GONZAGA UNIVERSITY

PEND OREILLE COUNTY PARK
IMPROVEMENT PROJECT

SENIOR DESIGN GROUP CE-9
FINAL REPORT

April 22, 2010

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EXECUTIVE SUMMARY

This is the final project report for the senior design project to design improvements to Pend Oreille County Park. These would include equestrian facilities and camping for recreational vehicles. The project plan includes twelve lots for equestrian facilities and twelve lots for RV’s, half of which would be designed with future expansion in mind. This document provides the background for this project, the specific design features, team identification, road design, water system design, and sanitation facility design.
# Table of Contents

1.0 Introduction ......................................................................................................................... 1  
   1.1 Problem Statement ............................................................................................................. 1  
   1.2 Mission Statement ............................................................................................................. 1  
   1.3 Team Description ............................................................................................................. 1  

2.0 Project Organization ............................................................................................................. 1  
   2.1 Project Deliverables .......................................................................................................... 2  

3.0 User Survey .......................................................................................................................... 2  

4.0 Road and Lot Design .......................................................................................................... 2  
   4.1 Lot Design ......................................................................................................................... 3  
   4.2 Road Design Overview and Process ................................................................................. 4  
   4.3 Horizontal Curves/ Lines ................................................................................................. 5  
   4.4 Profiles ............................................................................................................................ 7  
   4.5 Drainage ......................................................................................................................... 8  
   4.6 Roadway Sections ........................................................................................................... 9  
   4.7 Intersections ................................................................................................................... 12  
   4.8.0 Quantities .................................................................................................................... 13  
      4.8.1 Pavement .................................................................................................................... 13  
      4.8.2 Equestrian/ RV Lots ................................................................................................ 13  
      4.8.3 Cut/ Fill ...................................................................................................................... 13  
   4.9 Cost ................................................................................................................................. 14  

5.0 Water system Design .......................................................................................................... 14  
   5.1 Overview/ Assumption ...................................................................................................... 14  
   5.2 Water Demand ............................................................................................................... 15  
   5.3 Pipe Analysis .................................................................................................................. 15  
   5.4 Pipe/ Hydrant Locations ................................................................................................. 16  
   5.5 Material Costs/ Suppliers ............................................................................................... 17  

6.0 Sanitation Facility ............................................................................................................... 17  
   6.1 Composting Technologies ............................................................................................... 17  
   6.2 Toilet Design .................................................................................................................. 17  
   6.3 Cost ................................................................................................................................ 18  
   6.4 Alternative Design: Concrete Vault Toilet ................................................................. 18  

Appendix A: Pend Oreille Park Location .................................................................................. 20
Appendix B: Gant Chart...........................................................................................................21

Appendix C: Final Drawing....................................................................................................22

Appendix D: Water System Design Calculations.................................................................23

Appendix E: Frost-Free Hydrant Model S4H......................................................................39

Appendix F: Composting Toilet Quote...............................................................................40

Appendix G: Clovermist Precast Concrete Vault Toilet......................................................41
1.0 Introduction

Pend Oreille County Park is about 485 acres in the south side of Pend Oreille County adjacent to Highway 2. There exists a small campground for tent camping only, and a picnic area currently located in the southeast side of the park. There is also a trail system that circles the park and other trails that cross through the park.

1.1 Problem Statement

Over the last several years the trails have been cleared of fallen logs in the spring by the North East Chapter of the Back Country Horsemen of Washington (BCHW). Several members of the BCHW have ridden the trails there frequently. There are no current facilities for equestrians and there are no facilities for camping with recreational vehicles. The users of the park would like to see the park improved with appropriate facilities. Pend Oreille County has had limited funds for years, so nothing has been accomplished towards implementing these improvements, although the desire to improve the Park is a priority for the County.

1.2 Mission Statement

To address this issue, our design team this past year has been in the process of designing a practical solution to promote expanded facilities in Pend Oreille County Park for equestrian and recreational vehicle users. This solution is to be financially feasible, while also ensuring all deliverables are met. Within our design we have explored sustainable options, specifically those related to the sanitation and restroom facility.

1.3 Team Description

Our design group is comprised of three engineering students, two civil and one general, working on the requirements for a senior project for the university. The members all have diverse educations and backgrounds, but are all interested in seeing Pend Oreille County receive funding for this project. The team members are Ben Radchuk, C.E., Alex Canavan, G.E., and Michael Yoshihara, C.E. The team advisor and liaison engineer is Leon Sproule, P.E.

2.0 Project Organization

For an effective organization of this project, each team member has been responsible for working on specific design features. Ben completed the road design, Mike designed the water system, and Alex conducted an online user survey to assess the needs of experienced equestrians, and also determined which sanitation facility design was most suitable for our project.
2.1 Project Deliverables
1. Working model of project site.
2. Equestrian and RV lot designs.
3. Road design.
4. Analysis of proposed water system requirements.
5. Sanitation facility design.

3.0 User Survey

A ten question survey was sent to members of the Backcountry Horsemens of Washington (BCHW). Six weeks after the survey was sent out, the data was collected from the 56 responses received. After the data was organized it became clear what the users wanted to see improved in the park. Some examples of questions asked in the survey were:

- For parking your trailer would you prefer: back-in, pull through, or both?
- How important is it to have easy access to water, very, moderate, or indifferent?
- Would you like a non-equestrian parking area?

These types of questions assisted us in the design of our project, especially since our team had very little equestrian experience. The data was organized as shown in the following example:

4.0 Road and Lot Design

The completed road design for this project was planned in accordance with the Pend Oreille County Road Standards and Regulations effective August 28, 2007, and the Stormwater Management Manual for Eastern Washington. Results of the user survey were important in helping us select the most desirable equestrian and RV lots. The selected lots have been designed...
in accordance with the *Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds* published by the United States Department of Agriculture.

### 4.1 Lot Design

Based on the results of the user survey, it was determined that pull-through style equestrian sites and back-in style RV sites were the preferred choice. Parking spaces for automobiles were also designed. The three lot designs were based on examples from the USDA publication. The following pictures show the dimensions of the lots, with all measurements in ft.

![Figure 4.1.1 Equestrian Lot](image)

![Figure 4.1.2 RV Lot](image)
4.2 Road Design Overview and Process

Prior to beginning the road design for this project, it was necessary to ensure that the topographical information provided by Ron Curren was a valid representation of the proposed site. This information consisted of 1137 surveyed points, and was sufficient to create an existing surface within the AutoCAD Civil 3D software, which was used for the entire design.

The next step was to create a design center line alignment, which the design profile would be based upon. The design alignment for the main road has stationing ranging from 0+00 to 28+66.81, or for approximately half a mile. The secondary alignment which connects the entrance to the park to the approximate midpoint of the main alignment, has stationing from 0+00 to 3+43.32. Essentially, the alignments established x and y coordinates of the road and contained horizontal curves.

Based on these two design alignments, the software created existing profiles which show the elevation of the alignments from the beginning to the end of stationing. These elevations were based on the existing surface. The profiles showed the z coordinates of the road and contained vertical curves. Two design profiles were then created, which essentially ensured that the road would provide smooth transitions over the tops and bottoms of hills, also known as crest and sag vertical curves.

