

**Arrowhead Center – Project Coordination, Planning & Program
Management Team A
Project ID: CEEEn_2017CPST_004**

by

**Team Arrow
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A Capstone Project Final Report

Submitted to

**Bob Tandler
Fritzi Realty**

**Department of Civil and Environmental Engineering
Brigham Young University**

4/12/2018

Executive Summary

PROJECT TITLE: Arrowhead Center – Project Coordination, Planning & Program Management Team A
PROJECT ID: CEEEn-2017CPST-004
PROJECT SPONSOR: Fritzi Realty
TEAM NAME: Team Arrow

Team Arrow oversaw the creation of a detailed preliminary master plan for the development of the four parcels belonging Fritzi Realty at the intersection of Arrowhead Trail Road and Main Street in Spanish Fork, Utah. The team proposes land usage of the properties in accordance with owner objective views and Spanish Fork City parameters. The proposed master plan will need to be revised and approved by a Utah licensed professional engineer of the sponsor's choosing prior to initiating Spanish Fork City's property development application process. It is expected that multiple iterations with the City and other concerned parties may be necessary to achieve a mutually beneficial master plan for the project to move forward.

The team worked in coordination with other project teams within the Arrowhead Project to develop a preliminary master plan. The other teams analyzed the structural, geotechnical, electrical, mechanical, environmental, transportation, and urban planning aspects of the development. This report includes documentation for the preliminary master plan at the Arrowhead Center project site that can be submitted by Fritzi Realty to the city of Spanish Fork, Utah during the second quarter of 2018.

Table of Contents

Executive Summary.....	2
Table of Contents.....	3
List of Figures.....	4
List of Tables.....	4
Introduction.....	5
Schedule	5
Assumptions & Limitations	6
Design, Analysis & Results.....	6
Lessons Learned	12
Recommendations	13
Appendix A.....	14
Appendix B	19

List of Figures

Figure 1: Past Population in Spanish Fork

Figure 2: Expected Growth in Spanish Fork

Figure 3: Fritzi Realty Preliminary Master Plan

Figure 4: Team Arrow Preliminary Master Plan

Figure 5: Arrowhead Site Layout

List of Tables

Table 1: ROI and Payout Period

Table A.1: Revenue and Cost Data

Table A.2: Spanish Fork City Impact Fees (2017)

Introduction

Fritzi Realty tasked Team Arrow with developing a preliminary master plan for the four parcels owned by the company at the intersection of Arrowhead Trail Road and Main Street in Spanish Fork, Utah. Parcel C is mostly covered by a light industrial building that houses multiple local companies. Parcels A, B, and D are open, undeveloped parcels. The Spanish Fork River runs adjacent to the northeast of Parcel A with wetlands and trees on the property. Fritzi Realty developed a preliminary plan for these parcels. The differences between the parcels are analyzed in greater detail by other groups working within specific disciplines. Team Arrow has produced their own preliminary plan with confidence that it is a viable alternative development for the four parcels. The basis for the design and the economic results for Fritzi Realty and Spanish Fork are explored in the following sections.

Schedule

Milestone	Date
Kick-off meeting	January 12, 2018
Site visit	February 10, 2018
Began design of site plan	February 23, 2018
50% design report	March 20, 2018
Began production of presentation materials	March 20, 2018
Finalized CAD drawing of site plan	March 26, 2018
All deliverables completed and submitted	April 12, 2018

Assumptions & Limitations

Results and recommendations provided by Team Arrow cannot be construed as work performed by licensed professionals and cannot be used as “stamped deliverables” without first being reviewed, approved and stamped by a qualified and relevant license professional engineer.

The CAD and SketchUp drawings presented in this document should not be considered “exact” drawings as per dimensions or locations of buildings. The drawings must be reviewed and revised by a qualified professional engineer to verify compliance with all zoning and building regulations. All commercial office buildings and roads in parcels A and B may be redesigned and or located as desired by Fritzi Realty. Due to the large variety of options in commercial development, the design of building locations may also be edited by a licensed engineer if desired by Fritzi Realty.

