



District Energy Combined Heating and Cooling Conversion

December 2022

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1. Executive Summary

The University has arrived at a decision point where investments in the main campus district energy systems will carry us decades into the future. A combination of equipment reaching end of life (boilers and distribution system steam and condensate piping), climate action goals, air quality regulations and improvements in alternate technology means that the time to decide about the future of the district energy system is now.

A new direction in District Energy delivery is essential to address:

- CSU Commitment to Carbon Neutrality by 2040
- University and local utility commitment to 100% renewable electricity by 2030
- New statewide benchmarking and building performance legislation
- Front Range air quality deterioration, specifically, the Front Range was recently downgraded from “serious” nonattainment for ozone to “severe”.
- Existing district energy infrastructure that has reached end of life.
- Life cycle costs.

Facilities staff investigated what other universities were doing, researched new technology options, and kept abreast of the ever-changing regulatory environment. To get a more detailed picture, staff secured a consultant and conducted an analysis of the district energy system during FY22. After extensive analysis, the recommended district energy system moving forward is a combined heating and cooling system (CHC). The system consists of a hot and chilled water distribution system served by heat recovery chillers (HRC) that is backed up/supplemented by new ultra-low NOx natural gas boilers.

A 60-year Life Cycle Analysis showed expected savings of \$160M (2020 dollars) over continued repair and replacement of the existing system (Business as Usual). While this is the lowest life cycle cost, it does require significant capital investments in the next decade.

Implementation Timeline District Energy Master Plan:

- 10-year effort
 - First 5 Years
 - Heating Plant Sustainability Upgrade (State Capital Funding Request) - \$22M
 - Hot Water Distribution Phase 1
 - Hot Water Distribution Phase 2
 - Second 5 Years—no cost estimate at this time
 - Hot Water Distribution Phase 3
 - Hot Water Distribution Phase 4
 - Chill Plant #1 Replacement and Thermal Energy Storage

This program plan addresses the first five years of the conversion process. Construction will include new hot water supply and return lines as well as a pumping facility to provide hot water. At the end of the first 5 years the university will have addressed immediate operational concerns, including air quality restrictions and replacement of central heating equipment at end of life. At the end of the second 5 years Main Campus east of Meridian will have a fully functional combined heating and cooling utility that will significantly support all the goals listed above.

The estimated project budget for the first five-year period is \$56.8-\$62M (in 2024 dollars), funded by University resources. This is in addition to the funding currently being requested from the State Capital Construction fund to replace boilers.

Once necessary approvals and funding are in place it is estimated that this phase of the project will take approximately 5 years to complete. The current budget range assumes design in 2023 and bids in 2024.

2. Justification

2.1 Program Mission and History

The main campus district heating concept is nearly as old as the campus itself. The existing plant building and first district coal fired boilers were installed at the beginning of the last century (1915). In the 1960s, the plant was “modernized” and new boilers were installed to burn natural gas. The district cooling system construction began in 2000, out of the need to phase out old refrigerants in chiller equipment scattered across Main Campus.

District heating and cooling plants provide many benefits. Life cycle cost savings are realized due to the significant reduction of installed equipment required to meet redundancy and peak loads. Central plant equipment is generally more robust, more efficient, and has a longer life expectancy. Central plants are better able to respond to growth and load variation; in many cases growth can be absorbed into the existing central plant capacity due to inherent load diversity. Central plants also consolidate the equipment footprint, freeing space for other uses and avoiding equipment sprawl. Finally, there is a significant maintenance benefit due to the reduction in the number of pieces of equipment.

2.2 Physical Condition/functionality of Existing System

The last major renovation to the main campus district heating plant was in 1983, when Boiler #1 was installed and the building expanded. Boilers #2 and #3 date from the 1960s, when new boilers were installed to burn natural gas and to accommodate the dramatic expansion in campus development. These boilers are now at end of life (>60 years old), and miles of steam and condensate piping are aging and will need significant refurbishment/replacement.

Even though the district cooling system is much newer, chillers are not as long-lived as boilers. As a result, district cooling plant #1 will reach end of life in 2030 with district cooling plant #2 following in 2040.

2.2 Relation to Climate Action and Physical Master Plan

CSU’s Climate action plan was first written in 2010, with an update in 2022. The major change in the 2022 update is moving the goal for carbon neutrality from 2050 to 2040 based upon the urgency of reducing greenhouse gas emissions and the technological innovations that make achieving this goal possible.

The phasing of the District Energy Master Plan has been coordinated with the large development projects anticipated in the Physical Master plan: Clark Building redevelopment, Glover site redevelopment and the Biomedical Discovery Center. All projects will be constructed to be compatible with the Combined Heating and Cooling system. If funding aligns, projects could directly tie into the new system. The second half of the project will require installation of 2 very tall thermal energy storage tanks, currently planned for the

Motor Pool Parking Lot. The aesthetics of this installation, as well as the relocation of facilities management functions will need additional study.



New Equipment list

Existing autoclaves run on steam and will need to be replaced with electric autoclaves as buildings are converted to CHC. The first 5-year phase of the project will replace approximately 20 autoclaves.

Item	Number	Total Cost
Electric Autoclaves	20	2,000,000

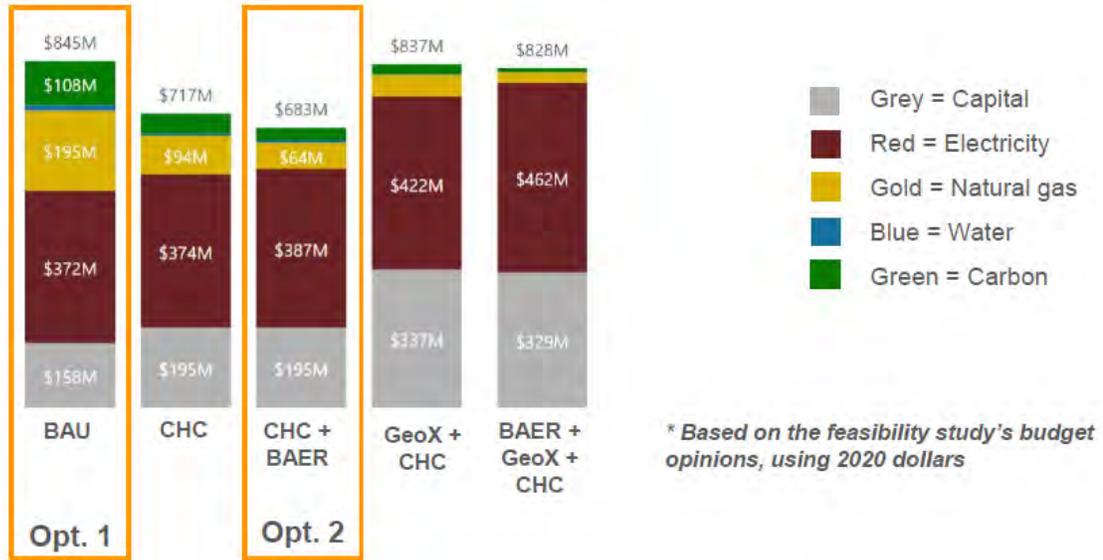
2.3 Alternative analysis

Facilities staff investigated what other universities were doing, researched new technology options, and kept abreast of the ever-changing regulatory environment. To get a more detailed picture, staff secured a consultant and conducted an analysis of the district energy system during FY22.

- Combined Heating and Cooling (CHC) is a system configuration including a hot water and chilled water distribution system serving buildings, tied together at a Heat Recovery Chiller (HRC) plant. A HRC is a piece of equipment that provides both cooling and heating. Traditional chillers create chilled water using the refrigeration cycle, but heat is rejected to the atmosphere via cooling towers. In an HRC, the waste heat is captured and used for process heating, hot water loads, or can be stored in the system tank for later use. By generating both heating and cooling in a HRC, efficiencies are dramatically improved. Most importantly, electricity is used to generate heat and displaces natural gas combustion as the primary source. A very important factor, and the most impactful part of the overall plan in both cost and construction, is the need to convert campus heating from steam to hot water. The HRC plant can only bridge between hot and cold-water systems, it does not produce steam.
- Building Airside Energy Recovery (BAER) utilizes equipment and controls already in our buildings. These modified control sequences will allow more captured energy to be carried back to the HRC plant to be either directly used for campus heating and cooling or sent to the storage tanks for use later. Note that BAER is an enhancement of CHC, and cannot be implemented alone.
- Business As Usual (BAU) is the option where we retain the existing steam system and traditional chilled water plants. Both utilities will require replacements and refurbishments over the 60-year study period, however, no efficiencies can be leveraged from the separated systems and campus heating will continue to be served through 100% natural gas combustion.

Based on a 60-year Life Cycle Analysis (LCA), CHC with heat recovery chillers and BAER is the least expensive option that meets university goals.

Life Cycle Cost Analysis



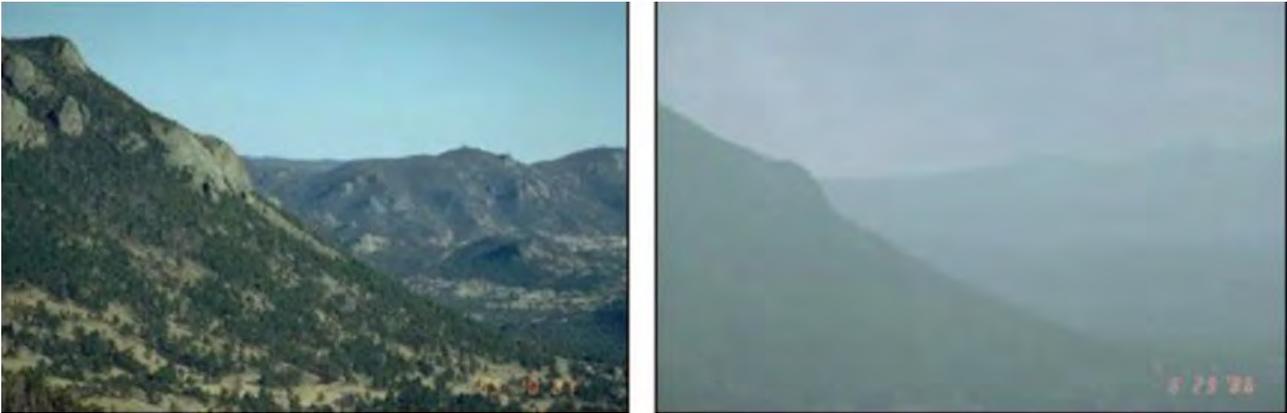
2.4 Benefits of the Project

There are tangible benefits in addition to the life cycle cost savings; however, these are very hard to quantify and are therefore not included in the LCA.

Air Quality Issues: Much of the Colorado Front Range is in an air quality non-attainment area for ozone. This includes Fort Collins and CSU's Main, South, and Foothills campuses. The Front Range EPA Air Quality assessment has been elevated to "Severe" because of very poor air quality in recent summers. The impacts of this designation are very low limits on NO_x emissions for new sources such as boilers. If any new sources (e.g., boilers at residence halls) installed within a three-year period exceed the threshold, the University will be subject to New Source Review (NSR) permitting. This permitting will require the University to install air pollution controls on other people's equipment in this region to offset the installation of new combustion equipment on our campus.