After the design alignments and profiles were created, it was necessary to design roadway sections based on Pend Oreille County standards. The resulting combination of alignments, profiles, and roadway sections created a corridor.

Another aspect of the road design was creating two intersections where the alignments intersected. This was successfully completed for the t-intersection, however, the final layout does not show the four-way intersection because errors within AutoCAD did not permit us to do so.
Nonetheless, this intersection is still part of our design, even if it does not show up in our final drawing.

4.3 Horizontal Curves/ Lines

The following is an excerpt from page 18 of the Pend Oreille County Road Standards and Regulations:

![Figure 4.3.1 Minimum Horizontal Radius Curves](image1)

The design speed of our RV/ Equestrian park is 15 mph, which is not in this table. Therefore, a graph plotting minimum radius vs design speed has been created to determine what minimum radius will be required for 15 mph.

![Figure 4.3.2 Horizontal Curves: Pend Oreille County](image2)

\[ y = 0.5725x^2 - 12.045x + 97.45 \]
Based on the function describing the table values shown above, the minimum radius for 15 mph is 46 ft. The following is a table from AutoCAD showing horizontal curve information:

![Table 4.3.1 Horizontal Curve Data](image)

Table 4.3.1 Horizontal Curve Data

The smallest horizontal curve radius in our design is 85.8 ft, which is significantly larger than the minimum of 46 ft.

The following table shows horizontal line information, which is another component necessary to construct our project.

![Table 4.3.2 Horizontal Line Data](image)

Table 4.3.2 Horizontal Line Data
4.4 Profiles

The design for the two profiles meets Pend Oreille County standards for maximum grade and minimum k-values. The following is an excerpt from page 19 of the Pend Oreille County Road Standards and Regulations:

Figure 4.4.1 Maximum Grades for Local Access and Collector Roads

Figure 4.4.2 Minimum k Values for Vertical Curves on Local and Collector Roads

Our project location is rolling terrain, which indicates a maximum grade of 8% and minimum k values of 30 for crest vertical curves and 40 for sag vertical curves. The following are tables from AutoCAD showing vertical line and curve information:
These tables show that the minimum k values have been achieved, and the maximum grade has not been exceeded.

**4.5 Drainage**

In September 2009 when our senior design group met with Ron Curren, he stated that the preferred method of drainage was ditches. The site terrain, as well as the design profile are consistent with this recommendation, and do not indicate that culverts are necessary in our design. Ron also clearly stated that he did not want any drywells in the design, since they would require further permitting. Consequently, the roadway sections in the next part of our report have ditches to provide for drainage within the park.
4.6 Roadway Sections

Pend Oreille County Road Standards and Regulations provides requirements for lane width, cross slope, ditch depth, and materials. The following table shows the pavement design schedule for our project.

<table>
<thead>
<tr>
<th>Element</th>
<th>WSDOT Specification</th>
<th>Surfacing Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>9.01.10 - Aggregate for Gravel Base, or 9.03.9(3) - Crushed Surfacing Base Course</td>
<td>BST 9”, HMA 6”</td>
</tr>
<tr>
<td>Top Course</td>
<td>9.03.9(3) - Crushed Surfacing Top Course</td>
<td>BST 3”, HMA 3”</td>
</tr>
<tr>
<td>Surface</td>
<td>5-02 BST, or 5-04 Hot Mix Asphalt</td>
<td>Class A and Class D BST, 2” Commercial HMA</td>
</tr>
</tbody>
</table>

Figure 4.6.1 Minimum Surfacing Requirements for Low Volume Roads

To help illustrate the design of our roadway sections, the following is our project near its completion (next page):
The two travel paths in the above picture are (1) the main alignment, and (2) the connecting alignment. For both alignments, materials follow the HMA pavement design from Figure 4.6.1. The main alignment section has a total width of 16 ft for clockwise one-way traffic, and the connecting alignment width is 28 ft for two-way traffic. Both sections have 2% cross slopes from their centerlines. Additionally, they have 2 ft deep ditches at a slope of 3:1. These two sections only apply to our project where there are no RV or equestrian lots. For stationing that included lots on one or both sides of the alignments, at least 10 other sections were created that would account for the necessary cut or fill to accommodate a lot. The following picture shows the roadway cross-sections from AutoCAD: The first is for the connecting alignment, then for the main alignment, and finally an example of another section created for an equestrian lot to the right of the alignment, looking ahead on stationing.
The next two images are cross-section views, showing how these roadway sections affect the existing terrain.
4.7 Intersections

The road design for this project has two intersections. One is a T-intersection and another is a 4-way intersection. Only the T-intersection was successfully included in our AutoCAD drawing, but all intersections have 65 ft turning radii, to ensure ample room for equestrian and RV users.
4.8.0 Quantities

In order to estimate the costs associated with the road and lot construction, it is first necessary to estimate the quantity of materials required as well as the amount of material involved in cut/fill. For simplicity, the quantities in the radii at the intersections were ignored.

4.8.1 Pavement

Based on the HMA pavement design schedule in figure 4.6.1 and the lengths of both alignments at approximately 2867 ft and 344 ft, the following quantities are required. Densities for all three materials were taken as 145 pcf.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CSBC</td>
<td>6</td>
<td>22936</td>
<td>1663</td>
<td>CSBC</td>
<td>6</td>
<td>4816</td>
<td>349</td>
</tr>
<tr>
<td>CSTS</td>
<td>3</td>
<td>11468</td>
<td>831</td>
<td>CSTS</td>
<td>3</td>
<td>2408</td>
<td>175</td>
</tr>
<tr>
<td>HMA</td>
<td>2</td>
<td>7645</td>
<td>554</td>
<td>HMA</td>
<td>2</td>
<td>1605</td>
<td>116</td>
</tr>
</tbody>
</table>

Table 4.8.1.1 Pavement Quantities

4.8.2 Equestrian/RV Lots

The Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds states that pavement offers poor traction for horseshoes and is not desirable for parking pads. Instead, our design includes 3/4-inch-minus crushed rock at a depth of six inches for both equestrian and RV lots, as well as for automobile parking. The density was also taken at 145 pcf. Quantities have been summarized in the following table:

<table>
<thead>
<tr>
<th>Lot Type</th>
<th># Lots</th>
<th>Area/lot (ft²)</th>
<th>Vol/lot (ft³)</th>
<th>Total Vol (ft³)</th>
<th>Mass (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equestrian</td>
<td>12</td>
<td>4800</td>
<td>2400</td>
<td>28800</td>
<td>2088</td>
</tr>
<tr>
<td>RV</td>
<td>12</td>
<td>2250</td>
<td>1125</td>
<td>13500</td>
<td>979</td>
</tr>
<tr>
<td>Automobile</td>
<td>7</td>
<td>275</td>
<td>137.5</td>
<td>963</td>
<td>70</td>
</tr>
</tbody>
</table>

Table 4.8.2.1 Equestrian/ RV Lot Quantities

4.8.3 Cut/Fill

AutoCAD Civil3D has calculated cut and fill volumes which have been summarized in the following table.
### Cut & Fill Volumes per Alignment (yd³)

<table>
<thead>
<tr>
<th></th>
<th>Main</th>
<th>Connecting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut</td>
<td>14106</td>
<td>1653</td>
</tr>
<tr>
<td>Fill</td>
<td>8500</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 4.8.3.1 Cut/ Fill Volumes

### 4.9 Cost

Unit prices for costs have been obtained from WSDOT unit bid histories which can be found at [http://www.wsdot.wa.gov/biz/contaa/uba/bid.cfm](http://www.wsdot.wa.gov/biz/contaa/uba/bid.cfm). Road and lot construction costs total $207,584 as shown in the following table.