During the economic return analysis, certain assumptions were made to create the preliminary master plan as proposed by Team Arrow. Profit estimates were calculated using current property prices and lease rates for similar buildings in Spanish Fork market. Building costs were assumed using data from national averages as reported by “HomeAdvisor”. Impact fee data was taken from the current Spanish Fork City website. The fees were reported as fiscal year 2017 values and may not accurately represent the impact fees in future years. A ten percent contingency was added to all of the assumed costs to cover unexpected or unforeseen costs. Data used in the economic analysis may be found in Appendix A in Table A.1 and A.2.

Design, Analysis & Results

As planned, Team Arrow and the other management team for the Arrowhead Project reviewed the designs presented by the CE En 201 groups. The teams decided that instead of picking the top three designs from the 201 class to analyze, each management team would create their own preliminary design using the general ideas from the 201 class. The other Arrowhead capstone groups would then compare the original plan provided by Fritzi Realty against the two plans by the capstone management teams. As there are very specific disciplines that the individual teams would be comparing, each management team would be responsible to then analyze their plan in a broader and more encompassing aspect.

The design presented by Team Arrow is designed to meet Spanish Fork's vision as described in the General Plan, provide a financial return for Fritz Realty, and meet future residential and commercial demands in the Spanish Fork market. Utah County is undergoing a high population growth rate and a growing tech sector. This has led to a boom in office construction in northern Utah County, causing excessive traffic congestion during morning and afternoon rush hours on Interstate 15 and local arterials. Spanish Fork offers an alternative location for office and residential development that has ready access to Interstate 15 and the growing population of southern Utah County communities. Figures 1 and 2 show the Spanish Fork's historical population and its projected growth respectively.

