29 inches

Thus the medium sand would be backfilled to a depth of ~~31~~ 25 inches below grade. The drainfield would then be installed on top of the leveled medium sand.

Note: Regardless of soil profile and treatment units necessary, drainfields must be installed no deeper than 48 inches below grade per IDAPA 58.01.03.008.04. Drainfield depth restrictions only apply to the aggregate as defined in IDAPA 58.01.03.008.08 or the gravelless trench components approved in section 5.6 of this manual. Medium sand may be installed to any depth necessary to reach suitable soils as long as the excavation and installation of the medium sand meet the requirements of section 4.24 of this manual.

Appendix P

4.24 In-Trench Sand Filter

Revision: ~~May 1, 2000~~July 18, 2013

4.24.1 Description

An in-trench sand filter is a standard trench or bed system receiving effluent by either gravity or low-pressure flow, under which is placed a filter of medium sand meeting the definitions provided in section 2.1.4. ~~An acceptable modification~~The standard design is typically used to excavate through impermeable or unsuitable soil layers down to ~~more~~ permeable or suitable soils. The standard design may also ~~and~~ have~~place~~ clean pit run sand and gravel placed between the medium sand and more permeable soils or ground water as long as minimum medium sand depths are utilized. A modified design to the standard in-trench sand filter is known as the enveloped in-trench sand filter. Enveloped in-trench sand filters consist of a disposal trench with medium sand placed below and to the sides of the ~~drainrock~~ drainfield and are utilized for sites with native soils consisting of very coarse sand. A complex installer's permit is needed to install pressurized in-trench sand filters and enveloped in-trench sand filters. A basic installer's permit may be used to install gravity flow in-trench sand filters that are not preceded by any complex alternative system components.

The term drainfield only applies to the aggregate as defined in IDAPA 58.01.03.008.08 or the gravelless trench components approved in section 5.6 of this manual. Medium sand and pit run may be installed deeper than 48 inches below grade as long as the drainfield maintains a maximum installation depth of 48 inches below grade in compliance with IDAPA 58.01.03.008.04.

4.24.2 Approval Conditions

1. Except as specified herein, the system must meet the dimensional and construction requirements of a standard trench, bed, or pressure distribution system.

2. The in-trench sand filter or any of its modifications may be used over very porous strata, coarse sand and gravel, or ground water.

3. The standard in-trench sand filter system ~~is~~ shall be sized ~~according to~~based on the native receiving soils at the medium sand, or pit run, and native soil interface ~~or at 1.2 gallons/ft^2, whichever is less.~~.

4. Standard in-trench sand filters must maintain a 12 inch minimum depth of suitable native soil below the filter above a porous or non-porous limiting layer.

5. Standard in-trench sand filters must maintain a minimum separation distance of 12 inches from the bottom of the drainfield to the seasonal high ground water level.

6. Standard in-trench sand filters must maintain a separation distance from the bottom of the drainfield and the normal high ground water level that is capable of meeting the Method of 72 as described in section 2.2.3.2.

a. Approval condition 6 may be waived if the standard in-trench sand filter is preceded by an alternative pretreatment system (e.g., extended treatment package system, intermittent sand filter, or recirculating gravel filter) as long as the bottom of the drainfield still meets the minimum separation distances of the applicable alternative pretreatment system.

7. If the enveloped in-trench sand filter modification is used the following conditions must be met:

a. Enveloped in-trench sand filters may ~~only~~ be installed in unsuitable native soils consisting of coarse sand or very coarse sand, or in suitable soils over ground water.

i. Unsuitable native site soils shall be evaluated and certified to not be any larger than the diameter of very coarse sand as described in Table 2-1.

ii. Unsuitable soils that have application rates greater than clay loam as described in Table 2-09 are not suitable for installation of an enveloped in-trench sand filter.

b. Enveloped in-trench sand filters installed in unsuitable soils (e.g., coarse sand and very coarse sand) as described in Table 2-1 and Table 2-9 must be preceded by an alternative pretreatment system (e.g., extended treatment package system, intermittent sand filter, or recirculating gravel filter).

