



NORTHERN ARIZONA UNIVERSITY



CENE 476: CAPSTONE PREP

NITRIFICATION COLUMN DESIGN PROPOSAL

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PROJECT UNDERSTANDING

Project Purpose

- Urine is Nutrient-Rich
- Fertilizer
- Separation of Solid/Liquid Waste
- Reduce Treatment Cost
- Improve Sanitation

Project Background

- House-hold Scale
- NAU Green-House



FIGURE 1: TOP VIEW
NAU GREEN-HOUSE



PROJECT UNDERSTANDING

Technical Considerations

- Exterior Climate
- Interior Climate
- Urine Composition
- Inlet Flow Conditions
- Bacterial Growth Conditions
- Outlet Flow Conditions
- Design Calculations

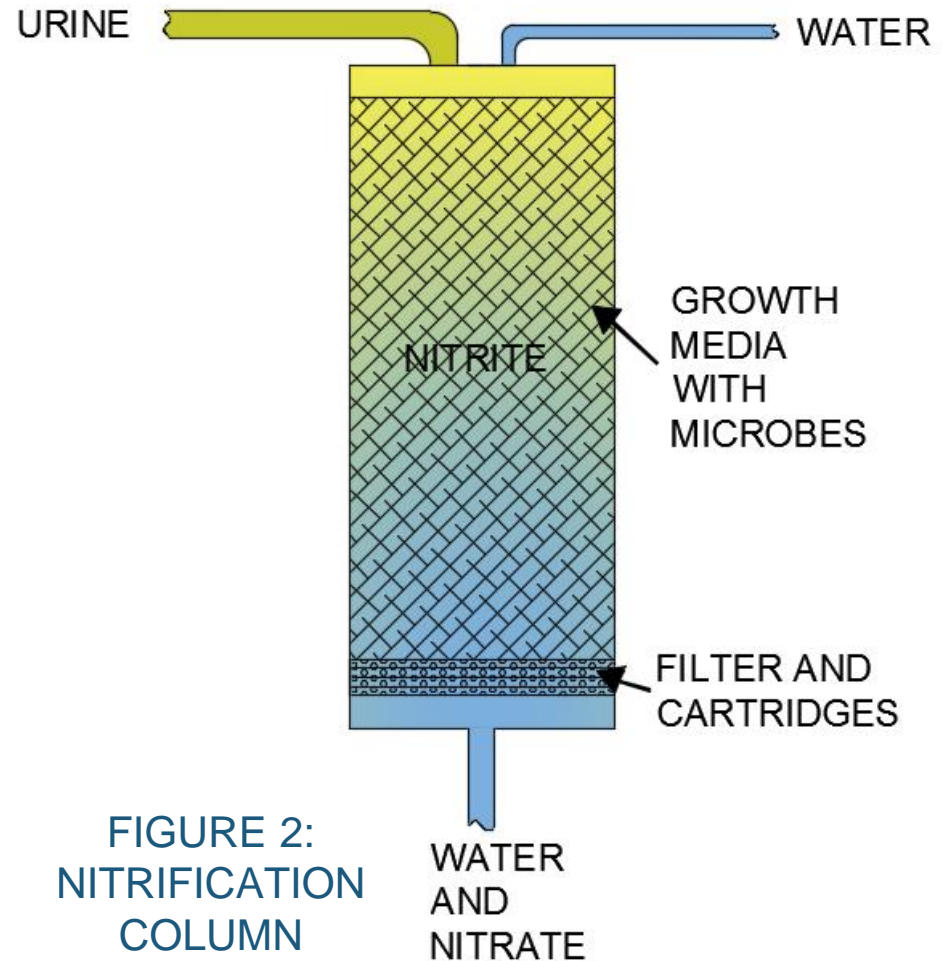


FIGURE 2:
NITRIFICATION
COLUMN



PROJECT UNDERSTANDING

Potential Challenges

- Required Bacteria Levels
- Bacterial Growth
- Contamination
- Effective Growth Media
- Changes in Climate
- Colony Inactivity
- System Flow

Stakeholders

- Client (Alarick Reiboldt)
- Design Team
- Future Homeowner
- Wastewater Treatment Industry
- Public (Food & Sanitation)
- Agriculture Industry
- Environment