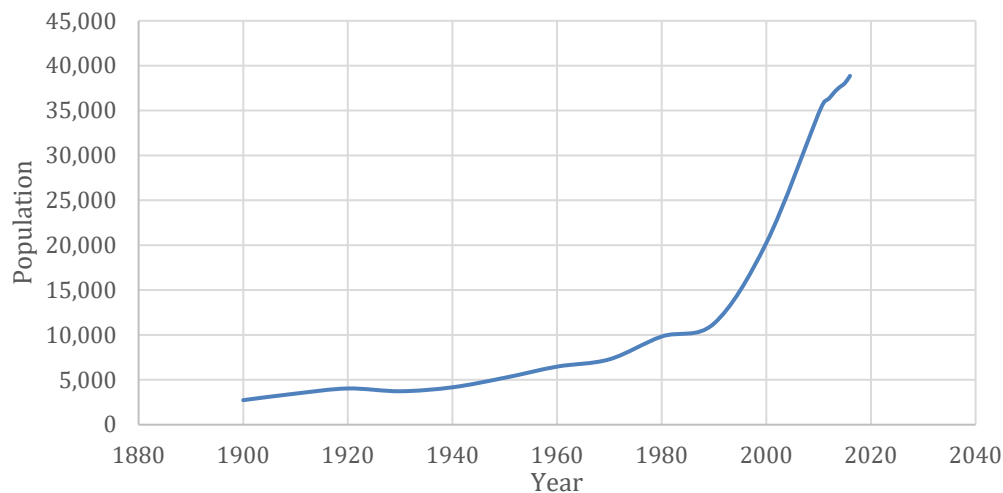


Figure 1: Historical Population in Spanish Fork

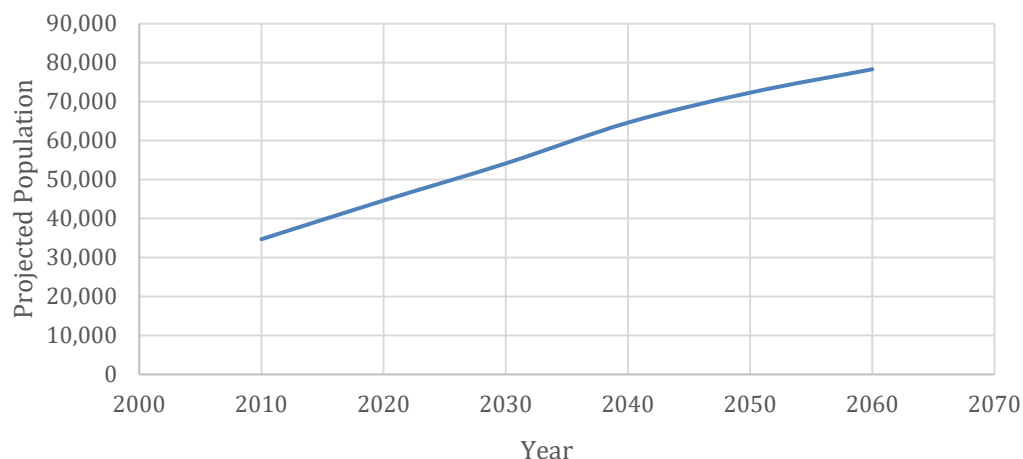


Figure 2: Expected growth in Spanish Fork

The population of Spanish Fork is projected to grow by about 20,000 people in the next twenty years. The population of Utah County is projected to nearly double in the next twenty years. Spanish Fork is geographically poised to benefit from the growth of its neighbors, Salem and Payson. Spanish Fork acts a local commercial hub for southern Utah County. Even as the neighboring towns grow, Spanish Fork will continue to serve more specialized commercial services and jobs than its smaller neighbors. The Arrowhead site has ready access to Interstate 15, downtown Spanish Fork, and can accommodate traffic coming from multiple directions. The Team Arrow site design provides residential, retail, and office space to provide for the growing population in Spanish Fork and southern Utah County. The Team Arrow preliminary master plan is presented in Figure 3. For comparison, the Fritz Realty preliminary master plan is presented in Figure 4. The proposed land usage of the Team Arrow plan can be seen in Figure 5 with violet indicating commercial and green indicating residential. Both plans call for low density residential in Parcel C and Parcel D. The primary difference between the plans is the land usage and layout in Parcel A and Parcel B.

When viewing the 50% design, Fritz Realty expressed concern that there is insufficient demand for the commercial space in the Team Arrow plan. This was partially based on the vacant commercial properties on Spanish Fork Main Street potentially indicating an excess supply. Team Arrow considers the possibility that commercial properties are closed and vacant for reasons other than strictly supply and demand. These possibilities include building condition, business model of former occupant, site accessibility, and similarly related issues. Any current excess supply of commercial property in the Spanish Fork market is likely to be quickly consumed by the rapid population growth in the county.



Figure 3: Fritz Realty Preliminary Master Plan



Figure 4: Team Arrow Preliminary Master Plan

As can be seen, the plans presented by Fritzi Realty and Team Arrow are similar. The individual parcels in the Team Arrow plan are divided as such:

Parcel A: Commercial space for small offices and/or highway-oriented retail and service businesses.

Parcel B: Commercial space for small offices and neighborhood highway-oriented retail and service businesses.

Parcel C: Quarter-half acre single-family residential lot with commercial strip along Arrowhead Trail Road.

Parcel D: Quarter acre single-family residential lots.



Figure 5: Arrowhead Site Layout

In the plan presented by Team Arrow, Calpac Avenue serves as a division between the residential area and the commercial use area (excluding the commercial strip in parcel C). The plots nearest Arrowhead Trail Road in Parcel C are designed for small retail use. Adjacent to the retail parcels, but facing an interior street, would be duplex housing. The rest of Parcels C and D are designed for quarter to half acre single family housing.

Based on current data from Spanish Fork City Team Arrow analyzed their proposed plan to ensure it provided an economic benefit for Fritz Realty. Table 1 shows the estimated cost and revenue for the construction of the project. As shown, the annual return on investment for the development is estimated to be around 9% with a payoff date of approximately 11 years. After the payoff date, the development is estimated to generate around 4.9 million dollars annually.

Table 1: ROI and Payout Period

Type	Total Space	Revenue		Cost
		Yearly	One time	
Office on A and B	16000 ft ²	\$ 3,680,000		\$ 25,600,000
Commercial on C	27000 ft ²	\$ 945,000		\$ 4,320,000
Townhomes	16 units	\$ 288,000		\$ 4,800,000
Home Sale	81 units		\$ 32,400,000	\$ 42,525,000
Roads	7000 linear ft			\$ 2,100,000
Non Residential Impact Fee	187000 ft ²			\$ 95,231
Townhomes Impact Fee	16 units			\$ 77,000
Single Family Impact Fee	81 units			\$ 236,000
Totals		\$ 4,913,000	\$ 32,400,000	\$ 79,753,231
Total + 10% Contingency				\$ 87,728,554
Pay Off (years)				11
Annual ROI				9%

Lessons Learned

Early in the project it became apparent that it would be hard for Team Arrow to find time in which they could work together on the project. Each team member had busy school and work schedules, and it left little time where everyone was available. We were able to overcome this more so later in the semester as schedules loosened up. Although inconvenient, we started meeting later in the evenings so all of us could be present.