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Est. Quantity</th>
<th>Unit Meas.</th>
<th>Price/Unit</th>
<th>Total Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway Excavation Including Haul</td>
<td>24265</td>
<td>C.Y.</td>
<td>4.75</td>
<td>115259</td>
</tr>
<tr>
<td>Crushed Surfacing Base Course</td>
<td>2012</td>
<td>Ton</td>
<td>15</td>
<td>30180</td>
</tr>
<tr>
<td>Crushed Surfacing Top Course</td>
<td>1006</td>
<td>Ton</td>
<td>15</td>
<td>15090</td>
</tr>
<tr>
<td>3/4-inch-minus crushed rock</td>
<td>3137</td>
<td>Ton</td>
<td>15</td>
<td>47055</td>
</tr>
</tbody>
</table>

**Total = $207,584**

Table 4.9.1 Road/ Lot Construction Costs

### 5.0 Water System Design

The water system for our project was designed in accordance with codes and specifications obtained from the Department of Health, the Equestrian Design Guidebook for Trails, Trailheads, and Campgrounds, and WAC 246-290-200 design standards.

### 5.1 Overview/ Assumptions

The scope of our water design was to extend the current system to meet the new demand associated with the implementation of the twenty-four lots. Our design was based on the MDD (Max Daily Demand) and the PHD (Peak Hourly Demand). ADD (Average Daily Demand) was neglected as a basis of our design due to the fact that it is assumed to be negligible on a daily basis when park facilities are not operating at full capacity. It was assumed that max capacities would be reached during summer holiday weekends, such as Memorial Day, Independence Day, and Labor Day. Storage was also neglected from our design as Pend Oreille has experienced past sanitation problems with their storage systems previously installed. Therefore, it was important for us to have a water system that could function without the use of any storage capacity. Also
neglected from our design was an analysis on water quality requirements, since Ron Curren stated that Pend Oreille County would provide a study regarding these issues. It must also be noted that the estimations of water demands (i.e., horses, people) used in our design were from the Department of Health records.

5.2 Water Demand

Table 5.2.1 below shows a summary of the water demand, and detailed calculations can be seen in Appendix D.

<table>
<thead>
<tr>
<th>Demand</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHD (gpm)</td>
<td>MDD (ERU)</td>
</tr>
<tr>
<td>21.4</td>
<td>4.66</td>
</tr>
</tbody>
</table>

Table 5.2.1 Results of new demand and available supply

The table above shows that the existing well can provide 35 gallons per minute, which is greater than the required 21.4 gpm at Peak Hourly Demand. Additionally, the well can provide 144 Equivalent Residential Units, and our new demand only requires 4.66. It must be noted that the following assumptions were made in obtaining the results from this table:

- Well can produce a discharge of 35 gpm
- Well can meet the existing demand in the system
- Well operates based on pressure differentials
- Well maintains a pressure range of 40-60 psi

Due to a change in personnel at Pend Orielle County we were unable to obtain the existing demand and actual well characteristics despite several efforts. Thus the assumptions above were made to ensure that we had the required capacity for our new demand. However, the person using our design must gather the existing system information from Pend Orielle County records and ensure that the well can meet the total demand (existing demand + new demand). If it can, then the existing well is does not need to be replaced. If it does not, then the well must be re-designed to do so.

5.3 Pipe Analysis

After the initial demand estimation for our proposed lots were calculated, as noted before, it was assumed that the well operates at a rate of 35 gpm, maintains a pressure ranging from 40-60 psi, and already meets the existing demand. Hence, the design of our system was to be able to
operate under this flow and pressure range. After a hydraulic analysis was performed, it was found that a 2 inch Poly pipe would more than sufficiently meet the new requirements of the system. The table below shows the results of the analysis, and detailed calculations of the analysis can be seen in Appendix D. These pressures provided sufficient conditions for our selected hydrants which required a minimum pressure of 20 psi.

<table>
<thead>
<tr>
<th>Well Press. 40 psi</th>
<th>Hydrant</th>
<th>Pressure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>36</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>55</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>37.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well Press. 60 psi</th>
<th>Hydrant</th>
<th>Pressure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>56.1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>76</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>47.7</td>
</tr>
</tbody>
</table>

Table 5.3.1 Pressure at each hydrant for a well pressure range of 40 to 60

5.4 Pipe/ Hydrant Locations

The following tables provide the necessary information for the location and construction of the water system.

<table>
<thead>
<tr>
<th>Pipe #</th>
<th>Length (ft)</th>
<th>Start Point</th>
<th>Elevation (ft)</th>
<th>End Point</th>
<th>Elevation (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>5216.6, 7038</td>
<td>1985</td>
<td>5205, 7054</td>
<td>1984</td>
</tr>
<tr>
<td>2</td>
<td>450</td>
<td>5205, 7054</td>
<td>1984</td>
<td>4792, 6876</td>
<td>1982</td>
</tr>
<tr>
<td>3</td>
<td>200</td>
<td>4792, 6876</td>
<td>1982</td>
<td>4687, 7045.5</td>
<td>1996</td>
</tr>
<tr>
<td>4</td>
<td>462</td>
<td>4792, 6876</td>
<td>1982</td>
<td>4368, 6694</td>
<td>1990.5</td>
</tr>
<tr>
<td>5</td>
<td>108</td>
<td>4368, 6694</td>
<td>1990.5</td>
<td>4305, 6782</td>
<td>1995</td>
</tr>
<tr>
<td>6</td>
<td>565</td>
<td>4368, 6694</td>
<td>1990.5</td>
<td>3848.6, 6471.5</td>
<td>1974</td>
</tr>
</tbody>
</table>

Table 5.4.1 Pipe Locations

<table>
<thead>
<tr>
<th>Description</th>
<th>Location (E,N,Z)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well</td>
<td>5216.6, 7038, 1985</td>
</tr>
<tr>
<td>Hydrant 1</td>
<td>3848.6, 6471.5, 1974</td>
</tr>
<tr>
<td>Hydrant 2</td>
<td>4305, 6782, 1995</td>
</tr>
<tr>
<td>Hydrant 3</td>
<td>4687, 7045.5, 1996</td>
</tr>
</tbody>
</table>

