The Kuwaiti Company

Northern Arizona University, Flagstaff, Arizona

Proposal for Engineering Services

“Hualapai Waste Lagoons”

Submitted to: Kevin Davidson

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1.0 Project Understanding

1.1 Project Purpose:
The purpose of this project is to study the algae of the lagoons provided by the Hualapai Nation in the city of Peach Springs, Arizona and convert algae waste into biodiesel. The team must figure out what types of algae grows there, harvest the algae, and convert the algae waste into bio-fuel (bio-diesel). This project is about creating another source of energy other than the fossil fuel to make diesel. Moreover, biodiesel has fewer effects on the environment than the fossil fuel. So, the project purpose is to create new source of energy that is safer to the environment than and as sufficient as the fossil fuel.

1.2 Project Background:
The lagoons are located in the city of Peach Springs, Mohave County, in the Northwest of the State of Arizona. Figure 2.1 shows a map of the location of Peach Spring relative to other cities in the state.

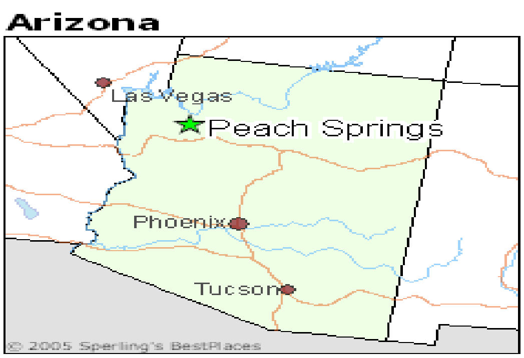


Figure 2. 1: Peach Springs map relative to Arizona [1]

There are five lagoons in Peach Springs located on the southwest end of the city, with a close proximate to Burlington Northern – Santa Fe Railroad and Highway 66. The close proximity to these roads makes transportation of materials easy and accessible. Figures 2.2 and 2.3 show an aerial photograph of Peach Spring showing the waste water lagoons and its distance from nearby roads and the city center.

Figure 2. 2: Detailed View of the lagoons [2].

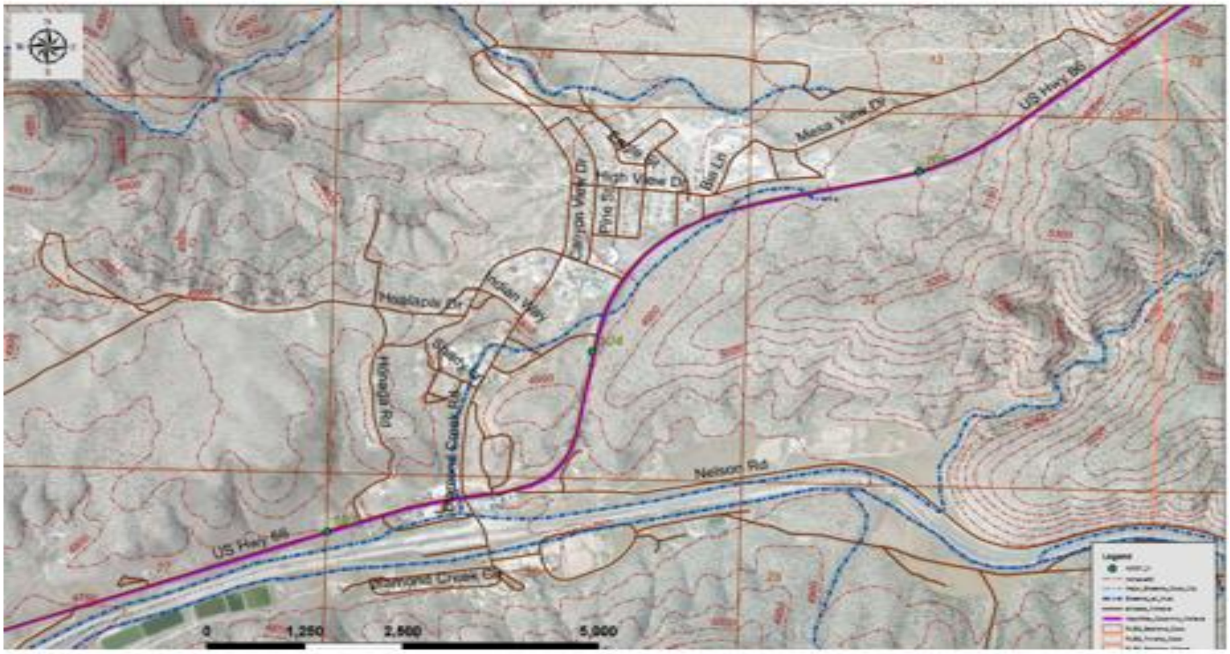


Figure 2. 3: Aerial Photograph of Central Peach Springs Showing Streets, Terrain, and Washes [2].

