Chapter 4: Field Test Program Development

Introduction

The innovative system field test program comprised one of the largest efforts of the La Pine Project in terms of funds, personnel and time. The program ultimately included 49 sites that were sampled monthly for a year and bimonthly or quarterly for an additional two years. Groundwater monitoring well networks were installed around each onsite system participating in the field test and monitored monthly for a year and then quarterly for the remaining two years. This relatively straightforward plan was complicated by the significant set of legal requirements that needed to be fulfilled because of the interactions between private property owners, vendors, and agencies involved in the project. The following is a list of the types of agreements and contracts required for the field test:

- *Contracts between Deschutes County and the vendors for the system installation portion of the project;*
- *Contracts between Deschutes County and the property owners establishing expectations and the extent of liability for the duration of the project;*
- *Permits issued to the property owners by DEQ to establish the requirements for onsite system operation; and*
- *Contracts between the homeowners and the service providers for onsite system maintenance.*

The project team relied heavily on Deschutes County's legal counsel and the DEQ's permitting process in order to create a binding but responsive relationship between the project staff and the property owners.

Between all of these various agreements, a significant portion of the first year was spent establishing agreements, screening homeowners and technologies and establishing the sampling infrastructure.

Selection Processes, Agreements and Permits

Homeowner selection

The La Pine Project field test program depended on finding cooperative homeowners to participate in this research-oriented project. As such, the project team advertised for participants in several ways. The solicitation took place over two years and included a written application, an interview/information meeting, and a site visit. Advertisement of the opportunity to participate in the field test included:

- *Word of mouth from Deschutes County Community Development Department (CDD) staff.*

  Deschutes County CDD includes the Building, Planning and Environmental Health Divisions and provides "one-stop shopping" for almost all permits needed to develop property in Deschutes County. This method of advertising produced the largest number of applicants, possibly because the sanitarians working in the study area were closely involved in the La Pine Project and were aware of situations where the onsite systems needed repairs or replacement.

- *Word of mouth from homeowners already participating in the La Pine Project.*

  Several new applicants were notified of the opportunity to participate in the project by friends, neighbors or relatives. This turned out to be a surprisingly effective way to advertise the project and the need for participants in the field test program.

- *Print media*

  The project team issued a series of press releases to advertise the project and the field test program. Subsequently the local papers published stories on the project and it goals. This form of advertising was not as effective as hoped because the project team could not necessarily control the points highlighted in the story. As a result the field test program was sometimes overshadowed by other elements of the La Pine Project that the particular reporter involved found the most interesting at the moment.

- *Direct mailing.*

  The county mailed a newsletter for another purpose to the study area residents that included the advertisement for the field test program. This method appears to have had limited success because a few area residents aware of the newsletter and the information it contained observed the trash cans at the local post office were full of the newsletters from that mailing shortly after it was delivered.

- *Web page.*

  While the request for participants was posted on the web page before any articles were published, this method produced no "cold" applications. The project team and Deschutes County staff used the web page primarily as a source of information to which they could refer people with whom they were already in contact.

  Recommendations for advertising a similar project: given the effectiveness of word of mouth in the study area, a more effective advertisement method could have included notices given at the community centers, churches and other public places in the study area. A more organized involvement of the current project participants would have expanded the use of that network to advertise the project as well.

Property owners interested in participating in the field test were required to complete an application form (Appendix A, Figure A-1) and participate in an interview/informational meeting. Project staff provided information on the goals and objectives of the field test program and the overall La Pine Project, the expectations for the homeowners and the responsibilities of the project, the innovative systems selected for participation, and example permits and contracts.

The first round of homeowner meetings took place at the county office. During the second round of selections, the project staff met with property owners on the site. The second approach worked better because it seemed to make homeowners more comfortable and project staff were able to familiarize themselves with the property earlier in the process. In several instances, the homeowners were able to provide information (e.g. water test results or well construction information) that they may not have thought to bring with them to the county offices.

As mentioned earlier, the project staff provided examples of the permits and contracts and a list of discussion topics covered during the meeting. Property owners signed this agenda (Appendix A, Figure A-2) at the end of the meeting to confirm their participation in the meeting. The signed agenda turned out to be a useful tool at a later date when a few property owners claimed that certain issues had not been discussed prior to their agreeing to participate in the field test. While these property owners were a small fraction of the total participants, the fact that project staff could show them their signatures on the agenda and review particular issues helped circumvent potential disputes.

The primary selection criteria turned out to be the physical characteristics of the site. In certain circumstances, more attention should have been paid to the manner in which the potential participants interacted with the project or county staff. A few of the property owners, while not completely uncooperative, were not as pleasant to work with on a recurring basis either because of a slight belligerence towards public employees or because they were skeptical of the need for advanced wastewater treatment. The fact that these persons actually agreed to participate in such a project was unexpected given their apparent skepticism. Overall, however, the application process appeared to create a self-selected group of participants who were interested in the outcome of the study and willing to cooperate.

The permit issued for the field test will be discussed in more detail below. Specifically in terms of homeowner agreements, however, the permit for innovative systems established a requirement for maintaining a contract with a service provider designated by the vendor. The contract between Deschutes County and the property owner (called a License by the County) established the duration of the project, the duties of the Licensee (the County) and the Licensor (the property owner), and the condition that would lead to default. The County recorded this license agreement on the chain of title for the property on which the onsite system was installed. The presence of this document on the title was helpful because it prompted prospective buyers to contact project staff to learn about the project and the terms of involvement. Two owners were so supportive of the project that they ensured that prospective buyers learned about the project to help make sure the field test was successfully completed. Having the license agreement recorded on the chain of title created a valuable educational opportunity for prospective homeowners during the time of sale. Prospective buyers otherwise may not have been aware of the requirements of the wastewater treatment system they were purchasing with their home.

Technology selection

The initial step taken to involve vendors and designers of innovative onsite systems was to solicit proposals from the national onsite professional community. This solicitation consisted primarily of a Request for Proposals (RFP) in publications like the Small Flows Quarterly or the National Onsite Wastewater Recycling Association (NOWRA) journal. Some contacts with vendors were made on a personal basis at national meetings. The RFP was published over 2 years and the second RFP published in the Small Flows Quarterly is provided as an example in Appendix A, Figure A-3.

About eight proposals were received during the first round of solicitation. The project team established a Technology Review Committee (TRC) consisting of two project team members (1 each from DEQ and Deschutes County) and three professionals from the national decentralized wastewater treatment community. The other members included a consultant, a regulator and a university researcher.

The TRC process was only partially successful. The members of the committee external to the La Pine Project provided valuable feedback on the first set of proposals received. During the second round of solicitation, the participation from these committee members declined. Decisions on the proposals for the second round of proposals were made almost entirely by the project team due to difficulties experienced obtaining feedback from the external TRC members. It is unclear at this point why the difficulty existed because there is no indication that interest in the success or results of the demonstration project had declined.

During the review process, each reviewer received a copy of the complete application package submitted by the vendor or manufacturer. The reviewer's charge was to evaluate the proposal against the project's performance criteria and decide whether the proposal met one of the following four criteria:

1. Information provided was sufficient and **met** the performance standards as advertised.
2. Information provided was sufficient and **did not meet** the performance standards as advertised.
3. Information provided was insufficient and **additional information as specified** should be furnished.
4. Information provided was insufficient and **additional information was not warranted**.

In general, the proposal solicitation process was successful given the wide variety of systems that participated in the field test program. Early in the process, project staff invested a considerable amount of time discussing the project goals with potential participants. Interestingly, some prospective applicants had to be assured that the field test welcomed a diversity of system types because a rumor implied the project was biased towards regional vendors. Ultimately, the list of participating manufacturers, vendors and designers was varied and represented a wide spectrum of wastewater treatment methodologies including: forced aeration processes, packed bed filters, sequencing batch reactors and rotating biological contactors. The treatment units or designs field tested during the La Pine Project were:

- Advantex® – RX-30 and AX-20:
  Orenco Systems, Inc., 814 Airway Avenue, Sutherlin, OR 97479
  (800) 348-9843 x 218
  http://www.orenco.com/ots/ots_index.asp
- Amphidrome®:
  FR Mahony & Assoc., Inc., 273 Weymouth St., Rockland MA 02370
  (781) 982-9300
  http://www.frmahoney.com/frmahony.htm
- Biokreisel®:
  Nordbeton North America, Inc., P.O. Box 470858, Lake Monroe, FL 32747
  (407) 322-8122
  http://www.nordbeton.com/biokreiselnna.htm
- Dyno2™:
  Reactor Dynamics, Inc., P.O. Box 758, Forest Lake, MN 55025-0758
  (651) 225-5070
  http://www.reactordynamics.com/HOMEPAGE.htm
- EnviroServer:
  MicroSepTec Inc., 26601 Cabot Road, Laguna Hills, CA 92653
  (949) 855-3500
  http://www.microseptec.com/

- FAST®:
  Bio-Microbics, Inc., 8450 Cole Parkway, Shawnee, KS 66227
  (800) 753-3278
  http://www.biomicrobics.com/
- IDEA BESTEP:
  Advanced Environmental Systems, Inc., P.O. Box 50356, Sparks NV 89435
  (775) 425-0911
  http://www.aeswastewater.com/
- Innovative Trench designs (three):
  Steve Wert & Associates, Inc., 2590 NE Courtney Dr., Suite 1, Bend OR 97701
  (541) 617-9100
- NAYADIC:
  Consolidated Treatment Systems, Inc., 1501 Commerce Center Drive, Franklin OH 45005
  (937) 746-2727
  http://www.consolidatedtreatment.com/nayadic.asp
- NiteLess:
  On Site Wastewater Management, LLC, 16 Stonebridge Road, Cherry Hill, NJ 08003
  (856) 751-8455
  http://www.oswm.com/index.htm
- NITREX™ filter:
  Lombardo Associates, Inc., 49 Edge Hill Road, Newton, MA 02467
  (617) 964-2924, Fax: (617) 332-5477
  http://www.lombardoassociates.com/nitrex.shtml
- Puraflo® system:
  Bord Na Mona, P.O. Box 77457, Greensboro NC 27417
  (800) 787-2356
  http://www.bnm-us.com/

Permitting Process

The onsite program permitting process in Oregon required the systems participating in the La Pine Project be permitted in one of two ways. The control systems, called "conventional systems" for the purposes of this report, included standard tank and drainfield, pressure distribution, and sand filter (bottomless and lined) systems, represented the typical systems permitted and inspected by the county environmental health staff. Permits for these systems were construction permits with scheduled inspections to confirm the installer's adherence to the prescriptive standards contained in onsite rules. These permits are finalized with the completion of construction and do not have a "life" beyond the construction phase apart from any requirements that might have been included on the Certificate of Satisfactory Completion (CSC) issued for the system. The county onsite regulators have the authority to add conditions to the CSC; however, the rules at the time did not allow the CSC to be revoked, which limited the enforcement actions available to the permitting agency. Revocation of a CSC would essentially revoke approval of an onsite system, a compliance issue that could be recorded in the permit file and disclosed at time of sale.

Sand filter systems have some O&M requirements specified in rule and, in this case, the permitting agency must specify the O&M requirements on the CSC. Again, however, there is no means of revoking the CSC and using this as a tool to achieve compliance.

The DEQ issued permits the innovative systems participating in the project using a Water Pollution Control Facility (WPCF) permit, which is an operating permit. This permit process was designed for systems with:

- *"Flows greater than 2,500 gpd;*
- *Greater than residential waste strength;*
- *Sand filter serving a commercial facility;*
- *Recirculating gravel filters; and*
- *Aerobic treatment facilities that don't meet the prescriptive standards in the rule."*

The innovative systems participating in the La Pine Project fell within the final category because the definition in rule for "Aerobic Sewage Treatment Facility" was "a sewage treatment plant that incorporates a means of introducing air and oxygen into the sewage to provide aerobic biochemical stabilization during a detention period. Aerobic sewage treatment facilities may include anaerobic processes as part of the treatment system." All of the innovative systems selected for participation in the field test met this definition and included forced aeration processes, packed bed filters, sequencing batch reactors and rotating biological contactors.

The requirements for the innovative systems permit application process resulted in significant project staff involvement. And, because the DEQ typically uses this permit exclusively for commercial facilities, the permit contains relatively legalistic language with significant monitoring and reporting requirements. The language constituted a barrier to most homeowners participating in the La Pine Project and the monitoring and reporting requirements would have been a major financial burden. The typical permit specified influent and effluent standards, a sampling schedule, a contract with a service provider, and an annual compliance fee ($300 during the La Pine Project). Annually, the sum of these costs could approach $1,000 if only one sampling event was required, but the permit typically required quarterly sampling, which would have caused the annual compliance costs to approach $2,000. Additional costs may have been incurred under other circumstances because an applicant for a WPCF permit typically hired a consultant to develop the application materials and follow the permit through the process.

