Onsite Wastewater and Drainage Systems for Ponderosa School, Santa Cruz, Bolivia

La Gente Engineering visited Ponderosa School, located in District 12 of Santa Cruz, Bolivia, for two weeks in May, 2008. With 350 students and 12 teachers, this public school educates neighborhood children from kindergarten through 8th grade. The school grounds flood regularly and standing water is common. The standing water leads to discomfort , skin disease, and serious illness. The school's toilets are not reliable and the current septic system must be pumped at least twice a year. The city of Santa Cruz is constructing a storm water canal through the street on which Ponderosa School is located, Nuevo Palmar. A municipal sanitary sewer is expected along Nuevo Palmar in the next five to ten years. La Gente Engineering investigated the situation at Ponderosa School, researched a variety of options, and concluded with final recommendations.

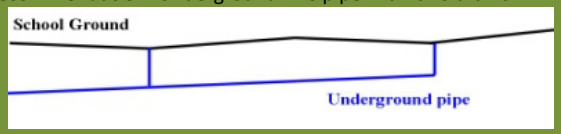
Water Testing : Drinking water tested as clean. Ground water near the existing system tested as contaminated. Standing water on the school site tested as contaminated. Water ran through soil tested as contaminated.
Soil Testing: Site is mostly sandy loam. Water table in May, 2008 at 1.55 m.
Flow Rate: One flush is about 6.6 liters. Kids use the bathroom twice a day. LGE estimated wastewater flow at about 7920 liters per day.

Drainage

Issue: Ponderosa School grounds are entirely paved. No drainage system exists, so rainwater floods the courtyard, causing standing water which can lead to a variety of illnesses.

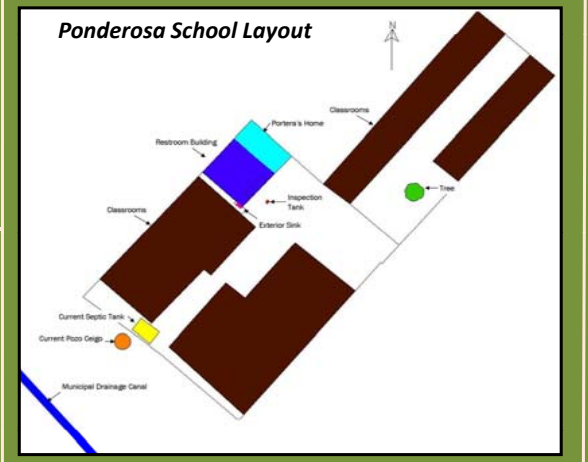
Ideas:
- Graded schoolyard
- Open Channel
- Underground PVC pipe with two drains

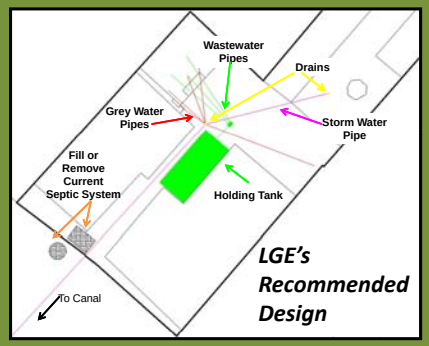
Recommendation: Underground PVC pipe with two drains



Why? Underground pipe will quickly remove water and keep debris and children out of the storm water. Grey water from sinks can easily be connected to these underground pipes. Having two drains will allow for quick drainage and will still provide drainage if one drain is blocked.
Estimated Cost for Construction: $47,250 or 350,000 Bolivianos

LGE could not have completed this International Senior Design project without the help and support of many people. Thanks to Michigan Tech faculty, mentors from around the United States and the many Bolivians who made all of this possible.



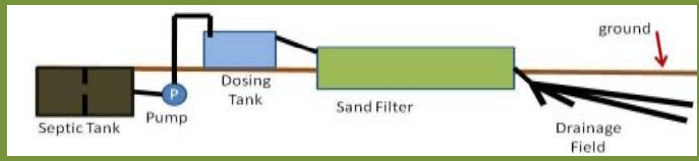


Wastewater

Issue: The current septic tank is undersized. The current pozo ciego (dry well) extends deeper than the wet-season water table and may be contaminating groundwater. Grey water from sinks is currently discharged very near the pozo ciego, saturating the nearby soil.

Ideas: Ten design options were considered and researched. Space, cost, constructability, and cultural acceptance constraints eliminated all but two options:

A. Septic tank discharging to a mid-sized sand filter followed by a small-scale drainage field.



B. Wastewater discharges to a holding tank. Wastewater stored until pumping.

Recommendation: Holding tank , sized for 12 pumpings per year.
Why? Simple construction, similar to a septic tank, with which Bolivians are familiar. Very simple maintenance. No moving parts. No electricity. LGE believes a holding tank is more feasible and more likely to last ten years in an elementary school setting.
Estimated Cost for Construction: $23,890 or 176,754 Bolivianos