Current regulation places annual limits on the heating plant's two largest boilers (Boiler #1 and Boiler #2). The FM team has found ways to supply heat to campus within these restrictions and emission limits in order to avoid significant regulatory costs, including equipment retrofits and continuous emission monitoring systems (CEMS). Costs for these modifications are in the millions of dollars, and may not satisfy regulation.

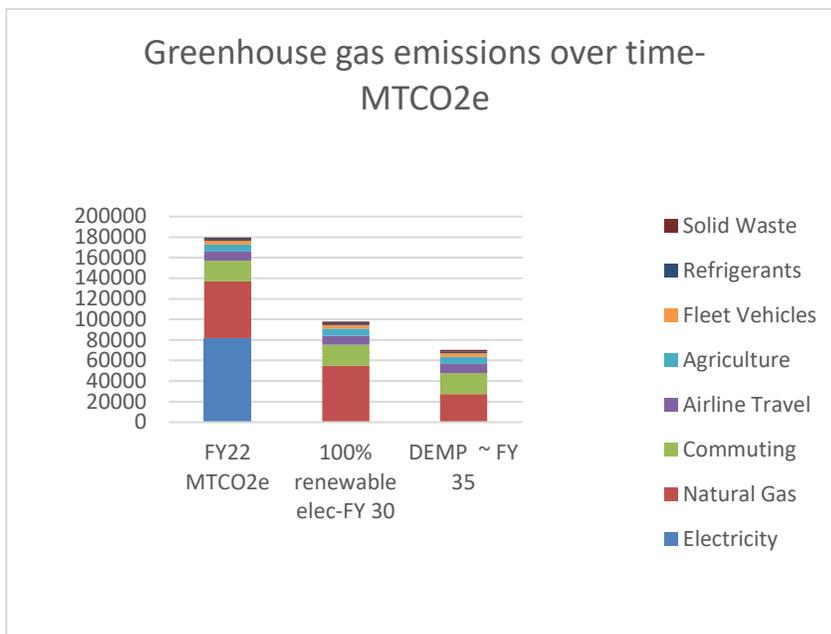
New regulation is already being implemented by the state, scheduled to become active in 2024. Without the Heating Plant Sustainability Upgrade, the university will be facing those millions of dollars in regulatory costs. FM staff foresee that CHC will become not simply the best option, but the only option. Main Campus must reduce its annual combustion and produce more heat with electricity in order to continue serving its customers.



Photos of Rocky Mtn National Park on a clear day vs a serious ozone day

Climate impacts: Currently emissions from natural gas combustion university-wide account for 31% of CSU’s total Greenhouse Gas (GHG) emissions. The district energy plant alone burns ~550,000 million BTUs (MMBTUs) of natural gas every year, which results in nearly 30,000 metric tons of carbon dioxide emitted (MTCO_{2e}) in GHG emissions (out of a university total of ~180,000 MTCO_{2e} in FY22) making up the majority of CSU’s natural gas related GHG emissions.

Electricity is currently the largest contributor to GHG emissions at 46%. However, CSU and the regional utilities have all made the commitment to 100% renewable electricity by 2030. This means that by 2030 CSU’s emissions related to electricity use are expected to be zero – cutting the University’s total emissions in half. However, at that time (if no changes are made), natural gas is estimated to be nearly 65% of GHG emissions. Implementing this District Energy Master Plan (DEMP) will shift significant heating and hot water energy use from natural gas to electricity –reducing the GHG emissions related to building heating and cooling by about 50% (natural gas will still be in use on South and Foothills campuses).



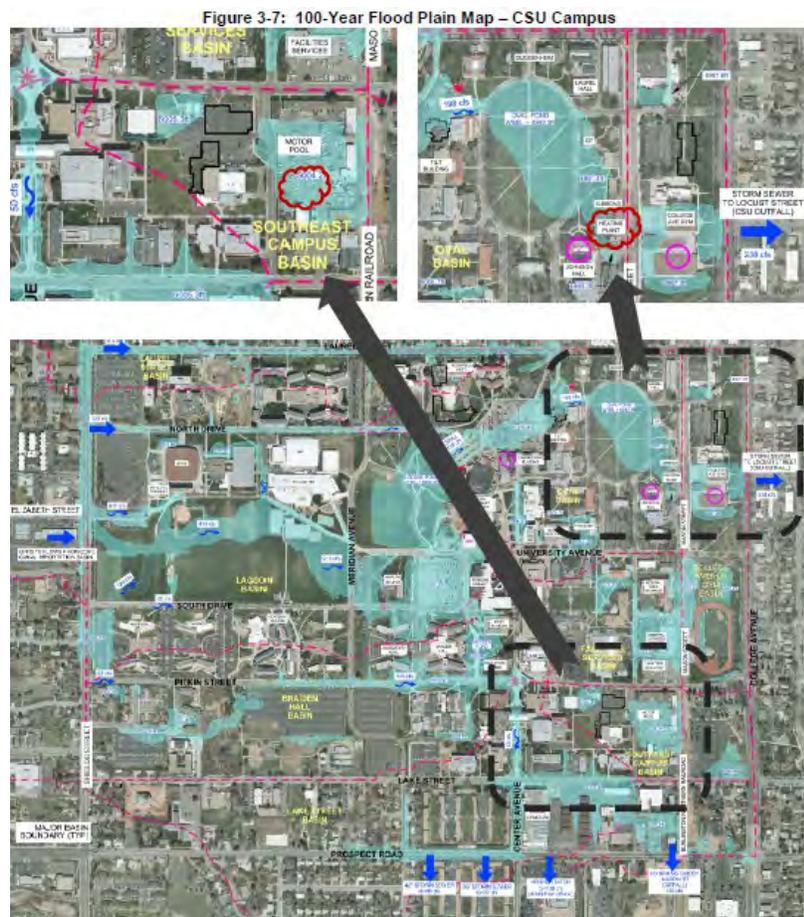
3. Design Criteria

3.1 Site Constraints

The full DEMP scope will disrupt approximately half of main campus as new hot water distribution lines are installed, plants are renovated, and storage is constructed. The existing steam system must remain functional until the CHC project is completed, so steam tunnels cannot be used for the hot water distribution system.

3.2 Flood Mitigation Analysis

Flood mitigation has been accomplished at the heating plant through previous projects. The construction of a new pumping facility and associated infrastructure in the motor pool lot will require flood mitigation, with options shown below. All options assume that stormwater improvements will connect to the MSO pipe stub beneath Lake Street, west of the railroad tracks, and that water quality will be provided by the MSO pond. Estimated cost is approximately \$1,000,000.



3.3 LEED Goal

The Main Campus District Energy Master Plan transitions the campus over time from steam to Combined Heating and Cooling (CHC) with Building Airside Energy Recovery (BAER). This helps to address the university's greenhouse gas, sustainability and air quality goals, and increases overall utility efficiency. Additionally, every new construction or renovation building project connected to the district utility will use the increased efficiency of CHC and BAER in their own LEED calculations.

3.4 Utility Incentive Programs

Utility incentive programs will be investigated during design. Discussions with utility providers have already begun, but due to the scale, complexity and unique nature of this project, rebate potential is uncertain.

3.5 Architectural/Mechanical Narrative

- Overall Scope of work:
 - Heating Plant Sustainability Upgrade (State Capital Funding Request) - \$22M
 - Hot Water Distribution Phase 1 - shown RED on map
 - Hot Water Distribution Phase 2 - shown PURPLE on map
- Heating Plant Sustainability Upgrade project includes:
 - Retirement of end-of-life equipment
 - Installation of new boilers in support of master plans and air quality regulations
 - Preparation for full system hot water generation
- Hot water distribution phases include:
 - Construction of new pump facility in Motor Pool lot, with additional equipment necessary to generate hot water during the transition phase
 - Distribution piping. Approximately 6600 LF of hot water supply and return lines, ranging from 12"-30" diameter
 - Connection to indicated buildings (approximately 30 buildings)
 - Conversion of internal building equipment (building heat, hot water, process equipment)
 - Retirement of steam distribution

3.6 CSU Standards

The CSU Building Construction Standards Manual is available at:

http://www.fm.colostate.edu/constr_standards

The CSU Standards are to be used as guidelines for design. They are divided into 3 parts for use by Architects and Engineers: the first part is administrative; the second part discusses requirements for design and deliverables at each stage of the design process; the third part consists of the technical standards arranged by CSI division. The Standards are a living document, and as such, any question about the applicability of a standard should be discussed with the project manager. The Standards should never be referenced or copied in Contract Documents – the design is expected to embody and conform to the Standards. Contractors are not to be directed to review the Standards as a contract requirement.

3.7 CSU Inclusivity Standards-not applicable to this project

3.8 List of Applicable Codes

Approved building codes and standards have been adopted by the Office of the State Architect (herein referred to as State Buildings Program (SBP)) and other state authorities, and are identified below as the minimum requirements to be applied to all construction projects at state agencies and institutions of higher education owned facilities.

Applicable codes:

2021	INTERNATIONAL BUILDING CODE
2021	INTERNATIONAL EXISTING BUILDING CODE
2021	INTERNATIONAL MECHANICAL CODE
2021	INTERNATIONAL ENERGY CONSERVATION CODE
2020	NATIONAL ELECTRICAL CODE
2018	INTERNATIONAL PLUMBING CODE
2018	INTERNATIONAL FUEL GAS CODE
2021	INTERNATIONAL FIRE CODE
CURRENT	ICC/ANSI A117.1

4. Project schedule, cost estimates and financing

4.1 Project schedule/phasing

The project phasing has been coordinated with construction of the Glover and Clark projects. If funding aligns, these projects could tie directly into the new system. Phase 1 and 2 of the Hot Water Distribution piping installation will impact approximately one quarter of the campus.

Once necessary approvals and funding are in place it is estimated that this phase of the project will take approximately 5 years to complete. The current budget range assumes design in 2023 and bids in 2024.