Table 5.4.2 Well/ Hydrant Locations
5.5 Material Costs/ Suppliers

A summary of material costs for the water system is presented below:

<table>
<thead>
<tr>
<th>Total Length of Pipe (ft)</th>
<th>Cost per ft</th>
<th>Total Cost of Pipe</th>
<th>90° Fitting (2 in)</th>
<th>(2) Tees (2 in)</th>
<th>Hydrants (3)</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1805</td>
<td>$ 1.87</td>
<td>$ 3,375.35</td>
<td>$ 2.23</td>
<td>$ 7.48</td>
<td>$ 2,430.15</td>
<td>$ 5,815.21</td>
</tr>
</tbody>
</table>

Table 5.5.1 Material Costs

Suppliers for these materials have been identified as such:
- **Woodford Hydrants** ([www.woodfordmfg.com](http://www.woodfordmfg.com), model S4H) See Appendix E
- **Consolidated Supply** (2” Poly Pipe, AWWA certified)—(509)535-0896
- **Home Depot** (fittings)

6.0 Sanitation Facility

To meet requirements of the Senior Design Project, a sustainable sanitation facility was necessary. A composting toilet was chosen to meet these requirements. After speaking with our advisor and liaison, we decided to select an existing design for our project.

6.1 Composting Technologies

Composting is an aerobic process that involves mixing wastewater solids and sources of carbon. The aerobic process is where bacteria can rapidly consume organic material and convert it into carbon dioxide, only in the presence of oxygen. The process can destroy enough of the disease-causing bacteria and parasites to a sufficient level so the digested solids can be applied to land as soil and for agriculture as fertilizer. The capital costs of using an aerobic process are low but the operating costs may be high.

6.2 Toilet Design

After doing much research on the technology of composting toilets and vendors, a toilet was chosen. Composting Toilet Systems, Inc. is located in Newport, Washington. They have an appropriate design that meets the needs of the proposed park.

The toilet design is a CTS – 904. It is a single stall, waterless, plumbless toilet designed for 0 – 80 uses per day and an annual use of 23,200. The toilet includes a digestion tank where the toilet-paper, wastes, tissues and other organic material accumulates and forms a compostable mass. There are baffle walls and air channels to provide an oxygen-rich environment for the microorganisms to continually digest and decompose the organic materials. There are also AC or
DC solar powered fans that will assist the natural air flow. These fans create a vacuum inside the digester tank so if the toilet seat is left open the air will be drawn down the toilet and through a vent stack so the restroom is left odorless. The accumulated waste slowly moves down the slopping floor and in the end, 90% of its volume is eliminated by decomposition and evaporation. The end product is fertile organic humus, similar to garden soil with no odor, and can easily be removed through the access door.

The toilet is compact and easy to maintain. The owner’s manual includes a simple maintenance schedule mapping out daily activities and appropriate bulking materials to be added to the composting.

![Figure 6.2.1 Plan View of Restroom Facility](image)

**Figure 6.2.1 Plan View of Restroom Facility**

### 6.3 Cost

After contacting Composting Toilet Systems, Inc. we were provided with a quote for two toilets along with two restroom facilities to house the toilets. The total cost was $43,100 (see Appendix F for full quote). Due to the high cost, other options such as a simple vault toilet may need to be explored.

### 6.4 Alternative Design: Concrete Vault Toilet

BOOM Concrete, Inc., located in South Dakota is a manufacturer of Precast Concrete vault toilets. They offer a single stall vault style toilet called The Clovermist. The concrete is precast
into several sections and is ready to be assembled as a single unit and can be ready to use in just hours.

Figure 4.6.1 Clovermist Precast Concrete Vault Toilet

The Clovermist is also designed to meet ADA accessibility requirements. The doors have easy access to enter and inside there are two grab bars around the toilet. There is also 60 inches of turning space for a wheel chair to comfortably move. The Clovermist is also equipped with “Sweet Smelling Technology,” designed by the US Forest Service. There is a ventilator that draws air down the toilet where the sludge is held. The odor rises up the vent through the roof leaving the restroom smelling sweet. The vault toilet requires no plumbing, no electricity and is low maintenance. The costs of the toilet are much lower than costs for the composting toilet. Each toilet is $9,668 not including the shipping cost from South Dakota to Pend Oreille County. See Appendix G for price breakdown.
Appendix A: Pend Oreille County Park Location

Pend Oreille County Park
## Appendix B: Gant Chart

<table>
<thead>
<tr>
<th>Task Name</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
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<tbody>
<tr>
<td>Site Analysis/Survey</td>
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<td>11/3</td>
<td>11/16</td>
<td>1/16</td>
<td>1/16</td>
<td>1/16</td>
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<td>4/1</td>
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<tr>
<td>User Survey</td>
<td>10/15</td>
<td>11/6</td>
<td>11/16</td>
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<td>3D Model/ Right-of-Way</td>
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<td>1/16</td>
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<td>4/1</td>
<td>4/2</td>
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<td>4/2</td>
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<td>2/7</td>
<td>2/7</td>
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<td>4/1</td>
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<td>4/2</td>
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<tr>
<td>Final Report Due</td>
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<td>2/5</td>
<td>2/5</td>
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<td>4/1</td>
<td>4/1</td>
<td>4/2</td>
</tr>
</tbody>
</table>

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Project: Pend Oreille Park Improvement Project

Date: 10/09/09

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Appendix C: Final Drawing

- 2 Restroom Facilities
- Automobile Parking

Scale: 100 ft
Appendix D: Water System Design Calculations

1/16

Horses: (12 gal/day/lot): 12 lots w/ 3 horses per lot

\[ \Rightarrow 36 \text{ gal/day} \times (1) = 432 \text{ gal/day} \]

People:

\[ 25 \text{ gal/day} \times (2 \text{ people/lot}) \times (24 \text{ lots}) = 1200 \text{ gal/day} \]

\[ \Sigma \text{ flows} = 1532 \text{ gal/day} = \text{ total demand (MDD for non-resident)} \]

In terms of ERU

\[ \Rightarrow \text{ MDD} = 350 \text{ gal/day ERU} \]

\[ \Rightarrow \frac{1532 \text{ gal/day}}{350 \text{ gal/ERU}} = 4.4 \text{ ERU's} \]

Source:

\[ N = \frac{Q_{\text{in}}}{MDD} \quad \text{Eqn. (6-2)} \]

* Pump operates 24/7 (1440 min)

* Assume well = 35 gal/min

\[ \Rightarrow N = \frac{35 \text{ gal/min}}{350 \text{ gal/ERU}} = 0.1 \text{ ERU's} \]

* Well can supply the demand
PEAK Hourly DEMAND

$$PHD = \frac{MDD}{1440} \left[ (C)(N) + F \right] + 18 \quad \text{(Eqn 5-3 DOH Manual, Chap B)}$$

* C = 3.0 \quad > \text{Table 5-1 (DOH, Chapter B)}
* F = 0
* MDD = 350 \text{ gal/day}

$$PHD = \frac{350}{1440} \left[ (3.0)(466) + 0 \right] + 18 = 21.4 \text{ gpm}$$

> Since our well pumps @ 35 gpm > 21.4 gpm
> We're good

Our source can supply both MDD and PHD all by itself. We don't need any storage.