i. Enveloped in-trench sand filters must maintain a minimum of 12 inches above the seasonal high water level from the bottom of the enveloped sand filter.

c. Enveloped in-trench sand filters installed in suitable soils over ground water or a porous limiting layer to obtain a reduced separation distances to the ground water or porous limiting layer shall utilize pressure distribution throughout the drainfield.

i. Enveloped in-trench sand filters installed in suitable soils to obtain a reduced separation distance to ground water or a porous limiting layer must maintain a minimum of:

1. 12 inches above the seasonal high water level from the bottom of the drainfield, and

2. 12 inches above the normal high water level from the bottom of the enveloped sand filter.

ii. Reduced separation distances to non-porous limiting layers may not be approved through use of this design.

d. The system shall be sized at 1.7 gallons/ft^2 if pretreatment is utilized. If pretreatment is not utilized the system shall be sized at 1.2 gallons/ft^2.

~~d.~~e. Enveloped in-trench sand filters may not be used in Large Soil Absorption System designs.

~~e.~~f. Effective disposal area for the installation of an enveloped in-trench sand filter shall only be credited to the width of the drainfield installed. Medium sand width enveloping the drainfield is not credited as disposal area.

4.24.3 Design and Construction

1. ~~Filter~~ Medium sand used in filter construction must conform to the gradation requirements ~~of ASTM C-33 (less than 2% may pass a #200 sieve)~~as described in section 2.1.4.

2. Pit run backfill material, if used, is to meet a soil design subgroup A-1 soil classification.

   a. Pit run backfill material may only be used if the minimum medium sand fill depths are met.

~~2.~~3. ~~The following m~~Minimum ~~filter~~ medium sand depths ~~must be used~~are dependent upon site specific soil profiles. The following site specific conditions outline the minimum sand filter depths:

   a. ~~Gravity flow system = 4 feet~~Excavation through an impermeable/unsuitable soil layer to access suitable soils and seasonal ground water or a porous limiting layer is not present.

      i. No minimum medium sand depth.

      ~~i.~~ii. Pit run material may ~~not~~only be installed ~~until medium sand has been installed to a depth~~ at depths of 8 feet below grade or more, medium sand must be used from the bottom of the drainfield to a depth of 8 feet below grade.

   b. ~~Pressure distribution = 2 feet in design group C soils~~
      ~~3 feet in design group A and B soils~~Excavation through an impermeable/unsuitable soil layer to access suitable soils and seasonal ground water or a porous limiting layer is present (Figure 4-25).

      i. The minimum medium sand depth is dependent upon meeting the Method of 72 as outlined in section 2.2.3.2.

ii. Pit run material may not be installed until the Method of 72 as described in section 2.2.3.2 is met.

c. Unsuitable ~~N~~native site soils consisting of very coarse sand

i. The filter sand shall envelop the drainrock so that at least 1 foot of medium sand is between the drainrock and the native soils as shown in Figure 4-26.

~~c.~~d. Suitable native site soils and a seasonal ground water level or porous limiting layer is present and the drainfield is designed with a reduced separation distance to the ground water or porous limiting layer.

i. The filter sand shall envelop the drainrock so that at least 1 foot of medium sand is between the drainfield and the native soil as shown in figure 4-27.

ii. The filter sand shall maintain a depth of:

1. 2 feet below the drainfield in design group C soils

2. 3 feet below the drainfield in design group A and B soils

iii. A minimum of 12 inches of suitable soils must be maintained between the sand filter and the normal high ground water level or a porous limiting layer.

