Verde Valley Water Treatment

December 9th, 2016
CRKL Engineering
CENE 476 Capstone Team
Robert Hoppe, Lizzie Tague, Kyle Weiss & Camille White

Stakeholders

Client: Dr. Paul Gremillion

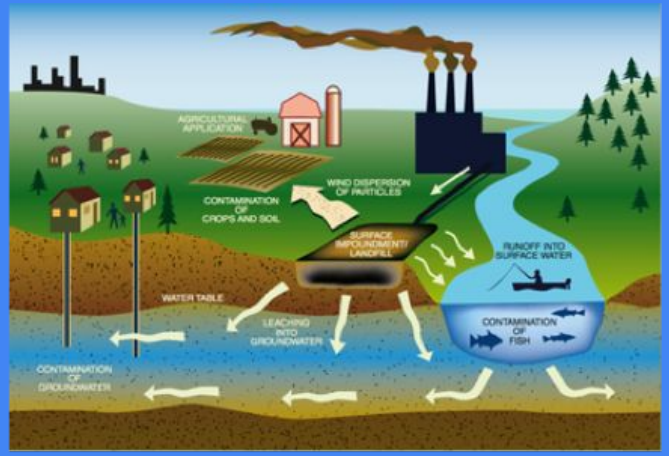
Verde Valley Community

Technical Advisor: Dr. Terry Baxter

Dr. Paul Gremillion [1]

Dr. Terry Baxter [2]

Project Understanding



Arsenic Cycle [3]

Contaminants

- Arsenic (As): 1-2 mg/L
- Nitrate (NO_3^-): 25-40 mg/L

Sources of Contamination

- Both sources naturally occurring
- As - agriculture & industrial activities
- NO_3^- - fertilizers, animal & plant waste

Health Effects

- As - heightened cancer risk, pregnancy complications
- NO_3^- - vascular collapse, Blue Baby Syndrome

Environmental Protection Agency Regulations

- As : 0.01mg/L
- NO_3^- : 10 mg/L

Scope

Task 1 - Preliminary Engineering

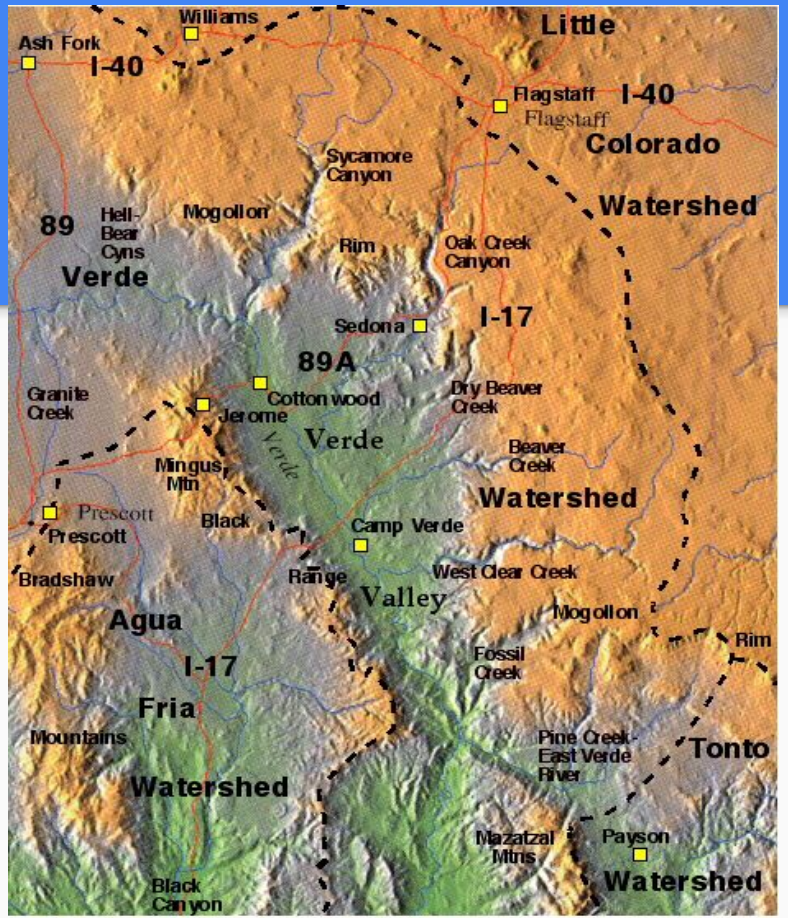
Task 2 - Literature Reviews

Task 3 - Design Decision

Task 4 - Design Preparation

Task 5 - Design Development

Task 6 - Project Management



Map of Verde Valley [4]

