Water Environment Federation (WEF) and Arizona Water Student Design Competition

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Figure 1: WEF Logo [1]

Introduction

Purpose
- Analyze/design a wastewater treatment facility, create design documents for entry into the AZ Water Spring 2021 student design competition

Location
- A small community in Arizona

Client
- Arizona Water (AZ Water)

Background
- Universities in Arizona compete to design/redesign a wastewater treatment plant based on a prompt
- Will get the prompt in January

Figure 2: Arizona State Map [2]

Figure 3: 2018 WEF Competition Wastewater Treatment Plant [3]

Introduction

Stakeholders

- The community/the city itself
- Residents/business discharging to the facility
- Arizona Department of Environmental Quality (ADEQ)
- People/animals using the water

Technical Considerations/Challenges

- Regulations
- Sustainable design
- Hydraulic and treatment process design
- Solids handling

Figure 4: AZ Water Logo [4]

Task 1 Prepare for Competition

1.1 Research for Treatment Process

1.2 Registration

Figure 5: AZ Water Logo [5]

Task 2 Site Investigation

2.1 Site Visit

2.2 Analysis of Provided Data

- 2.2.1 Treatment Plant Constraints/Criterion
- 2.2.2 Source Water Characteristics
- 2.2.3 Develop Site Plan of Existing Plant

Task 3 Treatment Design (½)

- 3.1 Design Capacity
  - 3.1.1 Estimate Daily Demand Factors
  - 3.1.2 Calc. End of Lifecycle Capacity
  - 3.1.3 Effluent Regulations
- 3.2 Preliminary Treatment
  - 3.2.1 Evaluate and Choose Preliminary Treatment
  - 3.2.2 Design Preliminary Treatment
- 3.3 Primary Treatment
  - 3.3.1 Evaluate and Choose Primary Treatment
  - 3.3.2 Design Primary Treatment

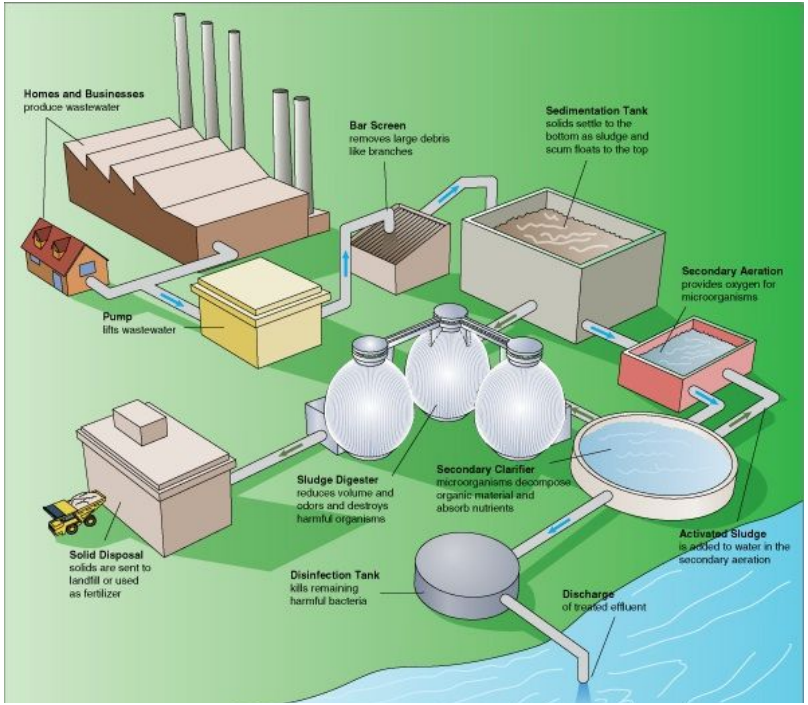


Figure 6: Treatment Process [6]

Task 3 Treatment Design (2/2)

3.4 Secondary Treatment

- 3.4.1 BOD/Organic Matter Removal
- 3.4.2 Disinfection

3.5 Tertiary Treatment

- 3.5.1 Evaluate and Choose Tertiary Treatment
- 3.5.2 Design Tertiary Treatment

3.6 Biosolids Management

- 3.6.1 Evaluate Biosolids
- 3.6.2 Design Biosolids

Figure 7: Aerial View of a Wastewater Treatment Facility [7]