4.2 Financing

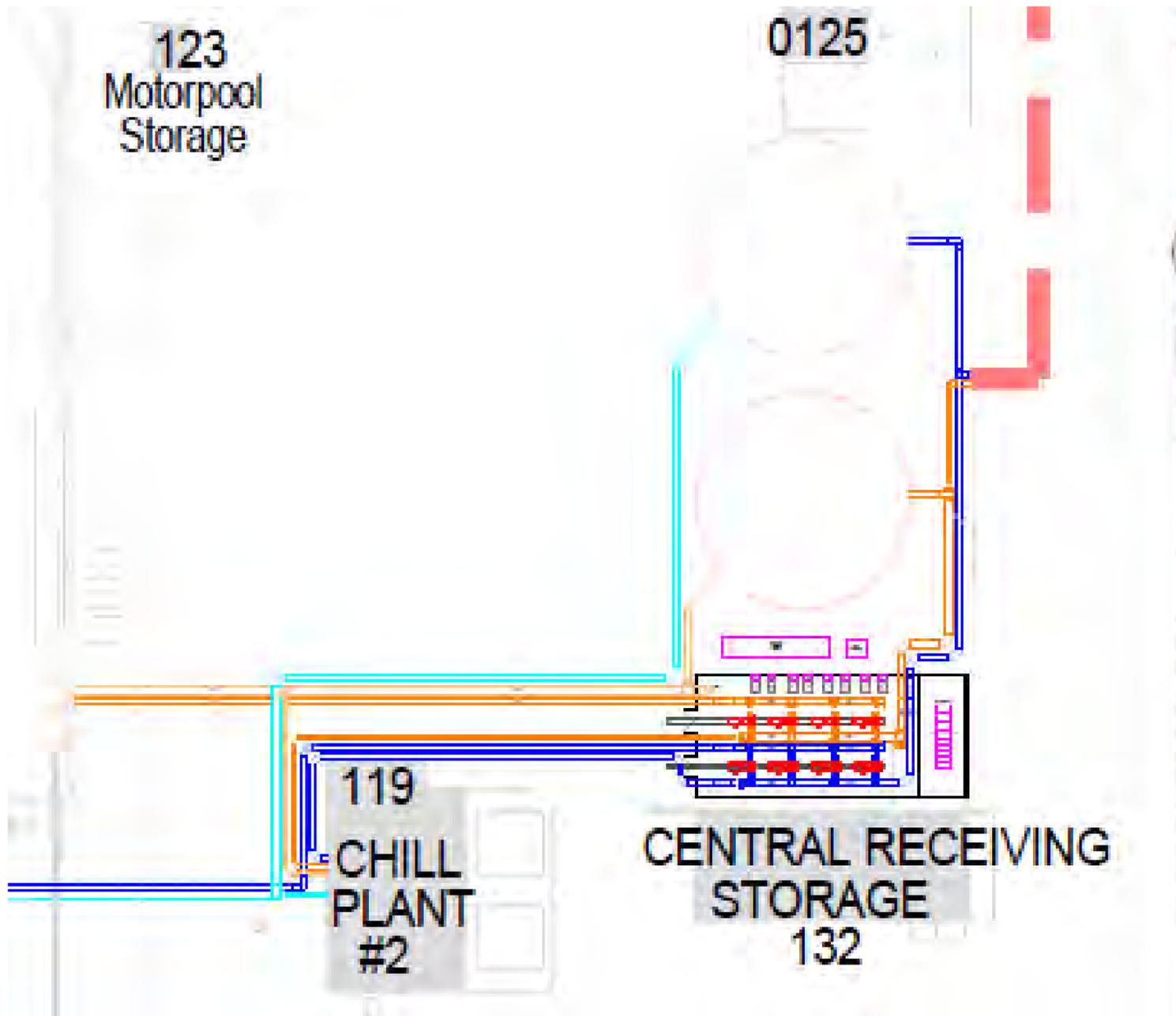
The estimated project budget for the first five-year period is \$56.8-\$62M (in 2024 dollars), funded by University resources. This is in addition to the funding currently being requested from the State Capital Construction fund to replace boilers.

4.3 Cost estimate/methodology

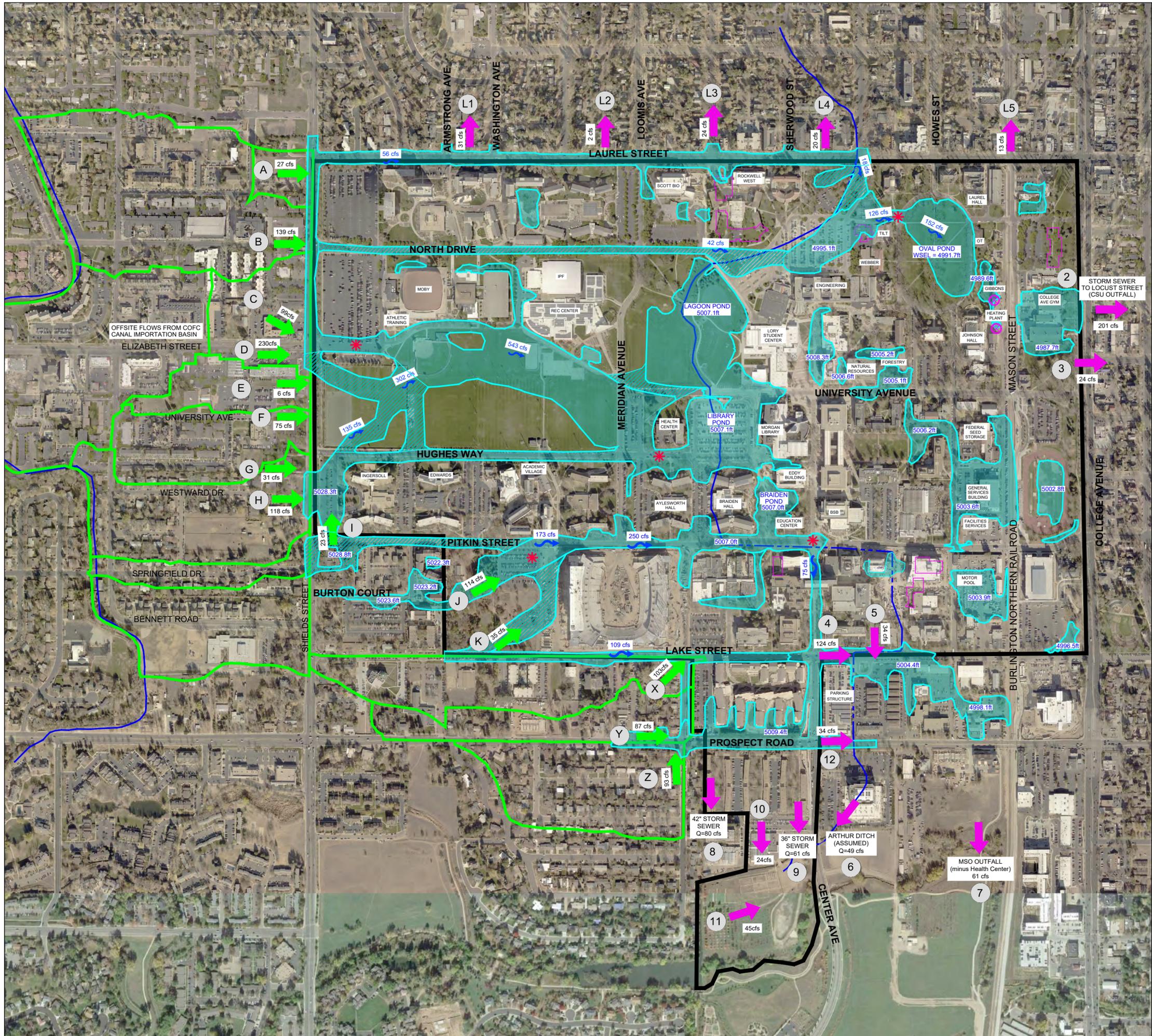
Cost estimates were developed by a 3rd party consultant. CSU standards specify that the A/E should document 20% of the construction budget in bid alternates, to cover potential volatility in the construction market as the project progresses.

Appendices

- **Hot water distribution map**
- **Pump facility site plan**
- **Flood plain map**
- **Budget Estimate**



Motor Pool Lot- Conceptual Pump Facility and Storage Tank Locations



LEGEND

NTS



- 4991.4ft WSEL (FT)
- 198.1 cfs FLOW (CFS)
- FLOODPLAIN BOUNDARY (POST PROJECT)
- SHALLOW FLOODING (CONVEYANCE AREAS LESS THAN 0.5FT DEEP)
- * CRITICAL CONVEYANCE LOCATION
- ⊗ ACTIVE FLOOD PROTECTION REQUIRED TO PROTECT BUILDING IN A FLOOD EVENT
- ↘ 107 cfs
OUTFLOW
- ↘ 27 cfs
INFLOW
- IGA BOUNDARY

COLORADO STATE UNIVERSITY
 100-YEAR FLOODPLAIN
 (2D MODEL RESULTS)
 AUGUST 2020
 PC SWMM FLOODPLAIN

ELEVATIONS BASED ON
 NAVD88 DATUM
 SOURCE: LIDAR MAY 2015

District Energy Master Plan Distribution phases 1 & 2

updated 12/28/2022

Project Budget	low	medium	high	Remarks
Professional Services				
Site Survey, Geotechnical	\$ 113,048	\$ 113,048	\$ 113,048	
Consultants - Architects, Engineers, Vibration, Acoustics	\$ 3,147,082	\$ 3,312,718	\$ 3,478,354	10% of subtotal construction costs
Advertisements	\$ 250	\$ 250	\$ 250	
CSU Facilities Project Management	\$ 1,180,000	\$ 1,180,000	\$ 1,180,000	for a \$59M project
Independent Code Review, code insp, material tests, commissioning	\$ 450,000	\$ 450,000	\$ 450,000	
Total Professional Services	\$ 4,890,380	\$ 5,056,016	\$ 5,221,652	\$ -
Land Acquisition				
purchase and closing costs		\$ -		
Total Land Acquisition		\$ -		
Construction				
New Space - 4500 gsf @ \$1486/gsf	\$ 6,351,001	\$ 6,685,264	\$ 7,019,527	includes back up generator
Infrastructure Service/Utilities	\$ 11,196,780	\$ 11,786,084	\$ 12,375,388	
Site Improvements/Landscaping	\$ 770,743	\$ 811,308	\$ 851,873	
Building side retrofits	\$ 7,125,000	\$ 7,500,000	\$ 7,875,000	
Contractor General conditions	\$ 6,027,296	\$ 6,344,522	\$ 6,661,748	
Subtotal Construction Costs	\$ 31,470,819	\$ 33,127,178	\$ 34,783,537	
Equipment & Furnishings				
Fixed Equipment	\$ 2,000,000	\$ 2,000,000	\$ 2,000,000	replace steam autoclaves w/ electric
Moveable Equipment-				
CSU Communications				
CSU Notifier system				
Total Equipment and Furnishings Costs	\$ 2,000,000	\$ 2,000,000	\$ 2,000,000	\$ -
Miscellaneous				
Estimating contingency @ 15%	\$ 4,720,623	\$ 4,969,077	\$ 5,217,531	
traffic control/signage/stockpile/erosion	\$ 2,002,563	\$ 2,002,563	\$ 2,002,563	
Total Miscellaneous Costs	\$ 6,723,186	\$ 6,971,640	\$ 7,220,094	\$ -
Subtotal Project Cost	\$ 45,084,385	\$ 47,154,834	\$ 49,225,282	\$ -
Project Contingency				
Project Contingency 5% for New				
Project Contingency 10% for Renovation	\$ 4,508,438	\$ 4,715,483	\$ 4,922,528	
Total Contingency	\$ 4,508,438	\$ 4,715,483	\$ 4,922,528	
Total Project Development cost --12/2022	\$ 49,592,823	\$ 51,870,317	\$ 54,147,810	\$ -
Escalation				
Project escalation @7% to 12/2023	\$ 53,064,321	\$ 55,501,239	\$ 57,938,157	
Project escalation @7% to 12/2024	\$ 56,778,823	\$ 59,386,326	\$ 61,993,828	
Project escalation @7% to 12/2025	\$ 60,753,341	\$ 63,543,369	\$ 66,333,396	
This opinion of probable cost is made on the basis of experience, qualifications and best judgement of a professional cost consultant familiar with the construction industry, combined with the professional experience of Facilities Management. FM cannot guarantee that proposals, bids or actual construction costs will not vary from this cost estimate due to market conditions at the time of the bid.				
Total Development Cost/sf	#DIV/0!	#DIV/0!	#DIV/0!	