<table>
<thead>
<tr>
<th>DEMAND</th>
<th>SOURCE</th>
</tr>
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<tbody>
<tr>
<td>PHD (gpm)</td>
<td>MDD (gpm)</td>
</tr>
<tr>
<td>21.4</td>
<td>4.66</td>
</tr>
</tbody>
</table>

Since our source has enough capacity to supply all our demands, we don't need any storage. The existing design does not need to be re-designed. Our design of source capacity / water demand is complete.

> It was agreed that Pend Oreille County will analyze water quality requirements...
Pend Oreille County Park Improvement Project

Final Report

3/16

Page 25
$d_2 = \sqrt{(4368 - 9792)^2 + (6694 - 6876)^2 + (1490.5 - 1482)^2}$

$d_2 = 461.5 \text{ ft} = 462 \text{ ft}$

$J_3 \rightarrow \text{ Hydrant (2)}$

$d_3 = \sqrt{(6782 - 6694)^2 + (4305 - 4368)^2 + (1995 - 1990.5)^2}$

$d_3 = 108.3 \approx 108 \text{ ft}$

$J_3 \rightarrow \text{ Hydrant (4)}$

$d_3 = \sqrt{(6471.5 - 6694)^2 + (3848.6 - 4368)^2 + (1974 - 1990.5)^2}$

$d_3 = 565.3 \text{ ft} = 565 \text{ ft}$
Given: pump flow rate is 20 gpm
* pressure @ pump is 50 psig
* PVC pipe
  * Start w/ 1 1/2" pipe
  * Start w/ Q = 0.013

Find's: determine if system works

Self:

\[ \frac{20 \text{ gpm}}{\text{min}} \times \frac{1.44 \text{ sq in}}{7.48 \text{ gpm}} \times \frac{1 \text{ min}}{60 \text{ sec}} = 0.045 \frac{\text{ft}^3}{\text{sec}} \]

Headlosses:

\[ h_1 = \frac{4 \cdot 60^2 \times (16)}{8 \cdot 0.002 \text{ ft}^2} = \frac{0.13 \times (20 \text{ ft})(0.045 \frac{\text{ft}^3}{\text{sec}})}{(1.5 \text{ ft})^2} \times \frac{(32.4 \text{ ft sec}^2)}{\text{ft}^2} = 1.43 \text{ ft} \]

\[ P = 8h = 63.4 \times \frac{16}{93} (1.43 \text{ ft}) = 26.9 \frac{\text{ft}}{\text{sec}^2} = 0.9 \text{ psig} \]

From J1 to J2:

\[ h_1 = \frac{0.13 \times (450 \text{ ft})(0.045)^2}{(1.5 \text{ ft})^2} \times \frac{(32.4 \text{ ft sec}^2)}{\text{ft}^2} = 9.7 \text{ ft} \]

\[ P = 8h = 62.4 \times (9.7 \text{ ft}) = 606 \frac{\text{ft}}{\text{sec}^2} = 4.2 \text{ psig} \]

From J2 to Hydrant (2):

\[ h_1 = \frac{0.13 \times (160 \text{ ft})(0.022)^2}{(1.5 \text{ ft})^2} \times \frac{(32.4 \text{ ft sec}^2)}{\text{ft}^2} + h_{min} \]

\[ 10 \text{ gpm} \times \frac{0.022 \frac{\text{ft}^3}{\text{sec}}}{\text{ft}^3} \]
Distances

\[ L = \sqrt{(y_2 - y_1)^2 + (x_2 - x_1)^2 + (z_2 - z_1)^2} \]

\[ L = \sqrt{(7085.6 - 7038)^2 + (5207 - 5216.6)^2 + (1985 - 1985)^2} \]

\[ L = 19.96 = 20' \]

\[ E1 \rightarrow J2 \]

\[ L = \sqrt{(6956 - 7085.6)^2 + (5029 - 5207)^2 + (1951 - 1985)^2} = 211' \]

\[ J2 \rightarrow H1 \]

\[ L = \sqrt{(7057 - 6956.6)^2 + (4967 - 5029)^2 + (1958 - 1958)^2} = 116' \]

\[ J2 \rightarrow J2 \]

\[ L = \sqrt{(6610 - 6956)^2 + (4230 - 5029)^2 + (1984.8 - 1984.8)^2} = 775.5' \]
D I S T A N C E S  C O N T ’ D

\[ L = \sqrt{(47.44 - 46.10)^2 + (42.56 - 43.30)^2 + (19.53.6 - 19.84.8)^2} \]

\[ L = 161.4^1 = 161.5^1 \]

\[ L = \sqrt{(63.40 - 63.10)^2 + (57.94 - 43.30)^2 + (19.72 - 19.84.8)^2} \]

\[ L = 595.24^1 = 596^1 \]

H E A D L O S S

* For initial design, assume the pressure at E is approximately the same as at the well (since \( L \) is only 20 ft).
* Pressure at well is 40-60 psi.
* Design for a well pressure of 40 psi, 1st.
* Design from E1 → H2 to get initial pipe diameter.

From E1 → H2

* Minimum pressure at P1 is 20 psi (hydrant spec).
* \( P_e = 20 \text{ psi} \), \( P_i = 40 \text{ psi} \), \( \alpha = 35 \text{ gpm}, R_e = 40 \text{ psi} \).

\[ z = 35 \text{ gpm}, P_e = 40 \text{ psi} \]

\[ L = 1532.5^1 \]

\[ 1^\circ \]

\[ 13^\circ \]

* Since the min. press at P1 is 20 psi, our max. press. difference between P1 and P2 is 20 psi.
\[ \frac{P}{\delta} + \frac{V^2}{2g} + Z_1 = \frac{P_2}{\delta} + \frac{V_2^2}{2g} + Z_2 + h_L \]

\[ h_L = \left( \frac{P_1 - P_2}{\delta} \right) + (Z_1 - Z_2) \]

\[ h = 20 \text{ psi} \left( \frac{231 \text{ ft}^3}{\text{psi}} \right) = 46.2 \text{ ft} \]

\[ h_L = 46.2 \text{ ft} + (13-0) = 59.2 \text{ ft} \]

\[ \text{allowable head loss for system} \]

\[ \text{Pipe Diameter given an allowable } h_L \text{ of } 59.2 \text{ ft} \]

\[ h_L = \frac{Q^2}{8 \Delta g \gamma} \]

\[ Q = 35 \text{ gpm} = \frac{0.78 \text{ ft}^3}{s} \]

\[ 59.2 \text{ ft} = \frac{(0.013)(1.5525)(0.078 \text{ ft}^3/s)}{D^2 \gamma} \]

\[ D = 1.397 \text{ ft} = 1.68 \text{ in} \rightarrow \text{Round up to 1.75 in} \]

\[ V = \frac{Q}{A} = \frac{0.78 \text{ ft}^3/s}{\frac{\pi}{4} (1.75 \text{ in})^2} = 4.67 \text{ ft/s} \]

