

CHICHICA AQUADUCT SYSTEM

Final Presentation



Samantha Kohls



David Kilpela



Megan Smaby



Pengcheng Zhou



International Senior Design, Michigan Technological University
Advisors: David Watkins, PhD & Mike Drewyor, PE, PS
November 27, 2011



Outline

- Introduction
 - Mission Statement
 - Chichica's Culture
- Project Scope
 - Existing Water System
 - Data Collection
 - Project Development
- Final Recommendations
 - Construction Schedule
 - Cost Estimate
- References and Questions



TMC Mission Statement

“With a combined focus of ethical responsibility and cross-cultural comprehension, TMC strives to be a leader in the efforts to expand access of clean water.”



Chichica



Chichica Culture

- Indigenous People
- Rural Community
- Water Shortage
- Community Involvement



Water Committee



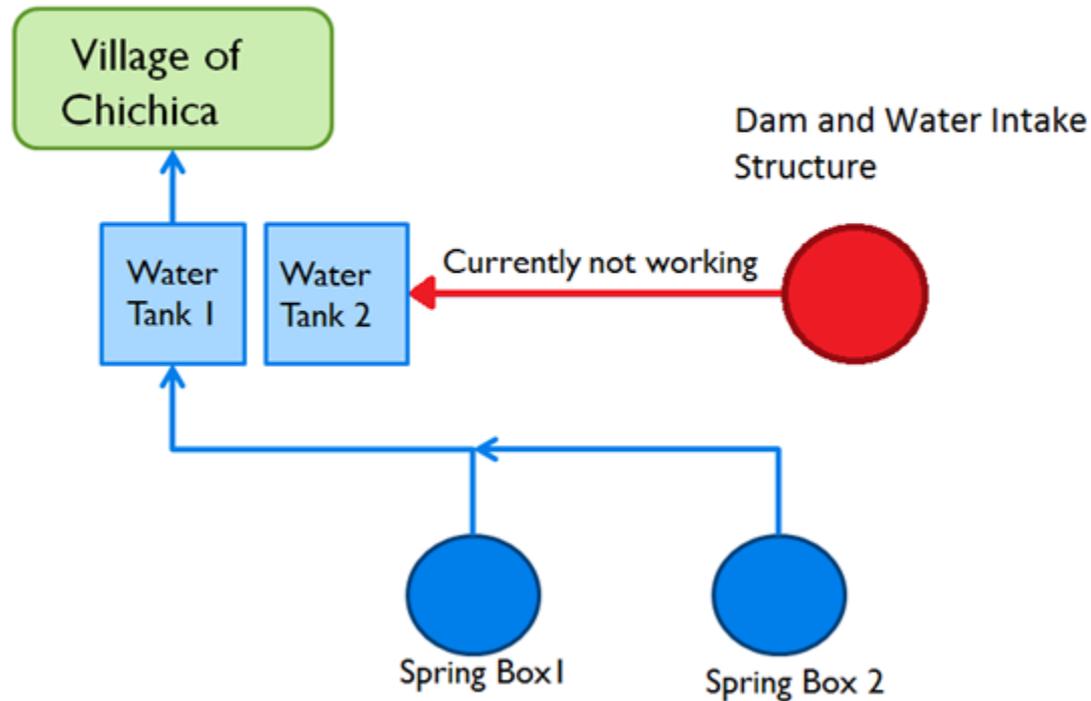
Project Scope

- Purpose: Find a feasible way to repair the aqueduct and water intake structure as well as ensure that the water is properly treated.
- Intake structure sediment
- Pipeline pressure
- Water source contamination