COLORADO STATE UNIVERSITY
 Facilities Planning Design and Construction



DEMP Program

PHASED ESTIMATE: All 4 Phases of Pipeline + Initial Building Phase

OVERALL COST

Basis of Estimate: Hot Water Buildout - Exhibit dated July 2021

Prepared By: BR/GL Date: 12/27/2022

Estimate Class: 5

CSI 0004	Item #	Description	Quantity	Unit	Unit Price	Ext Amount	NOTES/COST SOURCE
00-0000		CONTRACTING REQUIREMENTS					
	00-000	Contractor Overhead Indirect (8%)	1	LS		\$ 3,330,230.28	
	00-001	Contractor Profit (8%)	1	LS		\$ 3,596,648.71	Applied to Total prior to Bonds and Insur
	00-002	Weather Conditions Allowance (0.5%)	1	LS		\$ 242,773.79	Applied to Total prior to Bonds and Insur
	00-003	Bonds and Insurance (3%)	1	LS		\$ 1,463,925.94	
		Subtotal 00				\$ 8,633,578.71	
01-0000		GENERAL REQUIREMENTS					
	01-001	Mobilization	9	EA	\$ 287,035.54	\$ 2,583,320	5 Phases, 9 mobes (2 per pipe phase, 1 per building phase)
	01-002	Field Office	23	MON	\$ 26,250.00	\$ 594,989	Class 2 \$45000 per year; confirm what COL WTP is paying now?
	01-003	Fill/Test/Startup Bldg (one per building connection)	79	EA	\$ 15,000.00	\$ 1,185,000	TWP was \$55K
	01-004	Fill/Pressure Test/Drain Yard Piping Segments (Phased)	24	EA	\$ 15,000.00	\$ 360,000	
		Subtotal 01				\$ 4,723,308.93	
02-0000		SITE SPECIFIC REQUIREMENTS					
	02-001	Pedestrian Control	680	Day	\$ 2,350.00	\$ 1,597,971	80LF per day calc
	02-002	Traffic Control	680	Day	\$ 1,750.00	\$ 1,189,978	80LF per day calc
	02-003	Stockpile locations and short haul spoils	680	Day	\$ 1,350.00	\$ 917,983	80LF per day calc
	02-004	Erosion Control	680	Day	\$ 750.00	\$ 509,991	80LF per day calc
	02-005	Surveying	680	Day	\$ 350.00	\$ 237,996	80LF per day calc
		Subtotal 02-0				\$ 4,453,918.13	
		DEMOLITION					
	02-101	Demo Sidewalk - Direct Bury	3,978	SY	\$ 42.35	\$ 168,459	Assumed Width = 6' (100% of Concrete takeoff)
	02-102	Demo Sidewalk - Tunnel	1,553	SY	\$ 42.35	\$ 65,784	Assumed Width = 6' (100% of Concrete takeoff) (0.25 factor for partial demo areas)
	02-103	Demo Asphalt - Direct Bury	2,791	SY	\$ 8.73	\$ 24,367	Assumed Width = 6' (90% of Asphalt Takeoff)
	02-104	Demo Asphalt - Tunnel	529	SY	\$ 8.73	\$ 4,618	Assumed Width = 6' (90% of Asphalt Takeoff) (no factor for tunnel access, use 100% of area)
	02-105	Demo Curb and Gutter - Direct Bury	1,745	LF	\$ 9.10	\$ 15,875	(5% of Asphalt Takeoff converted to LF C&G, 10' min)
	02-106	Demo Curb and Gutter - Tunnel	331	LF	\$ 9.10	\$ 3,009	(5% of Asphalt Takeoff converted to LF C&G, 10' min)
	02-107	Demo Drive Pan "V" - Direct Bury	155	SY	\$ 21.84	\$ 3,387	(5% of Asphalt Takeoff)
	02-108	Demo Drive Pan "V" - Tunnel	29	SY	\$ 21.84	\$ 642	(5% of Asphalt Takeoff)
	02-109	Demo Landscaping - Direct Bury	39,300	SF	\$ 1.25	\$ 49,125	(100% of LSCAPE Takeoff) Assumed Width = 8'
	02-110	Demo Landscaping - Tunnel	7,806	SF	\$ 1.25	\$ 9,758	
	02-111	Haul + Dump Fees (Concrete + Asphalt Demo)	3,476	CY	\$ 45.00	\$ 156,436	\$29 dump fee and \$16 trucking (7" Avg thickness 8' width)
	02-112	Haul Excess Spoils Offsite	15,958	CY	\$ 32.00	\$ 510,664	
	02-113	Demo Steam Tunnel Lid	24,474	SF	\$ 18.00	\$ 440,532	1/4 of linear footage assumed, i.e. for every 100 lf, 25 lf of steam tunnel soffit removed, pipe welded in place in steam tunnel.
	02-114	Demo/Adjust Misc. valve boxes, util boxes	75	EA	\$ 805.00	\$ 60,375	Assumed Qty
	02-115	R&R irrigation (temp for trenching)	100	EA	\$ 1,250.00	\$ 125,000	Assumed Qty
	02-116	Tree Removal	15	EA	\$ 1,200.00	\$ 18,000	Assumed Qty
		Subtotal 02-1				\$ 1,656,029.04	
03-0000		CONCRETE					
	03-001	Place Sidewalk 6"	6,084	SY	\$ 85.61	\$ 520,870	
	03-002	ABC Leveling Course 2"	406	CY	\$ 62.02	\$ 25,156	
	03-003	Replace Steam Tunnel Soffit (Form/Reinf./Place)	1,088	CY	\$ 1,150.00	\$ 1,250,893	12" thick, double mat
	03-004	Replace Curb and Gutter	2,075	LF	\$ 9.10	\$ 18,884	
	03-005	Replace "V" Drive Pan	184	SY	\$ 116.98	\$ 21,578	
	03-006	Replace Misc. Concrete (Driveway, PCCP)	166	SY	\$ 116.98	\$ 19,420	5% of asphalt demo QTY
	03-007	Concrete Testing (30 CY/Day)	70	DAY	\$ 700.00	\$ 49,041	
	03-008	High Early Adder for 10% of Concrete	1,933	CY	\$ 20.00	\$ 38,655	
		Subtotal 03				\$ 1,944,497.52	
32-0000		EXTERIOR IMPROVEMENTS					
	32-001	Unsuitable Material Excavation and disposal	6,383	CY	\$ 40.00	\$ 255,332	
	32-002	Replace Asphalt (Trench Patch - 6")	1,194	TON	\$ 225.00	\$ 268,729	6" depth, SY HMA DEMO
	32-003	Place and compact Class 6 Base (12" depth)	2,389	TON	\$ 65.00	\$ 155,265	
	32-004	Replace Landscaping and Plantings (per sf)	47,106	SF	\$ 2.50	\$ 117,765	
	32-005	Replace Curb and Gutter	2,075	LF	\$ 31.00	\$ 64,329	Also shown above
	32-006	Asphalt Testing	15	DAY	\$ 850.00	\$ 12,690	80 ton/day
	32-007	Miscellaneous CLSM Backfill	600	CY	\$ 300.00	\$ 180,000	
	32-008	Temp CLSM for 75% of trench patching HMA	1,792	CY	\$ 300.00	\$ 537,457	
	32-009	Mill and Haul off Temp Paving CLSM	1,792	CY	\$ 65.00	\$ 116,449	
		Subtotal 32				\$ 1,708,016.43	



DEMP Program

PHASED ESTIMATE: All 4 Phases of Pipeline + Initial Building Phase

OVERALL COST

Basis of Estimate: Hot Water Buildout - Exhibit dated July 2021

Prepared By: BR/GL Date: 12/27/2022

Estimate Class: 5

CSI 2004	Item #	Description	Quantity	Unit	Unit Price	Ext Amount	NOTES/COST SOURCE
33-0000		EARTHWORK/UTILITIES - Combined with Earthwork					
		Direct Bury					
	33-001	Excavate/Bed/Lay/Backfill	30,129	LF	\$ 98.00	\$ 2,952,642	6' trench, 6' depth = 36 SF + layback = 45SF EX/LF, 1.67 CY/LF, 45/CY both EX and BF
	33-002	Bedding 6"-10"	19,950	TN	\$ 52.00	\$ 1,037,390	4*3', 22,466 LF
	33-003	Bedding 12"-16"	4,928	TN	\$ 52.00	\$ 256,277	6*3; 3,700 LF
	33-004	Bedding 30"	7,038	TN	\$ 52.00	\$ 365,991	6*4; 5,896 LF
	33-005	Compaction Testing	124	EA	\$ 155.00	\$ 19,234	
	33-006	Welding (small bore) - 2 hours per 25LF	2,410	HR	\$ 145.00	\$ 349,496	
	33-007	Welding (16"+) - 4 Hours per 25 LF	3,192	HR	\$ 145.00	\$ 462,836	
	33-011	Trench Box Rental (Short)	401	DAY	\$ 144.00	\$ 57,744	
	33-012	Hydraulic Shoring Rental (5' short Boxes)	401	DAY	\$ 520.00	\$ 208,520	
	33-013	6" Pipe - Direct Bury (Supply)	20,076	LF	\$ 93.79	\$ 1,882,928	
	33-014	8" Pipe - Direct Bury (Supply)	2,390	LF	\$ 112.88	\$ 269,783	
	33-015	12" Pipe - Direct Bury (Supply)	642	LF	\$ 147.99	\$ 95,010	
	33-016	14" Pipe - Direct Bury (Supply)	280	LF	\$ 158.55	\$ 44,394	
	33-017	16" Pipe - Direct Bury (Supply)	2,778	LF	\$ 181.11	\$ 503,124	
	33-018	30" Pipe - Direct Bury (Supply)	3,963	LF	\$ 309.00	\$ 1,224,567	
	33-019	Bends and Tees 6" to 16"	176	EA	\$ 295.00	\$ 51,920	
	33-020	Bends and Tees 30"	60	EA	\$ 2,900.00	\$ 174,000	
	33-022	Temp Valving - +10% pipe cost	1	LS	\$ 424,572.54	\$ 424,573	
	33-023	Temp Testing and Phasing - +10% pipe cost	1	LS	\$ 424,572.54	\$ 424,573	
	33-024	Cathodic Protection (2% add to Underground)	1	LS	\$ 324,150.01	\$ 324,150	
		Subtotal 33-0				\$ 11,129,150.33	
		Steam Tunnel Placement					
	33-101	Place Pipe - 6" to 16"	18,634	LF	\$ 116.60	\$ 2,172,724	crew of 10; 100 lf per day
	33-102	Place Pipe - 30"	5,636	LF	\$ 194.33	\$ 1,095,263	crew of 12; 60 lf per day
	33-103	Steam Tunnel Ventilation (for confined space)	303	DAY	\$ 150.00	\$ 45,506	
	33-104	Spyder Crane (small bore)	150	DAY	\$ 350.00	\$ 52,500	
	33-105	Small Hydro Crane (24" +)	100	DAY	\$ 2,100.00	\$ 210,000	
	33-106	Welding (small bore) - 2 hours per 25LF	1,491	HR	\$ 145.00	\$ 216,154	
	33-107	Welding (16"+) - 4 Hours per 25 LF	902	HR	\$ 145.00	\$ 130,755	
	33-110	Fabricate and install pipe racks (Special) (small bore)	1,863	EA	\$ 155.00	\$ 288,827	Wall mount - 1 every 10 lf (Knee brace type)
	33-111	Fabricate and install pipe racks (Special) (heavy duty)	705	EA	\$ 375.00	\$ 264,188	Floor mount support rack every 10 LF (double vertical support rack)
	33-112	6" Pipe - Tunnel Install (Supply)	5,820	LF	\$ 49.29	\$ 286,868	Nov 2022 Steel Pricing for 30" @ 0.20 Inch thickness
	33-113	8" Pipe - Tunnel Install (Supply)	3,800	LF	\$ 61.22	\$ 232,636	
	33-114	12" Pipe - Tunnel Install (Supply)	4,216	LF	\$ 87.99	\$ 370,966	
	33-115	14" Pipe - Tunnel Install (Supply)	-	LF	\$ 102.55	\$ -	
	33-116	16" Pipe - Tunnel Install (Supply)	4,798	LF	\$ 117.11	\$ 561,894	
	33-117	30" Pipe - Tunnel Install (Supply)	5,636	LF	\$ 219.00	\$ 1,234,284	Nov 2022 Steel Pricing for 30" @ 0.20 Inch thickness
	33-118	Bends and Tees 6" to 16"	84	EA	\$ 1,000.00	\$ 84,000	
	33-119	Bends and Tees 30"	25	EA	\$ 2,900.00	\$ 72,500	
	33-120	Entry and Exit to Tunnel	80	EA	\$ 15,000.00	\$ 1,200,000	
	33-121	Temp Valving - +10% pipe cost	1	LS	\$ 404,314.74	\$ 404,315	
	33-122	Temp Testing and Phasing - +10% pipe cost	1	LS	\$ 404,314.74	\$ 404,315	
		Subtotal 33-1				\$ 9,327,694.32	
		Subtotal Yard Piping and Building Connections				\$ 34,942,614.70	