The project team understood that the existing WPCF permit would not be viable in the long-term for permitting innovative systems for residential use. Ultimately the use of this permit would establish a disincentive to use innovative systems and/or an incentive to sewer the rural areas of the state. The annual costs associated with the WPCF permits can be at least triple the monthly cost of sewer service in nearby cities. For example, in Bend, Oregon, about 20 miles north of the La Pine Project study area, the monthly sewer bill is about $20 for an annual total of about $240. (City of Bend, *personal communication*, 2005)

The process described above was required by the onsite regulations in effect at the time. In March 2005, the DEQ revised the state regulations to establish the process for approving innovative onsite technologies and to facilitate the permitting process for the systems at the local level (DEQ, 2005).

Sampling and Analysis

Existing studies or protocols developed for sampling onsite wastewater systems were scarce when the La Pine Project began work. This section contains a discussion of the analyses chosen for the sampling program and the sampling procedures used in the La Pine Project. The primary source of information was the procedures used in sampling municipal wastewater treatment plants and industrial pretreatment processes. Onsite wastewater treatment systems turned out to be sufficiently different from municipal and industrial; therefore, the La Pine Project Team defined some alternative methods of obtaining representative data and also provided initial testing of a hypothesis that grab sampling produced nearly identical results for most parameters as composite sampling.

Sample parameters

Defining the sample parameters depends largely on the local situation and contaminants of concern. The La Pine Project study is located in an area where nitrogen contamination is a concern due to the presence of an unconfined drinking water aquifer, the shallow depth to the water table, and rapidly draining soils. Therefore, one of the most important sample sets to take is the individual nitrogen species. This includes total Kjeldahl nitrogen, ammonium, and nitrate-nitrite. A separate analysis for nitrite may be warranted if there are difficulties troubleshooting the treatment process. The separate nitrogen species show how well the treatment system accomplishes the different stages of the primary treatment and nitrification/denitrification processes.

The 5-day bio-chemical oxygen demand (BOD_5), total suspended solids (TSS) and bacteria analyses provide a basic characterization of wastewater quality. The chloride analysis provided a way to account for dilution (from precipitation or irrigation) or concentration (by evaporation) in systems that are open to the atmosphere. Chloride data can also provide an indication that residential sewage is the source of the nitrogen because humans are a significant source of chloride. Chloride's utility may be limited in those areas near saltwater bodies or where roadway salting is common in the winter. Total alkalinity is a useful diagnostic parameter because the nitrification process for a milligram (mg) of ammonia consumes a maximum of 7.14 mg of alkalinity. Typically, less alkalinity than the theoretical quantity is used because of the nitrogen used in building cell bodies, but the 7.14 mg/L provides a conservative means to determine if the nitrification process is alkalinity limited. (Crites and Tchobanoglous, 1998; Burks and Minnis, 1994)

Fats, oils and grease samples were taken from septic tanks but no other location in the treatment stream because the project team uses this parameter primarily in the evaluation of septic tank effluent against the definition of residential waste strength that was currently in the Oregon regulations (Oregon DEQ, 2000). This parameter is also used when troubleshooting systems' performance, however, the advanced treatment systems were not required to reduce fats, oils and grease as part of the demonstration project.

Figure 4-1 lists the parameters taken during sampling for the La Pine Project and the methods used to analyze the samples. This figure provides an example of the page dedicated to each property in the Quality Assurance Project Plan (QAPP) that specified the parameters taken at each location on the site. Each site could vary from the standard set of parameters but the baseline typically remained the same.

Site:
Address:
System Type:
Start-up Date: First Samples:

SAMPLE POINT

ANALYTE	Septic Tank Effluent (STE) Lat: Long: LASAR #	Treatment unit Effluent Lat: Long: LASAR #	Groundwater Monitoring Well (GW) Lat: Long: LASAR # DEQ ID:	Groundwater Monitoring Well (GW) Lat: Long: LASAR # DEQ ID:	Groundwater Monitoring Well (GW) Lat: Long: LASAR # DEQ ID:	Groundwater Monitoring Well (GW) Lat: Long: LASAR # DEQ ID: Drainfield Well	Analytical Method
BOD_5	X	X				X	**5210 B**
Total Alkalinity	X	X				X	**2320 B**
TSS	X	X				X	**2540 D**
Total Phosphorus	X	X					**4500-P E**
TKN	X	X	X	X	X	X	**351.2**
Ammonia as N	X	X	X	X	X	X	**4500-NH3 H**
Nitrate+Nitrite as N	X	X	X	X	X	X	**353.2**
Chloride	X	X	X	X	X	X	**4500-Cl C**
Fats, Oil & Grease	X						**1664**
E. Coli	X	X	(X)	(X)	(X)	(X)	**9213 D***
Fecal Coliform	X	X	(X)	(X)	(X)	(X)	**9213 D***
*** Monitoring Wells denoted (X)** = Coli-lert bacteria screen to be performed at Deschutes Co. If POSITIVE result, then bacteria sample to OHD until 3 consecutive NEGATIVE results.							
Bottle Types	X, STP, R, DP, C	P, R, DP, C	R, DP, C	R, DP, C	R, DP, C	P, R, DP, C	
Frequency	1st yr: monthly 2nd yr: 2-3 month 3rd yr: 2-3 month	1st yr: monthly 2nd yr: 2-3 month 3rd yr: 2-3 month	quarterly	quarterly	quarterly	1st yr: monthly 2nd yr: 2-3 month 3rd yr: 2-3 month	

12/11/2002 (S:\CDD\ehealth\EPA Grant\work plan\LaPine QAPP)
Amendment to ONSITE WASTEWATER SYSTEMS SAMPLE ANALYSIS PLAN, Appendix 1
La Pine National Decentralized Wastewater Demonstration Project
Deschutes County, Oregon

Figure 4-1. Example QAPP page.

Preparation for sampling

The preparation for sampling was as important as the sampling activity itself. In general, the more details attended to during preparation for sampling, fewer mistakes were made during the sampling event. Obviously, sampling is expensive so fewer mistakes equates with greater integrity of the dataset because of the increased confidence level in the quality of the work performed and the fewer missed sample events.

Deschutes County established a small lab in one of the County buildings, which served as the base the sampling activities. This space was separated from the Environmental Health Division offices in order to provide storage for sampling equipment and supplies, an area for equipment maintenance, and adequate ventilation to minimize odor complaints caused by sample preparation and clean up operations.

Long-term sampling warranted using portable meters instead of test kits when taking field parameters (dissolved oxygen, conductivity, temperature, pH) to ensure consistency and lower overall operating costs. We calibrated the pH and DO/conductivity meters at the beginning of each sampling day, which was a more stringent schedule than required by the equipment manufacturers. However, the project team felt this approach was more defensible over the long term, especially as the sampling events became less frequent towards the end of the project. The DO/conductivity meters were also calibrated to the altitude of the sampling site upon arrival because the elevation of the lab (located in Bend) was significantly lower than the south Deschutes County area (4,200 feet above mean sea level).

Sample bottles are prepared for the event by separating them into sets by sampling location and recording the bottle identification numbers on the field/chain of custody forms in advance. The sampling teams bound the bottles into sets using rubber bands or by using a dedicated bucket for each location. Creating bottle sets before the start of the sample day ensured there were enough bottles to complete the day's sampling and recording the bottle numbers before arrival on the site dramatically reduced the number of transcription errors.

Preparation for sampling on the site

Two people typically comprised the wastewater sampling team where each person performed the same task (reading meters, taking samples, opening components, etc.) to ensure consistency in procedure. While a single person could perform the sampling tasks alone, this division of duties was also the most efficient in terms of the amount of time spent on a site. For example, the team member that usually operated the meters also set up the sample table, the meters, set the bottles next to each sample location and records field observations. At the same time, the other team member opened the component lids, unloaded the sampling devices and clean up station, and filled the sample bottles.

The sampling team used a small folding table for the meters and sample preservation. The table required frequent cleaning and sanitizing but the ergonomic advantages outweighed this relatively minor reduction in time efficiency.

Groundwater sampling employed 1-2 persons depending on the sampling schedule. The most efficient arrangement for groundwater sampling tended to be individuals working on a site or on individual wells on a site rather than dividing the sampling activities.

Sampling procedures and equipment

Procedures – the sampling procedures are provided in the Quality Assurance Project Plan for the project. The wastewater sampling procedure is provided in Appendix A, Figure A-4. Groundwater sampling and sampling follow-up procedures are also provided in the appendix as Figures A-5 and A-6, respectively. Each procedure was formatted to be easily replicated and laminated for field use in the event that additional personnel needed to be trained.

The primary approach used to sample wastewater treatment systems was to sample from "clean" to "dirty." Sampling began at the location where effluent discharged from the treatment train into the environment and then continued up stream to the septic tank or primary processing tank. For example, sampling a packed bed filter system including a lysimeter in the dispersal field would begin with the lysimeter, then the effluent pipe of the packed bed filter and, last, the septic tank. This ensured that a downstream or "cleaner" sample was not inadvertently contaminated with upstream or "dirty" effluent.

Equipment - apart from the fundamental question of where and how to sample, there was the more basic question of what kind of equipment should, or shouldn't be used. Some of these conclusions were drawn through trial and error and some as a matter of practicality or safety. The sample collection tools used at different types of sample sites are summarized in Table 4-1.

Table 4-1. Sample collection device used to sample different effluent discharge points.

Equipment	Sampling site	Comment
Dedicated disposable Teflon bailer	Septic tank effluent – gravity discharge	Each site requiring a bailer was assigned a dedicated bailer that was cleaned/sanitized after each use and replaced quarterly.
Dipper	Septic tank effluent – screened pump vault	NOTE: Particular care was required to avoid disturbing the attached growth on the side of the screened vault or on the floats and to avoid disrupting the operation of the floats
	Treatment unit discharge pipe	Dippers were used when the system discharged frequently enough and in great enough volume to collect effluent during a sample visit. Basic protocol was not to force the system to discharge prematurely.
	Pump chamber following the treatment unit	This was the sample site of last resort because the bacteria data from this site was not representative of what the treatment unit discharged. This location was typically used for extremely low flow households.
Bucket	Treatment unit discharge pipe	The clean/sanitized bucket was left at those treatment unit effluent pipes that did not discharge frequently enough or did not discharge a large enough quantity during a sampling visit. The bucket is left so that it performs as a flow through cell until the sample is collected. The collection period is typically 2-24 hours.
	Lysimeter or Sand Filter Effluent	The bucket was left for a period of a day to several days and used as a flow through cell. Typically lysimeter or sand filter effluent was not discharged fast enough for the sample to be collected during the sample visit.

All equipment was scrubbed and washed with detergent and then sanitized using a bleach solution. The project team discussed the potential for the chlorine bleach to confound the sample results, in particular the bacteria results. However, the team decided that, while the risk was minimal because of the length of time between uses, rinsing the sampling equipment in the effluent before sampling and always taking the bacteria samples last could further minimize the effects on sample results from residual sanitizer.

All wastewater sample collection equipment was cleaned and sanitized before leaving the site. Three five-gallon buckets with lids were carried in the sampling vehicle for detergent wash, rinse, and sanitizer. The dipper, bailer, bucket, and sludge judge were scrubbed, rinsed, and sanitized before leaving the site. This practice ensured that the equipment met the minimum contact time with the sanitizer and was ready for use at the next site.

The chloride samples required filtration prior to shipping to the lab for analysis. Normal procedure (derived from standard monitoring well sampling procedures) was to filter in the field; however, filtration in the field required the use of a peristaltic pump and an in-line filter. This approach not only increased the quantity and kinds of equipment required for sampling but also posed a significantly higher risk for the sampling personnel to come into contact with wastewater. Septic tank effluent and some treated effluents clog in-line filters quickly, which caused significant pressure build up in the pump line. The result was often a high-pressure stream of effluent and an unhappy sampling team when the hose clamps failed. As an alternative, the sampling team took the unfiltered samples to the Deschutes County lab space where they used a filter holder with a receiver and funnel. This filter is operated with a peristaltic pump providing a vacuum so that the effluent is pulled through the filter rather than pushed as with the in-line filters. This method also allowed the sampling team to pre-filter the effluent with a large pore filter paper. (Figure 4-2) The main complaints with this method were odor complaints from neighbors in the building where the lab was located; these were significantly reduced when the ventilation was improved. The advantages to this approach included a safer process and significantly lessened costs for materials.

Because most of the wastewater sampling equipment was cleaned in the field, clean up in the lab consisted primarily of servicing any meters or other equipment as required, packing samples for shipping to the analytical lab, completing paperwork, and restocking supplies. Groundwater monitoring required more clean up in the lab because the tubing required cleaning and sanitizing that could not be accomplished in the field.