SCOPE OF SERVICES

List of Tasks

1.0: Legality and Sanitation

- 1.1: State, Local, and Federal Regulations
- 1.2: Regulations in Regard to Effluent Quality
- 1.3: Prediction of Public Health & Environmental Impacts
- 1.4: Water Usage Restrictions

2.0: Urine Samples

- 2.1: Surrogate or Natural Urine Samples
- 2.2: Sample Collection/Creation
- 2.3: Antibiotic Residuals Analysis

List of Tasks

3.0: Lab Analysis Procedures

- 3.1: List Standard Methods
- ✓ Lab Analysis Procedures
- 3.2: Acquire Materials/ Lab Access
- ✓ Lab Cost Requirements

4.0: Implementation of Lab Work

- 4.1: Bacterial Effectiveness
- 4.2: Bacterial Growth Parameters
- 4.3: Effect of Antibiotics



SCOPE OF SERVICES

List of Tasks

5.0: Preincubated Cartridge Analysis

5.1: Preincubated Cartridge Use?

5.2: Cartridge Design Specs

5.3: Construction of Cartridge

5.4: Testing of Cartridge

6.0: Concept Generation & Selection

6.1: Design Concept Generation

6.2: Design Selection

6.3: Preliminary Design Creation

7.0: Conduction of Field Evaluation

List of Tasks

8.0: Conduction of Plant Evaluation

8.1: Feasibility of Edible Plants

8.2: Required Urine Dilution

9.0: Design Calculations

9.1: Column Dimensions

9.2: Overall System Efficiency

10.0: Final Design

10.1: Column Materials Required

10.2: Column Dimensions

10.3: Final Design Submittal

10.4: Feedback Consideration

✓ Final Design Specifications

✓ Design Cost Requirements



SCOPE OF SERVICES

11.0: Construction of Model

- ✓ Nitrification Column Model

12.0: Final Testing

13.0: Project Management

13.1: Project Schedule

13.2: Design Report

13.3: Final Presentation

13.4: Website

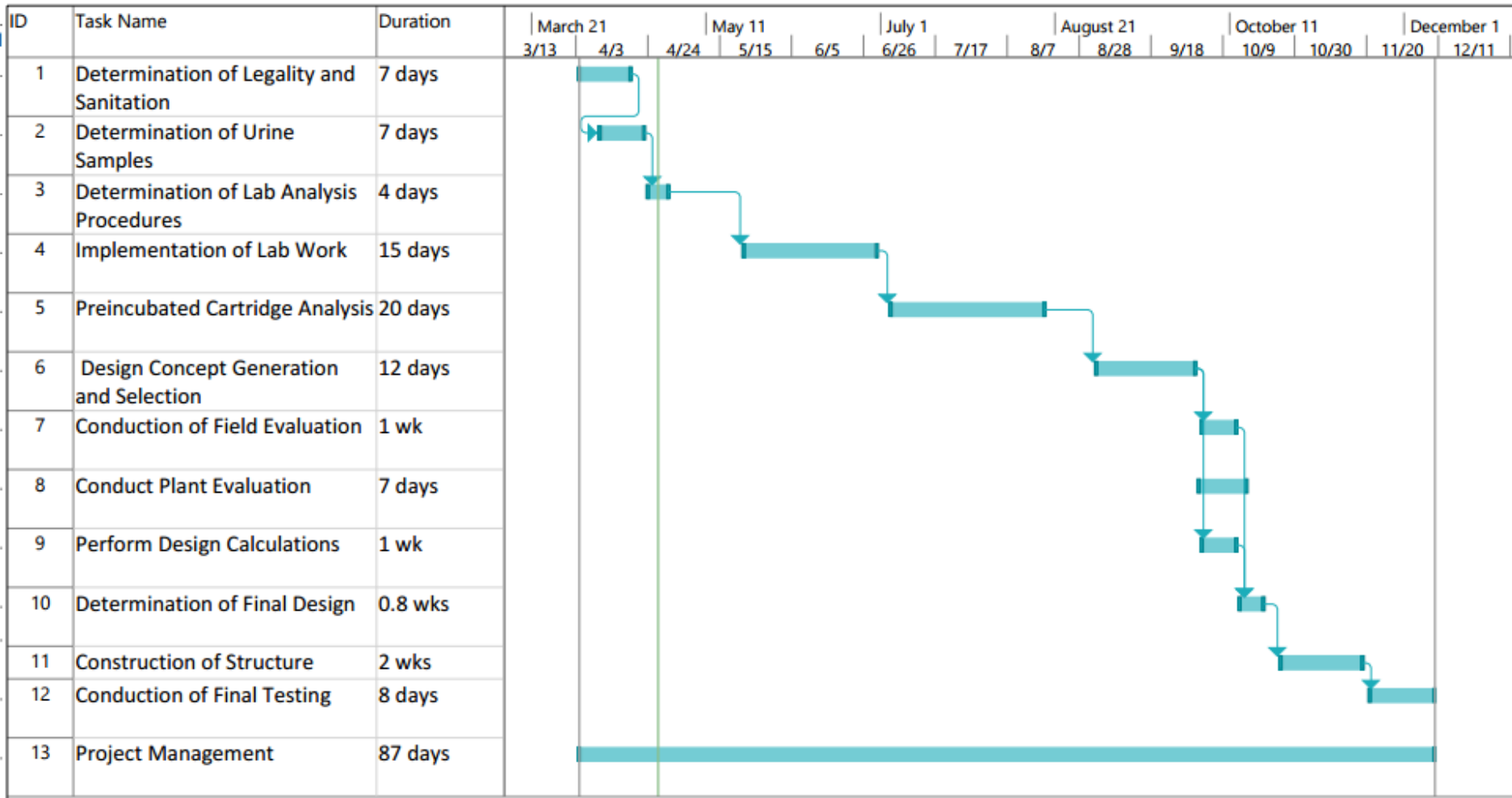
- ✓ Final Project Presentation

List of Exclusions

- Consider only Liquid Waste
 - Exclude Separation of Solid