~~5. When the native soils are design subgroup A-1 or coarser, the filter sand shall envelop the drainrock so that at least 1 foot of filter sand is between it and the native soils, as shown in Figure 4-25.~~

~~6. The seasonal or normal ground water must not come within 12 inches of the bottom of the sand filter.~~

Figure 4-25 shows two ~~types~~ scenarios for use of in-trench sand filters. Figure 4-26 provides an example of an enveloped in-trench sand filter installed in unsuitable coarse native soil. Figure 4-27 provides an example of an enveloped in-trench sand filter installed in suitable native soils with a reduced separation distance to ground water or a porous limiting layer.

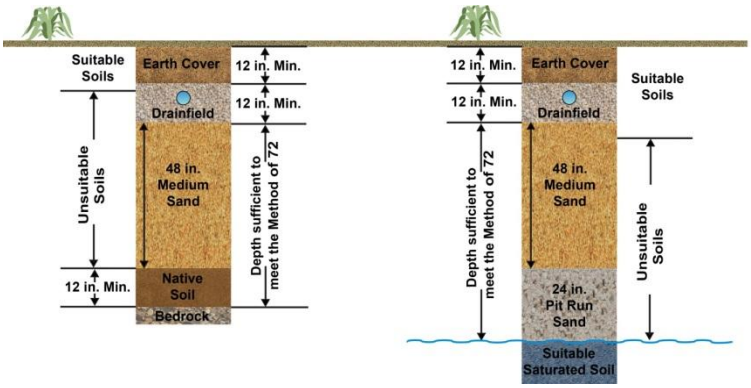


Figure 4-25. In-trench sand filter accessing suitable soils through an unsuitable soil layer.

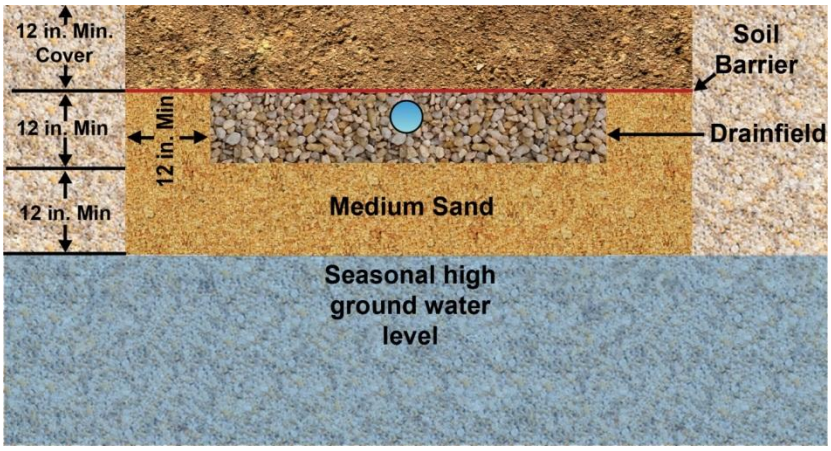


Figure 4-26. Enveloped in-trench sand filter for installation in unsuitable coarse native soils (i.e., ~~A-1~~coarse or very coarse~~r~~ sand).

