

Mother Road Brewing Company Pre-Treatment

STILL WATER TREATMENT ENGINEERING:
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CENE 476, 12/9/2022



Project Purpose

- Reduce contaminant of concern (COC) concentrations in the Mother Road Brewing Company (MRBC) wastewater effluent
- Lower MRBC monthly expenditures
- Increase company's environmental sustainability

Client: Michael Marquess, CEO of Mother Road Brewing Company



Site Location



Figure 1: Flagstaff in Arizona [1]

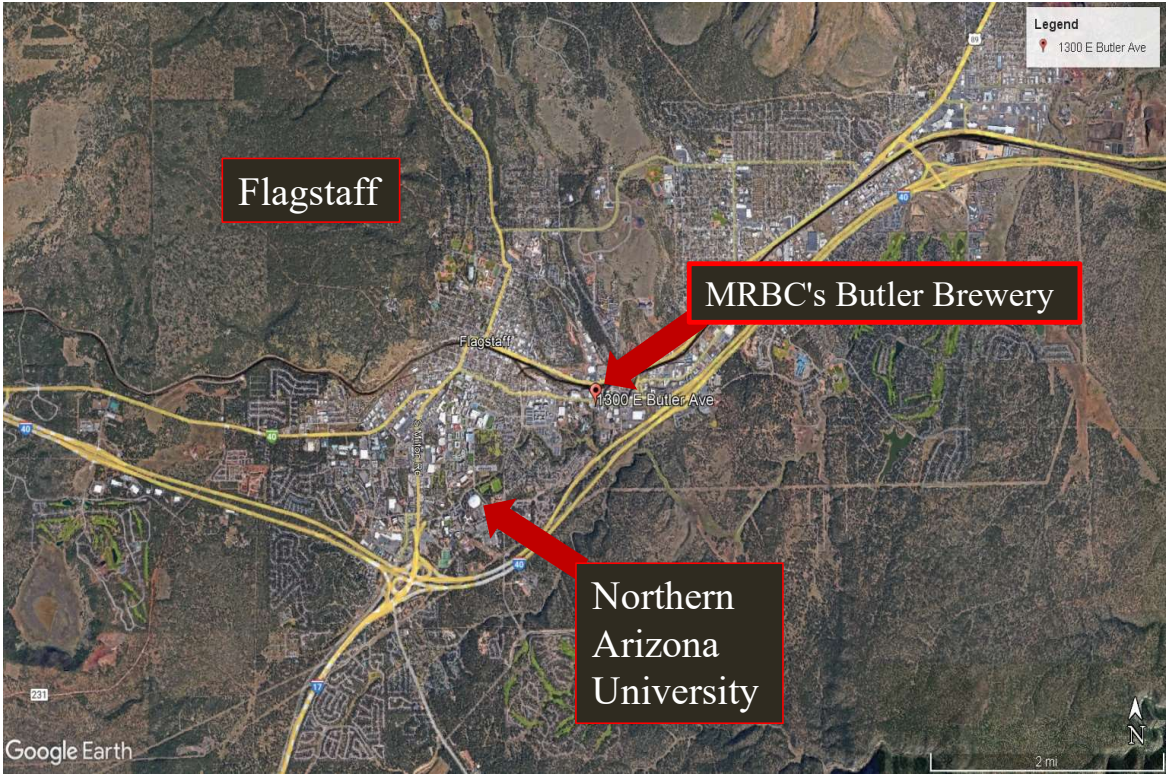


Figure 2: MRBC Location in Greater Flagstaff [1]

Site Location



Figure 3: Town Location of MRBC Brewery [1]



Figure 4: Street Location of MRBC Brewery [1]

Site Background

Table 1: Current Concentrations and Regulations

Contaminant	Current Concentration (mg/L)	Permit Limit (mg/L)	Test Method
BOD	3,108-21,075	8,047*	Standard Method (SM) 5210 B
TSS	444-1,104	1,494*	Standard Method (SM) 2540 C
TKN	108-189	173	EPA 351.2

* Limit changes based on discharge volume [2]