Task 4 Hydraulics

4.1 System Analysis

4.2 Pump Analysis

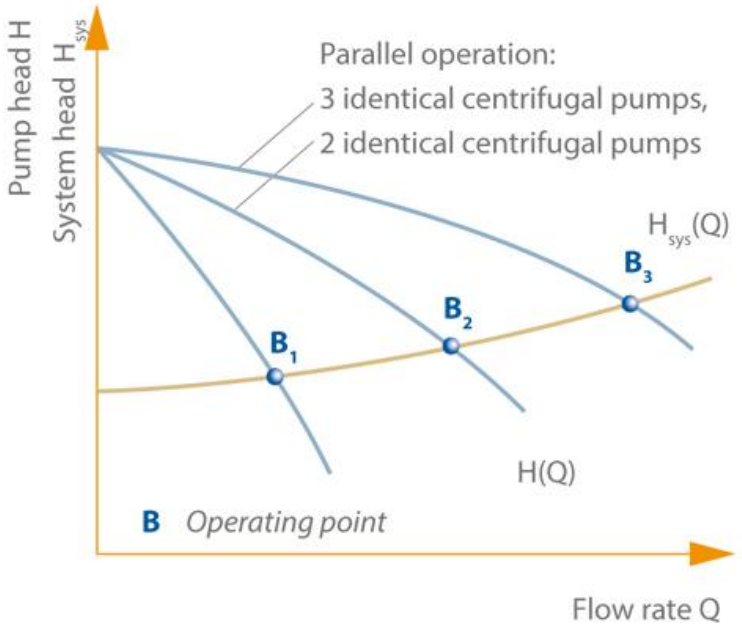


Figure 8: Pump and System Curve [8]

Task 5 Cost of Project

5.1 Construction Cost

5.2 Operation Cost

5.3 Expected Lifespan Cost

Figure 9: Economic/Social/ Economic Impacts [9]

Task 6 Project Impacts

6.1 Societal Impact

6.2 Environmental Impact

6.3 Economical Impact

Task 7 Project Deliverables

7.1 30% Completion

7.2 60% Completion

7.3 90% Completion

7.4 100% Completion

7.5 Competition Deliverables

Task 8 Project Management

8.1 Meetings

- 8.1.1 Client/GI/TA Meetings
- 7.1.2 Team Meetings

8.2 Schedule Management

8.3 Resource Management

Exclusions

Construction

Figure 10: “Blue” Print [10]

Stormwater

Figure 11: Stormwater Drain [11]