\[ Re = \frac{VD}{\nu} \quad \nu = 1.217 \times 10^{-6} \text{ ft}^2/s \quad \text{(Table 2.11, p. 16)} \]

\[ Re = \frac{(4.67 \text{ ft/s})(1.75 \text{ in})}{1.217 \times 10^{-6} \text{ ft}^2/s} = 55,961 \]

\[ \Rightarrow \text{From Moody, } f = 0.0204 \quad \text{(use by 36\% from initial guess of } f_0 = 0.13 \text{ so must re-iterate using } f = 0.0204) \]
2nd Iteration

\[ \frac{F}{A} = 0.204 \]

\[ h_L = \frac{5.20 (16)}{D^2 \cdot 2g \cdot \pi^2} \]

\[ 59.2 \frac{\text{ft}}{\text{s}^2} = \frac{0.0204 (1582.5)(0.078 \frac{\text{ft}}{\text{s}^2}) (16)}{D^2 \cdot 2g \cdot \pi^2} \]

\[ D = 1.53 \text{ ft} = 1.83 \text{ in} \rightarrow \text{Round to 2"} \]

\[ y = \frac{Q}{A} = \frac{0.078 \frac{\text{ft}^3}{\text{s}}}{\pi \left( \frac{2}{12} \right)^2} = 3.58 \frac{\text{ft}}{\text{s}} \]

\[ R_e = \frac{VD}{y} = \frac{(3.58 \frac{\text{ft}}{\text{s}})(\frac{2}{12})}{1.217 \times 10^{-5} \frac{\text{ft}}{\text{s}}} = 491,028 \]

\[ \Rightarrow \text{From Moody using } \tau = 0 ; \quad R_e = 491,028 \]

\[ \Rightarrow F = 0.0207 \]

\[ D = 2" \]

**Analysis of System Using a Pipe \( D = 2" \)**

Actual Pressure at Exit (point 1 is H well)

\[ P_i + \frac{v_i^2}{2g} + h_i = P_2 + \frac{v_2^2}{2g} + h_2 \]

\[ \frac{5.760 \text{ psi}}{62.37 \frac{\text{ft}}{\text{s}^2}} = P_i + \frac{(0.207) \frac{20^2}{2(3.58 \frac{\text{ft}}{\text{s}})}}{2(3.58 \frac{\text{ft}}{\text{s}})} \]

\[ (92.4 \text{ ft} - 5') 62.37 \frac{\text{ft}}{\text{s}^2} \]

\[ P_2 = 5,732 \text{ psi} = 342.8 \text{ psi} \]
Pressure at S1

\[ P_1 = \frac{3h_1}{8} \text{ psf} \]

\[ V = 3.6 \text{ ft/s} \]

\[ L = 21 \text{ ft} \]

\[ z_1 + \frac{V^2}{2g} + h_1 = \frac{P_1}{\rho} + z_2 + h_2 \]

\[ h_L = h_{min} + h_{min} = 0.25 \left( \frac{3.6 \text{ ft/s}}{2g} \right) + 0.02 \left( \frac{21 \text{ ft}}{2g} \right) \left( \frac{3.6 \text{ ft}}{2g} \right) = 5.25 \text{ ft} \]

\[ P_2 = \left( \frac{P_1}{\rho} + z_1 - z_2 - h_L \right) g \]

\[ P_2 = \left( \frac{5.73 \text{ psf}}{62.37 \frac{\text{ lb}}{\text{ ft}^2}} + 4 - 0 - 5.35 \right) \left( 2.37 \frac{\text{ ft}}{g} \right) = 5.697 \text{ psf} \]

\[ P_2 = 39.2 \text{ psf} = P_{31} \]

Pressure at Hydrant 0

Since \( P_{32} = 39.2 \text{ psi} \), assume \( Q = 10 \text{ gpm} \) (From hydrant chart)

Note: The chart given gives the pressures at the hydrant location and their corresponding flow rates. Since pipe flow problems are indeterminate, we have to assume (i.e., guess) the flow through the pipe. I chose 10 gpm because that would be the max flow (assuming that there are no heads losses along the way; the \( \Delta P_{32} \rightarrow H_2 = 0 \)). That is, I can't go over 9 gpm because the pressure at \( 12 \) is 32.2 psi. And if there is no \( \Delta P \), then \( P_{32} = 32.2 \text{ psi} \). So \( Q = 9 \text{ gpm} \)

\[ Q = 10 \text{ gpm} \times \frac{1 \text{ ft}^3}{7.48 \text{ gpm}} \times \frac{1 \text{ min}}{60 \text{ sec}} = 0.022 \text{ ft}^3 / \text{s} \]

\[ A = \frac{P_2}{2} \times \frac{1}{4} = 0.0218 \text{ ft}^2 \]

\[ V = \frac{Q}{A} = \frac{0.022 \text{ ft}^3 / \text{s}}{0.0218 \text{ ft}^2} = 1 \text{ ft/s} \]
Pend Oreille County Park Improvement Project

Pressure @ H1 cont'd

\[
\frac{P_1}{\pi} + \frac{V_1^2}{2g} + h_1 = \frac{P_2}{\pi} + \frac{V_2^2}{2g} + h_2 + z_2 + z_1
\]

\[
h_1 = h_{w_1} + h_{l_1} = f(\frac{V_1}{5}2g) + \frac{V_1^2}{2g} = 0.0207 \left(\frac{12}{5}\right) + 1.0 \left(\frac{1}{64.4}\right)
\]

\[
P_1 = 39.2 \text{ psi} \times \frac{12,000}{144} = 536.47 \text{ psi}
\]

\[
\frac{V_1}{3} = 120 \text{ ft} / \text{s}
\]

\[
\frac{V_2}{3} = 36 \text{ ft} / \text{s}
\]

\[
P_2 = 36 \text{ psi}
\]

Pressure @ H2

\[
V = 3.6 \text{ ft} / \text{s}
\]

\[
\frac{\Delta h}{\Delta t} = \frac{m_{in} - m_{out}}{\Delta t} = \frac{\Delta m}{\Delta t}
\]

\[
\frac{\Delta A}{\Delta t} V_2 = \frac{\Delta A}{\Delta t} V_3 + \frac{\Delta A}{\Delta t} V_3
\]

\[
\Delta A = A_2 = A_3
\]

\[
V_3 = V_1 - V_2 = 3.6 - 1.2 = 2.4 \text{ ft} / \text{s}
\]
\[ \begin{align*}
V_1 &= 3.4 \text{ ft/s} \\
\frac{P_1}{\theta} + \frac{V_1^2}{2g} + z_1 &= \frac{P_2}{\theta} + \frac{V_2^2}{2g} + z_2 + h_L \\
\text{Predicted since } L &\text{ is negligible}
\end{align*} \]

\[ h_L = \frac{\theta}{2} \left( \frac{V_2^2}{2g} - \frac{V_1^2}{2g} \right) \frac{L^2}{2} = 10.11 \text{ ft} \]

\[ V_2 = \frac{3.4 \text{ ft/s}}{5} \]