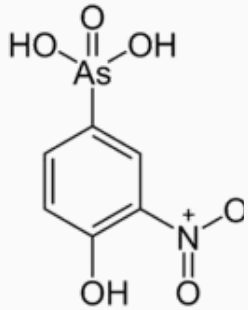
Scope

Task 1.0 Preliminary Engineering

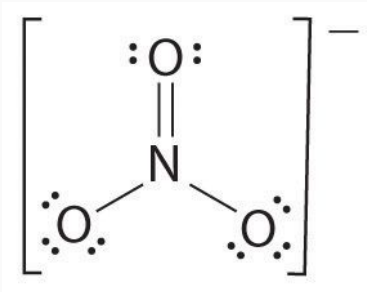
- 1.1 Chemical Research
- 1.2 Staffing and Cost

Task 2.0 Literature Reviews

- 2.1 Conventional Treatment Method
- 2.2 Sustainable Treatment Method
- 2.3 Innovative Treatment Method



Arsenic [5]



Nitrate [6]

Scope

Task 3.0 Design Decision

- 3.1 Presentation
- 3.2 Preliminary Website
- 3.3 Design Proposal

Task 4.0 Design Preparation

- 4.1 Acquiring Lab Space
- 4.2 Proper Certifications
- 4.3 Acquiring Materials
- 4.4 Water Contamination

Scope

Task 5.0 Design Development

- 5.1 Construction
- 5.2 Water Testing
  - 5.2.1 Outsource Samples
- 5.3 Analyze Test Results
- 5.4 Final Presentation
- 5.5 Design Report and Website