Existing Water System

Existing Water System



Project Focus



Data Collection: Pipeline

- Abney Level Survey
- GPS survey



Data Collection: Intake Structure



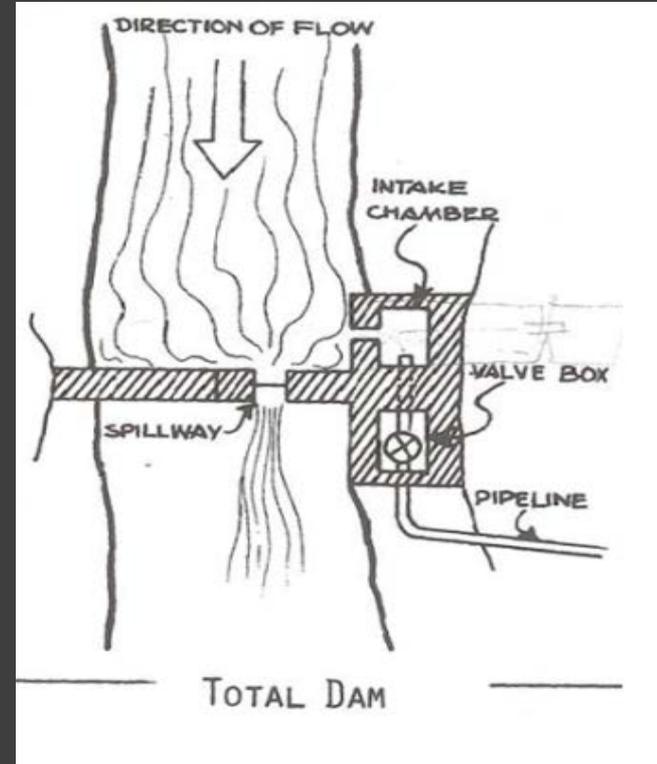
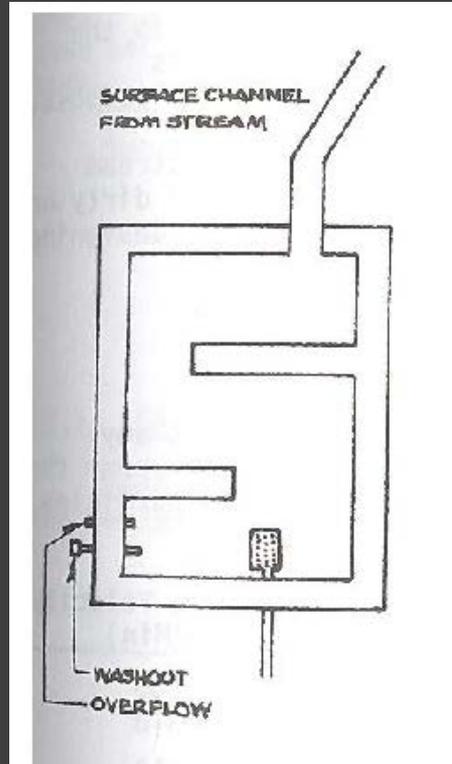
- Dimensions
- Flow of River

Data Collection: Water Quality

3M Petrifilm Test



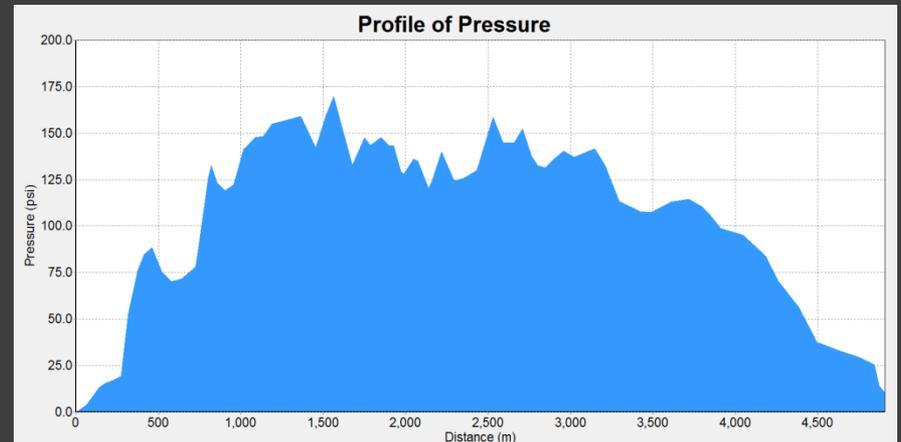
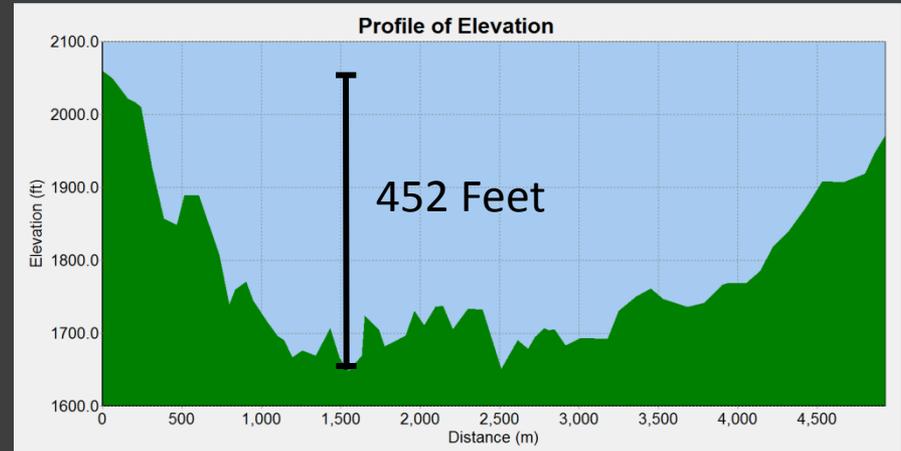
Project Development: Intake Structure