Transportation

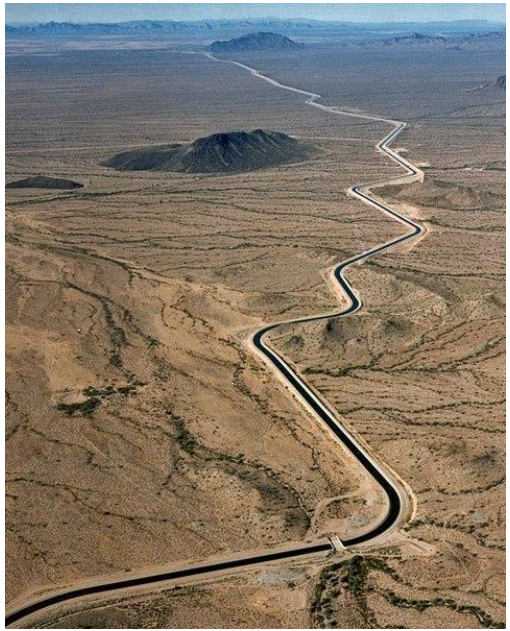
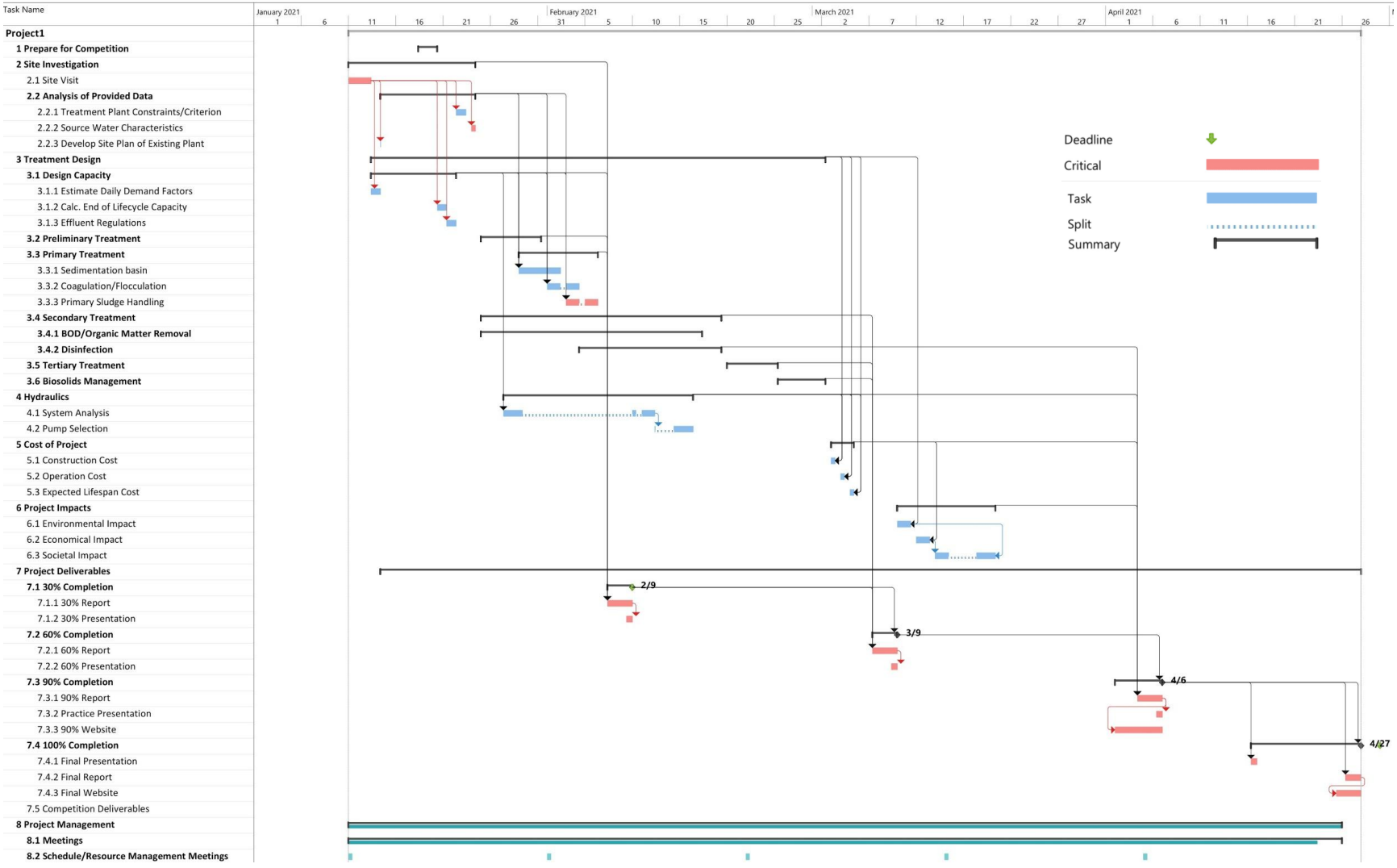


Figure 12: AZ CAP Canal [12]

Schedule


Task Name
January 2021
February 2021
March 2021
April 2021
Project1
1 Prepare for Competition
2 Site Investigation
2.1 Site Visit
2.2 Analysis of Provided Data
2.2.1 Treatment Plant Constraints/Criterion
2.2.2 Source Water Characteristics
2.2.3 Develop Site Plan of Existing Plant
3 Treatment Design
3.1 Design Capacity
3.1.1 Estimate Daily Demand Factors
3.1.2 Calc. End of Lifecycle Capacity
3.1.3 Effluent Regulations
3.2 Preliminary Treatment
3.3 Primary Treatment
3.3.1 Sedimentation basin
3.3.2 Coagulation/Flocculation
3.3.3 Primary Sludge Handling
3.4 Secondary Treatment
3.4.1 BOD/Organic Matter Removal
3.4.2 Disinfection
3.5 Tertiary Treatment
3.6 Biosolids Management
4 Hydraulics
4.1 System Analysis
4.2 Pump Selection
5 Cost of Project
5.1 Construction Cost
5.2 Operation Cost
5.3 Expected Lifespan Cost
6 Project Impacts
6.1 Environmental Impact
6.2 Economical Impact
6.3 Societal Impact
7 Project Deliverables
7.1 30% Completion
7.1.1 30% Report
7.1.2 30% Presentation
7.2 60% Completion
7.2.1 60% Report
7.2.2 60% Presentation
7.3 90% Completion
7.3.1 90% Report
7.3.2 Practice Presentation
7.3.3 90% Website
7.4 100% Completion
7.4.1 Final Presentation
7.4.2 Final Report
7.4.3 Final Website
7.5 Competition Deliverables
8 Project Management
8.1 Meetings
8.2 Schedule/Resource Management Meetings
Deadline
Critical
Task
Split
Summary
2/9
3/9
4/6
4/27