DEMP Program
PHASED ESTIMATE: PHASES 1 & 2 Only

Basis of Estimate: Hot Water Buildout - Exhibit dated July 2021
Prepared By: BR/GL Date: 12/27/2022

				Estimate Class: 5				PHASE 1: 2024 + 2025				PHASE 2: 2026 + 2027				TOTAL COST PHASE 1 + 2
CSI 2004	Item #	Description	Overall Quantity	Unit	Total Cost (2022 Dollars)	QTY 2024	Cost 2024	QTY 2025	Cost 2025	QTY 2026	Cost 2026	QTY 2027	Cost 2027			
00-0000		CONTRACTING REQUIREMENTS														
	00-000	Contractor Overhead Indirect (8%)	1	LS	\$ 3,330,230	0.14	\$ 474,558	0.14	\$ 474,558	316,371.88	\$ 316,372	0.10	\$ 316,372	\$ 1,581,859		
	00-001	Contractor Profit (8%)	1	LS	\$ 3,596,649	0.14	\$ 512,522	0.14	\$ 512,522	341,681.63	\$ 341,682	0.10	\$ 341,682	\$ 1,708,408		
	00-002	Weather Conditions Allowance (0.5%)	1	LS	\$ 242,774	0.14	\$ 34,595	0.14	\$ 34,595	23,063.51	\$ 23,064	0.10	\$ 23,064	\$ 115,318		
	00-003	Bonds and Insurance (3%)	1	LS	\$ 1,463,926	0.14	\$ 208,609	0.14	\$ 208,609	139,072.96	\$ 139,073	0.10	\$ 139,073	\$ 695,365		
		Subtotal 00			\$ 8,633,579		\$ 1,230,285		\$ 1,230,285		\$ 820,190		\$ 820,190	\$ 4,100,950		
01-0000		GENERAL REQUIREMENTS														
	01-001	Mobilization	9	EA	\$ 2,583,320	1.00	\$ 368,123	1.00	\$ 368,123	245,415.39	\$ 245,415	0.86	\$ 245,415	\$ 1,227,077		
	01-002	Field Office	23	MON	\$ 594,989	3.23	\$ 84,786	3.23	\$ 84,786	56,523.96	\$ 56,524	2.15	\$ 56,524	\$ 282,620		
	01-003	Fill/Test/Startup Bldg (one per building connection)	79	EA	\$ 1,185,000	11.26	\$ 168,863	11.26	\$ 168,863	112,575.00	\$ 112,575	7.51	\$ 112,575	\$ 562,875		
	01-004	Fill/Pressure Test/Drain Yard Piping Segments (Phased)	24	EA	\$ 360,000	3.42	\$ 51,300	3.42	\$ 51,300	34,200.00	\$ 34,200	2.28	\$ 34,200	\$ 171,000		
		Subtotal 01			\$ 4,723,309		\$ 673,072		\$ 673,072		\$ 448,714		\$ 448,714	\$ 2,243,572		
02-0000		SITE SPECIFIC REQUIREMENTS														
	02-001	Pedestrian Control	680	Day	\$ 1,597,971	96.90	\$ 227,711	96.90	\$ 227,711	151,807.21	\$ 151,807	64.60	\$ 151,807	\$ 759,036		
	02-002	Traffic Control	680	Day	\$ 1,189,978	96.90	\$ 169,572	96.90	\$ 169,572	113,047.92	\$ 113,048	64.60	\$ 113,048	\$ 565,240		
	02-003	Stockpile locations and short haul spoils	680	Day	\$ 917,983	96.90	\$ 130,813	96.90	\$ 130,813	87,208.40	\$ 87,208	64.60	\$ 87,208	\$ 436,042		
	02-004	Erosion Control	680	Day	\$ 509,991	96.90	\$ 72,674	96.90	\$ 72,674	48,449.11	\$ 48,449	64.60	\$ 48,449	\$ 242,246		
	02-005	Surveying	680	Day	\$ 237,996	96.90	\$ 33,914	96.90	\$ 33,914	22,809.58	\$ 22,810	64.60	\$ 22,810	\$ 113,048		
		Subtotal 02-0			\$ 4,453,918		\$ 634,683		\$ 634,683		\$ 423,122		\$ 423,122	\$ 2,115,611		
		DEMOLITION														
	02-101	Demo Sidewalk - Direct Bury	3,978	SY	\$ 168,459	566.83	\$ 24,005	566.83	\$ 24,005	16,003.59	\$ 16,004	377.89	\$ 16,004	\$ 80,018		
	02-102	Demo Sidewalk - Tunnel	1,553	SY	\$ 65,784	221.35	\$ 9,374	221.35	\$ 9,374	6,249.45	\$ 6,249	147.57	\$ 6,249	\$ 31,247		
	02-103	Demo Asphalt - Direct Bury	2,791	SY	\$ 24,367	397.75	\$ 3,472	397.75	\$ 3,472	2,314.88	\$ 2,315	265.16	\$ 2,315	\$ 11,574		
	02-104	Demo Asphalt - Tunnel	529	SY	\$ 4,618	75.38	\$ 658	75.38	\$ 658	438.73	\$ 439	50.26	\$ 439	\$ 2,194		
	02-105	Demo Curb and Gutter - Direct Bury	1,745	LF	\$ 15,875	248.59	\$ 2,262	248.59	\$ 2,262	1,508.12	\$ 1,508	165.73	\$ 1,508	\$ 7,541		
	02-106	Demo Curb and Gutter - Tunnel	331	LF	\$ 3,009	47.11	\$ 429	47.11	\$ 429	285.83	\$ 286	31.41	\$ 286	\$ 1,429		
	02-107	Demo Drive Pan "V" - Direct Bury	155	SY	\$ 3,387	22.10	\$ 483	22.10	\$ 483	321.73	\$ 322	14.73	\$ 322	\$ 1,609		
	02-108	Demo Drive Pan "V" - Tunnel	29	SY	\$ 642	4.19	\$ 91	4.19	\$ 91	60.98	\$ 61	2.79	\$ 61	\$ 305		
	02-109	Demo Landscaping - Direct Bury	39,300	SF	\$ 49,125	5,600.25	\$ 7,000	5,600.25	\$ 7,000	4,666.88	\$ 4,667	3,733.50	\$ 4,667	\$ 23,334		
	02-110	Demo Landscaping - Tunnel	7,806	SF	\$ 9,758	1,112.36	\$ 1,390	1,112.36	\$ 1,390	926.96	\$ 927	741.57	\$ 927	\$ 4,635		
	02-111	Haul + Dump Fees (Concrete + Asphalt Demo)	3,476	CY	\$ 156,346	495.38	\$ 22,292	495.38	\$ 22,292	14,861.38	\$ 14,861	330.25	\$ 14,861	\$ 74,307		
	02-112	Haul Excess Spoils Offsite	15,958	CY	\$ 510,664	2,274.05	\$ 72,770	2,274.05	\$ 72,770	48,513.07	\$ 48,513	1,516.03	\$ 48,513	\$ 242,565		
	02-113	Demo Steam Tunnel Lid	24,474	SF	\$ 440,532	3,487.55	\$ 62,776	3,487.55	\$ 62,776	41,850.54	\$ 41,851	2,325.03	\$ 41,851	\$ 209,253		
	02-114	Demo/Adjust Misc. valve boxes, util boxes	75	EA	\$ 60,375	10.69	\$ 8,603	10.69	\$ 8,603	5,735.63	\$ 5,736	7.13	\$ 5,736	\$ 28,678		
	02-115	R&R Irrigation (temp for trenching)	100	EA	\$ 125,000	14.25	\$ 17,813	14.25	\$ 17,813	11,875.00	\$ 11,875	9.50	\$ 11,875	\$ 59,375		
	02-116	Tree Removal	15	EA	\$ 18,000	2.14	\$ 2,565	2.14	\$ 2,565	1,710.00	\$ 1,710	1.43	\$ 1,710	\$ 8,550		
		Subtotal 02-1			\$ 1,656,029		\$ 235,984		\$ 235,984		\$ 157,323		\$ 157,323	\$ 786,614		
03-0000		CONCRETE														
	03-001	Place Sidewalk 6"	6,084	SY	\$ 520,870	867.00	\$ 74,224	867.00	\$ 74,224	49,482.68	\$ 49,483	578.00	\$ 49,483	\$ 247,413		
	03-002	ABC Leveling Course 2"	406	CY	\$ 25,156	57.80	\$ 3,585	57.80	\$ 3,585	2,389.84	\$ 2,390	38.53	\$ 2,390	\$ 11,949		
	03-003	Replace Steam Tunnel Soffit (Form/Reinf./Place)	1,088	CY	\$ 1,250,893	155.00	\$ 178,252	155.00	\$ 178,252	118,834.87	\$ 118,835	103.33	\$ 118,835	\$ 594,174		
	03-004	Replace Curb and Gutter	2,075	LF	\$ 18,884	295.71	\$ 2,691	295.71	\$ 2,691	1,793.95	\$ 1,794	197.14	\$ 1,794	\$ 8,970		
	03-005	Replace "V" Drive Pan	184	SY	\$ 21,578	26.28	\$ 3,075	26.28	\$ 3,075	2,049.87	\$ 2,050	17.52	\$ 2,050	\$ 10,249		
	03-006	Replace Misc. Concrete (Driveway, PCCP)	166	SY	\$ 19,420	23.66	\$ 2,767	23.66	\$ 2,767	1,844.89	\$ 1,845	15.77	\$ 1,845	\$ 9,224		
	03-007	Concrete Testing (30 CY/Day)	70	DAY	\$ 49,041	9.96	\$ 6,988	9.96	\$ 6,988	4,658.92	\$ 4,659	6.66	\$ 4,659	\$ 23,295		
	03-008	High Early Adder for 10% of Concrete	1,933	CY	\$ 38,655	275.42	\$ 5,508	275.42	\$ 5,508	3,672.25	\$ 3,672	183.61	\$ 3,672	\$ 18,361		
		Subtotal 03			\$ 1,944,498		\$ 277,091		\$ 277,091		\$ 184,727		\$ 184,727	\$ 923,636		
32-0000		EXTERIOR IMPROVEMENTS														
	32-001	Unsuitable Material Excavation and disposal	6,383	CY	\$ 255,332	909.62	\$ 36,385	909.62	\$ 36,385	24,256.54	\$ 24,257	606.41	\$ 24,257	\$ 121,283		
	32-002	Replace Asphalt (Trench Patch - 6")	1,194	TON	\$ 268,729	170.19	\$ 38,294	170.19	\$ 38,294	25,529.23	\$ 25,529	113.46	\$ 25,529	\$ 127,646		
	32-003	Place and compact Class 6 Base (12" depth)	2,389	TON	\$ 155,265	340.39	\$ 22,125	340.39	\$ 22,125	14,750.22	\$ 14,750	226.93	\$ 14,750	\$ 73,751		
	32-004	Replace Landscaping and Plantings (per sf)	47,106	SF	\$ 117,765	6,712.61	\$ 16,782	6,712.61	\$ 16,782	11,187.68	\$ 11,188	4,475.07	\$ 11,188	\$ 55,938		
	32-005	Replace Curb and Gutter	2,075	LF	\$ 64,329	295.71	\$ 9,167	295.71	\$ 9,167	6,111.24	\$ 6,111	197.14	\$ 6,111	\$ 30,556		
	32-006	Asphalt Testing	15	DAY	\$ 12,690	2.13	\$ 1,808	2.13	\$ 1,808	1,205.55	\$ 1,206	1.42	\$ 1,206	\$ 6,028		
	32-007	Miscellaneous CLSM Backfill	600	CY	\$ 180,000	85.50	\$ 25,650	85.50	\$ 25,650	17,100.00	\$ 17,100	57.00	\$ 17,100	\$ 85,500		
	32-008	Temp CLSM for 75% of trench patching HMA	1,792	CY	\$ 537,457	255.29	\$ 76,588	255.29	\$ 76,588	51,058.45	\$ 51,058	170.19	\$ 51,058	\$ 255,292		
	32-009	Mill and Haul off Temp Paving CLSM	1,792	CY	\$ 116,449	255.29	\$ 16,594	255.29	\$ 16,594	11,062.66	\$ 11,063	170.19	\$ 11,063	\$ 55,313		
		Subtotal 32			\$ 1,708,016		\$ 243,392		\$ 243,392		\$ 162,262		\$ 162,262	\$ 811,308		