All samples were shipped overnight to ensure the analyses could begin promptly and minimize conflicts with sample holding times. The samples contained in glass bottles required particular care in packing (bubble wrap or other protective packing) and all samples required refrigeration (reusable blue ice packs).

Personal Protective Equipment

Figure 4-2. Chloride sample filtering equipment.

The primary method of ensuring personal protection during sampling was to avoid splashing or spraying wastewater. Groundwater monitoring posed significantly fewer risks because microbiological hazards were minimal. Groundwater monitoring hazards were also limited by proper lifting and carrying techniques, appropriate care when using extension cords for the peristaltic pumps, and attentiveness when dealing with property owner or neighborhood domestic animals. Gloves and proper hand washing techniques and eye/face protection were some of the personal protective equipment used to protect sampling team members. Overall, the foremost concern during wastewater sampling was the potential for effluent splashing or spilling during sampling. Using a dipper with a six or nine-foot handle greatly minimized the potential for sampling personnel to come in contact with effluent. Bailers were slightly more risky to use, particularly because they were used almost exclusively for septic tank sampling, but careful technique minimized the potential for splashing. In addition, some sampling personnel preferred to use a face shield and apron during sampling for greater protection.

Boots are particularly important if concrete riser lids are present or if the native wildlife warrants it. During winter sampling, boots with insulated soles were essential protection from snow or ice. Appropriate cold weather gear was essential because the wastewater sampling could not stop for inclement weather, in fact, this data can be important in determining whether or not the treatment units are sensitive to environmental conditions

Sample locations

Identifying representative sample locations included a discussion on the different approaches to taking samples and types of sampling devices to use. The project team adhered to the primary goal of the La Pine Project (evaluate the performance of advanced treatment systems for nitrogen reduction) when designing the sampling approach. Therefore, the septic tank evaluation, while a valuable study in and of itself, remained a supporting effort to the primary goal. As a result, the project team decided to focus on septic tank effluent, rather than raw wastewater influent to septic tanks or primary processing tanks, in order to best characterize the influent quality that the innovative treatment units received. Septic tank effluent quality from the La Pine Project is discussed in Chapter 5.

The project team also considered how results might differ between sample locations, in particular what differences might exist between free-flowing grab samples taken from the discharge pipe of the treatment units and grab samples taken from the pump chamber following the treatment units. To test the hypothesis, the sampling team took a series of side-by-side samples from the effluent pipes of three different types of treatment units and the pump chambers following the treatment units for a total of six systems over a six to ten month period. The sampling team collected the effluent pipe sample by waiting for the normal discharge cycle to occur. The chamber sample was collected by dipping the sample from the pump chamber following the treatment unit's effluent discharge pipe. The data, in the form of correlation coefficients, are presented in Table 4-2 and data plots are provided in Figures 4-3 through 4-20.

Table 4-2. Correlation coefficients for comparative sampling from the effluent pipe vs. the collection chamber.

System type	System name	BOD-5	TSS	TN	Fecal	E. coli
RX-30	System-R	0.99	0.64	0.99	0.91	0.94
RX-30	System-H2	0.22	0.72	0.99	0.96	0.09
RX-30	System-M	0.64	-0.20	0.79	-0.21	-0.23
NITREX	System-F	0.99	0.92	0.99	0.06	0.01
NITREX	System-S	0.98	0.61	0.99	0.48	0.28
FAST	System-P	0.89	0.98	0.97	0.98	0.98

A question also raised during sampling program design concerned the possible compositing effects of the septic tank, treatment unit and other components of onsite wastewater treatment systems. In most of the single-pass septic tanks, the household daily flow ranged between 4% and 20% of the tank volume with average flow being 10% of the tank volume. Potentially, this is a composite, or blending, of the number of days that is equivalent to the residence time in the tank or chamber. Unfortunately, the project team could not warrant the extra expense and effort required to use composite samplers to test the hypothesis that the septic tank and treatment unit (if present) are compositing devices. This could be a valuable avenue of investigation in the future because if it proves to be true it would maximize the resources of service providers or local jurisdictions that are sampling onsite systems.

The correlation coefficients shown in Table 4-2 provide a comparison of samples taken from the collection chamber following the treatment device versus grab samples taken from the treatment unit effluent pipe. In most cases, the collection chamber sample quality correlated highly with the effluent pipe sample for BOD-5. Two exceptions, the System-M and System-H2 RX-30 units showed discrepancies in the results. The field observation records show significant upsets in the operation of System-M during this sample period. The records for System-H2 showed some non-specific issues (solids sloughing from the treatment process) that suggested operational upsets with this system as well. Apart from these issues, it appears the most consistent results between the two sample locations were the BOD-5 and TN. The total nitrogen pipe vs. chamber sampling results were highly correlated with the one poor correlation produced by the system with numerous operational upsets.

Total suspended solids pipe vs. chamber results were not as consistently correlated with each other although typically a correlation coefficient of greater than 0.7 is considered a good correlation. The differences may be due to difficulties in sampling the chamber without disturbing the attached growth on the chamber walls and pump fittings in those cases where the TSS is higher in the chamber than from the pipe. Higher results from the pipe samples may indicate settling in the pump chamber.

The bacteria results did not correlate well between sampling locations and were highly variable across the six systems. The project team expected the bacteria results would not be representative when sampling from the chamber because of either die off or growth, depending on the conditions in the chamber. Additionally, standard operating procedures for wastewater sampling require that bacteria samples be taken as grab samples from, typically, a free flowing sample stream. (Sams [Bush], 2003) This sample location could be of benefit when the system's evaluation focuses on potential impacts to the immediate environment rather than strictly the performance of the treatment system.

Figures 4-3 through 4-8 show the BOD-5 data for all six systems. A visual inspection of the data illustrates a high correlation for this parameter over time. Again, the data for Systems H2 and M indicate the difficulties these systems experienced during the sampling period. Generally, however, data from the chamber follows the trend of the pipe discharge in both cases, which implies that the chamber data is a good indicator of performance of the system. Systems-R, -F, and –S show such high correlations and strong relationships over time that there is no practical difference between sampling the effluent pipe or pump chamber. One possible reason for this is the effluent is blended as it moves through the septic tank. The effluent was further blended during the treatment process in the unit itself. As stated previously, the extent to which this blending can be relied upon to produce a representative sample warrants further investigation.

The TSS data was variable over the six systems. In general, the trend of the chamber data follows that of the pipe data as shown in Figures 4-9 through 14. However, in several instances, there were considerably higher levels of TSS in the chamber vs. the pipe. This may have been caused by sampling error if the sampler dislodged attached growth from the walls of the chamber or the pump fittings or by suspended growth if the effluent in the chamber was of such a quality as to support secondary growth. There are also several instances when there was greater TSS in the pipe sample than the chamber. This could be due to settling of solids in the pump chamber. Figure 4-11 illustrates a time when the pipe effluent was higher than the pump chamber effluent by approximately 10 mg/L. From the chart it appears that there was a significant difference in the quality of the effluent taken from the pump chamber. The negative correlation of the data points to a poor relationship between sampling results from the two locations. However, when the first three months data is removed from the data set, the correlation is good for the remainder of the sample record (r = 0.77). Based on these data, the project team felt that the TSS results from the chamber were not as representative of the quality of effluent that the advanced treatment unit produced.

The total nitrogen data provided in Figures 4-15 through 4-20 show the highest correlations of the study. At each site, nitrogen data from the pump chamber correlated strongly with the effluent pipe data regardless of the systems' performance or operational history. The lowest correlation of the group, System-M at r = 0.79, was caused by significant differences between the first set of sampling results of the record. While this r-value was lower than the rest of the systems studied, it is still considered a high correlation according to conventional statistical methods (Osborn, 2003). These methods typically consider r>0.70 to be highly correlated. When the first set of data was removed from the calculation for System-M, the correlation coefficient of the sampling period equals 0.96, equivalent to the correlations produced by the other systems.

Given these results, the project team believed that total nitrogen data was representative of the systems' performance and of the quality of effluent discharged to the dispersal field independent of whether the sample was taken from the effluent pipe or the pump chamber following the treatment unit. Originally, the project team hypothesized that additional nitrogen reduction would occur in the pump chamber because of the attached and suspended growth commonly observed in pump chambers. However, given the lack of difference between the results, additional nitrogen reduction did not occur and the compositing nature of the upstream components appeared to have more effect on the results.

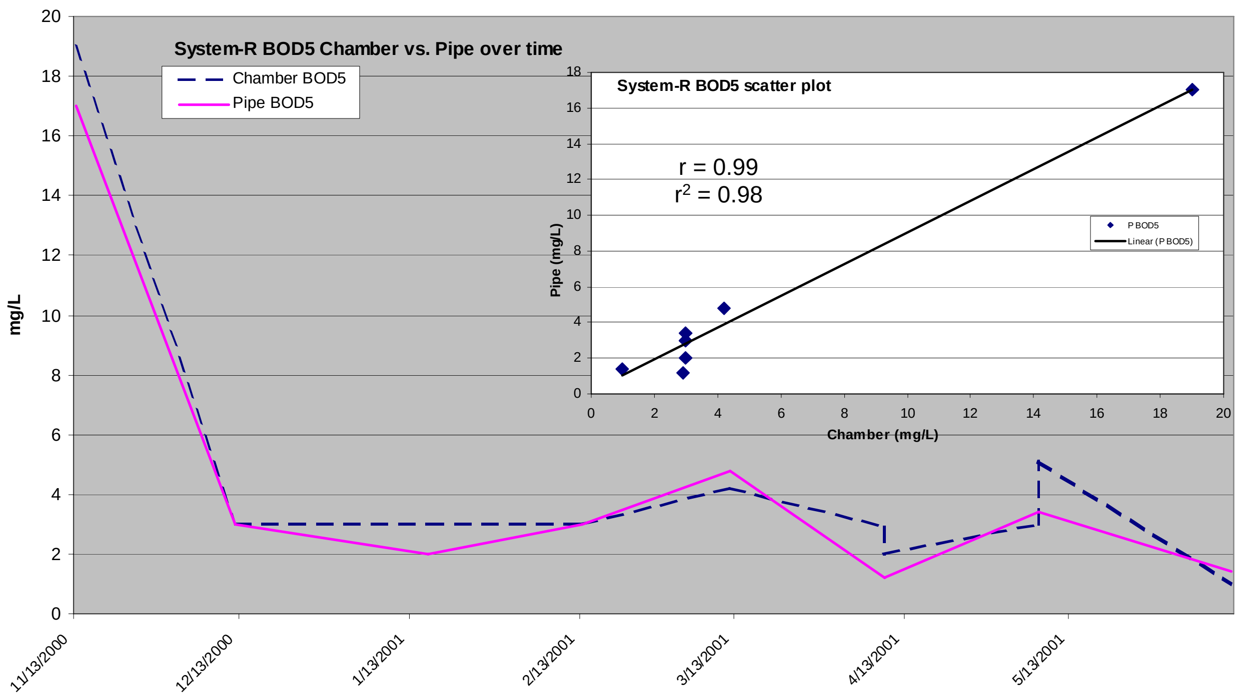

Figure 4-3. RX-30 System-R pipe vs. chamber BOD-5 data

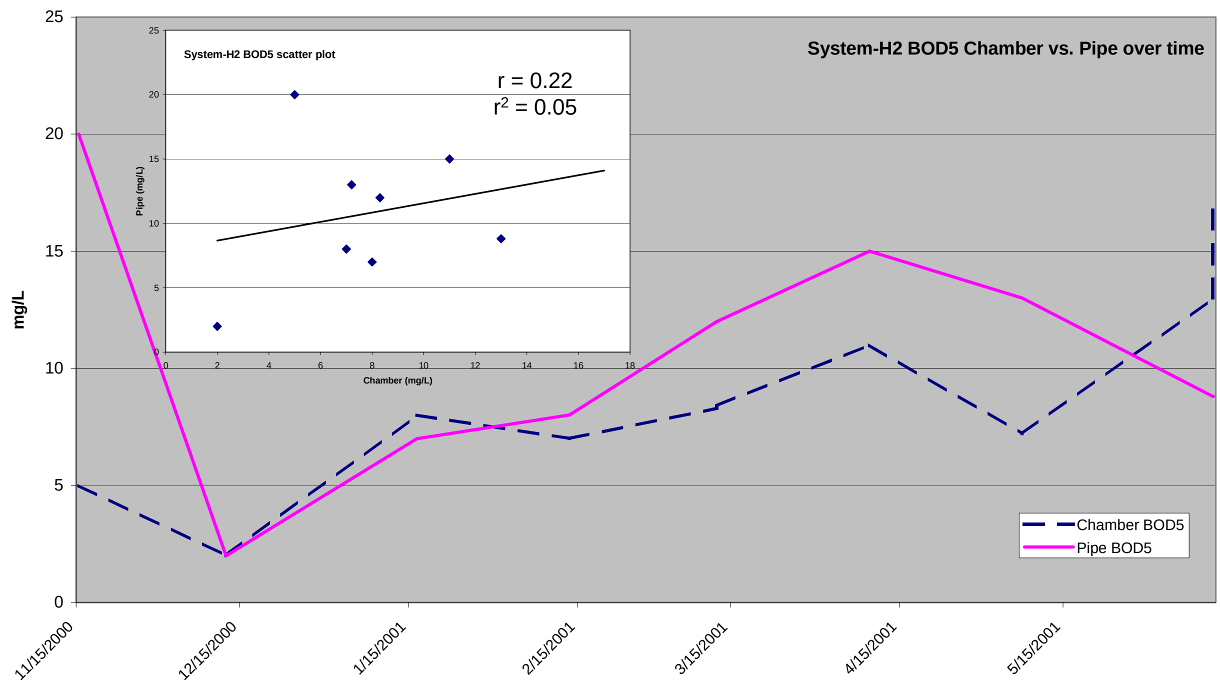

Figure 4-4. RX-30 System-H2 pipe vs. chamber BOD-5 data.