- Design only for Nitrate Collection
 - Exclude all other Nutrient Collection
- Design only for Household Scale
 - Exclude Utility Scale
- Construct only Model Scale



SCHEDULING





STAFFING

Table 1: Service Classification

Classification	Code
Project Manager	PM
Administrative Assistant	AA
Microbiologist	MB
Biochemical Engineer	BENG
Environmental Engineer	ENENG



STAFFING

Table 2: Staffing Time Table

Task	Total Hours	PM Hours	AA Hours	MB Hours	BENG Hours	ENENG Hours
1.0 Determination of Legality	10	-	10	-	-	-
2.0 Determination of Urine Samples	32.5	7.5	15	-	-	10
3.0 Determination of Lab Analysis Procedure	15	7.5	7.5	-	-	-
4.0 Implementation of Lab Work	75	-	-	25	25	25
5.0 Preincubated Cartridge Analysis	175	-	-	50	67.5	57.5
6.0 Design Concept Generation and Selection	30	11	-	6.5	6	6.5
7.0 Conduction of Field Evaluation	7.5	-	-	5	2.5	-
8.0 Conduction of Plant Evaluation	10	-	-	2.5	2.5	5



STAFFING

Table 2: Staffing Time Table Continue

Task	Total Hours	PM Hours	AA Hours	MB Hours	BENG Hours	ENENG Hours
9.0 Preformation of Design Calculations	10	-	-	-	5	5
10.0 Determination of Final Design	20	-	-	2	8	10
11.0 Construction of Model Sturcture	22.5	-	-	5	7.5	10
12.0 Conduction of Final Testing	17.5	-	-	-	17.5	-
13.0 Project Management	25	25	-	-	-	-
Total Hours	450	51	32.5	96	141.5	129



COST ASSESSMENT

Table 3: Classification of Labor Cost

1.0 Personnel	Classification	Hours	Rate (\$/hour)	Cost
	PM	20.4*2.5=51	145	\$7,395
	AA	12.8*2.5=32	42	\$1,344
	BM	38.4*2.5=96	61	\$5,856
	BENG	56.6*2.5=141.5	60	\$8,490
	ENENG	51.8*2.5=129.5	80	\$10,360
Total Personnel		450		\$33,445
2.0 Lab	Classification	Days	Rate (\$/Day)	Cost
	Lab Rental	60	30	\$1800
	Lab Equipment and Materials			\$500
Total Lab				\$2,300
3.0 Total				\$35,745



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