DEMP Program
PHASED ESTIMATE: PHASES 1 & 2 Only

Basis of Estimate: Hot Water Buildout - Exhibit dated July 2021
 Prepared By: BR/GL Date: 12/27/2022

Estimate Class: 5

CSI 2004	Item #	Description	Overall Quantity	Unit	Total Cost (2022 Dollars)	PHASE 1: 2024 + 2025				PHASE 2: 2026 + 2027				TOTAL COST PHASE 1 + 2
						QTY 2024	Cost 2024	QTY 2025	Cost 2025	QTY 2026	Cost 2026	QTY 2027	Cost 2027	
33-0000		EARTHWORK/UTILITIES - Combined with Earthwork												
		Direct Bury												
	33-001	Excavate/Bed/Lay/Backfill	30,129	LF	\$ 2,952,642	6,628.38	\$ 649,581	6,628.38	\$ 649,581	280,500.99	\$ 280,501	2,862.26	\$ 280,501	\$ 1,860,164
	33-002	Bedding 6"-10"	19,950	TN	\$ 1,037,390	4,388.96	\$ 228,226	4,388.96	\$ 228,226	98,552.05	\$ 98,552	1,895.23	\$ 98,552	\$ 653,556
	33-003	Bedding 12"-16"	4,928	TN	\$ 256,277	1,084.25	\$ 56,381	1,084.25	\$ 56,381	24,346.30	\$ 24,346	468.20	\$ 24,346	\$ 161,454
	33-004	Bedding 30"	7,038	TN	\$ 365,991	1,548.42	\$ 80,518	1,548.42	\$ 80,518	34,769.14	\$ 34,769	668.64	\$ 34,769	\$ 230,574
	33-005	Compaction Testing	124	EA	\$ 19,234	27.30	\$ 4,232	27.30	\$ 4,232	1,827.24	\$ 1,827	11.79	\$ 1,827	\$ 12,117
	33-006	Welding (small bore) - 2 hours per 25LF	2,410	HR	\$ 349,496	530.27	\$ 76,889	530.27	\$ 76,889	33,202.16	\$ 33,202	228.98	\$ 33,202	\$ 220,183
	33-007	Welding (16"+) - 4 Hours per 25 LF	3,192	HR	\$ 462,836	702.23	\$ 101,824	702.23	\$ 101,824	43,969.38	\$ 43,969	303.24	\$ 43,969	\$ 291,586
	33-011	Trench Box Rental (Short)	401	DAY	\$ 57,744	88.22	\$ 12,704	88.22	\$ 12,704	5,485.68	\$ 5,486	38.10	\$ 5,486	\$ 36,379
	33-012	Hydraulic Shoring Rental (5' short Boxes)	401	DAY	\$ 208,520	88.22	\$ 45,874	88.22	\$ 45,874	19,809.40	\$ 19,809	38.10	\$ 19,809	\$ 131,368
	33-013	6" Pipe - Direct Bury (Supply)	20,076	LF	\$ 1,882,928	2,265	\$ 212,434.35	2,265	\$ 212,434.35	1,763	\$ 165,351.77	1,763	\$ 165,351.77	\$ 755,572
	33-014	8" Pipe - Direct Bury (Supply)	2,390	LF	\$ 269,783	307	\$ 34,654.16	307	\$ 34,654.16	-	\$ -	-	\$ -	\$ 69,308
	33-015	12" Pipe - Direct Bury (Supply)	642	LF	\$ 95,010	321	\$ 47,504.79	321	\$ 47,504.79	-	\$ -	-	\$ -	\$ 95,010
	33-016	14" Pipe - Direct Bury (Supply)	280	LF	\$ 44,394	140	\$ 22,197.00	140	\$ 22,197.00	-	\$ -	-	\$ -	\$ 44,394
	33-017	16" Pipe - Direct Bury (Supply)	2,778	LF	\$ 503,124	798	\$ 144,525.78	798	\$ 144,525.78	-	\$ -	-	\$ -	\$ 289,052
	33-018	30" Pipe - Direct Bury (Supply)	3,963	LF	\$ 1,224,567	2,155	\$ 665,895.00	2,155	\$ 665,895.00	793	\$ 245,037.00	793	\$ 245,037.00	\$ 1,577,258
	33-019	Bends and Tees 6" to 16"	176	EA	\$ 51,920	38.72	\$ 11,422	38.72	\$ 11,422	4,932.40	\$ 4,932	16.72	\$ 4,932	\$ 32,710
	33-020	Bends and Tees 30"	60	EA	\$ 174,000	13.20	\$ 38,280	13.20	\$ 38,280	16,530.00	\$ 16,530	5.70	\$ 16,530	\$ 109,620
	33-022	Temp Valving - +10% pipe cost	1	LS	\$ 424,573	0.22	\$ 93,406	0.22	\$ 93,406	40,334.39	\$ 40,334	0.10	\$ 40,334	\$ 267,481
	33-023	Temp Testing and Phasing - +10% pipe cost	1	LS	\$ 424,573	0.22	\$ 93,406	0.22	\$ 93,406	40,334.39	\$ 40,334	0.10	\$ 40,334	\$ 267,481
	33-024	Temp Testing and Phasing - +10% pipe cost	1	LS	\$ 324,150	0.22	\$ 71,313	0.22	\$ 71,313	30,794.25	\$ 30,794	0.10	\$ 30,794	\$ 204,215
		Subtotal 33-0			\$ 11,129,150		\$ 2,691,267		\$ 2,691,267		\$ 1,085,777		\$ 841,171	\$ 7,309,481
		Steam Tunnel Placement	-	0										
	33-101	Place Pipe - 6" to 16"	18,634	LF	\$ 2,172,724	1,211.21	\$ 141,227	1,211.21	\$ 141,227	206,408.82	\$ 206,409	1,770.23	\$ 206,409	\$ 695,272
	33-102	Place Pipe - 30"	5,636	LF	\$ 1,095,263	366.34	\$ 71,192	366.34	\$ 71,192	104,049.95	\$ 104,050	535.42	\$ 104,050	\$ 350,484
	33-103	Steam Tunnel Ventilation (for confined space)	303	DAY	\$ 45,506	19.72	\$ 2,958	19.72	\$ 2,958	4,323.09	\$ 4,323	28.82	\$ 4,323	\$ 14,562
	33-104	Spyder Crane (small bore)	150	DAY	\$ 52,500	9.75	\$ 3,413	9.75	\$ 3,413	4,987.50	\$ 4,988	14.25	\$ 4,988	\$ 16,800
	33-105	Small Hydro Crane (24" +)	100	DAY	\$ 210,000	6.50	\$ 13,650	6.50	\$ 13,650	19,950.00	\$ 19,950	9.50	\$ 19,950	\$ 67,200
	33-106	Welding (small bore) - 2 hours per 25LF	1,491	HR	\$ 216,154	96.90	\$ 14,050	96.90	\$ 14,050	20,534.67	\$ 20,535	141.62	\$ 20,535	\$ 69,169
	33-107	Welding (16"+) - 4 Hours per 25 LF	902	HR	\$ 130,755	58.61	\$ 8,499	58.61	\$ 8,499	12,421.74	\$ 12,422	85.67	\$ 12,422	\$ 41,842
	33-110	Fabricate and install pipe racks (Special) (small bore)	1,863	EA	\$ 288,827	121.12	\$ 18,774	121.12	\$ 18,774	27,438.57	\$ 27,439	177.02	\$ 27,439	\$ 92,425
	33-111	Fabricate and install pipe racks (Special) (heavy duty)	705	EA	\$ 264,188	45.79	\$ 17,172	45.79	\$ 17,172	25,097.81	\$ 25,098	66.93	\$ 25,098	\$ 84,540
	33-112	6" Pipe - Tunnel Install (Supply)	5,820	LF	\$ 286,868	178	\$ 8,773.62	178	\$ 8,773.62	497	\$ 24,497.13	497	\$ 24,497.13	\$ 66,542
	33-113	8" Pipe - Tunnel Install (Supply)	3,800	LF	\$ 232,636	-	\$ -	-	\$ -	-	\$ -	-	\$ -	\$ -
	33-114	12" Pipe - Tunnel Install (Supply)	4,216	LF	\$ 370,966	1,523	\$ 134,008.77	1,523	\$ 134,008.77	585	\$ 51,474.15	585	\$ 51,474.15	\$ 319,703
	33-115	14" Pipe - Tunnel Install (Supply)	0	LF	\$ 0	-	\$ -	-	\$ -	-	\$ -	-	\$ -	\$ -
	33-116	16" Pipe - Tunnel Install (Supply)	4,798	LF	\$ 561,894	-	\$ -	-	\$ -	610	\$ 71,437.10	610	\$ 71,437.10	\$ 71,437
	33-117	30" Pipe - Tunnel Install (Supply)	5,636	LF	\$ 1,234,284	147	\$ 32,193.00	147	\$ 32,193.00	544	\$ 119,136.00	544	\$ 119,136.00	\$ 183,536
	33-118	Bends and Tees 6" to 16"	84	EA	\$ 84,000	5.46	\$ 5,460	5.46	\$ 5,460	7,980.00	\$ 7,980	7.98	\$ 7,980	\$ 26,880
	33-119	Bends and Tees 30"	25	EA	\$ 72,500	1.63	\$ 4,713	1.63	\$ 4,713	6,887.50	\$ 6,888	2.38	\$ 6,888	\$ 23,200
	33-120	Entry and Exit to Tunnel	80	EA	\$ 1,200,000	5.20	\$ 78,000	5.20	\$ 78,000	114,000.00	\$ 114,000	7.60	\$ 114,000	\$ 384,000
	33-121	Temp Valving - +10% pipe cost	1	LS	\$ 404,315	0.07	\$ 26,280	0.07	\$ 26,280	38,409.90	\$ 38,410	0.10	\$ 38,410	\$ 129,381
	33-122	Temp Testing and Phasing - +10% pipe cost	1	LS	\$ 404,315	0.07	\$ 26,280	0.07	\$ 26,280	38,409.90	\$ 38,410	0.10	\$ 38,410	\$ 129,381
		Subtotal 33-1			\$ 9,327,694		\$ 606,643		\$ 606,643		\$ 897,444		\$ 655,622	\$ 2,766,353
		Subtotal Yard Piping and Building Connections			\$ 34,942,615									