Project Development: Pipeline

- Elevation Profile
 - 452 ft Max Elevation Drop
 - 81 ft Net Elevation Difference

- Pressure Profile
 - 172 psi Max
 - 7.2 psi at End
 - Within 4" Sch. 40 limits



Project Development: Pipeline

GPS and EPANET Model

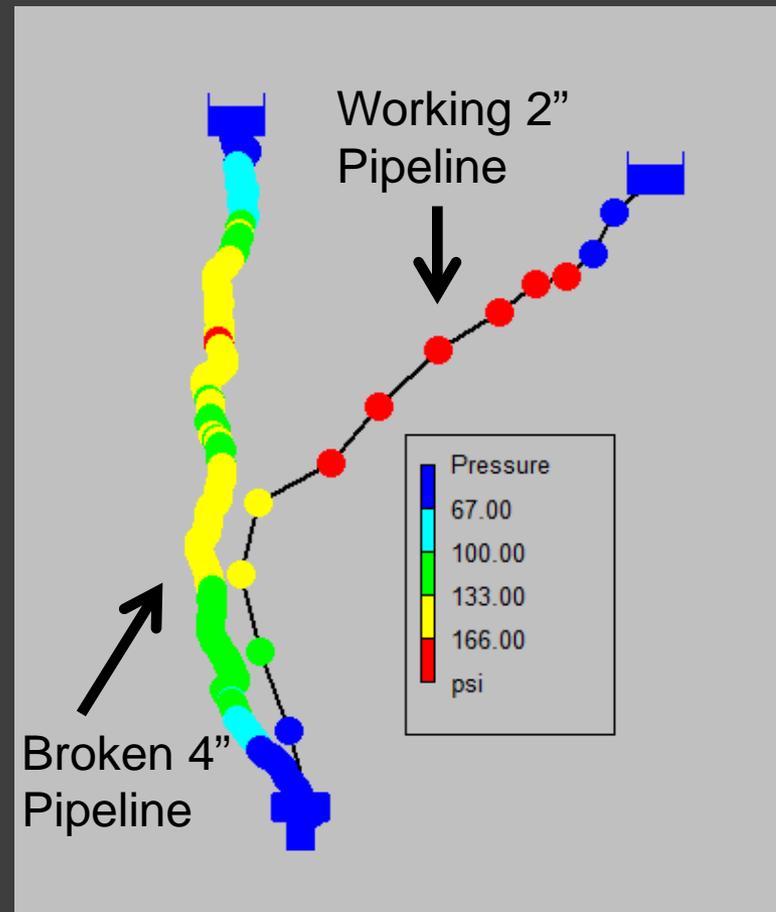
4" line: Within pressure limits, High flowrate

2" line: Just within pressure limits

$\frac{1}{4}$ flowrate

4" Pipeline
Schedule 40 Pipe
Flowrate: 95.2 gpm

2" Pipeline
Schedule 40 Pipe
Flowrate: 23.7 gpm



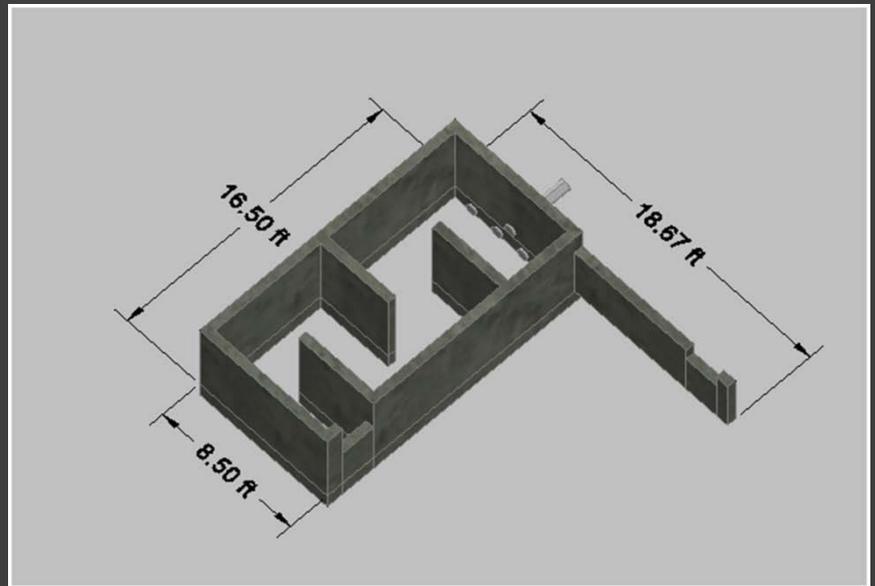
Project Development: Water Quality

- Coliform and E. Coli counts
- Research chlorination systems and sand filtration