Yellow: Consistently Over Exceedance

BOD: Biological Oxygen Demand

- Amount of oxygen used by organisms in water

TKN: Total Kjeldahl Nitrogen

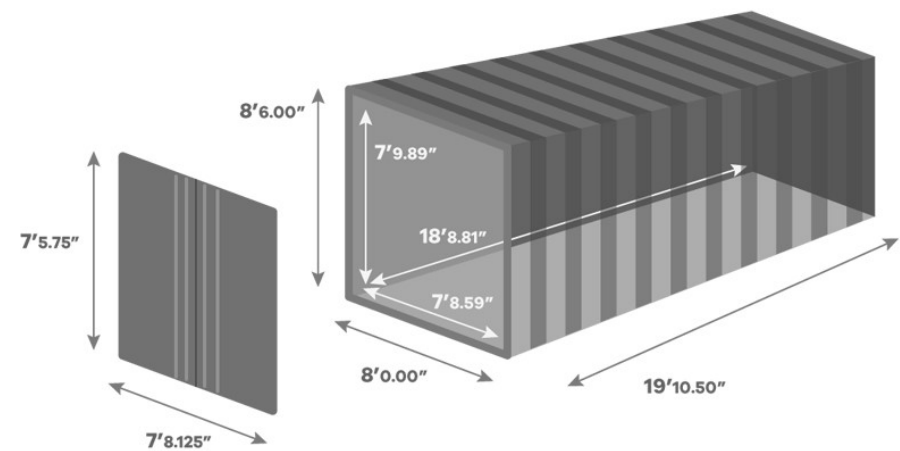
- Sum of organic nitrogen and ammonia

TSS: Total Suspended Solids

- Amount of solids in water that do not settle

Critical Constraints

- Design Space: 8' x 20' shipping container size
 - Successfully accommodate MRBC's production volume
 - Treat wastewater streams to acceptable discharge levels
- Budget: supplies, materials, and personnel