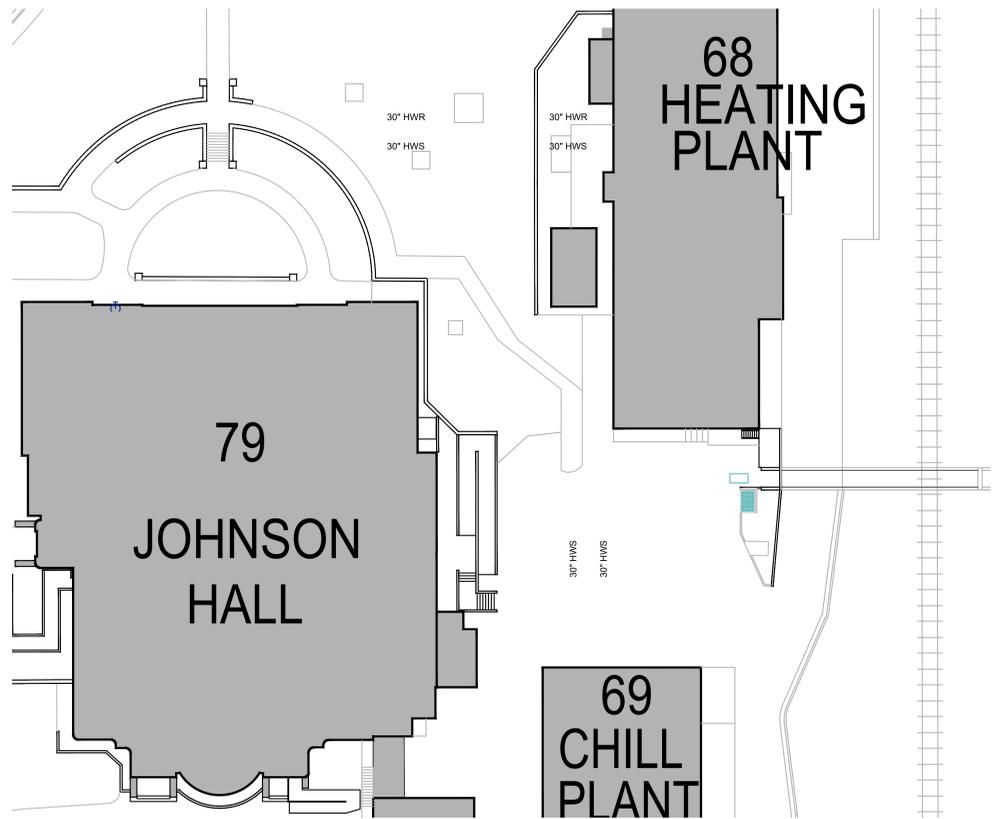


DEMP Program
PHASED ESTIMATE: PHASES 1 & 2 Only

Basis of Estimate: Hot Water Buildout - Exhibit dated July 2021
 Prepared By: BR/GL Date: 12/27/2022

Estimate Class: 5

CSI 2004	Item #	Description	Overall Quantity	Unit	Total Cost (2022 Dollars)	PHASE 1: 2024 + 2025				PHASE 2: 2026 + 2027				TOTAL COST PHASE 1 + 2
						QTY 2024	Cost 2024	QTY 2025	Cost 2025	QTY 2026	Cost 2026	QTY 2027	Cost 2027	
		Initial Phase Facility												
02-0000	02-201	Site Demo and Excavation	1	LS	\$ 183,750	0.5	\$ 91,875	0.5	\$ 91,875	0	\$ -	0	\$ -	\$ 183,750
03-0000	03-201	Concrete	0.25	LS	\$ 290,325	0.5	\$ 145,163	0.5	\$ 145,163	0	\$ -	0	\$ -	\$ 290,325
04-0000	04-201	Masonry (Composite CMU/PEMB)	1.3	LS	\$ 455,455	0.5	\$ 227,728	0.5	\$ 227,728	0	\$ -	0	\$ -	\$ 455,455
05-0000	05-201	Misc. Metals	1	LS	\$ 56,350	0.5	\$ 28,175	0.5	\$ 28,175	0	\$ -	0	\$ -	\$ 56,350
06-0000	06-201	Rough Carpentry	1	LS	\$ 7,350	0.5	\$ 3,675	0.5	\$ 3,675	0	\$ -	0	\$ -	\$ 7,350
07-0000	07-201	Damproffing, Roofing Membrane	1	LS	\$ 110,250	0.5	\$ 55,125	0.5	\$ 55,125	0	\$ -	0	\$ -	\$ 110,250
08-0000	08-201	Doors, Windows, Storefronts	1	LS	\$ 80,850	0.5	\$ 40,425	0.5	\$ 40,425	0	\$ -	0	\$ -	\$ 80,850
09-0000	09-201	Interior Painting and Sealing	0.35	LS	\$ 87,465	0.5	\$ 43,733	0.5	\$ 43,733	0	\$ -	0	\$ -	\$ 87,465
10-0000	10-201	Signage	1	LS	\$ 7,350	0.5	\$ 3,675	0.5	\$ 3,675	0	\$ -	0	\$ -	\$ 7,350
11-0000	11-201	Equipment and Installation	1	LS	\$ 1,675,273	0.5	\$ 837,637	0.5	\$ 837,637	0	\$ -	0	\$ -	\$ 1,675,273
13-0000	13-201	Supply and Install PEMB (Composite CMU/PEMB)	1.3	LS	\$ 1,060,605	0.5	\$ 530,303	0.5	\$ 530,303	0	\$ -	0	\$ -	\$ 1,060,605
22-0000	22-201	Interior Plumbing	0.4	LS	\$ 141,120	0.5	\$ 70,560	0.5	\$ 70,560	0	\$ -	0	\$ -	\$ 141,120
23-0000	23-201	HVAC	0.6	LS	\$ 433,671	0.5	\$ 216,835	0.5	\$ 216,835	0	\$ -	0	\$ -	\$ 433,671
26-0000	26-201	Electrical, Gear, Install, Instrumentation, Testing	1	LS	\$ 541,450	0.5	\$ 270,725	0.5	\$ 270,725	0	\$ -	0	\$ -	\$ 541,450
26-1000	26-202	1.5 MW Backup Generator	1	LS	\$ 648,000	0.5	\$ 324,000	0.5	\$ 324,000	0	\$ -	0	\$ -	\$ 648,000
26-1000	26-203	Service Entrance, Transformer	1	LS	\$ 111,000	0.5	\$ 55,500	0.5	\$ 55,500	0	\$ -	0	\$ -	\$ 111,000
26-1000	26-204	Motor Control Center	1	LS	\$ 115,000	0.5	\$ 57,500	0.5	\$ 57,500	0	\$ -	0	\$ -	\$ 115,000
32-0000	32-201	Yard Improvements / building siting / Earthwork	1	LS	\$ 320,000	0.5	\$ 160,000	0.5	\$ 160,000	0	\$ -	0	\$ -	\$ 320,000
33-0000	33-201	Underground piping to building limits	1	LS	\$ 360,000	0.5	\$ 180,000	0.5	\$ 180,000	0	\$ -	0	\$ -	\$ 360,000
					\$ 6,685,264		\$ 3,342,632		\$ 3,342,632		\$ -		\$ -	\$ 6,685,264
		Project Totals												
		Project Subtotal Div 1-Div 33			\$ 41,627,879		\$ 8,704,765		\$ 8,704,765		\$ 3,359,369		\$ 2,872,941	\$ 23,641,839
		Project Subtotal Div 0			\$ 8,633,579		\$ 1,230,285		\$ 1,230,285		\$ 820,190		\$ 820,190	\$ 4,100,950
		Project Total			\$ 50,261,457		\$ 9,935,050		\$ 9,935,050		\$ 4,179,559		\$ 3,693,131	\$ 27,742,789
		Contingency												
		Estimating Contingency (15%)			\$ 7,539,219		\$ 1,987,010		\$ 1,987,010		\$ 835,912		\$ 738,626	\$ 5,548,558
		Owners Contingency (10%)			\$ 5,026,146		\$ 1,490,257		\$ 1,490,257		\$ 626,934		\$ 553,970	\$ 4,161,418
		Contingency Total			\$ 12,565,364		\$ 3,477,267		\$ 3,477,267		\$ 1,462,845		\$ 1,292,596	\$ 9,709,976
		Project + Contingency Total			\$ 62,826,822		\$ 13,412,317		\$ 13,412,317		\$ 5,642,404		\$ 4,985,727	\$ 37,452,765