Table 1: 3M Petrifilm Test Count Results			
Sample #	Location	Coliform Count CFU	E. Coli Count CFU
1	Upstream Broken River Intake	130	2
2	Upstream Broken River Intake	250	6
3	Upstream Broken River Intake	170	6
4	At Functioning Spring Box	10	0
5	At Functioning Spring Box	9	0
6	Peace Corps Water Tap	49	0
7	Peace Corps Water Tap	64	0
8	Peace Corps Water Bucket	250	0

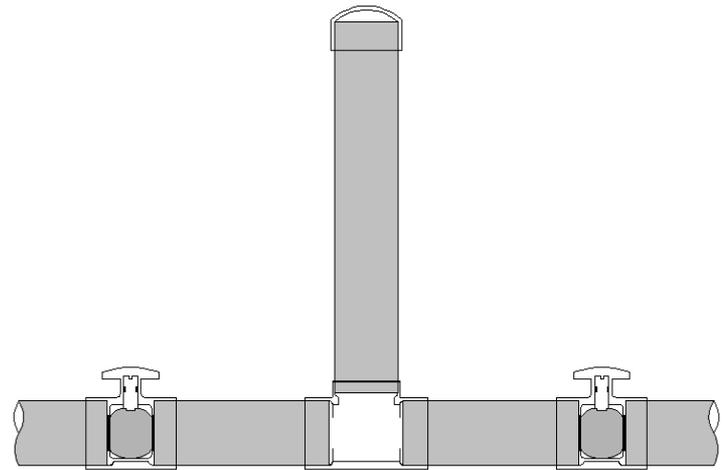
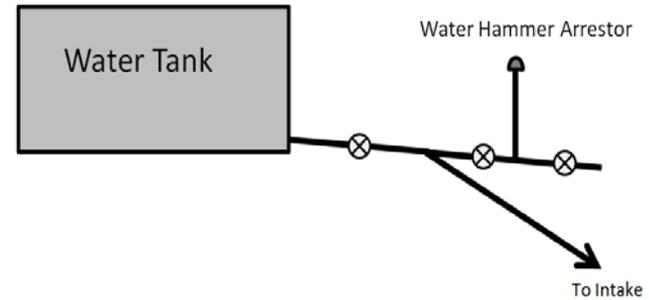
Final Recommendation: Intake Structure

- 16.5'x8.5' settling tank
- Three wing walls
- Perpendicular intake spillway
- Weir and intake spillway equal elevations
- Cleanout valves



Final Recommendation: Pipeline

- Replace 7550 ft pipeline
4" schedule 40
- Bury pipeline
- Add 18 air relief valves
- Add water hammer
arrestor near the tank



Final Recommendation: Water Quality

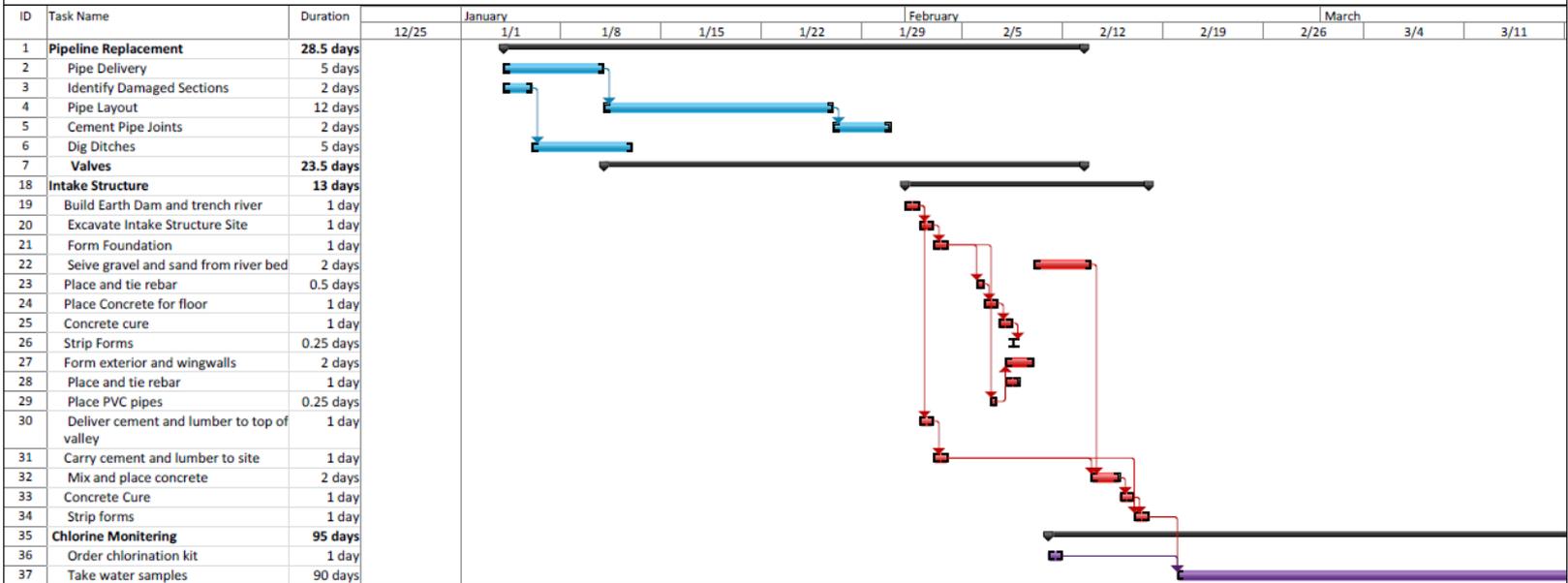
- Chlorine tablet test kit
- Sand filters