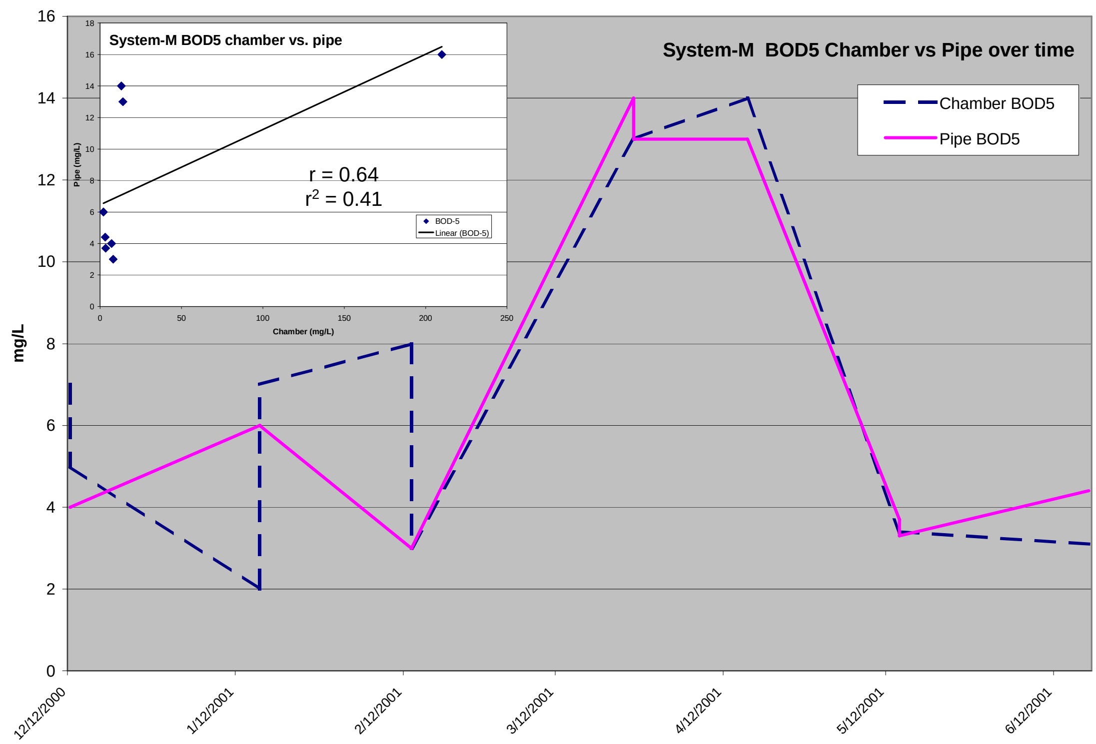

Figure 4-5. RX-30 System-M pipe vs. chamber BOD-5 data.

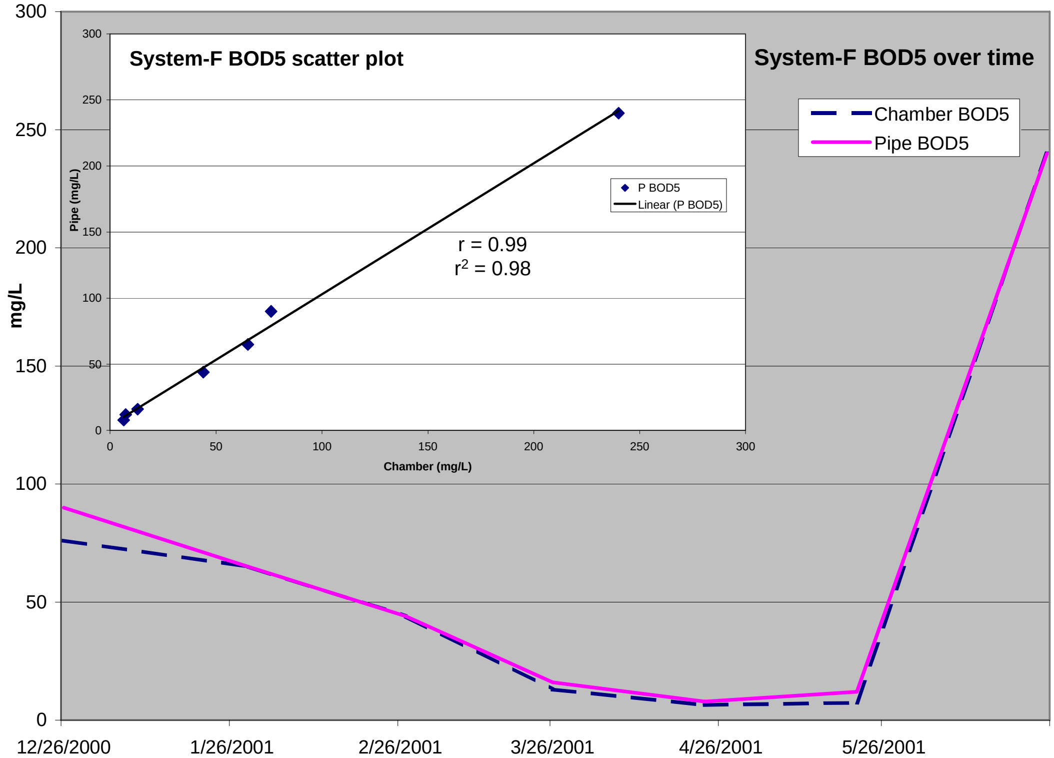

Figure 4-6. NITREX System-F pipe vs. chamber BOD-5 data.

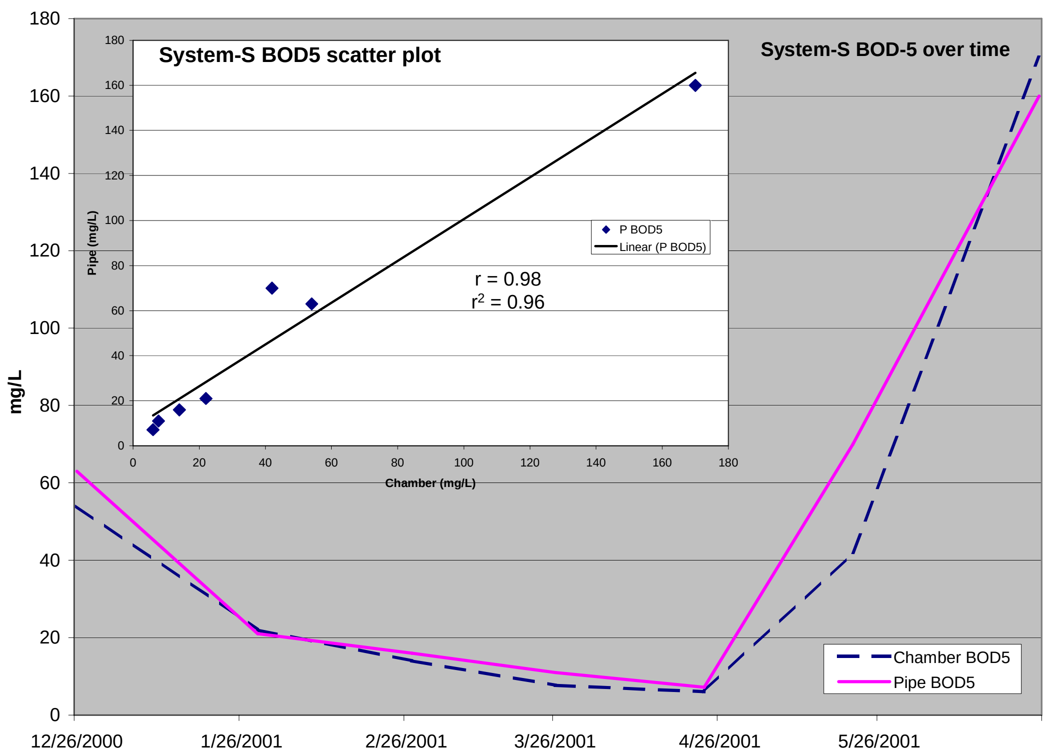

Figure 4-7. NITREX System-S pipe vs. chamber BOD-5 data.

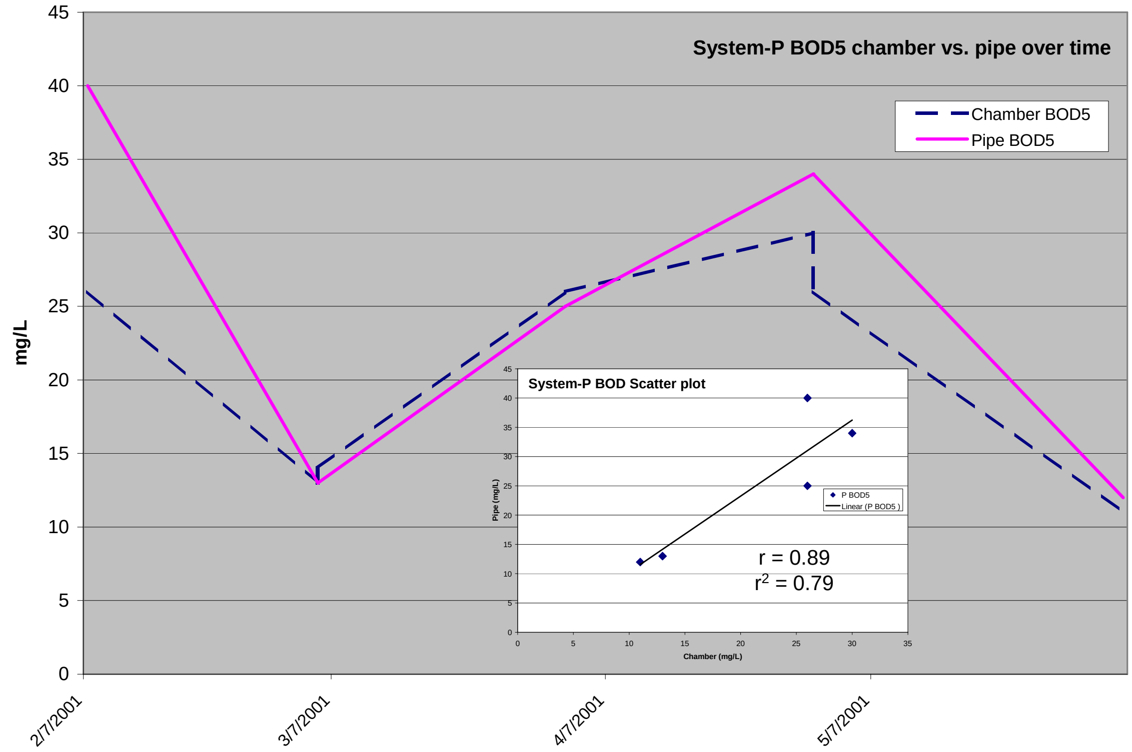

Figure 4-8. FAST System-P pipe vs. chamber BOD-5 data.