Task 6.0 Project Management

- 6.1 Team Meetings
- 6.2 Technical Advisor Meetings
- 6.3 Client Meetings

Schedule

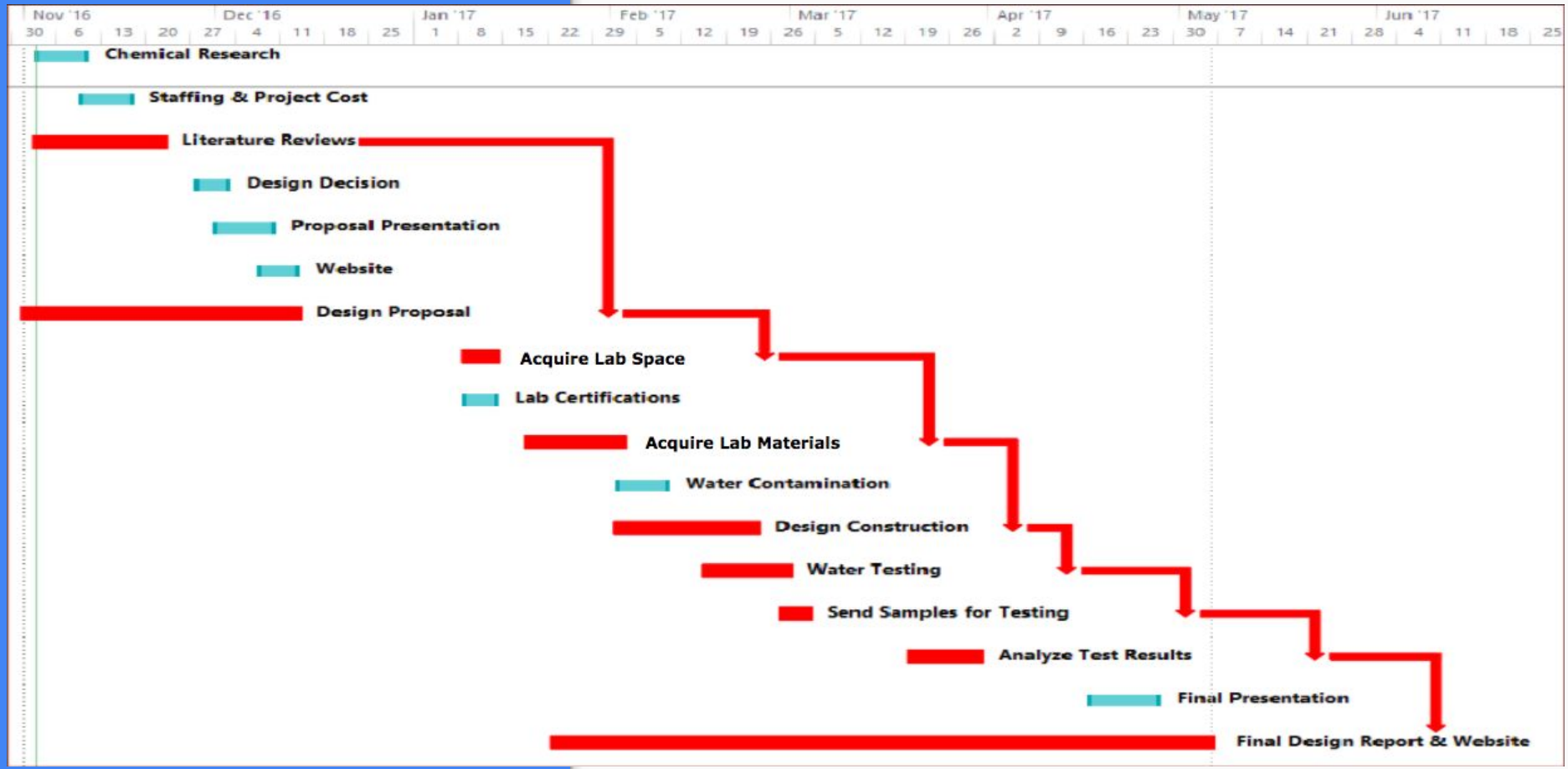
FALL 2016

Task Name	Duration
1.0 Preliminary Engineering	**12 days**
1.1 Chemical Research	*6 days*
1.2 Staffing & Cost	*6 days*
2.0 Literature Reviews	**17 days**
3.0 Design Decision	**19 days**
3.1 Proposal Presentation	*5 days*
3.2 Website	*4 days*
3.3 Design Proposal	*10 days*

SPRING 2017

Task Name	Duration
4.0 Design Preparations	**27 days**
4.1 Acquire Lab Space	*5 days*
4.2 Lab Certifications	*5 days*
4.3 Acquire Lab Materials	*11 days*
4.4 Water Contamination	*6 days*
5.0 Design Development	**67 days**
5.1 Design Construction	*16 days*
5.2 Water Testing	*9 days*
5.2.1 Send Samples for Testing	*4 days*
5.3 Analyze Test Results	*9 days*
5.4 Final Presentation	*9 days*
5.5 Final Design Report & Website	*75 days*

Schedule


Nov '16
Dec '16
Jan '17
Feb '17
Mar '17
Apr '17
May '17
Jun '17
30 6 13 20 27 4 11 18 25 1 8 15 22 29 5 12 19 26 5 12 19 26 2 9 16 23 30 7 14 21 28 4 11 18 25
Chemical Research
Staffing & Project Cost
Literature Reviews
Design Decision
Proposal Presentation
Website
Design Proposal
Acquire Lab Space
Lab Certifications
Acquire Lab Materials
Water Contamination
Design Construction
Water Testing
Send Samples for Testing
Analyze Test Results
Final Presentation
Final Design Report & Website

Staffing

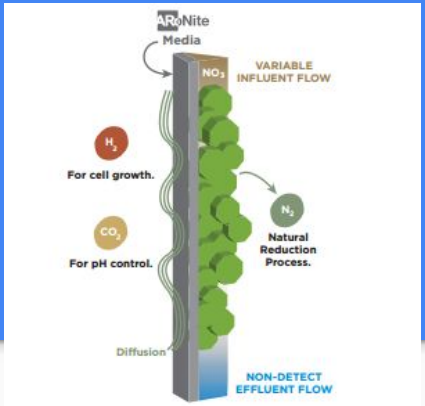
Senior Engineer	SENG
Engineer	ENG
Lab Technician	LAB
Engineering Intern	INT
Administrative Assistant	AA

Task	SENG Hours	ENG Hours	LAB Hours	INT Hours	AA Hours
Research	0	40	0	20	0
Water Contamination Preparation	24	0	80	80	0
Model Construction	40	56	40	24	0
Modeling	16	24	24	16	0
Result Analysis	32	32	0	0	160
Total	**112**	**152**	**144**	**140**	**160**
Total Project Hours		**708**			

Project Cost

	Classification	Hours	Rate $/hr	Cost
Personnel	SENG	112	$132	$14,780
	ENG	152	$69	$10,490
	LAB	144	$52	$7,490
	INT	140	$19	$2,660
	AA	160	$41	$6,560
	Total personnel			$41,980
Lab Work	Materials		$2,500	$2,500
	Lab Rental	40 days	$100/day	$4,000
	Total Lab Work			$6,500
Subcontract	Analytical			$2,500
TOTAL				$50,980

Literature Reviews



Sustainable Nitrate Treatment Option [7]

Conventional

Nitrate - Ion exchange with Chloride

Arsenic - Oxidation

Innovative

Nitrate - Titanium oxide based ion exchange

Arsenic - ElectroChemical Arsenic Remediation

Sustainable

Nitrate - Autotrophic bacteria reduction

Arsenic - Phytoremediation using hyacinth roots

Sustainable

Nitrate - Permeable reactive barriers

Arsenic - Ceramic membrane filters paired with metal oxides

References

[1] https://www.linkedin.com/in/paul-gremillion-7b4b84108
[2] https://nau.edu/cefns/engineering/civil-environmental/directory/baxter-terry/
[3] http://www.catawbariverkeeper.org/coal-ash-fact-sheet
[4] http://jan.ucc.nau.edu/rcb7/verde.html
[5] https://upload.wikimedia.org/wikipedia/commons/thumb/2/20/Roxarsone.png/140px-Roxarsone.png
[6] https://www.thestudentroom.co.uk/showthread.php?t=2734351
[7] http://vertassets.blob.core.windows.net/download/97114a3f/97114a3f-376b-4912-99a6-d1828a86bf7e/aptwateraronitetechnologyoverview.pdf

Thank you

NORTHERN ARIZONA UNIVERSITY

CRKL Engineering Team