Construction Schedule



iDesign Chichica Aqueduct Project Schedule



Project: Project_Schedule.mpp Date: Sun 12/4/11	Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline	
	Split	External Tasks	Inactive Summary	Manual Summary	Progress	
	Milestone	External Milestone	Manual Task	Start-only		
	Summary	Inactive Task	Duration-only	Finish-only		

Cost Estimate



Component	Cost
Intake Structure	\$990
Water Quality	\$40
Pipeline	\$3,160
Labor- estimated at \$1,313, but will be donated	\$0
Total Cost	\$4,200
Total Cost + 15% contingency for unexpected costs	\$4,850

Cost for Intake Structure

	Quantity	Unit Price (\$)	Cost
Cement (42.5 kg bag)	75 bags	\$8 / bag	\$600
Cement Transportation Truck cost	1 day	\$55 / day	\$55
Rebar 3/8" (#3) (30ft)	0 rods	\$5.30 / rod	\$0
Rebar 1/2" (#4) (30ft rods)	12 rods	\$10 / rod	\$120
Sand	4.667 yd ³	\$0 (river)	\$0
Aggregate	6.5 yd ³	0 (river)	\$0
Board (per foot)	700 board feet	\$0.30 / board ft	\$210
Total Cost for Intake Structure			\$1,000

Cost for Pipeline

	Quantity	Unit Price (\$)	Cost
Replacement Pipes (schedule 40)	170 units	\$16.08 / pipe	\$2,734
Pipe Transportation from Tole' to Chichica	1 day	\$44 / day	\$44
Joint Fittings / coupling	10	\$1 / coupling	\$10
Socket T	18 sockets	\$9 / socket	\$162
Cap	\$18 caps	\$4 / cap	\$72
Screen	2 screens	\$5 / screen	\$10
Cable	140 ft	0.25 per foot	\$35
4' by 8' welded wire mesh	2 pannels	15 / pannel	\$30
Gate Valves	1	65 / valve	\$65
Total Cost for Pipeline			\$3,200

Water Treatment



Cost for Water Quality Improvement

	Quantity	Unit Price (\$)	Cost
Chlorine tablets	determined by test kit	\$0 (MINSAs)	\$0
Chlorine test kit	1	\$40 / kit	\$40
Total Cost for Water Quality Improvement			\$40

Conclusion

- Send Data to Peace Corps Volunteers and Chichica Water Committee



Acknowledgments



Peace Corps Volunteers: Jessica Rudder, Chris Kingsley

Chichica Water Committee

ISD Advisors: David Watkins Ph.D., Michael Drewyor PE, PS

Other Acknowledgments: Brian Barkdoll P.E, PS, Martin Auer Ph.D.



References

ASTM D 1785-06. ASTM International. *Standard Specification For Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120* . West Conshohocken, PA: , 2006. Print

3M Food Safety. *3M Petrifilm E. Coli/ Coliform Count Plate*. 2008. Print.

Jordan, Thomas D. *A Handbook of Gravity-Flow Water Systems*. Warwickshire: Intermediate Technology Publications, 1980. Print.

WHO (2004). *Guidelines for drinking-water quality*, 3rd ed., World Health Organization, Geneva.

Questions?

