



**ABCC
Projects**



DEWEY ALTERNATIVE SEPTIC SYSTEM: PROPOSAL OF WORK

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Figure 1:Planned Pre-Fab House to be built and connected to the alternative septic system

Coventry Log Homes-Lakeside Model



PROJECT INTRODUCTION

- What is being done
 - Design of an off-grid wastewater treatment system that allows for treated water to be recycled into irrigation use
- Client
 - Taylor Layland, P.E., Remal Consulting LLC
- Technical Advisor
 - Rand Decker, P.E., NAU Professor
- Grading Instructor
 - Wilbert Odem, P.E., NAU Professor



Figure 2: Example of a drip irrigation septic water disposal system, Parker's Septic Services



PROJECT BACKGROUND

- Site Details
 - 5-Acre Parcel of Land in Dewey-Humboldt, AZ
 - Single-Family Residence, 2 Bed, 2 Bath
- All Codes regarding Septic and similar systems fall under Yavapai County and AZDEQ



Figure 3: Map of 5-Acre Site, USGS GIS Survey

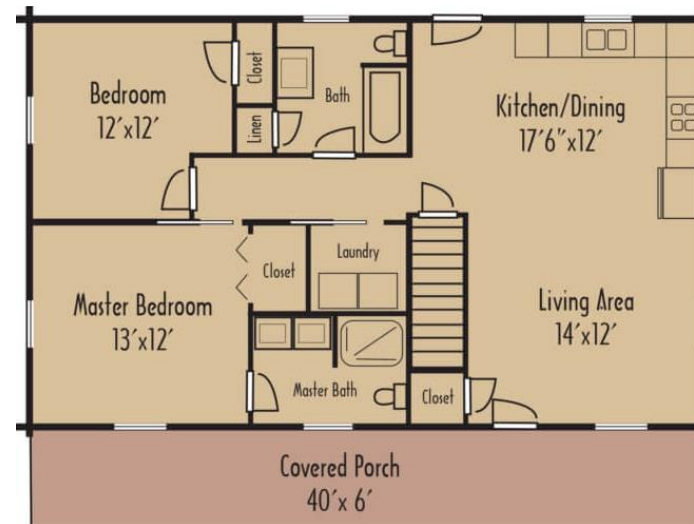


Figure 4: Pre-Fab House Floorplan, Coventry Log Homes-Lakeside Model

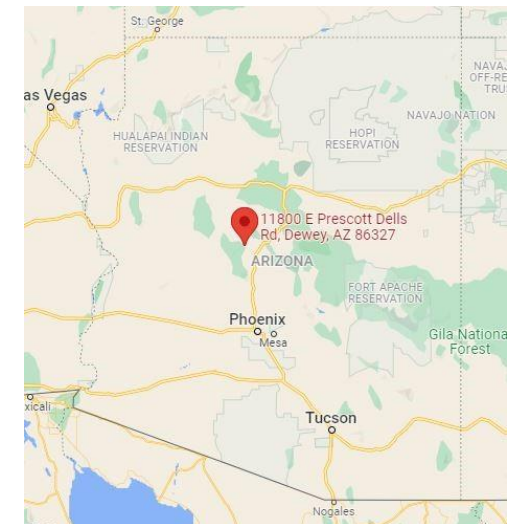


Figure 5: Site Location in Arizona, Google Maps



MAP OF DEWEY-HUMBOLDT

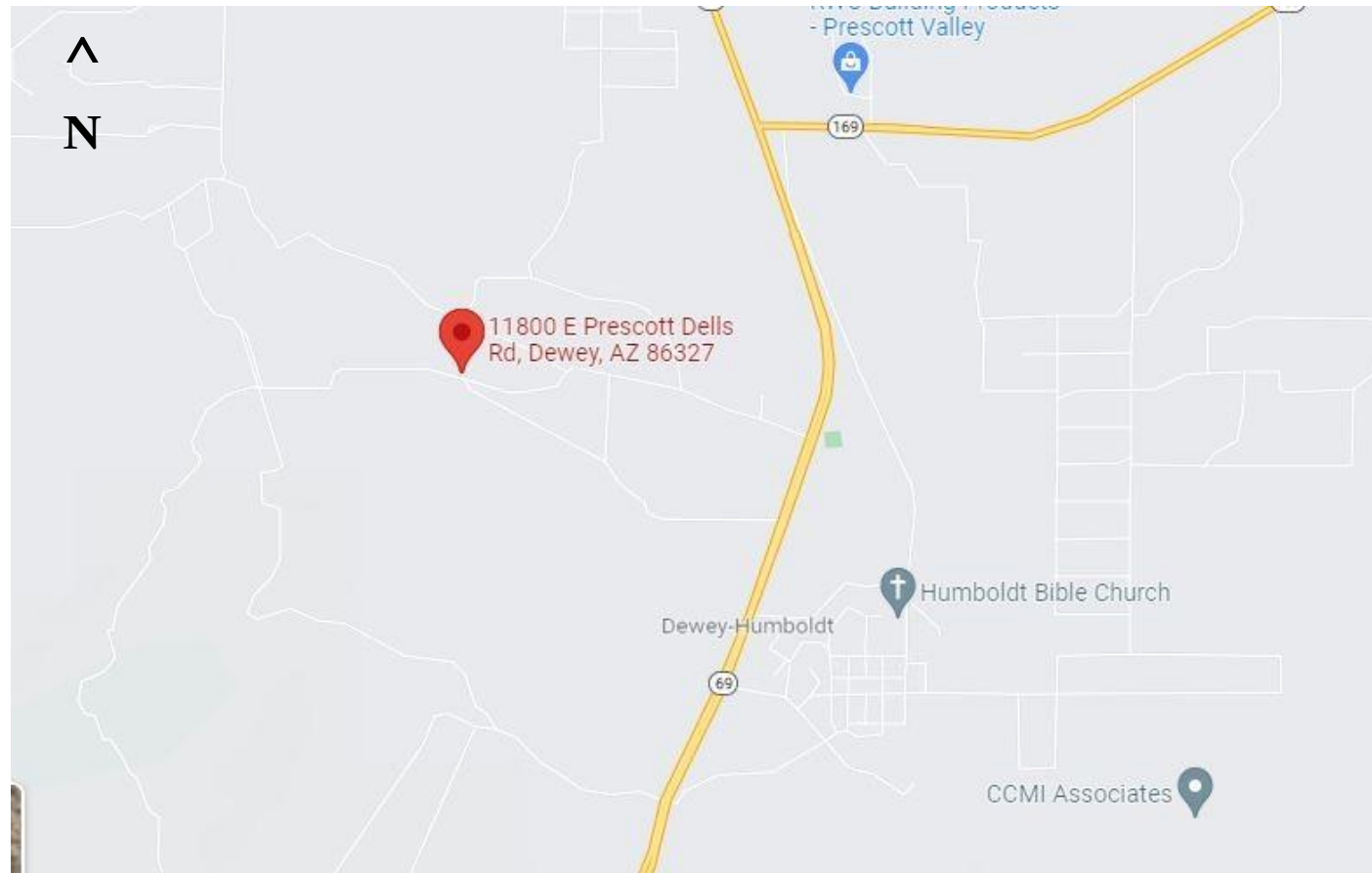


Figure 6: Map of Dewey Humboldt, Google Maps



CONSTRAINTS AND CHALLENGES

- Constraints
 - Physical System Budget: \$35,000
 - Infiltration rates control system size
- Challenges
 - Inability to access site
 - Avoidance of contamination hazards
 - Strict regulations on treated wastewater



Figure 7: Example of soil conditions surrounding Dewey-Humboldt, Karyl Moore Real Estate



TECHNICAL APPROACH

- Technical Field Considerations
 - Hydrologic
 - Geotechnical
 - Wastewater Treatment Design
 - Septic System Design



Figure 8: Typical Septic Tank Installation, House Logic-Understanding Your Septic System