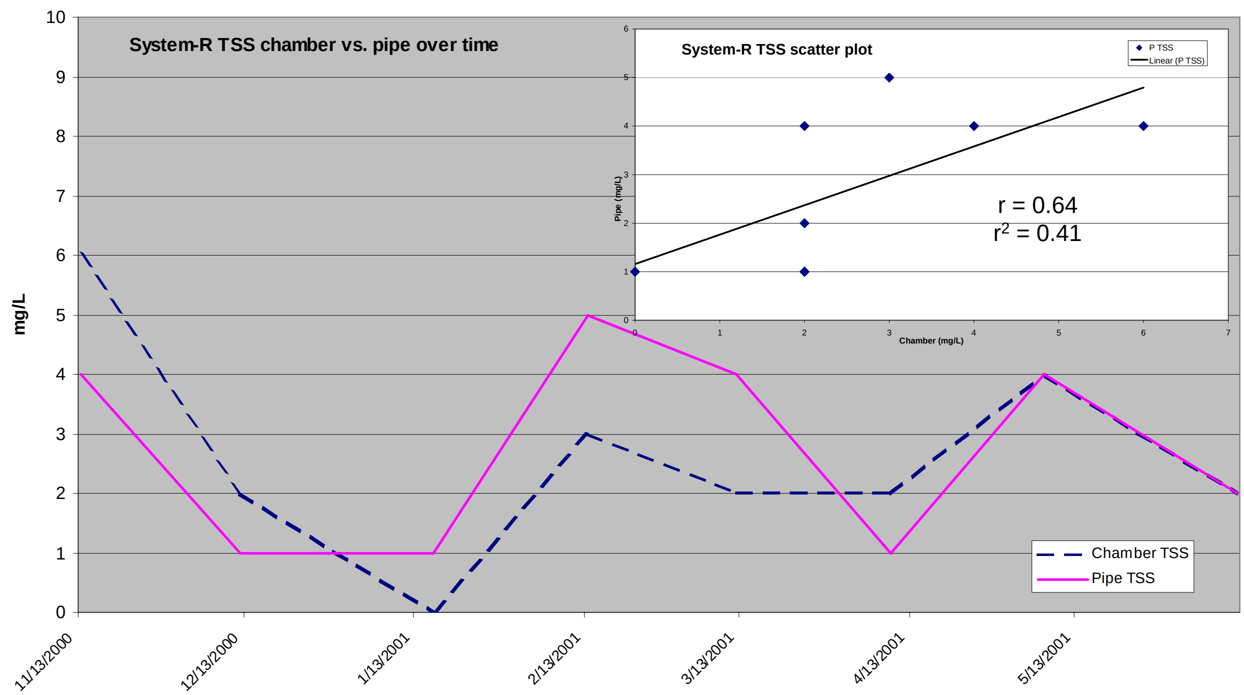

Figure 4-9. RX-30 System-R pipe vs. chamber TSS data.

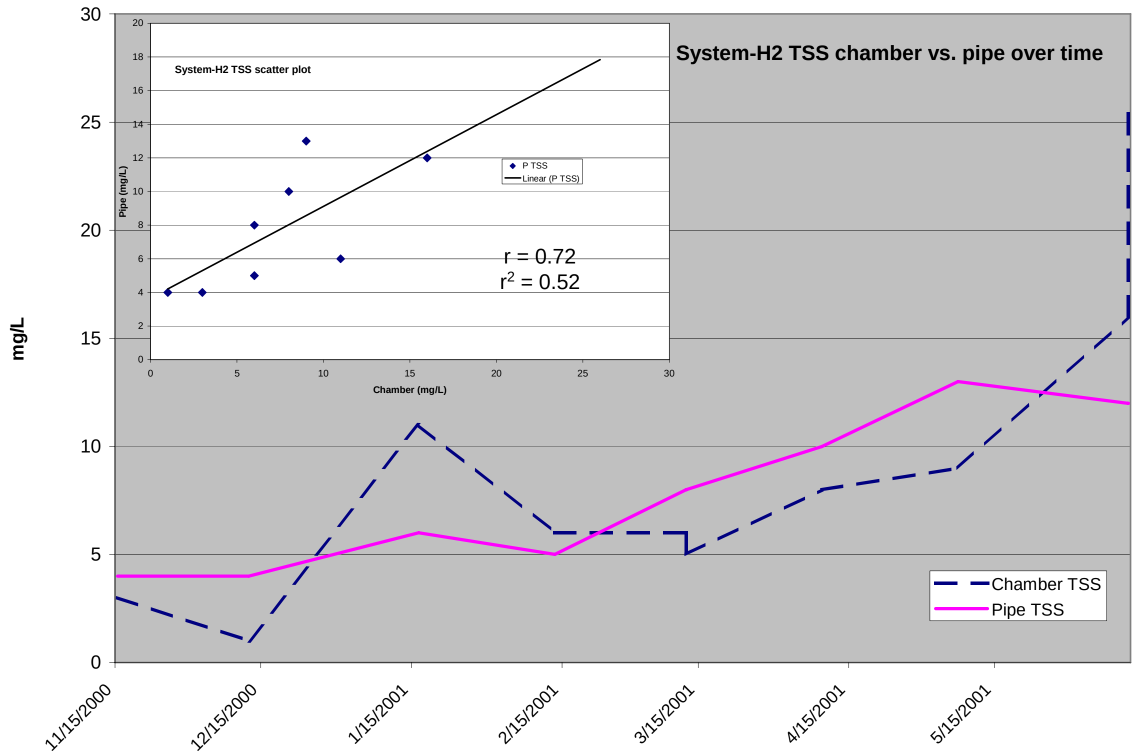

Figure 4-10. RX-30 System-H2 pipe vs. chamber TSS data.

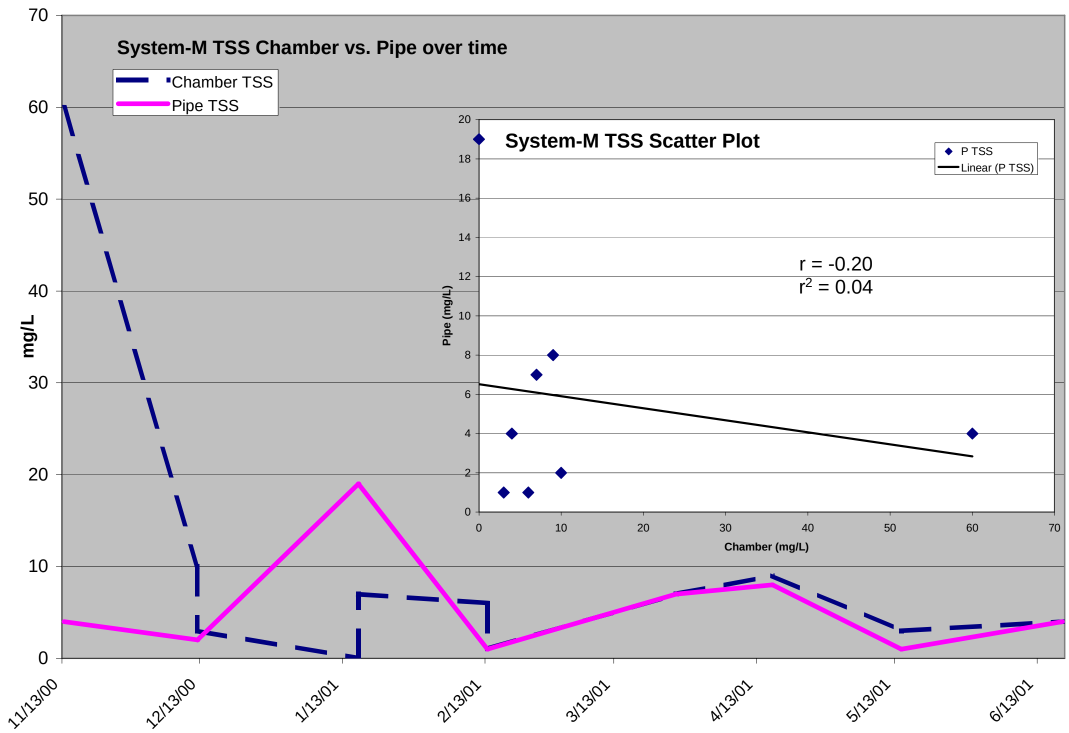

Figure 4-11. RX-30 System-M pipe vs. chamber TSS data.

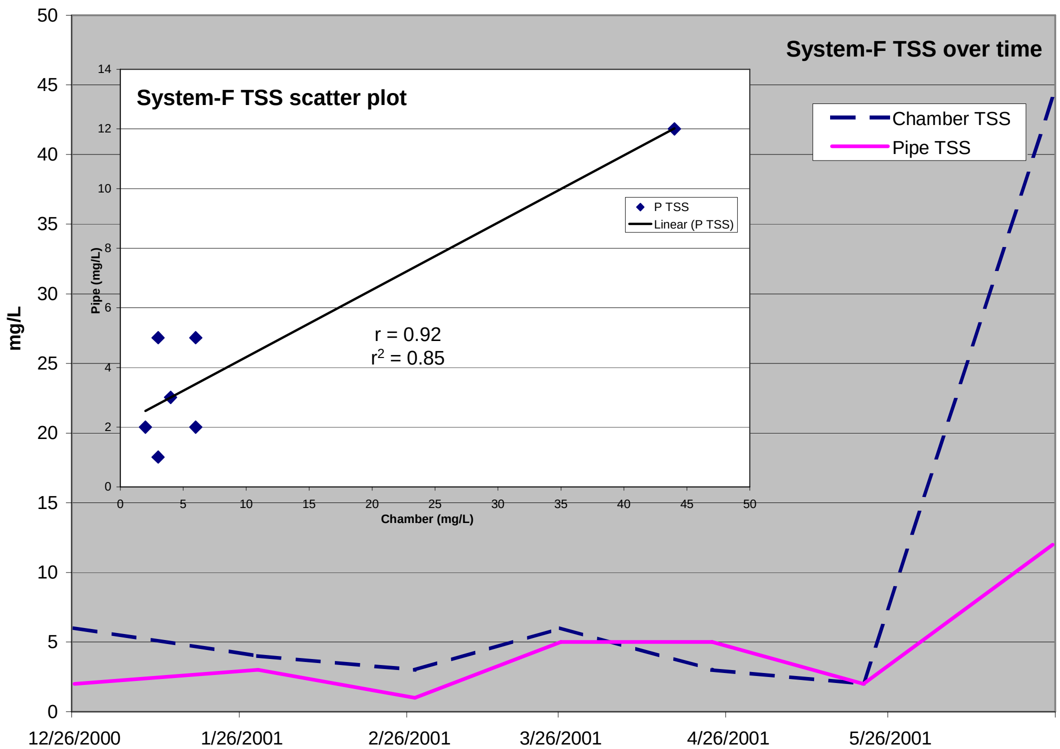

Figure 4-12. NITREX System-F pipe vs. chamber TSS data.

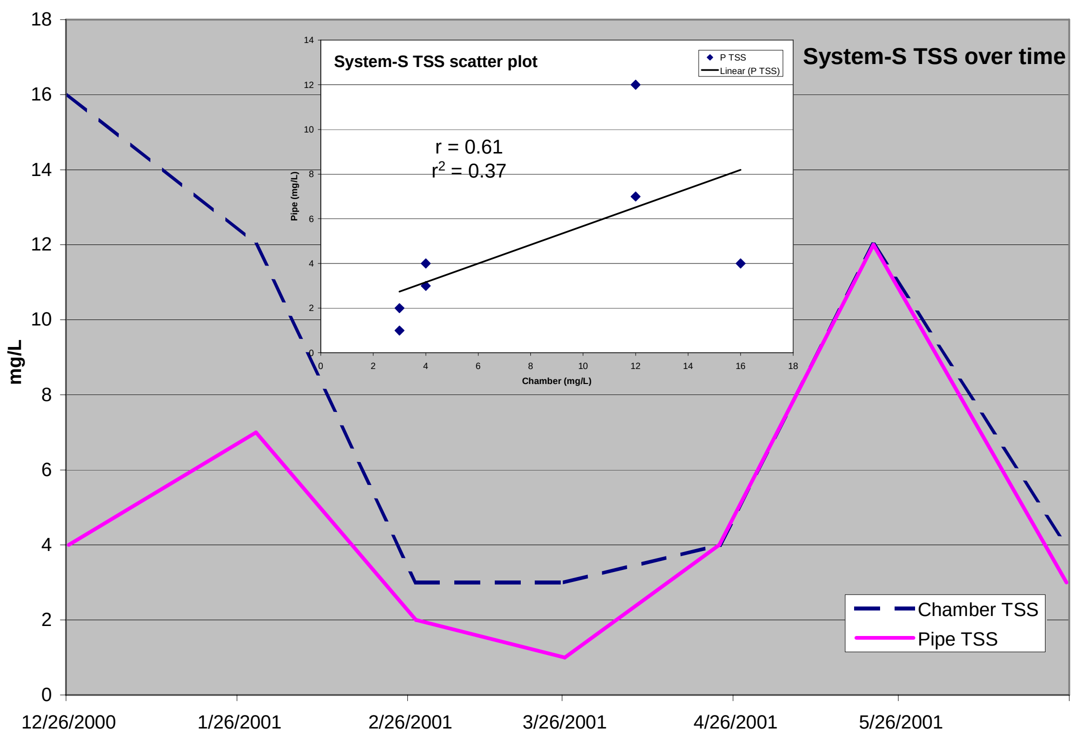

Figure 4-13. NITREX System-S pipe vs. chamber TSS data.