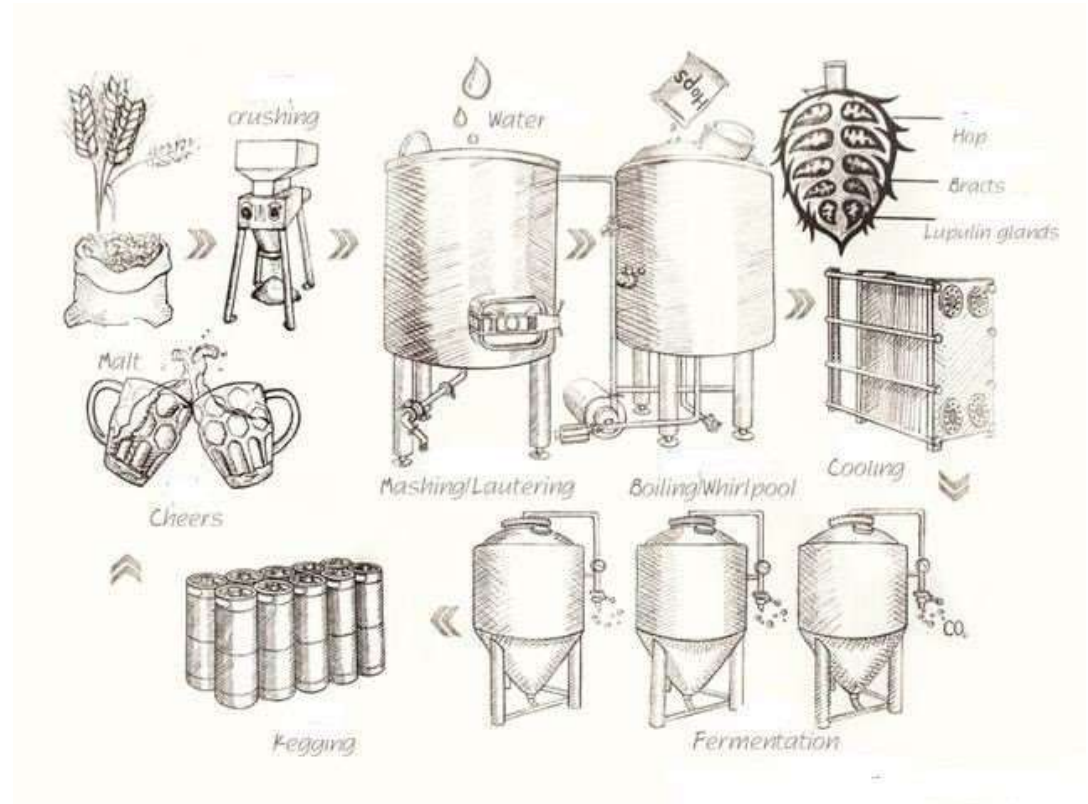


<https://www.earthrelocation.com/20-foot-shipping-container/>

Scope

Task 1.0: Preliminary Work

- Task 1.1: Conduct Research
 - Task 1.1.1: Research on Effects of BOD, TSS, TKN in Wastewater
 - Task 1.1.2: Research on Pretreatment Methods
 - Task 1.1.3: Research on Codes and Standards
 - Task 1.1.4: Research on Testing Methods
- Task 1.2: Identify Existing MRBC Process
- Task 1.3: Obtain COC Data



https://www.bestbeerbrewingequipment.com/Beer-brewing-process_145.html

Scope

Task 2.0: Lab Testing

- Task 2.1: Creation of a Lab Binder
- Task 2.2: Obtain Samples
- Task 2.3: Conduct Testing and Analysis
 - HACH Methods 10099, 8000, 8048, 8075, 8158, 8164

Scope

Task 3.0: Treatment Alternatives

- Task 3.1: Identify Technologies
- Task 3.2: Create Screening Decision Matrix for Initial Alternatives
- Task 3.3: Select Alternatives
- Task 3.4: Create Digital Models
- Task 3.5: Conduct Model Analysis
- Task 3.6: Create Final Decision Matrix for Selected Alternatives
- Task 3.7: Analyze Results and Select a Preferred Alternative

Scope

Task 4.0: Unit Design

- Task 4.1: Calculate Operational Parameters and Sizing
- Task 4.2: Material Selection
- Task 4.3: Create Final Design Drawings

Scope

Task 5.0: Impact Analysis



Scope

Task 6.0: Deliverables

- Task 6.1: 30% Deliverables
 - Report and Presentation
 - Tasks 1.0 and 2.0
- Task 6.2: 60% Deliverables
 - Report and Presentation
 - Addition of Task 3.0
- Task 6.3: 90% Deliverables
 - Website and Report
 - Addition of Tasks 4.0 and 5.0
- Task 6.4: Final Project Deliverables
 - Report, Presentation, Website, and Operations and Maintenance Manual



Task 7.0: Project Management

- Task 7.1: Meetings
- Task 7.2: Schedule Management
- Task 7.3: Resource Management