SCOPE OF SERVICES: MILESTONE 30%

- Task 1: Research and Preparation
 - Task 1.1: City and State Regulations
 - Task 1.1.1: ADEQ, Yavapai, Dewey-Humboldt Construction Regulations
 - Task 1.1.2: Operation Regulation
 - Task 1.2: Site Sampling Plan
 - Task 1.3: Laboratory Access Plan
 - Task 1.4: Technology Options Research
- Task 2: Site Investigation
 - Task 2.1: Surveying
 - Task 2.2: Site Soil Sampling
 - Task 2.3: On-Site Perc Test
- Task 3: Data Analysis
 - Task 3.1: Topographical Map
 - Task 3.2: Soil Composition Test
 - Task 3.3: Percolation Test



Figure 9: Data Gathering, Research Gate



SCOPE OF SERVICES: MILESTONE 60%

- Task 4: Design Solutions
 - Task 4.1: Design Alternatives
 - Task 4.1.1: Final Site Location
 - Task 4.1.2: Separate Design Configurations
 - Task 4.2: Design Decision Matrix
 - Task 4.3: Final Design Recommendation

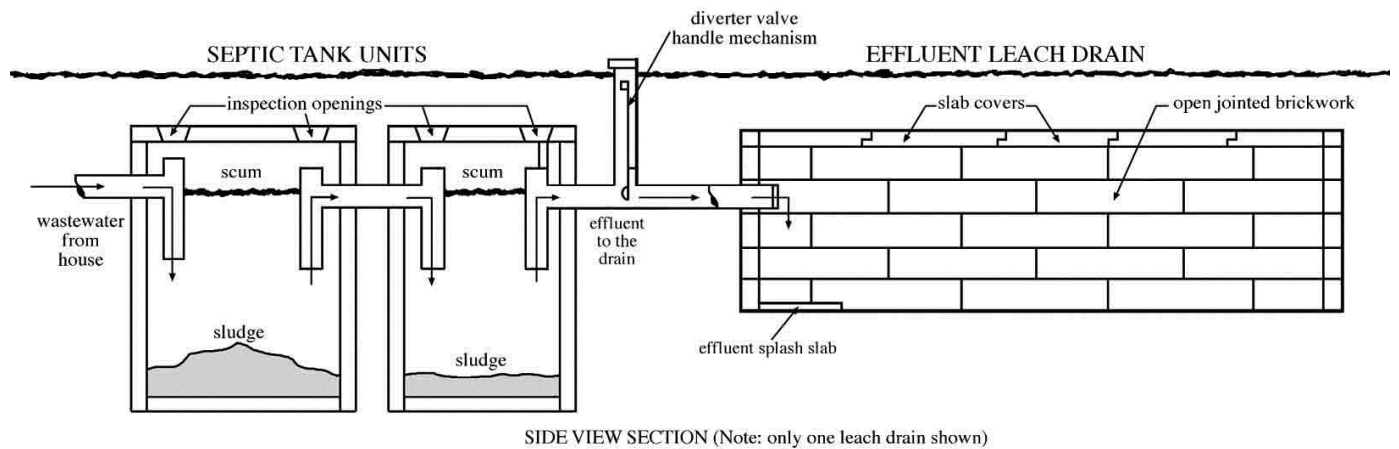


Figure 10: Example of a simple septic system using an effluent leach drain and multiple septic tanks, Government of West Australia Department of Health



SCOPE OF SERVICES: MILESTONE 90%

- Task 5: Impact Analysis
 - Task 5.1 Economic Impacts
 - Task 5.2 Social Impacts
 - Task 5.3 Environmental Impacts
- Task 6: Installation and Operation
 - Task 6.1: Installation Plan Set
 - Task 6.2: Owners and Operators Manuals
- Task 7: Project Management
 - Task 7.1: Meeting Recording
 - Task 7.2: Schedule Management
 - Task 7.3: Resource Management