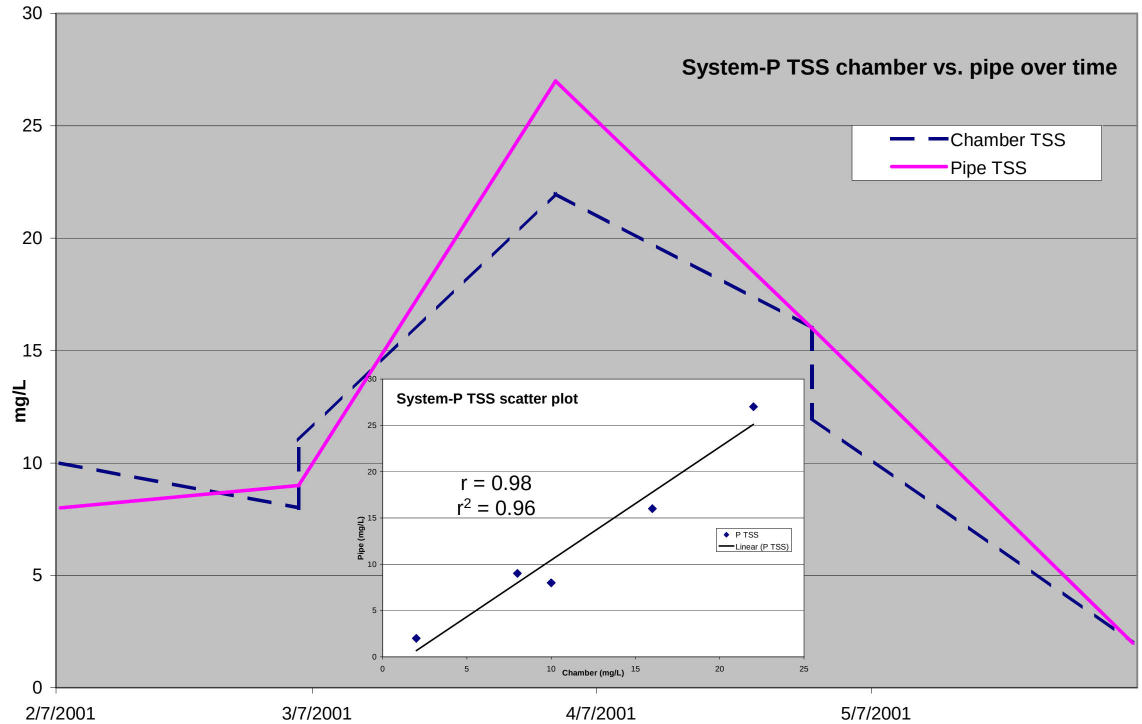

Figure 4-14. FAST System-P pipe vs. chamber TSS data.

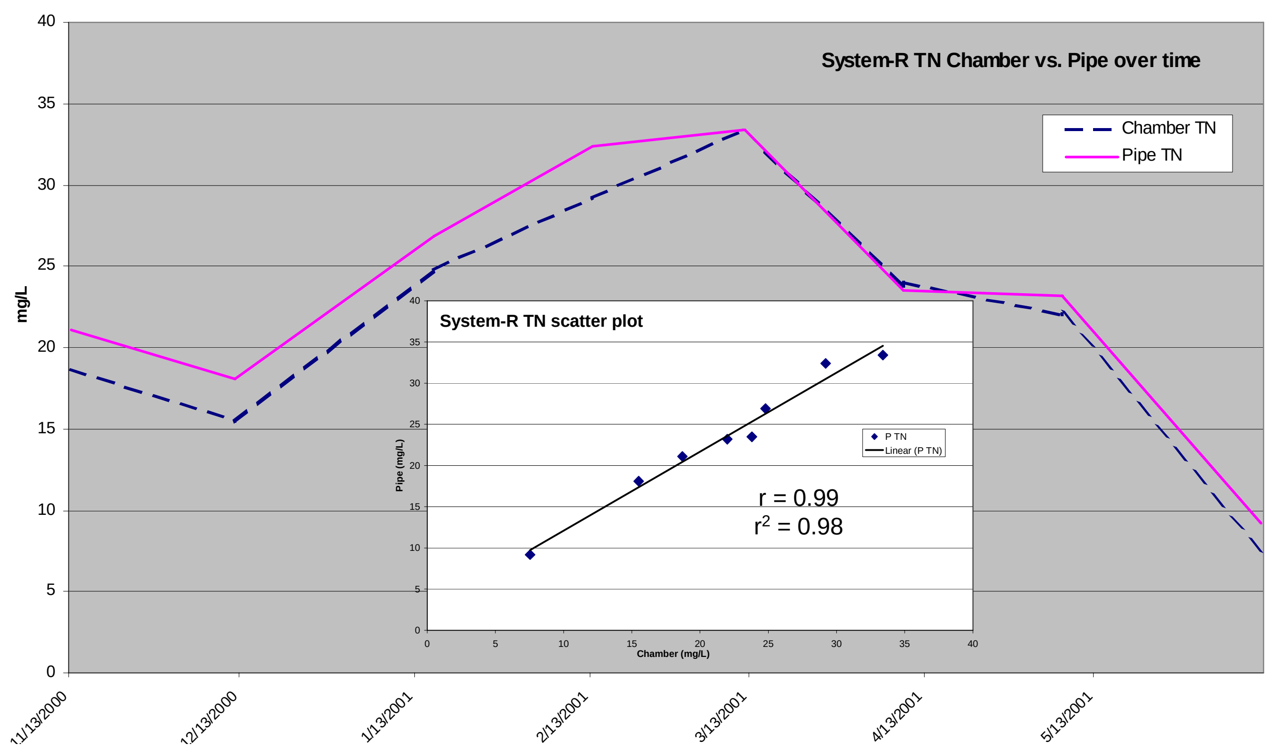

Figure 4-15. RX-30 System-R pipe vs. chamber Total Nitrogen data.

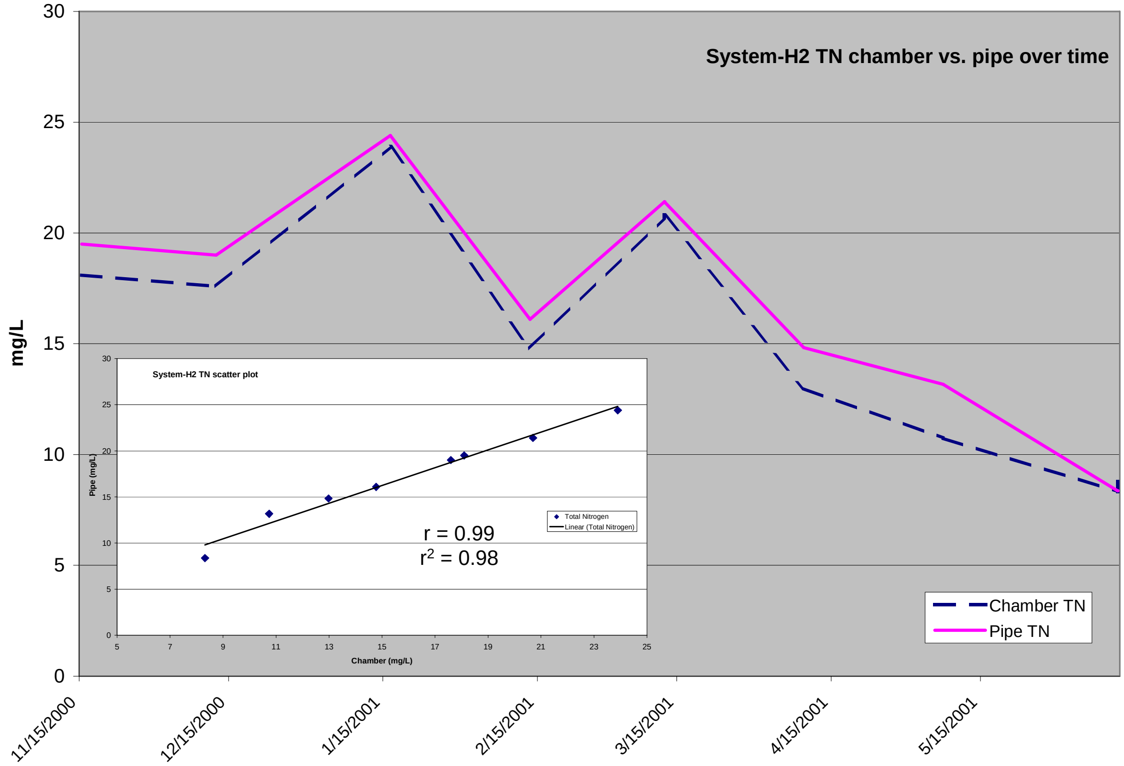

Figure 4-16. RX-30 System-H2 pipe vs. chamber Total Nitrogen data.

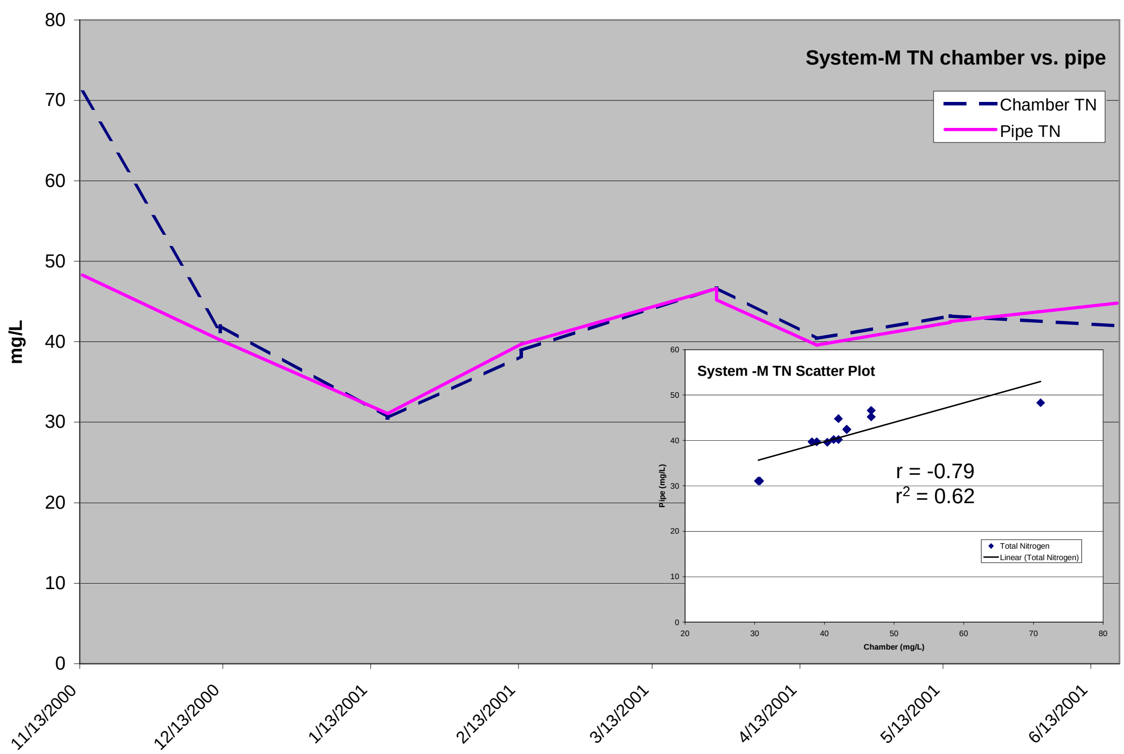

Figure 4-17. RX-30 System-M pipe vs. chamber Total Nitrogen data.