Assume \( P_2 = P_1 \) since \( h_L \) is very small (because \( L \) is negligible)

\[ \begin{align*}
P_2 &= \left[ \frac{P_1}{\theta} + \frac{V_1^2}{2g} + z_2 - z_1 + h_L \right] \gamma \\
P_2 &= \left( \frac{4.637 \text{ psf}}{62.37} + \frac{(3.4)^2 - (3.4)^2}{2(32.2)} + 0 \right) 62.37 \text{ lb ft}^{-1} = 4638 \text{ psf} \\
&= 32.2 \text{ psf}
\end{align*} \]

Pressure at 32 cont'd

\[ P_2 = \left( \frac{P_1}{\theta} + z_1 - z_2 - h_L \right) \gamma = \left( \frac{5.647}{62.37} + 0 - 4' - 10.11 \text{ ft} \right) \\
= 4.767.6 \text{ psf} = 33.1 \text{ psi} \]
Pressure @ H2

\[ P_1 = 33 \text{ psi} \]
\[ \frac{V_1}{\gamma} = \frac{1}{0.61} \]
\[ L = 161.5' \]

Assume \( Q_1 = 0.0 \quad \text{gpm} = 0.02 \quad \frac{\text{ft}^3}{\text{s}} \)
\[ V = \frac{Q}{A} = \frac{0.02 \cdot \frac{\text{ft}^3}{\text{s}}}{0.02 \cdot 1.87} = 0.92 \quad \frac{\text{ft}}{\text{s}} \]
\[ \frac{P_1}{\gamma} + V_1^2 + z_1 = \frac{P_2}{\gamma} + V_2^2 + z_2 + h_L \]

\[ h_L = 5 \left( \frac{V_1^2}{2g} \right) = 0.207 \left( \frac{161.5}{144} \right) \left( \frac{0.92^2}{2g} \right) = 0.269 + 0.0013 \]
\[ P_2 = \left( \frac{4767.6}{62.87} + 51 - 0 - 0.0061 \right) 62.87 \left( \frac{1}{144} \right) = 7.93 \text{ psi} \]
\[ \Rightarrow P_{H2} = 55 \text{ psi} \]

(Enough pressure)

Pressure @ H3

\[ P_1 = 33 \text{ psi} \]
\[ \frac{V_1}{\gamma} = \frac{1}{0.58} \]
\[ Q = 35 - 10 - 9 = 16 \quad \text{gpm} = 0.086 \quad \frac{\text{ft}^3}{\text{s}} \]
\[ \frac{P_1}{\gamma} + V_1^2 + z_1 = \frac{P_2}{\gamma} + V_2^2 + z_2 + h_L \]

\[ h_L = 0.207 \left( \frac{596}{2g} \right) \left( \frac{(1.44)^2}{2g} \right) = 3.06 \quad \text{psi} \]
\[ P_2 = \left( \frac{4767.6}{62.87} + 13 - 0 - 3.06 \right) 62.87 = 5.386 \text{ psi} \]
\[ \Rightarrow P_{H3} = 37.4 \text{ psi} \]

\[ \Rightarrow \]
Analysis Using a Well Pressure of 60 psi

\[
\frac{P_1}{8} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{8} + \frac{V_2^2}{2g} + z_2 + h_L
\]

\[P_1 = 60 \text{ psi} = \frac{144}{144} \cdot \frac{110}{144} = \frac{8.640}{110} = 8.640 \frac{110}{144}\]

\[P_2 = (\frac{P_1}{8} - h_L) \gamma = \left(\frac{8.640}{62.37} \cdot \frac{110}{144}\right)^2 - .51 \cdot 62.37 \cdot \frac{110}{144} = 8.608.8\]

\[P_{2a} = 59.8 \text{ psi}^{\circ}\]

\[\frac{P_1}{8} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{8} + \frac{V_2^2}{2g} + z_2 + h_L
\]

\[P_a = \left(\frac{P_1}{8} + z_1 - z_2 - h_L\right) \gamma, \quad P_a = 59.8 \text{ psi}^{\circ} = 8.611.2\]

\[P_2 = 8.527 \text{ psi}^{\circ} = 59.2 \text{ psi}^{\circ} \]

\[P_{2a} = 59.2 \text{ psi}^{\circ}\]

\[\frac{P_1}{8} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{8} + \frac{V_2^2}{2g} + z_2 + h_L
\]

\[Q = \frac{P_2}{8} = 0.0267 \frac{P_3}{8} \quad \Rightarrow \quad V = \frac{Q}{A} = \frac{0.0267}{0.0212} = 1.22 \frac{P_3}{s}
\]

\[h_L = f\left(\frac{V^2}{2g}\right) + k\left(\frac{V^2}{2g}\right) = .0201 \left(\frac{110}{167 h}\right) \left(\frac{110}{64.4}\right) + 1.0 \left(\frac{110^2}{64.4}\right) = 1.351\]
Pressure @ H₂ control

\[ P_2 = \left( \frac{P_1}{\rho} + 2 \cdot \frac{\rho}{\rho} \cdot \frac{V}{\rho} \right) Y \]

\[ P_2 = \left( \frac{8.580}{62.37} + 0 - 7 - 2.35 \right) \cdot 62.37 = 7.769 \cdot \frac{10}{5} = 7.769 \text{ psi} \]

\[ P_{H_2} = 76 \text{ psi} \]

\[ \frac{1}{2} \rightarrow \frac{2}{3} \]

\[ Q = 2.5 \cdot 2.2 = 5.5 \text{ gpm} \]

\[ \frac{P_1}{A} + \frac{V^2}{2g} + Z_1 = \frac{P_2}{A} + \frac{V^2}{2g} + Z_2 + h_\ell \]

\[ h_\ell = 0.027 \left( \frac{775.5}{167} \right) \frac{V^2}{2g} \]

\[ V = \frac{Q}{A} = \frac{1.026}{0.0245} = 41.7 \text{ ft/s} \]

\[ h_\ell = 0.027 \left( \frac{775.5}{167} \right) \left( \frac{41.7^2}{2g} \right) = 8.2 \text{ ft} \]

\[ P_2 = \left( \frac{8.580 \text{ psi}}{62.37} + 0 - 7 - 8.2 \right) \cdot 62.37 = 7.769 \text{ psi} = 76.9 \text{ psi} \]

\[ P_{H_2} = 54 \text{ psi} \]

\[ \frac{22}{5} \rightarrow \frac{2}{3} \]

\[ Q = 11 \text{ gpm} \]

\[ \frac{Q}{A} = \frac{0.025}{0.025} = 1.0 \text{ ft/s} \]

\[ h_\ell = 0.027 \left( \frac{102.5}{66.4} \right) \left( 1.0 \right) \left( \frac{102.5^2}{66.4} \right) + 1.0 \left( \frac{102.5^2}{66.4} \right) = 43.9 \text{ ft} \]

\[ P_2 = \left( \frac{7.769}{62.37} + 0 - 8.2 \right) \cdot 62.37 = 10.8 \text{ psi} \]

\[ P_{H_2} = 76 \text{ psi} \]
\[
\begin{align*}
\Delta^2 x &= 3.5 - 12 - 11 = 12 \\
\alpha &= \frac{12}{12} = 1.0267 \\
\beta &= \frac{12}{12} = 1.23 \\
\gamma &= 0.0267 \left( \frac{596}{167} \right) = 1.74 \\
P_Z &= \left( \frac{P}{z} + (z - z) - h \right) \\
P_Z &= \left( \frac{7.769 \times 10^5}{62.37} - 12.8 - 1.74 \right) = 6562 \text{ psf} = 47.7 \text{ psi} \\
P_{H_g} &= 47.7 \text{ psi} 
\end{align*}
\]
Appendix E: Frost-Free Hydrant Model S4H