Figure 11: Septic Tank Inspection, The Durango Herald



SCOPE OF SERVICES: DELIVERABLES, EXCLUSIONS, AND COMPLETION

- Task 8: Deliverables
 - Task 8.1: 30% Submittal
 - Task 8.1.1: Milestone: Tasks 1-3
 - Task 8.1.2: 30% Report and Presentation
 - Task 8.2: 60% Submittal
 - Task 8.2.1: Milestone: Task 4
 - Task 8.2.2: 60% Report and Presentation
 - Task 8.3: 90% Submittal
 - Task 8.3.1: Milestone: Tasks 5-7
 - Task 8.3.2: 90% Report and Presentation
 - Task 8.4: Final Submittal
 - Task 8.4.1: Final Report
 - Task 8.4.2: Website
 - Task 8.4.3: Presentation
- Exclusions
 - Hydrologic Analysis
 - Water Utilities Planning
 - System failure environmental impact



Figure 12: Job Completion, BBC



SCHEDULE

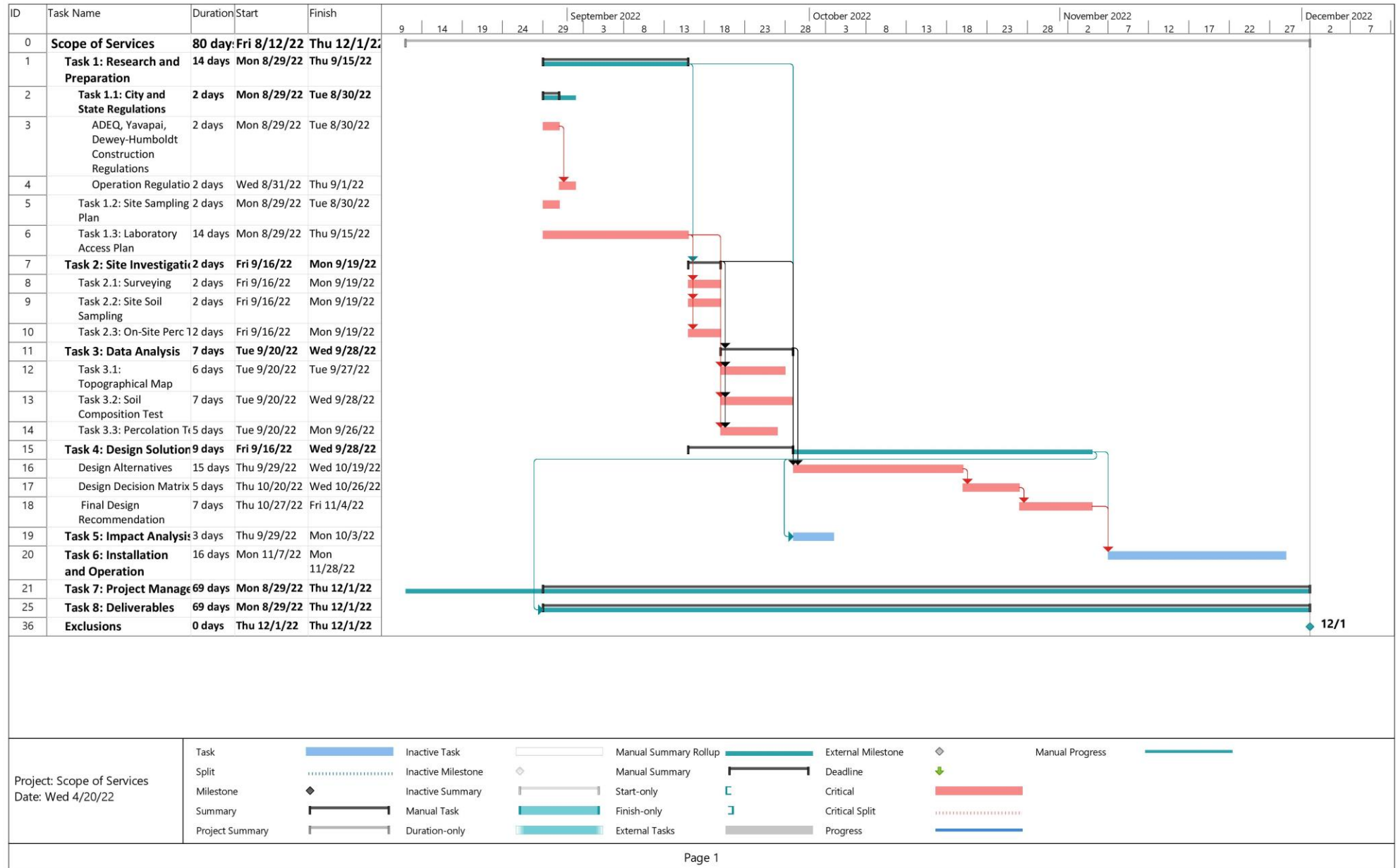


Figure 13: Gantt Chart Schedule, ABCC Projects



COST PROPOSAL: STAFFING

- Staffing broken down into four positions
 - Senior Engineer (P.E. and Years of Tenure)
 - Research and Project Management
 - Engineer (P.E.)
 - Design and Calculations
 - Lab Technician (Lab Certified)
 - Soil Sampling and Data
 - Engineering Intern (EIT, CENE Graduate)
 - Assist Engineer and Senior Engineer
- Personnel Cost: \$70,488

Hours Sum		Staffing Time			
600	Total Hours	138	220	39	203
Task #	Task	SENG	ENG	LAB	INT
1 Research and Preparation					
	1.1 City and State Regulations	20	6	0	6
	1.1.1 ADEQ, Yavapai, Dewey-Humboldt Construction Reg	4	0	0	0
	1.1.2 Operation Regulation	2			
	1.2 Site Sampling Plan	4			
	1.3 Laboratory Access Plan	2			
	1.4 Technology Options Research	10	6		6
2 Site Investigation					
	2.1 Surveying			13	12