Exclusions



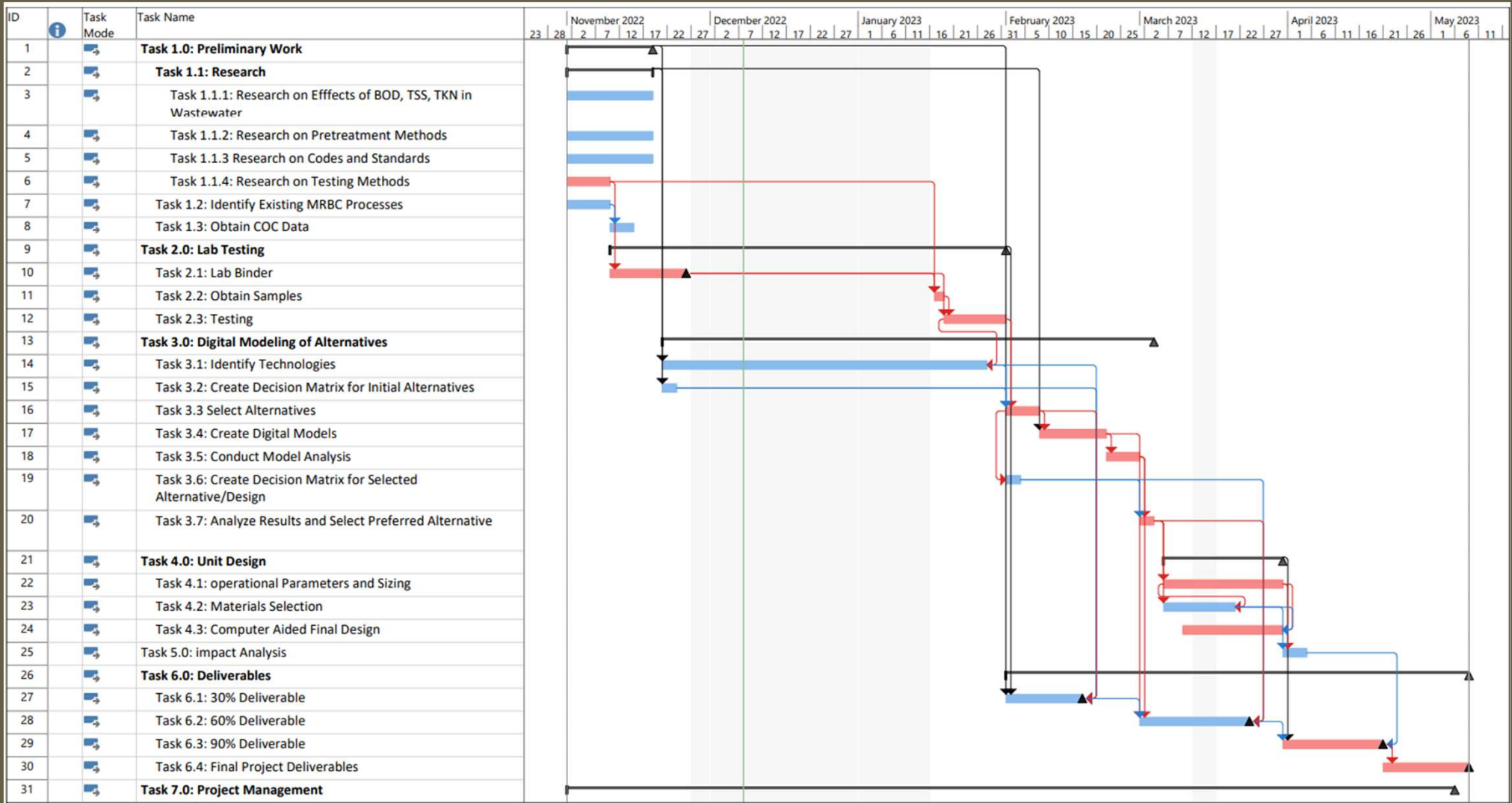
Physical Modeling



Treatment targets
only the three
identified COCs



Designed for current
MRBC Production
(20,000 BBL beer/year)



Schedule: Critical Path

- Task 1.1.4 Research on Testing Methods
- Task 2.1 Lab Binder
- Task 2.2 Obtain Samples
- Task 2.3 Testing and Analysis
- Task 3.3 Select Alternatives
- Task 3.4 Create Digital Models
- Task 3.5 Conduct Model Analysis
- Task 3.7 Analyze Results and Select Preferred Alternative
- Task 4.1 Operational Parameters and Sizing
- Task 4.3 Final Design Drawings
- Task 6.3 90% Deliverables
- Task 6.4 Final Project Deliverables