The other main obstacle came from a lack of communication. Many, if not all, of the Arrowhead groups were greatly confused as to what Fritzi Realty was expecting. A few different CAD drawings were sent to us by Mr. Tandler and they had slight differences which confused the groups. It took a while for us to understand exactly all his proposed master plan entailed. As the project progressed, and the teams reached out to their mentors and Bob Tandler, expectations became clearer.

Additionally, all team members had a chance to use AutoCAD and Sketchup drawing software for site layout and modeling, this was a great experience and it will be helpful in our future career.

Recommendations

Team Arrow recommends that Fritzi Realty considers the team's proposed design as previously described and explained for further study and analysis. This will involve licensed professional engineers reviewing the site plan and adjusting it to be ready for construction. The necessary adjustments will depend on the findings of future financial and legal review. Team Arrow recommends that Fritzi Realty proposes this site plan to Spanish Fork City for approval after the necessary revisions have been made.

With this design, see Figure 2, the annual return on investment is around 9%, with a pay off period of approximately 11 years.

Appendix A

Table A.1: Revenue and Cost Data

Possible Sources	Estimated Revenue	Estimated Costs
Office	\$20/ft ² /year	\$160/ft ²
Retail	\$35/ft ² /year	\$160/ft ²
Townhomes	\$18000/year	\$150/ft ²
Homes	\$400,000/unit	\$150/ft ²
Road	-----	\$300/ft
Impact Fees	-----	See Table A.2

Table A.2: Spanish Fork City Impact Fees (2017)

SPANISH FORK CITY IMPACT FEES 2017				
	Recreational Fee	Public Safety	Transportation	Storm water
Non-Residential	N/A	\$428.51/1000 ft ²	Contact Building Department	\$673.66/acre
Single Family Detached	\$ 3,775.59	\$ 423.37	\$ 473.58	\$673.66/acre
Townhome	\$ 2,149.33	\$ 428.51	\$ 317.30	\$673.66/acre



Figure A.1: Sketchup Model of Arrowhead Site



Figure A.2: Office Space on Parcel A



Figure A.3: Office Space on Parcel B



Figure A.4: Townhomes on Parcel C



Figure A.5: Single Family Houses on Parcel D

Appendix B

Yaqi Huang

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Education

Bachelor of Science, Civil Engineering, Brigham Young University
Provo, UT

April 2018,

- Bachelor of Science, Civil Engineering
- GPA: 3.68
- Coursework: Structural Analysis, Geology for Engineers, Soil Mechanics, Fluid Flow Theory, Sustainable Infrastructure, Intro to Transportation, Global Leadership, Statistics for Scientists and Engineers, Civil Engineering Materials

Associate of Pre-Engineering, Snow College
Ephraim, UT

May 2016,

- GPA: 3.72
- Magna Cum Laude
- Coursework: Engineering Graphics and Design, Surveying and Global Positioning, Statics, Strengths of Materials, Dynamics, Physics for Scientists and Engineers, Principles of Chemistry, Calculus I-III, Differential Equations and Linear Algebra
- Scholarships: Snow College Engineering Scholarship Fund, Center of Global Engagement merit grant

Skill & Abilities

- Familiar with SOLIDWORKS, C++, R
- Native proficiency: Mandarin Chinese, Cantonese

Work Experience

Teaching Assistant, BYU Chinese Flagship Program
Provo, UT

August 2016 – Present,

- Tutor Engineering, Math, Statistics, Physics terms in Chinese to native English speakers
- Assist students to bridge the gap between Chinese language and their professional careers