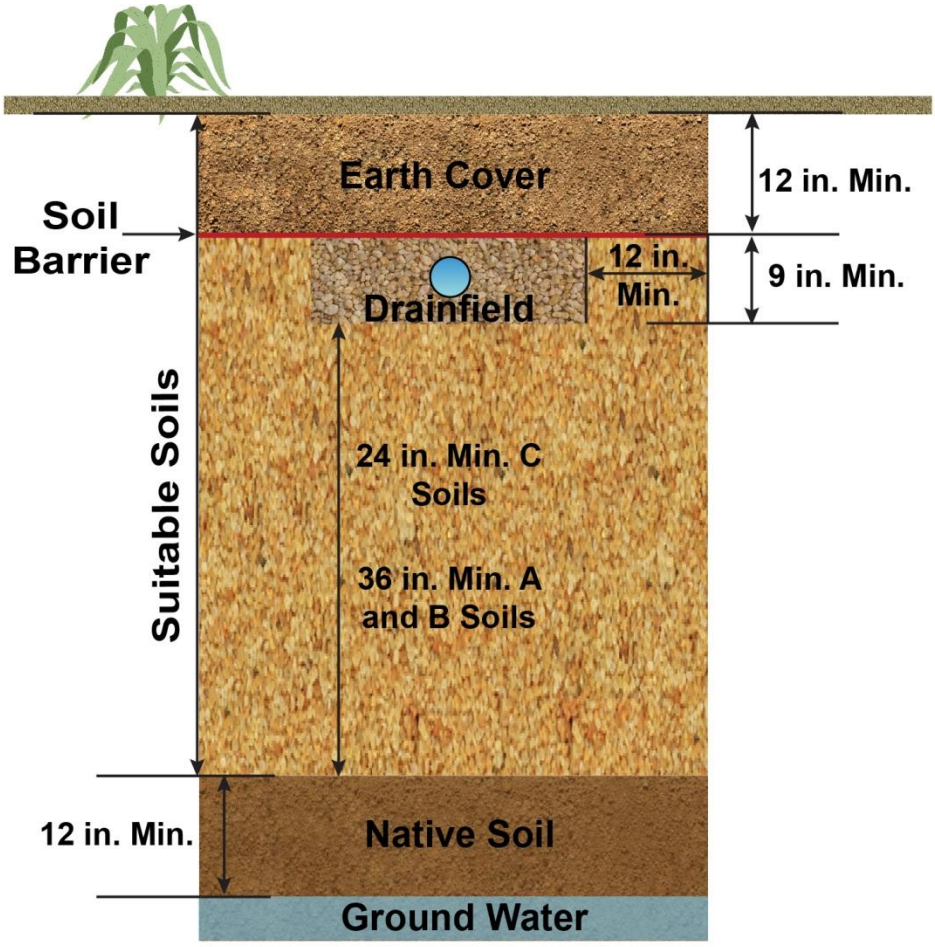


Figure 4-27. Enveloped in-trench sand filter for installation in suitable soils for a reduction in separation to ground water or a porous limiting layer.

Appendix Q

4.4 Easement

Revision: ~~April 21~~October 31, 2013~~00~~

The Individual/Subsurface Sewage Disposal Rules provide that every owner of real property is responsible for storing, treating, and disposing of wastewater generated on that property. This responsibility includes obtaining necessary permits and approvals for installation of the individual or subsurface disposal system. Therefore, a property owner wishing to install an individual or subsurface disposal system must obtain a permit under these Rules, and any other necessary approval for the installation of a system, including any authorization needed to install the system on another property that does not contain the wastewater generating structure. This property may be owned by the same individual that owns the parcel with the wastewater generating structure or another individual. Consistent with this requirement, the Rules require an applicant for a permit to include in the application copies of legal documents relating to access to the system (IDAPA 58.01.03.005.04.l). This section provides guidance regarding the circumstances under which the health district should permit a system to be located on another property that does not contain the wastewater generating structure and the legal documents that must be included in or with an application for such a system.

A. The health district will consider allowing the installation of a ~~private, individual~~ subsurface sewage disposal system on ~~an adjoining~~ another property (e.g., lot, parcel, etc.) ~~owned by a second property owner~~. However, this option should be considered a last resort for use only when other practical solutions for subsurface sewage disposal are not available on the applicant's property. In addition, the entire site (i.e., the area for both the primary and replacement drainfield) on the other property must be reviewed by the health district and the site must meet all requirements of the "Individual/Subsurface Sewage Disposal Rules" (IDAPA 58.01.03).

B. The placement of an individual subsurface sewage disposal system on another property requires that an easement be in place prior to subsurface sewage disposal permit issuance. Easements are required anytime a subsurface sewage disposal system is proposed on another property regardless of property ownership. Easements will need to be obtained for each property, other than the wastewater generating parcel that the application is submitted for, that any portion of the subsurface sewage disposal system is proposed to be installed upon. ~~The following is guidance and guidelinesprovides guidance for approval of an easement to construct an individual subsurface sewage disposal system:~~It is the applicant's responsibility to include an easement that:

1. Contains a sufficient description of the easement area, and of the property to be benefited by the easement (the property of the applicant).