	2.2 Site Soil Sampling		5	5	5
	2.3 On-Site Perc Test		5	5	5
3 Data Analysis					
	3.1 Topographical Map	10	10		
	3.2 Soil Composition Test			10	10
	3.3 Percolation Test			6	6
4 Design Solutions					
	4.1 Design Alternatives	7	65	0	50
	4.1.1 Final Site Location	2	60	0	45
	4.1.2 Separate Design Configurations		60		45
	4.2 Design Decision Matrix	5	5		5
	4.3 Final Design Recommendation				
5 Impact Analysis					
	5.1 Economic	5	5		5
	5.2 Social	5	5		5
	5.3 Environmental	5	5		5
6 Installation and Operation					
	6.1 Installation Plan Set	10	30		20
	6.2 Owners and Operators Manual	20	30		20
7 Project Management					
	7.1 Meeting Recording	5			
	7.2 Schedule Management	15			
	7.3 Resource Management	15			
8 Deliverables					
	8.1 30%	5	15	0	15
	8.1.1. Milestones: Tasks 1-3		5		5
	8.1.2. Report and Presentation	5	10		10
	8.2 60%	5	15	0	15
	8.2.1. Milestones: Tasks 4		5		5
	8.2.2. Report and Presentation	5	10		10
	8.3 90%	5	15	0	15
	8.3.1. Milestones: Tasks 5-7		5		5
	8.3.2. Report and Presentation	5	10		10
	8.4 Final Submittal	6	9	0	9
	8.4.1. Final Report	2	5		5
	8.4.2. Website	2	2		2
	8.4.3. Presentation	2	2		2

Figure 14: Staffing Time Breakdown, ABCC Projects



COST PROPOSAL: SUPPLIES AND TRAVEL

- Travel Expenses
 - Single trip to Dewey-Humboldt
 - Soil Sampling and Site Overview
 - Includes:
 - NAU Travel Reimbursement (158.2 Miles)
 - NAU Vehicle Rental
- Cost: \$135
- Supplies and Equipment
 - Required materials for work
 - Physical: Pens, Paper, Printer Ink, Planset Paper, etc
 - Digital: AutoCAD
 - Rental: Soil Auger
 - Cost: \$862