Backflow Protected
Automatic Draining
Freezeless, Self Closing
Sanitary Yard Hydrant
Model S4H

The Model S4H is an automatic draining, sanitary, frost proof Yard Hydrant, with ASSE 1052 double check backflow preventer. This hydrant is designed for use in public areas such as campgrounds and parks or any location were potable water is required.

Unlike conventional hydrants which drain the water into the ground, the Model S4H employs a reservoir below frost line to contain the water. The hydrant is completely sealed to prevent surface and ground water from entering reservoir or service line. The valve, with its unique venturi design, removes the stored water along with the water being used.

The Model S4H is equipped with a diverter spout, which allows the hydrant to be operated independently from the backflow preventer. When the hydrant is to be used with a hose, the diverter sleeve is pulled down during flow and water is automatically diverted to the backflow preventer hose connection. The diverter will work with or without a hose attached to the backflow preventer and will automatically release any time the hydrant is shut off.

An important feature of the S4H is easy maintenance. The entire working portion of the hydrant can be removed from the reservoir without any excavation.

SPECIFICATIONS:
HOSE CONNECTION BACKFLOW PREVENTER
- NIDEL® Model 37HF
- ASSE 1052 Approved
- Field Testable (see instruction sheet)
- Two Check Valves

ADA COMPLIANT - Meets ADA requirements for height and 5 lbs. Max operating force.
PATENT - U.S. Patent number 5248028 (Additional Patents Pending)
FEMALE INLET - 1" N.P.T.
FINISH - Painted Forest Service brown.
MIN PRESSURE - 20 psi
MAX PRESSURE - 100 psi
MAX TEMPERATURE - 120° F

FLOW RATES (GPM)

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<tr>
<th>PSI</th>
<th>DIVERTER</th>
<th>BFP</th>
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<tr>
<td>20</td>
<td>7.0</td>
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<tr>
<td>100</td>
<td>15.0</td>
<td>10.0</td>
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</table>

NOTICE
FOR WINTER USE: The hydrant must be operated at full flow, through the diverter, for a minimum of 30 seconds before and after each use to drain the hydrant and prevent freezing.

When ordering, specify bury depth.
Appendix F: Composting Toilet Quote

Composting Toilet Systems, Inc.  
February 1, 2010

P.O. Box 1928  
Newport, WA 99156

Phone: (888) 786-4538 or (509) 447-3708  
Fax: (509) 447-3708

Quote No.: 10-100

Quote To:  
Alex Canavan  
502 E. Boone Ave.  
Spokane, WA 99258

Ship To:  
Diamond Lake, WA

We will be happy to provide the package listed below:

(2) **CTS-904 Digester System**  
(0-80 uses per day)

- Complete with baffle walls separating waste chamber, finished compost chamber and liquid end product chamber, associated hardware, caulking, easy drain system, and access doors.
- Ventilation System complete with 12V DC fan 15’ of 8” galvanized vent pipe, 5’ of 10” insulated pipe, support package, roof flashing, storm collar, elbows and vent cap.
- Solar Vent Kit complete with solar panel with mount, load controller, battery, and fuse block.
- Installation Assembly Kit including installation instructions, owner’s manual and all necessary miscellaneous hardware for a complete installation.
- Includes one C-14H (**handicap**) contemporary toilet with air tight seat and lid and stainless steel toilet chute.
- Tank Support Cradle  
  $18,400.00

(2) **CP-100 restroom facility**  
(One stall)

- The shingles are class “A” fire rated, 35 year fiberglass, 30lb felt
- The roof slope is 3:12, designed for a 30 PSF live load.
- The floor system is 2”x 10” treated material with ¾” sub flooring (unfinished)
- Exterior doors are 18 GA metal @ 16 GA metal frame (includes hardware)
- The exterior wall is 5”X8” 5-Ply Glue-Lam decorative grade Inland Red Cedar
- The interior walls are 2”X4” field frame, interior lavatory covered with FRP
- Skylights are 24”x 48”.
- All fasteners are provided above ground, working drawings are furnished with order
- Fixtures package includes grab bars, toilet paper dispenser, and hand sanitizing dispenser.

  $25,700.00

*Quote total including freight:  
$44,100.00 - $1,000.00  
$43,100.00

Optional:  
Installation  
$5,600.00

**Terms:** 50% due upon order, balance due prior to shipment

*Price quote is good for 120 days. **Price does not include structural calculations, unloading, permits, storage or installation of materials.** Lead time is tentatively 10 weeks for building to be manufactured and shipped. Building is shipped knocked down and will need to be assembled on site. **Foundation and excavation work not included.** Design, stamp drawings and calculations for foundations are not included. Freight quote is based on the date above and may change based on the actual date of shipment. This quote does not include customs clearance, duties, or taxes that may be associated with this shipment.

Thank you for your interest in Composting Toilet Systems, Inc. I look forward to working with you. Please give me a call if I can be of further assistance.

Jon Hinchliff
Appendix G: Clovermist Precast Concrete Vault Toilet

Clovermist single precast concrete vault toilet shown in standard configuration. Exposed aggregate outside finish, smooth epoxy white finished walls inside, and tan epoxy non-slip floor. The Clovermist meets ADA accessibility requirements for persons with disabilities and has a 60" turning circle. Comes with a 7' by 5' concrete entry slab. Unit will be offloaded and set into owner supplied excavated hole at jobsite.

**Benefits of a BOOM Precast Vault Toilet**

- “SST” Technology
- Visually Appealing
- ADA Compliant
- No Plumbing
- Vandal Resistant
- Weather Resistant
- Factory Built
- Low Maintenance
- Installs in Hours
- Ready to Use
- Odor Free
- Options Available

**Price**

<table>
<thead>
<tr>
<th>SIN # 361-10H</th>
<th>Commercial Price</th>
<th>Net GSA Price</th>
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<tbody>
<tr>
<td></td>
<td>$7,650.00</td>
<td>$7,476.15</td>
</tr>
</tbody>
</table>

**Added Cost Options**

- Optional wall texture - Colonial Dry Stack or Barnwood
- Plastic Urinal
- Solar Vent Stack Fan

Call for quote on transportation costs from Newell SD

GSA Schedule

Contract GS-07F-0389V

Prices effective January 1, 2010