2. Contains language that ensures that the other property can be used for the system, and that the applicant or a subsequent purchaser of the applicant's property has access to make repairs or perform routine maintenance, until the system is

abandoned. The language must ensure such use and access even when the applicant's property or the other property is sold or otherwise transferred.

3. Contains language that restricts the use of the easement area in a manner that may have an adverse effect on the system functioning properly.

C. It is the responsibility of the applicant to ensure that a legally sufficient document is prepared to establish the necessary easement for the subsurface disposal system located on another property. This document must be submitted to the health district with the permit application. The health district must ensure that an easement document is included in the application. However, the health district does not have the expertise, nor is it the duty of the health district, to determine the legal adequacy of the easement document, and the issuance of a permit does not in any way represent or warrant that an easement has been properly created. In order to issue a permit that includes a system on another property, the health district must ensure that the easement document included with the application:

1. Has been prepared by an attorney.

2. Has been recorded in the county with jurisdiction. Evidence that the document has been recorded must be provided.

If the easement document meets the above two criteria, the health district may issue a permit. It is not the health district's responsibility to ensure the easement document meets the requirements in section B above. It is the responsibility of the applicant and the applicant's attorney to ensure the easement is legally sufficient and will meet the requirements in section B.

4. ~~The entire site (i.e., the area for both the primary and replacement drainfield) for the proposed easement area must be reviewed by the health district for approval prior to recording and surveying of the easement and issuance of the permit.~~

5. ~~Site must meet all requirements of the "Individual/Subsurface Sewage Disposal Rules" (IDAPA 58.01.03) (section 8.1), including but not limited to soils, setbacks,slope, and sufficient area for the original primaryand replacement drainfields, and slope~~.

6. ~~The easement is to be professionally prepared by an attorney and recorded in the county courthouse of local jurisdiction, or a written agreement prepared from the grantor granting an easement to the grantee, both of which will be surveyed and recorded after the system is installed. A copy of the easement is to be made available to the local health district and attached to the sewage disposal permit before final permit approval.~~

a. ~~AThe easement shall include a survey, including monumenting the corners of the entire easement area, of the proposed easement site shall be made to supply an accurate legal description of the easement and enable the health district to properly evaluate the site.~~

b. ~~The entire easement area shall be monumented at all corners to identify the area of system placement prior to permit issuance and the monuments should be identified on the easement survey.~~

7. ~~The easement shall be signed by all individuals or entities listed on the deed or title for each impacted property.~~

8. ~~A copy of the easement is to be provided to the local health district prior to permit issuance.~~

~~7.~~9. ~~A copy of the recorded easement and survey is to be provided to the local health district prior to final permit approval.~~

~~8. The attorney shall include in the written easement the following items:~~

~~a. Easement shall be in perpetuity or until the system is abandoned by the grantee.~~

~~b. Grantor is to be protected with enforceable provisions that will require the owner of the system to make repairs as needed.~~

~~c. Grantee is to have access to the system to make repairs or perform routine maintenance.~~

~~d. Grantee must have ability to restrict any use of the easement area that may have an adverse effect on the system functioning properly.~~

~~9.~~10. ~~A survey, including monumenting the corners, of the proposed easement site shall be made to supply an accurate legal description of the easement and enable the health district to properly evaluate the site.~~

4.4.1 Easement Restrictions

1. Effluent transport pipes for separate properties should not occupy the same trench within an easement.
2. If easements for drainfields under separate ownership result in more than 2,500 gallons per day of effluent being disposed of on the same property then the drainfield(s) must be designed as a Large Soil Absorption System and undergo a Nutrient-Pathogen Evaluation.

~~1.~~3. Easement boundaries that are not adjacent to the grantee's property line must meet the separation distance of 5 feet between the drainfield and/or septic tank and the easement boundary.