The weather in Peach Springs varies throughout the year. In the winter temperatures can be as low as 9 F°, in the summer it can be as high as 113 F°. Furthermore, the precipitation and snowfall rates are lower than the United States average, despite this there is a significant precipitation and snowfall in the city during the winter and spring seasons. The average precipitation is at 8.88 inches per year and the average snowfall is at 0.72 inches per year. Table 2.1 shows the maximum, minimum and average temperatures of Peach Springs, as well as the average rainfall and snowfall throughout the year.

Table 2. 1: Weather in Peach Springs [3].

Month	Temp. (Min) ˚F	Temp. (Max) ˚F	Temp. (Avg.) ˚F	Average Rainfall(Inches)	Average Snowfall(Inches)
January	9	73	43	0.64	0
February	20	73	46	1.1	0
March	21	90	52	0.35	0
April	25	94	59	0.44	0
May	32	103	72	0.13	1
June	46	106	80	0.02	0
July	57	113	86	0.69	0
August	54	107	83	0.71	0
September	45	104	76	0.61	0
October	29	93	63	0.6	0
November	18	86	54	0.67	0
December	11	73	41	0.97	10.56

1.3 Technical Consideration:
For this project, a study of algae growing conditions is required to obtain the optimal results to grow algae in the lagoons. Several conditions must be considerate such as: light, pH, aeration, mixing, temperature and salinity. Moreover, the best type of algae to be grown and harvested is to be analyzed; microalgae are typically the best type of algae to extract lipids and convert it to biodiesel because it produces large amounts of lipids and has a fast grow rate. However the optimal algae type for the Hualapai lagoons must be determined to decide on which is the most compatible type of algae for site conditions. Also an analysis of the algae's biological aspects, methods of harvesting and processing is required for the project. Furthermore, mixing the algae is important to distribute nutrients and to avoid sedimentation. Currently, in the Hualapai Lagoon, there is no mixing at all which can reduce the algae growth.

1.4 Potential Challenges:
The main challenge is to decide which algae type is suitable for the site conditions in comparison with the algae type that now grows in the Hualapai waste water lagoon. Currently, the algae that grows in the lagoon are greenish. However, the type of algae is unknown. While there are several preferred species of algae for oil production, it is unknown whether the existing algae specie will be able to provide sufficient oil to make this a commercially viable project. The team will visit the site and see what is the type of algae are existent in the lagoons. This will allow the team to research more about whether the existing algae are able to produce sufficient oil for commercial projects. However, if the existing algae are not sufficient to produce sufficient oil, the team will research about what is the best type of algae to produce oil and is suitable to be grown in the Hualapai lagoons.

1.5 Stakeholders:
The people of the Hualapai nation, as the project stakeholders would like to create and manage the project to use biodiesel in a local gas stations and for personal usage. The Hualapai Nation will benefit from the project because the local stores in Peach Springs will be affected as well as the local consumers.

2.0 Scope of Work

The scope is of work details the work that P2BK will perform to meet project requirements. The scope contains the deliverables, timeline, algae characterization, algae harvesting options, algae processing options, system final design and project management.

2.1 Task 1.0: Algae Characterization:

This section describes the methods of algae characterization, and the procedures that must be done to determine the type of algae in the lagoon. There are three subtasks under this task Identifying Algae Specie, Algae Production Quantities and Algae Annual Production.

2.1.1 Task 1.1 Identifying algae specie

P2BK will determine the algae type that grows in Hualapai lagoons. The team will visit the site and collect samples from each of the lagoons, and then perform microscopic analysis in the environmental labs at Northern Arizona University.