Figure 15 : I-17 South of Flagstaff, Signals AZ



COST PROPOSAL: FINAL PROJECT COST

- Final Project Cost:
\$75,459

Total Cost Analysis					
Client:	Taylor Layland				
Company:	ABCC Projects				Total Cost of Project
				\$	75,485.85
Index	Item	Rate (\$/hr)	Hours	Subcost	Cost
1	1.0 Personnel				\$ 70,488.00
2	Senior Engineer (SENG)	\$ 240.00	138	\$ 33,120.00	
3	Engineer (ENG)	\$ 137.00	220	\$ 30,140.00	
4	Lab Technician (LAB)	\$ 50.00	39	\$ 1,950.00	
5	Engineering Intern (INT)	\$ 26.00	203	\$ 5,278.00	
6					
7	2.0 Travel				\$ 135.40
8	NAU Travel Reimbursement (79.1 miles x 2	\$0.445	158.2	\$ 70.40	
9	Chevy Tahoe SSP, NAU Rental (1 day)			\$ 65.00	
10					
11	3.0 Supplies				\$ 862.45
12	Expendable Supplies			\$ 250.96	
13	Equipment Usage			\$ 611.49	
14					
15	4.0 Subcontract				\$ 4,000.00
16	Installation Cost			\$ 4,000.00	

Figure 16: Total Cost Analysis, ABCC Projects



REFERENCES

T. Layland, Interviewee, *Professional Engineer*. [Interview]. 26 January 2022.

EPA, "Septic Systems (Onsite/Decentralized Systems)," Environmental Protection Agency, [Online]. Available: <https://www.epa.gov/septic>. [Accessed 7 Feb 2022].

H. A.-H. a. M. Bino, "Effect of treated grey water reuse in irrigation on soil and plants," *Desalination*, vol. 256, no. 1-3, pp. 115-119, 2010.

W. S. D. o. Health, "Signs of Septic System Failure," Washington State Department of Health, 2022. [Online]. Available: <https://doh.wa.gov/community-and-environment/wastewater-management/septic-system/signs-failure>. [Accessed 26 January 2022].

ASTM, *D6913/D6913M-17 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis*.

ASTM, *D5856-15 Standard Test Method for Measurement of Hydraulic Conductivity of Porous Material Using a Rigid-Wall, Compaction-Mold Permeameter*.

QUESTIONS?



Figure 1. <https://coventryloghomes.com/floorplan/floorplan-tradesman-style-lakeside/>

Figure 2. <https://parkerssepticsservices.com/solutions/drip-irrigation-disposal/>

Figure 3. <https://www.usgs.gov/the-national-map-data-delivery/gis-data-download>

Figure 4. <https://coventryloghomes.com/floorplan/floorplan-tradesman-style-lakeside/>

Figure 5. <https://www.google.com/maps>

Figure 6. <https://www.google.com/maps>

Figure 7. <https://karylmoore.com/listing-details/14240-e-meadow-road-dewey-humboldt-86327/1042420/>

Figure 8. <https://www.houselogic.com/organize-maintain/home-maintenance-tips/understanding-your-septic-system/>

Figure 9. https://www.researchgate.net/figure/Example-of-data-collection-in-the-field-using-PDA-and-GPS-tools_fig3_274077288

Figure 10. https://www.healthywa.wa.gov.au/Articles/U_Z/Understanding-Septic-Tank-Systems

Figure 11. <https://nsr.durangoherald.com/articles/275267>

Figure 12. <https://www.bbc.com/worklife/article/20130809-more-than-a-handshake>

Figure 13. ABCC Projects Gantt Chart

Figure 14. ABCC Projects Staffing Breakdown Chart

Figure 15. <https://www.signalsaz.com/articles/lane-restrictions-on-i-17-phoenix-to-flagstaff/>

Figure 16. ABCC Total Cost Analysis