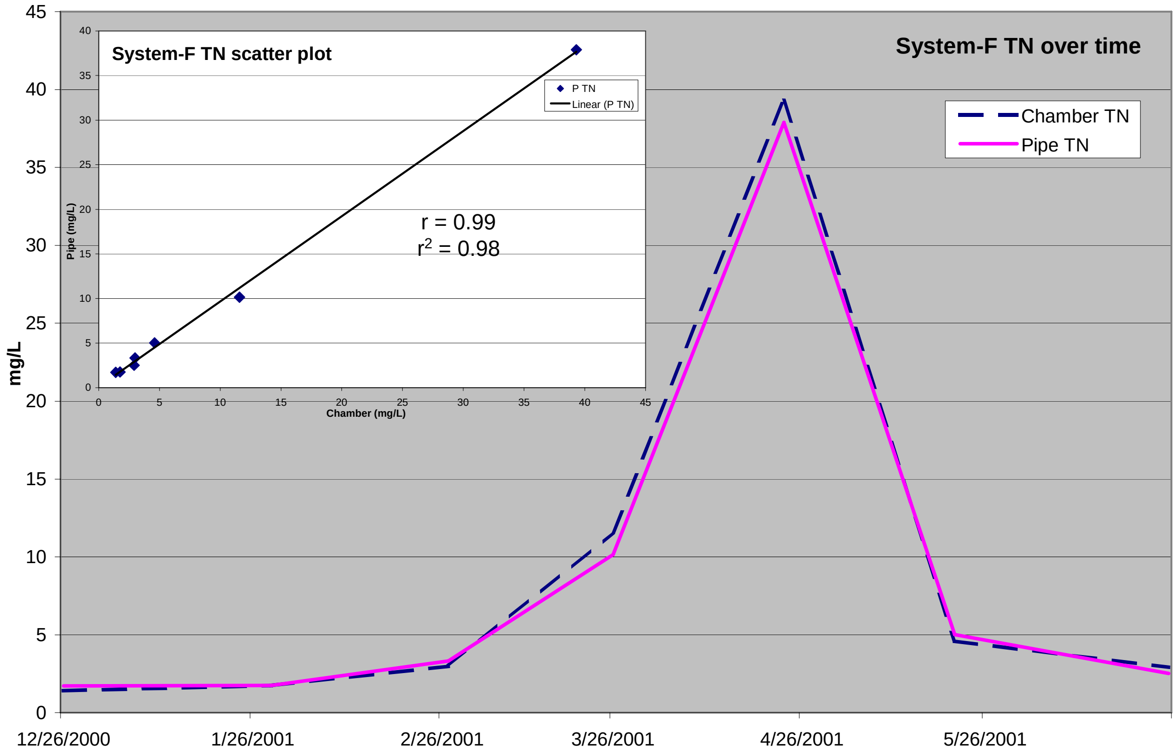

Figure 4-18. NITREX System-F pipe vs. chamber Total Nitrogen data.

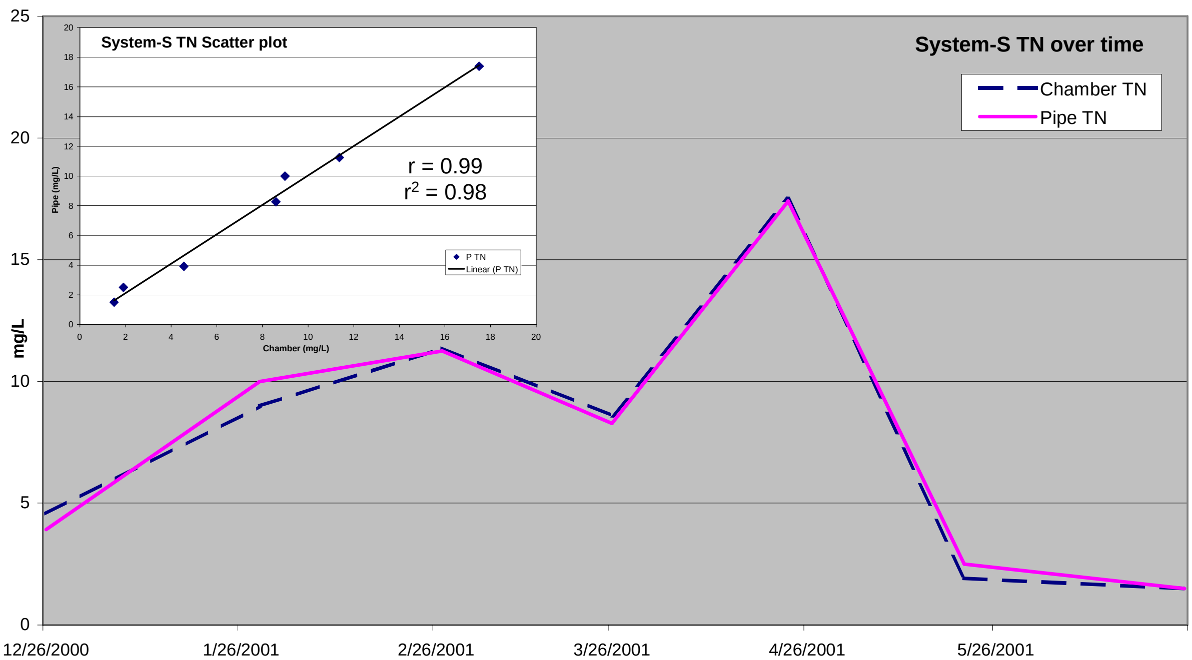

Figure 4-19. NITREX System-S pipe vs. chamber Total Nitrogen data.

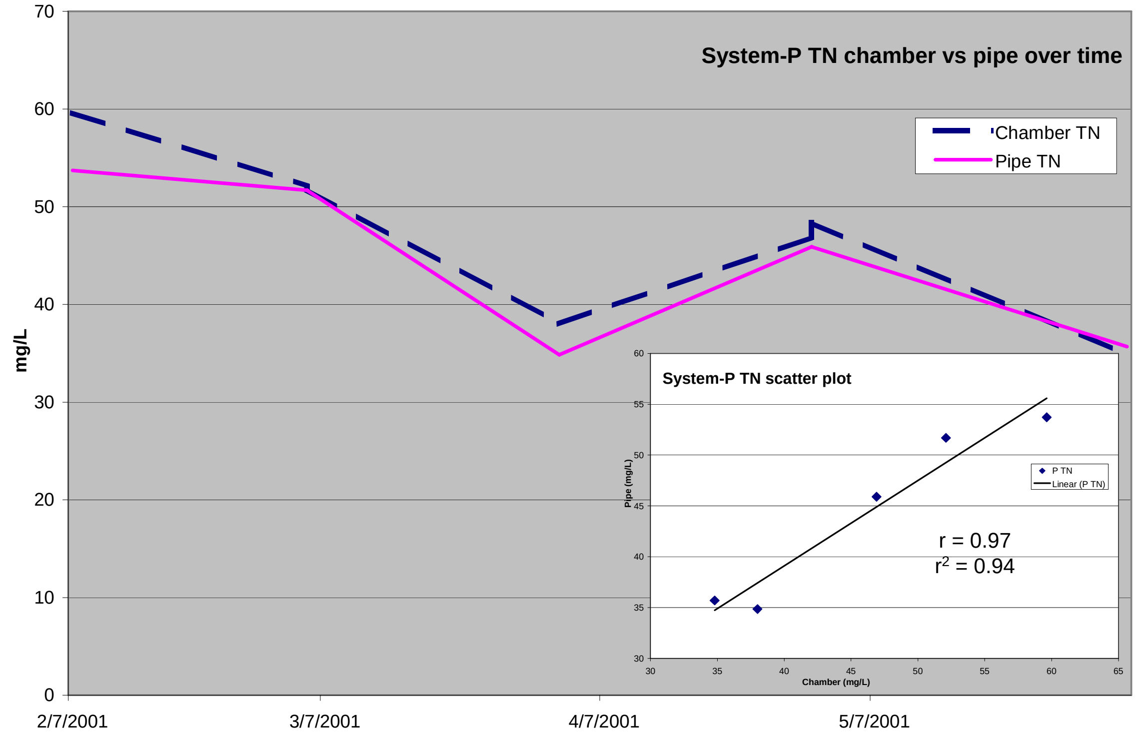

Figure 4-20. FAST System-P pipe vs. chamber Total Nitrogen data.

Management and Education

Onsite System Maintenance: A demonstration project within the demonstration project

This section reviews the approach taken in the La Pine Project to ensure that the innovative and control onsite systems were properly maintained for at least the duration of the project and, if successful, in perpetuity. As we found, the operation and maintenance program existing in Oregon during the La Pine Project provided only part of the mechanism needed to ensure that onsite system maintenance was completed in a timely and professional manner. In illustrating the existing situation, this section outlines the baseline from which the La Pine Project started, lessons learned during the project, and possible alternative approaches. The approach described below was allowed by the onsite regulations in effect at the time. In March 2005, the DEQ revised the state regulations to establish the process for approving innovative onsite technologies and to facilitate the permitting process for the systems at the local level (DEQ, 2005).

Water Pollution Control Facilities (WPCF) Permit Requirements

The Oregon Administrative Rules (OARs) in effect at the beginning of the La Pine Project (DEQ, 2000) provided the starting point from which the La Pine Project developed the demonstration maintenance program. There were several provisions in the rule that the project team applied to the 49 systems and property owners participating in the project.

Section 340-071-0130, General Standards, Prohibitions and Requirements, specifically stated that,

> *"all systems shall be operated and maintained so as not to create a public health hazard or cause water pollution. Those facilities specified … as requiring a [Water Pollution Control Facilities] WPCF permit shall have operation and maintenance requirements established in the permit."*

Each property owner in the La Pine Project receiving an innovative treatment system was required to obtain a WPCF permit from the DEQ. Each property owner receiving a standard septic tank and gravity drainfield, pressure distribution system or bottomless sand filter obtained a construction/installation permit from the county. (Construction/installation permits are discussed below.)

OAR 340-071-0162, Permit Application Procedures – WPCF Permits, stated that applicants wishing to obtain a WPCF permit must identify the person responsible for operation and maintenance activities before the permit can be issued. Ultimately, however, the responsible person was the property owner. There were few or no specifications in the rule for the minimum type of maintenance or the minimum information to be included in the operation and maintenance manual for the system. The intent behind these omissions was to allow the rule to remain flexible and adapt to different wastewater treatment technologies. Manufacturers or vendors of advanced treatment units were required to specify maintenance schedules and activities and these requirements were incorporated into the permit by reference.

The WPCF permit language used for the La Pine Project systems included the following as a compliance condition:

> *"Compliance Conditions and Schedules*
>
> *1. The permittee shall, at all times, maintain a contract with the manufacturer's authorized representative to operate, manage and implement preventative maintenance practices or corrections at the frequencies pursuant to the Department-approved O&M Plan for the permitted sewage treatment and disposal system. A copy of this contract shall be provided to the Department within 30 days of the issuance date of this permit."*

The homeowner had a definite requirement to report the O&M activities and other occurrences related to the onsite system. Unfortunately, there was not a corresponding method by which to require or otherwise enforce the maintenance performance or reporting requirements on the service provider. The contract for the maintenance existed between the homeowner and the service provider and, with few service providers available, the homeowner had little recourse if the service provider did not perform adequately. In most instances, the homeowner was uninformed as to whether the service provider was performing the appropriate service or not because of the lack of reporting to the homeowner or the permitting agency. Typically, the county's first approach to enforcement was to obtain voluntary compliance first and take more stringent action if voluntary compliance was not forthcoming. The county first attempted to obtain voluntary compliance and only recommended more stringent action if unsuccessful. However, the demonstration project found that there was little practical recourse for enforcement action if the homeowners were powerless to improve the basic underlying competence of their particular service provider or service providers in general. This became a particular issue in the La Pine Project where there was only one service provider trained by the vendor to maintain their systems. Homeowners in these situations often felt coerced into paying service providers because 1) they had no choice, and/or 2) they were not convinced that the service providers were actually providing them with a service of value (*Operation and Maintenance Advisory Committee members, personal communications*).

Construction/Installation Permit Requirements

The systems installed under a construction/installation permit had to meet the statewide standards whether a contract county or the state issued the permit. The construction specifications for standard tank and drainfield systems and pressure distribution systems were prescribed in rule. During the La Pine Project, property owners were required to enter into contracts with a service provider but specific requirements were not prescribed in conjunction with any of these systems.

Sand filter construction was also prescribed in rule and OAR 340-071-0305, Sand Filter System Operation and Maintenance, provided operation & maintenance guidelines for these systems. This section included specific recommendations in terms of inspection schedules and the levels of sludge and scum accumulation at which the septic tank should be pumped. This section also included this language:

> *"Operation and Maintenance Standards for All Sand Filters. The owner/purchaser of a sand filter system shall assume the continuous responsibility to preserve the installation as near as practical in its "as built" state. This responsibility includes the control or erosion of any "mound," the control and removal of large perennial plants, the fencing out of livestock and the control of burrowing animals."*

The latter provisions are an example of how specific the rule is for sand filters; including a fee that allows the permitting agency to cover the costs of inspections. However, few jurisdictions in Oregon have implemented this rule. Reasons commonly cited included an unwillingness to impose an additional fee on the regulated population, inadequate staff levels, too few sand filters to make the effort worthwhile, and the fear of liability for the outcome of the inspections. Some jurisdictions believed that they were infringing on the private sector if they provide inspections of this nature. The corollary to this last concern was that although OAR-340- 071-0305 allows for an inspection, the work that may be required as a result of the inspection would be undertaken by the private sector for completion. Common concerns cited by jurisdictions included the associated uncertainty that the work performed would be adequate (because of the lack of specified maintenance activities) or if the person hired was competent (because, as stated earlier, no basic educational requirements or certification were needed to become an onsite system service provider at that time).