There are several reasons why algae are grown in ponds, however nutrients are what generally limits algal growth. Algae grow when it is exposed to the right conditions such as adequate nutrients, light levels, pH and temperature. Generally the amount of phosphorus controls the amount of algae found in freshwater ponds. The more nutrient-enriched a pond, typically the more algae in the pond. The team will attempt to obtain pH, P, N, C from existing water quality data. However, it is outside of the scope of the project to study and analyze the water quality of the Hualapai lagoon, and to perform any toxicity testing on lagoon water.

- **Transportation**

Samples will be collected and returned to the Northern Arizona University laboratories. When transporting the contaminated samples to the lab from the field, it is important to avoid any damage to the samples. Transported samples should be cooled so the algae does not grow rapidly, which creates a large difference and error in the sample analysis.

- **Analysis**

Equipment needed to analyze the samples taken from the Hualapai lagoons are microscopes, test tubes and filters. A filter will be placed above a beaker, and then the sample is poured into the beaker. The filter will capture the algae and a microscope will be used to determine the type and size of the algae that grows in the lagoon.

- **Safety Procedures**

Safety procedures will be followed before starting any experiment in the lab to ensure the team's safety. Safety procedures require completion of the safety and hazardous online trainings by each member of the team. There will be a contract between the lab instructor and the team members to follow the Personal Protective Equipment (PPE) rules, to dispose the contaminated samples properly to prevent any harm. The contaminated samples that are used in the lab have to be labeled and stored correctly to prevent any confusion or damage to the samples.

2.1.2 Task 1.2 Algae Production Quantities

According to a study made by Kumaraguru College of Technology on waste water, a kinetic study of the algae biomass growth is an important parameter for determining its suitability for commercial or large scale mass production for the extraction of oil and other useful compounds. In this study the growth kinetics of the algae was studied by the use of spectroscopic analysis, which is used to determine energy levels, chemical composition and molecular structure of substances. This growth study was conducted without the addition of required nutrients because the waste water used contains the nutrient available in the growth medium. The focus of the research was to determine the capability of the algae to uptake the nutrients available in growth medium at Kumaraguru

College hostel grey wastewaters. The results of the study has shown important algae growth parameters are percentage transmission, concentration and optical density. These parameters are measurable with dry mass measurements. (Kumaraguru College of Technology)

To calculate the annual production of algae, there are two equations. Annual biomass productivity which calculates yearly biomass production and Annual lipid productivity which calculates yearly lipid production. (Sudhakar,Premalatha)

(1) BM Annual (T/ha/yr) = BM daily production (g/m /day) x n (days) x10E2
(2) Lipid annual (L/ha/yr) = C x BM (T/ha/yr) x 10000 / D (kg/L)

Where:
T = Metric Tons
ha = Hectare
yr = year
C = lipid fraction of algae biomass
Lipid Annual = Annual average lipid productivity (L/ha/yr)
BM Annual = Annual average biomass productivity (T/ha/yr)
BM Daily = Daily average biomass productivity (g/ m2 /day)
D = specific gravity (kg/L)
n = Number of operating days of pond

2.2 Task 2.0: Algae Harvesting Options

P2BK will investigate harvesting options and evaluate these options and develop selected option for harvesting algae. Evaluation will be based on cost and other factors defined by the client.

2.3 Task 3.0: Algae Processing Options

P2BK will investigate processing options and evaluate them and develop a selected option for processing algae.

2.4 Task 4.0: System Final Design

The purpose of the project is to decide whether the project is economically feasible to be further developed. P2BK will conduct a system final design cost to harvest and process algae into commercially acceptable quantities of bio-diesel that results in a profit for the city of Peach Springs.

2.5 Task 5.0: Project Management

Project management aims to organize the team’s communication and assure that the deliverables are met.

2.5.1 Task 5.1: Client and Team Communication

P2BK will identify one member who will be the primary contact with the client.