Staffing

Task Number	Task Name	Work (Hours)	SENG	ENG	LAB	INT	AA
1	Prepare for Competition	20	2	6	3	6	3
2	Site Investigation	55	14	5	17	0	19
3	Treatment Design	325	41	176	11	86	11
4	Hydraulics	40	4	23	1	11	1
5	Cost of Project	30	3	18	0	9	0
6	Project Impacts	60	6	33	3	15	3
7	Project Deliverables	105	20	51	8	22	4

Cost of Engineering Services

Summary:

- Staffing
  - $ 47,534
- Travel
  - $ 1,495
- Supplies
  - $ 225

Total: $ 49,254

Staffing

Positions	Hours	Billing Rate	Total Pay
Senior Engineer	90	$185.00	$16,650
Engineer	312	$80.00	$24,960
Lab Technician	43	$45.00	$1,935
Intern	149	$17.00	$2,533
Admin Assistant	41	$35.50	$1,455.5
		Subtotal	*$47,533.5*

Travel

Item	Notes	Rate	Total Pay
Site Visit	1 trip at 288 miles	$0.58/ miles	$67.04
Rental Vehicle	1 day	$62/day	$62
Competition	1 trip at 310 miles	$0.58/miles	$179.8
Rental Vehicle	3 days (extra 1 day to return the vehicle)	$62/day	$186
Hotel	2 rooms 2 nights	$100/ night/room	$400.00
Meals	2 nights (3 meals per day for 5 people)	$60/person/day	$600
		Subtotal	*$1494.84*

Supplies

Items	Notes	Rate	Total
3D Printing	at 1kg	$0.05/g	$50
Membership	5 people	$35/person	$175
		Subtotal	*$225*

[1] Water Environment Federation - WEF Home, “WEF - WEF Home.” [Online]. Available: https://www.wef.org/. [Accessed: Sep-2020].

[2] G. L. McNamee and M. E. Hecht, “Arizona,” *Encyclopædia Britannica*, 30-Jul-2020. [Online]. Available: https://www.britannica.com/place/Arizona-state. [Accessed: Sep-2020].

[3] 2018. [Online]. Available: https://www.ceias.nau.edu/capstone/projects/CENE/2018/WastewaterFacility/.

[4] “Welcome to ADEQ,” 11-Dec-2020. [Online]. Available: https://www.azdeq.gov/.

[5] “We are Professionals Dedicated to Arizona's Water!,” *AZ Water Association*. [Online]. Available: https://www.azwater.org/. [Accessed: Sep-2020].

[6] T. English, “Dirty to Clean: How a Water Treatment Plant Works,” 22-Mar-2020. [Online]. Available: https://interestingengineering.com/dirty-clean-how-water-treatment-plant-works. [Accessed: 09-Nov-2020].

[7] “Major Renovations Reshape Ann Arbor Wastewater Treatment Plant,” 2017. [Online]. Available: http://www.walshgroup.com/news/2017/majorrenovationsreshapeannarborwastewatertreatmentplant.html. [Accessed: Nov-2020].

[8] The EcoAmbassador. 2020. *Increasing Wastewater Pump System Efficiency*. [online] Available at: <https://www.theecoambassador.com/WastewaterPump.html> [Accessed 2 November 2020].

[9] “Goal 12: Ensure sustainable consumption and production patterns - SDG Indicators,” *United Nations*. [Online]. Available: https://unstats.un.org/sdgs/report/2018/goal-12/. [Accessed: Sep-2020].

[10] Doherty, P., 2020. *Best Regions To Start A Construction Business - Build Magazine*. [online] Build Magazine. Available at: <https://www.build-review.com/best-regions-to-start-a-construction-business/> [Accessed 12 November 2020].

[11] CRWD. 2020. *Stormwater Runoff - CRWD*. [online] Available at: <https://www.capitolregionwd.org/our-water/stormwater-runoff/> [Accessed 12 November 2020].

[12] En.wikipedia.org. 2020. *Arizona Cap Canal.Jpg*. [online] Available at: <https://en.wikipedia.org/wiki/File:Arizona_cap_canal.jpg> [Accessed 12 November 2020].

Works Cited

Questions?