Staffing Plan

Table 2: Staffing Plan

Task	Senior Engineer (hours)	Project Engineer (hours)	EIT (hours)	Lab (hours)	Total (hours)
Task 1.0: Preliminary Work					61
Task 1.1: Research					
<i>Task 1.1.1: Research on Effects of BOD, TSS, TKN in Wastewater</i>	0	3	10	0	13
<i>Task 1.1.2: Research on Pretreatment Methods</i>	0	3	8	0	11
<i>Task 1.1.3: Research on Codes and Standards</i>	0	3	6	0	9
<i>Task 1.1.4: Research on Testing Methods</i>	0	3	6	3	12
Task 1.2: Identify Existing MRBC Process	0	1	4	0	5
Task 1.3: Obtain COC Data	0	1	6	4	11
Task 2.0: Development of a Biological Treatment Solution					61
Task 2.1: Lab Binder	3	10	10	4	27
Task 2.2: Obtain Samples	0	0	2	0	2
Task 2.3: Testing	0	1	6	25	32
Task 3.0: Treatment Alternatives					65
Task 3.1: Identify Technologies	0	8	6	0	14
Task 3.2: Create Decision Matrix for Initial Alternatives	2	2	0	0	4
Task 3.3: Select Alternatives	1	1	0	0	2
Task 3.4: Create Digital Models	0	8	20	0	28
Task 3.5: Conduct Model Analysis	0	3	8	0	11
Task 3.6: Create Decision Matrix for Selected Alternative/Design	2	2	0	0	4
Task 3.7: Analyze Results and Select a Preferred Alternative	1	1	0	0	2

Task	Senior Engineer (hours)	Project Engineer (hours)	EIT (hours)	Lab (hours)	Total (hours)
Task 4.0: Unit Design					80
Task 4.1: Operational Parameters and Sizing	2	15	10	0	27
Task 4.2: Material Selection	1	10	6	0	17
Task 4.3: Final Design Drawings	6	20	10	0	36
Task 5.0: Impact Analysis	2	3	2	1	8
Task 6.0: Deliverables					56
Task 6.1: 30% Deliverables	2	5	5	0	12
Task 6.2 60% Deliverables	2	5	5	0	12
Task 6.3: 90% Deliverables	2	5	5	0	12
Task 6.4: Final Project Deliverables	4	10	6	0	20
Task 7.0: Project Management					143
Task 7.1: Meetings					
<i>Task 7.1.1: Client Meetings</i>	5	5	5	0	15
<i>Task 7.1.2: Grading Instructor Meetings</i>	0	5	5	0	10
<i>Task 7.1.3 Technical Advisor Meetings</i>	2	10	10	4	26
<i>Task 7.1.4 Team Meetings</i>	20	20	20	20	80
Task 7.2: Schedule Management	2	3	1	0	6
Task 7.3: Resource Management	2	3	1	0	6
Summary					
Total (hours)	61	169	183	61	474

Cost: Engineering Services

Table 3: Cost of Engineering Services

Cost of Engineering Services							
Personnel				Cost of Consumables			
Position	Hours	Dollars/Hour	Dollars	Consumable	Cost/Unit	Unit/Test	Cost/Test
Senior Engineer	61	\$218/hr	\$13,286	Lithium Hydroxide, powder pillow	\$1.12	6	\$6.69
Project Engineer	169	\$134/hr	\$22,629	Grease, stopcock, tube	\$0.10	1	\$0.10
Engineer in Training	183	\$94/hr	\$17,047	BOD Nutrient Buffer Pillow	\$0.59	1	\$0.59
Lab Technician	61	\$68/hr	\$4,099	COD, Low Range, 3-150 mg/L	\$3.37	2	\$6.73
		Sub Total	\$57,061	COD, High Range, 20-1500 mg/L	\$3.32	2	\$6.63
Cost of Non-Consumables				COD, High Range Plus, 200-15,000 mg/L	\$3.32	2	\$6.63
Non-Consumable	Units	Dollars/Unit	Dollars	PhosVer 3 Phosphate Reagent Powder Pillow	\$0.77	1	\$0.77
NAU EnE Lab Rental	44	\$100/Unit	\$4,400	Nitrogen Reagent Set	\$1.18	1	\$1.18
Lab PPE	4	\$50/Unit	\$200	Filter Disk, glass fiber, 47mm	\$0.59	1	\$0.59
		Sub Total	\$4,400			Cost for 4 Tests	\$119
Summation							
						Total	\$61,580

Questions?

References

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- [1] Google, "Google Earth," The Alphabet Company, 2022.
 - [2] City of Flagstaff, "Chapter 7-02 Wastewater Regulations," 2022.