2.5.2 Task 5.2: Deliverables

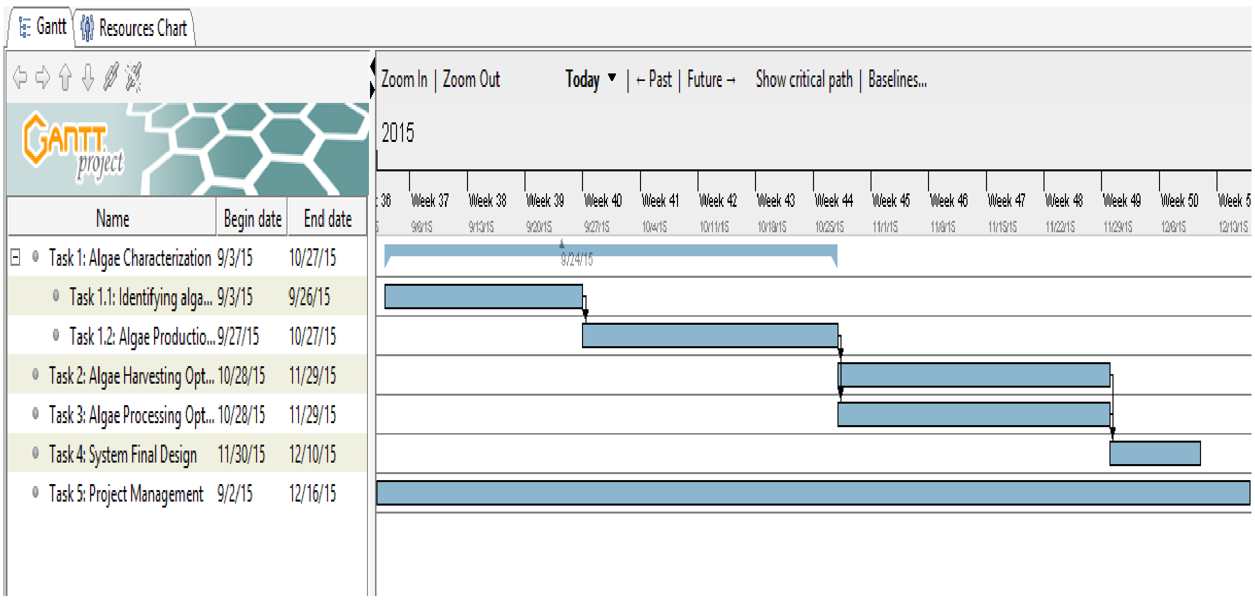
P2BK will provide the following deliverables for the project:

- A 50% report by the end of October 31, 2015 will be delivered to the technical advisor to show the progress made towards the final design.
- The final design report will present the design information, analysis, technologies, and techniques that can be done in the field to convert algae to biofuel. This report will be provided to the client to review and evaluate by December 12, 2015.
- The final presentation will present the project data, analysis and final design to the client and the public by December 12, 2015.
- P2BK will create a website that has all relevant information on the project. This website will be a formal archive of all project work to the public so people can use it as a source or for knowledge; it will be completed by December 13, 2015.

3.0 Schedule

Figure 3.1 shows the list of tasks and their beginning and end dates. Furthermore, the critical path of the project is shown in the figure. The critical path starts with task 1.1, when it ends task 1.2 starts which is dependent on the previous task, tasks 2 and 3 are both dependent on the previous task, and they start when it ends. Task 4 is dependent on the two previous tasks, it begins after they end and it ends in the end of the semester.

Figure 3.1: Gantt chart



4.0 Project costs and staffing

The project's staff include a Senior Engineer (SENG), an Engineer (ENG), and a Lab Technician (LAB).

Table 4.1 shows each staff member's working hours.

Table 4.1: Staff member's anticipated hours.

Task	SENG,hr	ENG,hr	Lab Technician,hr
1.0 Algae Characterization	0	40	100
2.0 Algae Harvesting Options	30	60	0
3.0 Algae Processing Options	30	60	0
4.0 Final design	5	10	0
5.0 Project Management	30	40	60
Total for each personnel	95	210	160

Total hours for all staff members will be 465 hours.

Table 4.2 shows the cost of engineering services for the project.

Table 4.2: Cost of Engineering Services.

Item	Classification	Hours	Rate $/hr	Cost
1.0 Personnel	SENG	90	130	$11,700
	ENG	200	71	$14,200
	LAB	160	50	$8,000
	Total Personnel			**$33,900**
2.0 Analytical supplies	Glassware, PPE, filters and microscope			**$1,000**
3.0 Travel	2 trips,226 miles/trip	$0.4/mile		$181
	2 days vehicle rental $55/day			$110
	3 persons per diem, $34/day			$204
	Total Travel			**$495**
Project Total				**$35,395**

The total cost of engineering services is **$35,395**.

4.0 References:

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