Event Organizer, Snow College
Ephraim, UT

February 2016,

- Collaborated with club members to organize events for engineering club

Summer Camp Workshop Assistant, Pacific Links Foundation
Vietnam

June 2015 – August 2015,

- Assisted an Introduction to Computer Programming workshop at Summer Camp for At-Risk children
- Collaborated with a team of 5 to introduce the concepts of the digital world and computers to children
- Utilized MIT's Scratch Programming Language to teach the children how to create their own interactive video games

Stuart C Withers

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Work Experience:

Intern – JWO Engineering (May 2016 - present)

- Worked on the design of onsite water and wastewater treatment systems
- Developed local limits and surcharge rates for local POTWs
- Reviewed design standards for local improvement district
- Provided engineering support for local treatment plant
- Provided construction administration for secondary clarifier rehabilitation project

Installer – Action Target (September - December 2015)

- Installed steel and electrical work on shooting ranges and tactical combat houses
- Involved in layout, setting, and anchoring of steel panels
- Filled out daily reports of project progress and issues
- Worked on an international project with workers from various countries

Research Assistant – BYU Civil Eng. Department (September 2013 - April 2014)

- Worked on team researching a new model for sustainable city development
- Specifically studied issues relating to water and wastewater treatment
- Work involved traveling to present research at the National Sustainable Design Expo

Student Lead – BYU Recycling (January 2012 – May 2016)

- Responsible for training and leading of coworkers
- Operated forklift moving materials in excess of 2 tons, requiring safety awareness
- Loaded trucks and conex boxes for product shipping

Education:

Brigham Young University Fulton College of Engineering and Technology

- Civil Engineering Major
- Anticipated Graduation: April 2018

Volunteer Experience:

Representative – The Church of Jesus Christ of Latter-day Saints (2009 - 2011)

- Served as a District Leader supervising the activities of 5 other representatives
- Functioned as personal trainer for newly arrived volunteer for 3 months
- Worked in the mission office managing finances, supplies, and other administrative tasks

KIRK D. KAUER

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EXPERIENCE

Hansen, Allen & Luce, Inc.: Engineering Intern

JAN 2018- PRESENT

- Analyze energy saving opportunities for various city water systems using EPANET
- Research relevant topics and prepare data for presentations and reports

Geostrata Engineering: Lab Technician

AUG 2016- DEC 2017

- Perform various ASTM standard tests on soil samples in the lab
- Analyze data to be used in reports
- Occasionally perform site visits around Salt Lake and Utah counties

Research Assistant (with Dr. Kyle Rollins at BYU)

April 2016-Aug 2016

- Perform unconfined compressive strength tests in lab
- Assist Grad student in testing passive strengths of various backfills/ skew angles of bridge abutments
- Survey points of interest before and after field testing using total station and level

Edge Pest Control

April 2015-Nov 2015

- Managed routes for service vehicles for assigned areas (Portland, Oregon area)
- Negotiated deals with potential customers (generated over \$79,000 in revenue)
- Worked with current customers to maintain customer satisfaction

Farm Laborer/ Ranch Hand

MAY 2006-JULY 2014

- Manage irrigation for fields
- Built corrals and fixed broken fence lines frequently
- Maintained grounds on ranch base (located in Rexburg, ID)

EDUCATION

BRIGHAM YOUNG UNIVERSITY

NOV. 2014-PRESENT

- Sophomore - Senior years (3.42 Cumulative GPA)
- Projected graduation dates: June 2018 (B.S.), December 2020 (M.Eng.)

BRIGHAM YOUNG UNIVERSITY IDAHO

FALL 2011-WINTER 2012

- Freshman year (3.94 GPA)

MADISON HIGH SCHOOL

GRADUATED IN 2011
REXBURG, IDAHO

- Achieved high school diploma (3.97 GPA)
- Student class publicity manager in freshman year

EXTRACURRICULAR ACTIVITIES/ ACHIEVEMENTS

- Active member of the national and local sections of the ASCE (American Society of Civil Engineers)
- Member of the service council for BYU's student chapter of ASCE (Fall 2014)
- Member of BYU's steel bridge team for the 2016 AISC steel bridge competition
- Achieved Eagle Scout Award, Boy Scouts of America (2011)
- Completed an honorable two year service mission for The Church of Jesus Christ of Latter-Day Saints in the Philippines, Baguio/Urdueta mission (2012-2014)