During the La Pine Project, the only means of enforcing the O&M provisions in either the WPCF or the construction permit program was the Notice of Non-compliance/civil penalty route. There was no opportunity to stimulate voluntary compliance in advance. One recommendation of the O&M Advisory Committee (appointed by Oregon DEQ and Deschutes County and funded by the La Pine Project) was to require time of sale inspections for properties served by onsite systems (Chapter 7). This would create an incentive where the permitting agency could waive or significantly lower the agency's time of sale inspection fee if the system had been maintained appropriately and the records were up to date. The second incentive would be the easier closing process and fewer potential repairs required by the permitting agency if the system had been properly operated and maintained over its life.

As a result of the difficulties encountered when requesting reports of service providers participating in the La Pine Project, the onsite systems appeared to be inconsistently maintained. Only two or three service reports were submitted and the copies of the few service contracts (executed between the homeowners and the service providers) received by the project team did not state that any reports, to the homeowners or the permitting agency, would be provided.

Private service providers

In an effort to increase the level of expertise at the local level, the La Pine Project team required each vendor participating in the project to train a local maintenance or service provider on the system installed. The service provider became the local designated representative for maintaining that type of system. At the time the majority of systems were installed, there was one person already working as an onsite system service provider in Central Oregon. This person was selected by several vendors to become the designated service provider for their system. In other cases, the vendors worked with installers of the systems to train them on the maintenance activities required for their systems. In both instances the vendors typically worked with the designated service provider during or shortly after installation of the system to review the maintenance requirements. The information was also typically provided in a manual or other hard copy format.

The non-proprietary control systems were treated in different manners. The septic tank and drainfield systems were turned over to the homeowner with educational materials on what should and should not be put down the drain and with recommendation schedules for pumping the septic tank or primary processing tank. The pressure distribution and sand filter system owners were required to have a contract with a service provider for annual service visits. The state or county offices provided the requirements for maintenance of these systems upon request.

A fundamental requirement missing from this scenario was a provision in the rule or the permit requiring the service provider to meet basic educational requirements for maintaining onsite systems. The ability of any person wishing to maintain onsite systems was taken at their word. The result was that several service providers were servicing systems without basic knowledge of how onsite systems were supposed to work beyond the hydraulics of making water flow down gradient. This lack was even more problematic with advanced treatment systems. For example, project staff encountered difficulties discussing problems a denitrifying system was having because the service provider was convinced that the system was not performing because the anoxic process was not working properly. Project staff tried to point out that the field measurements indicated that the aerobic process wasn't functioning. The service provider did not seem to understand the biologic process needed properly aerated (nitrified) wastewater before the anoxic portion of the cycle could denitrify the effluent. This highlights a significant barrier, which could affect any jurisdiction seeking to implement innovative wastewater treatment units. Onsite system professionals, including regulators, should have an academic understanding of the biological processes contained in the various treatment systems.

The service providers working on the La Pine Project systems tended to have multiple businesses, the most common combination being that of onsite system installer and service provider. Others included residential excavation and construction and stormwater drainage system maintenance. The installer/service provider business model, at first review, appeared to be a logical approach because the installers are familiar with onsite system designs and components. The combination of businesses did not work well in practice in the demonstration project because the installers tended to focus first on their installation jobs and secondly on the maintenance needs of the systems under their care. As a result, maintenance activities tended to become a reaction to alarms or other events with the system and proactive maintenance was overlooked. Again, the lack of service records makes understanding the interplay in these situations difficult. It is unclear if the informal nature of training most service providers received contributed to an informal attitude towards maintenance. The lump sum payment received by some service providers may also have devalued the preventative service visits because the actual cost of performing service exceeded the amount collected for the initial two-year warranty for NSF certified systems (NSF, 2000) due to travel time or other factors.

Homeowner Education

Homeowner education efforts during the La Pine Project met with somewhat limited success from the time that onsite system design choices were made through long-term operating choices. The La Pine Project team noted that consumers tended to choose the cheapest available package when it came to onsite system installations. This tendency prevailed even when a poor choice at the design phase could have deleterious effects on long–term home life and household function. Part of this mindset may have been due to the fact that many homes in the area are built on speculation or that many homeowners seemed to place a low value on a household system that was installed as much out of sight as possible. Several of the homeowners participating in the field test program asked about performing maintenance on their own system. When asked why they were interested in this activity, all of the homeowners stated that the primary reason was to save the cost of hiring an independent maintenance provider. At the time, the cost of the maintenance contract ranged between $150 and $300 per year. As homeowners learned what was required to properly maintain an onsite system, interest in undertaking the activity waned dramatically because, in the words of one homeowner, they were not interested in "getting to know their sewage that well."

At the time the La Pine Project was conducted, no minimum educational standards were required of installers to enter the business. As a result, many installers did not have basic understanding of how onsite systems operate in terms of the wastewater treatment processes that occur within the treatment system and the soil dispersal site. No standards for basic educational requirements or certification within the installer community meant that there was no minimum standard for bids on installation. This affects homeowners and installation quality because homeowners typically request bids from installers and accept the lowest cost without questioning the quality of the bid. This was not necessarily a failing of the homeowner but instead indicated a role for the regulatory agency to improve the educational and credential requirements for onsite wastewater professionals. This role could be a cornerstone in a robust customer service oriented program because the agency could provide important information on what should be included in a good bid, basic provisions to watch for in a service provider contract and basic operating needs of onsite systems.

The La Pine Project team believed that homeowner education would be essential to the success of a long-term maintenance program. Therefore, the project team included the following steps in working with homeowners participating in the project.

1. *Individual meetings.* Each homeowner participating in the innovative treatment system field test program met with project staff individually for an information sharing session. Each meeting included discussion of project goals, expectations for their participation, permit conditions and the contract to be executed between the property owner and Deschutes County. In addition, project staff included information on the kinds of treatment systems they might receive and their operating requirements.

2. *Written information.* After the initial meeting and once participation was assured by completion of all pertinent legal agreements, the participant received a binder which included the permit, contract with the county, general O&M information, and specific information about the system they were to receive. The binder also included log sheets for noting alarms and observations, and space was provided for the service provider contract, as-built drawings and other pertinent information for their site or system.

3. *Site visits.* Once the system was installed, the sampling team visited the property monthly for the first year. This visit became an important point of contact with many of the property owners and a significant amount

of education took place in this fashion. Because of differing work schedules, this approach did not reach all property owners.

4. *Direct mailings.* Occasionally, project staff sent informational mailings to the property owners. This occurred irregularly and was generated more out of need or opportunity than any planned process. For example, when the county developed a new brochure on the use of anti-bacterial products, the property owners received a copy directly by mail. Each property owner also received a midterm report to describe the system and its operation, performance data to date, and the cost of their system and monitoring wells.

Many of the homeowners participating in the project were conscientious and appreciated the information and service the project provided. A number of homeowners, however, either did not understand or read the information that was provided. A common example was the use of "every flush" toilet bowl cleaners. Project staff mailed information to all the participating homeowners and advised them not to use these products because of manufacturer specifications or because of water quality effects (see for example, Figure 6-76) in systems exposed to them. However, the sampling team still observed several sites where the treatment system and, on one site, the lysimeter one foot below the drainfield discharged effluent that was distinctly blue in color despite efforts to work with the homeowner to avoid these products during the test period.

Homeowner education might have been more effective if the service providers had taken a more active role. The service providers have the opportunity each time they visit sites to give the homeowner substantive feedback on the performance of the system and potential impacts of different activities. Service providers are a non-regulatory presence paid by the homeowners and a third party source of information. There is potential, as certification programs develop, to foster a strong sense of customer service in service providers so that they actively work to help homeowners understand potential impacts, including financial impacts, of their actions.

The service providers participating in the La Pine Project systems did not appear to provide much organized homeowner education. Some service calls were accompanied by verbal reports to the La Pine Project team, but written reports were rare to non-existent even after repeated requests for information. In addition, homeowners often asked project staff how their system was working because they did not get reports from the service providers. Because there was no certification or license required, there was no way for the permitting agency or the homeowner to divest non-performers of the ability to continue to work. Other feedback received from homeowners included concern about the lack of bond required for service providers as there was for installers and septic tank pumping services. This lack caused the homeowners to feel their investment was at risk if the service provider damaged the system.

An issue highlighted earlier related to the two year warranty required for NSF certification can also impact homeowner perceptions on the value of service providers because the homeowners tended to view the first two years of service as free (the fee was actually included in the price of the system). As a result, they undervalued the service they received during that period, particularly when the service provider did not give significant feedback to the homeowner on the system's performance. Homeowners also tended to forget that the service contract should be extended after the warranty period or complained because they felt the contract was not worth the price. The vendors that were candid about the maintenance requirements of the system and made contact frequently with the homeowner had more success in keeping the systems maintained beyond the warranty period. However, this latter scenario tended to occur only with those products where vendors provided service rather than using a third party. This outcome highlights the need for service providers to educate homeowners about the value of their product.

Service Provider Certification

The service providers working in Oregon under the rules in place during the La Pine Project had no requirement to obtain a license, bond or certification, as has been mentioned above. Therefore, no minimum education was required to enter the business, which meant that there were service providers working with limited knowledge of how onsite systems, conventional or advanced, treat wastewater. Many providers had a working knowledge of the hydraulics involved or the control panel of a system but did not comprehend the biological processes. This inhibited their ability to provide appropriate service, particularly when an advanced treatment system process was compromised.

The lack of a license or certification also meant that there were no minimum standards for a job well done. And if a job was not well done, there was no recourse to prevent that service provider from continuing to work. This has been a recurring theme in this section because of homeowner concerns stated to the La Pine Project team about minimum qualifications and consumer protection. The lack of a certification program also removed an incentive or obligation for the regulatory agency to follow up on the work of a service provider.

In March 2005, the DEQ revised the state regulations to establish a certification program for onsite system service providers. Certification for service providers in Oregon is required after March 1, 2006. (DEQ, 2005)

Conclusion

Sampling onsite wastewater treatment systems originates in the standard operating procedures for sampling larger centralized or municipal systems but different approaches are required to accommodate the differences in process. Further examination is necessary to determine the standard operating procedures for sampling onsite systems that will support a long-term sustainable monitoring program for permitting authorities and private constituents. The suite of sample parameters taken from a system will largely be driven by site-specific or regional environmental and public health concerns. The La Pine Project, located in a nitrogen sensitive area, concentrated on BOD-5, TSS and nitrogen as the primary constituents for evaluating the systems' performance. A secondary suite of parameters provided further information on the quality of system performance or troubleshooting for underperforming systems. These parameters included bacteria, total alkalinity, chloride, and the field parameters of DO, pH, conductivity and temperature.

The type of sampling equipment can be an important factor in the ease and safety of sampling an onsite wastewater system. Consistency of technique and personnel can directly impact the quality and reliability of the dataset. Dataset quality also relies upon using consistent and representative sampling stations. A grab sample from the pump chamber following the treatment unit correlated strongly to the end of the pipe discharge for BOD-5 and total nitrogen and relatively well for TSS. Therefore, if no other option is available, sampling from the pump chamber can be substituted for the effluent pipe sample if necessary. Bacteria results from the pump chamber are suspect and standard procedure should be to sample from the effluent pipe if the quality of the effluent discharged from the treatment is desired. However, the quality of effluent discharged to the environment may be better characterized by samples from the pump or collection chamber following the treatment unit. In general, the La Pine project team decided to take grab samples from the effluent pipe leaving the treatment unit to represent the performance of that unit whenever possible and at least for the bacteria samples if the total sample suite could not be taken from free falling effluent.

The hypothesis that septic tanks, treatment units and pump chambers have a compositing effect on the effluent needs to be tested with side-by-side comparative sampling. The potential financial benefit to the homeowner, permitting agency and maintenance service provider of a representative alternative to composite sampling would be significant.

The La Pine Project used private sector services providers with a regulatory requirement for service imposed on the homeowners. This scenario contained the three stakeholders shown in national onsite system management models (Otis, 2003). However, the link between the regulatory agency and the service providers was not adequate. This link, while creating another layer of regulation on the service provider, can establish a mechanism to foster consumer protection in the onsite industry by providing a means of constructive or code enforcement feedback to service providers. This could also help build homeowner confidence in the quality and value of the service provided. The La Pine Project found that private sector service providers have the potential to perform well as long as there is a minimum level of education and professional integrity. The other link missing in this demonstration was that of regulatory requirements for maintenance on conventional systems (standard tank and drainfield, pressure distribution and sand filter systems). The experience described was influenced by the onsite regulations in effect at the time. In March 2005, the DEQ revised the state regulations significantly (DEQ, 2005).

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