2 ENLARGED CAMPUS HOT WATER PLAN
 SCALE: 1" = 25'
 GRAPHIC SCALE (IN FEET)

Narrative

The first step in the hot water distribution phasing is to construct the new pump house building north of Central Receiving Storage. This building will eventually hold both hot water secondary pumps and chilled water secondary pumps, as well as having hot water and chiller water thermal energy storage tanks to the north. While the first two phases of the hot water distribution work is being completed, the pump house building will have a temporary steam to hot water converting station in the place of the chilled water secondary pumps. Utilizing the 12" steam pipe fed from the North in Libbie Coy Way, will allow for Phase 1 (red) of the new hot water pipe distribution to begin to the South, replacing sections of steam pipe where necessary. During this phased approach, temporary steam valves may need to be put in place to allow steam service to remain to certain buildings while being shut off to others. The main goal of Phase 1 is to get hot water distribution to Clark Hall. Phase 2 (magenta) shall start where Phase 1 left off, to the North of Clark Hall, and work its way North and East toward the Heating Plant. The Heating Plant will have a permanent 240,000 MBH firm capacity steam to hot water converting station, but due to space restrictions, the secondary hot water pumps for this converting will be in Chiller Plant 1. As shown in Detail 2 on this sheet, hot water return will enter the Heating Plant and the hot water supply exiting the plant will be directed to Chiller Plant 1, where it will be pumped to campus. Once Phase 2 of the hot water distribution is completed, the permanent steam to hot water converting station shall be set up in the Heating Plant. Phase 3 (blue) begins, the temporary steam to hot water converting station, in the new Pump House building, will be deactivated. Phase 3 will start to the South, in Libbie Coy Way, where Phase 1 was left. This will allow steam service to remain to the buildings to the North as Phase 3 begins to work its way back towards the Heating Plant. Phase 4 (green) shall start in University Avenue, at the junction between Phase 1 and 2, and begin making its way clockwise back to the Heating Plant. This again will allow for steam service to remain to buildings as the hot water distribution continues to be extended.

Cost Breakdown by Phase

Phase 1	Phase 2	Phase 3	Phase 4
28%	21%	33%	18%

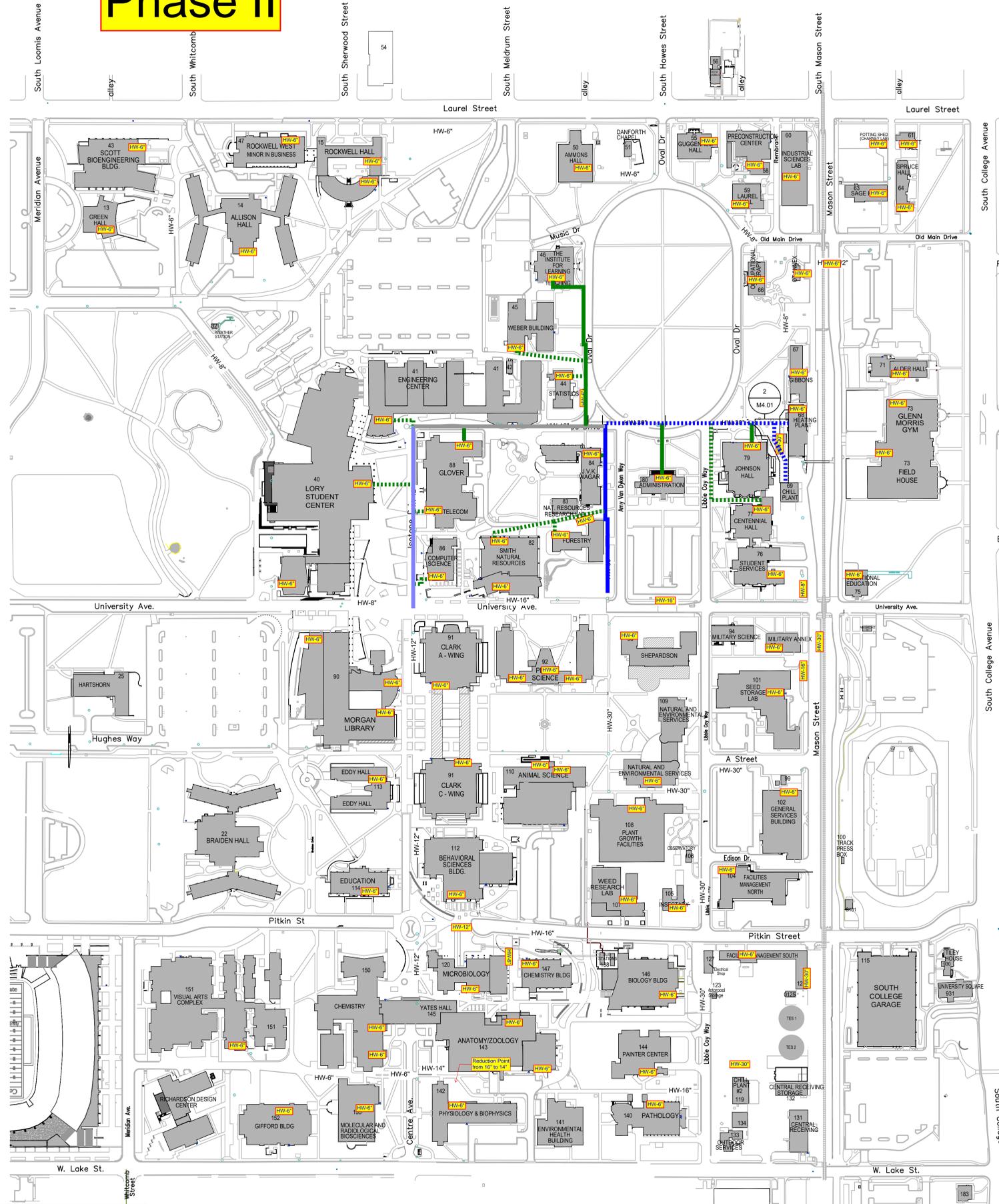
LEGEND:

PIPE SIZE	DIRECT BURY	TUNNEL
6"		
8"		
12"		
14"		
16"		
30"		

ASSUMPTIONS:

- All building feeds are 4" and smaller.
- All single lines shown represent HW supply and HW return.
- Assumed pipe sizes shown on drawings in yellow text boxes w/ blue lettering.

Phase II



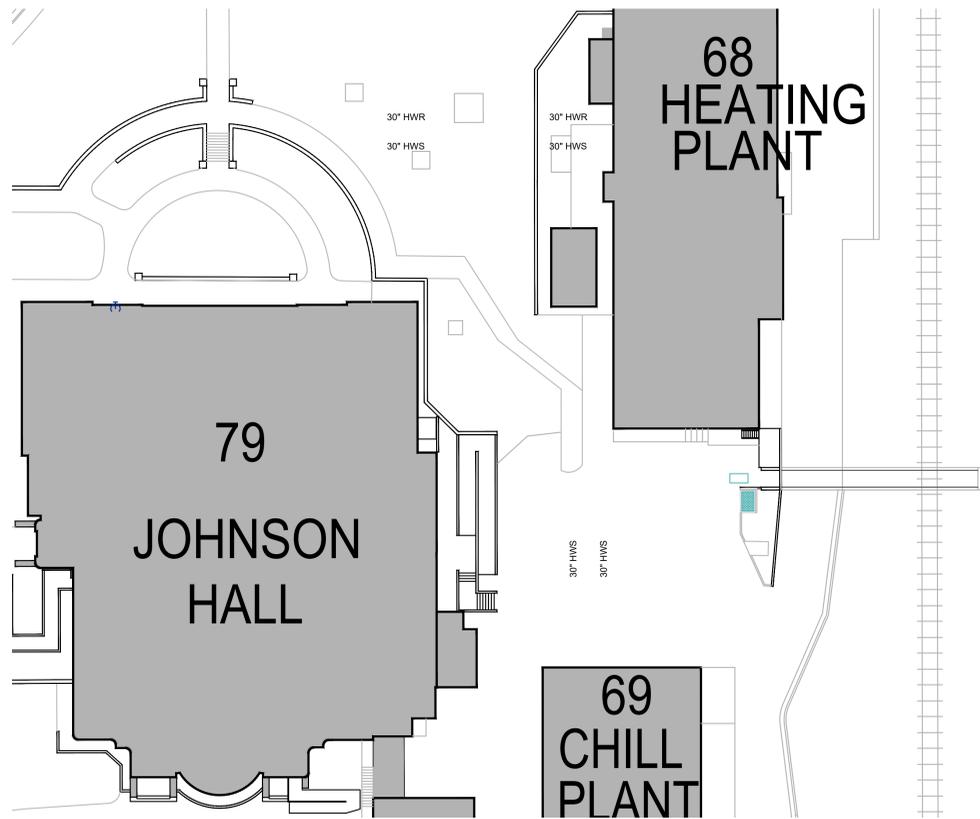
1 CAMPUS HOT WATER PLAN
 SCALE: 1" = 150'
 GRAPHIC SCALE (IN FEET)



BUILDING OFFICIAL STAMP

Project	DISTRICT ENERGY MASTER PLAN
Project No.	21440-00
Work Order No.	M4.01
Sheet Title	HOT WATER DISTRIBUTION PHASING
Scale	1" = 150'
Date	04/14/22
Drawn By	XX/XX/2X
Project No.	21440-00
Checked By	
Sheet No.	M4.01

Phase III



2 ENLARGED CAMPUS HOT WATER PLAN
 SCALE: 1" = 25'
 GRAPHIC SCALE (IN FEET)

Narrative

The first step in the hot water distribution phasing is to construct the new pump house building north of Central Receiving Storage. This building will eventually hold both hot water secondary pumps and chilled water secondary pumps, as well as having hot water and chiller water thermal energy storage tanks to the north. While the first two phases of the hot water distribution work is being completed, the pump house building will have a temporary steam to hot water converting station in the place of the chilled water secondary pumps. Utilizing the 12" steam pipe fed from the North in Libbie Coy Way, will allow for Phase 1 (red) of the new hot water pipe distribution to begin to the South, replacing sections of steam pipe where necessary. During this phased approach, temporary steam valves may need to be put in place to allow steam service to remain to certain buildings while being shut off to others. The main goal of Phase 1 is to get hot water distribution to Clark Hall. Phase 2 (magenta) shall start where Phase 1 left off, to the North of Clark Hall, and work its way North and East toward the Heating Plant. The Heating Plant will have a permanent 240,000 MBH firm capacity steam to hot water converting station, but due to space restrictions, the secondary hot water pumps for this converting will be in Chiller Plant 1. As shown in Detail 2 on this sheet, hot water return will enter the Heating Plant and the hot water supply exiting the plant will be directed to Chiller Plant 1, where it will be pumped to campus. Once Phase 2 of the hot water distribution is completed, the permanent steam to hot water converting station shall be set up in the Heating Plant. Phase 3 (blue) begins, the temporary steam to hot water converting station, in the new Pump House building, will be deactivated. Phase 3 will start to the South, in Libbie Coy Way, where Phase 1 was left. This will allow steam service to remain to the buildings to the North as Phase 3 begins to work its way back towards the Heating Plant. Phase 4 (green) shall start in University Avenue, at the junction between Phase 1 and 2, and begin making its way clockwise back to the Heating Plant. This again will allow for steam service to remain to buildings as the hot water distribution continues to be extended.

Cost Breakdown by Phase

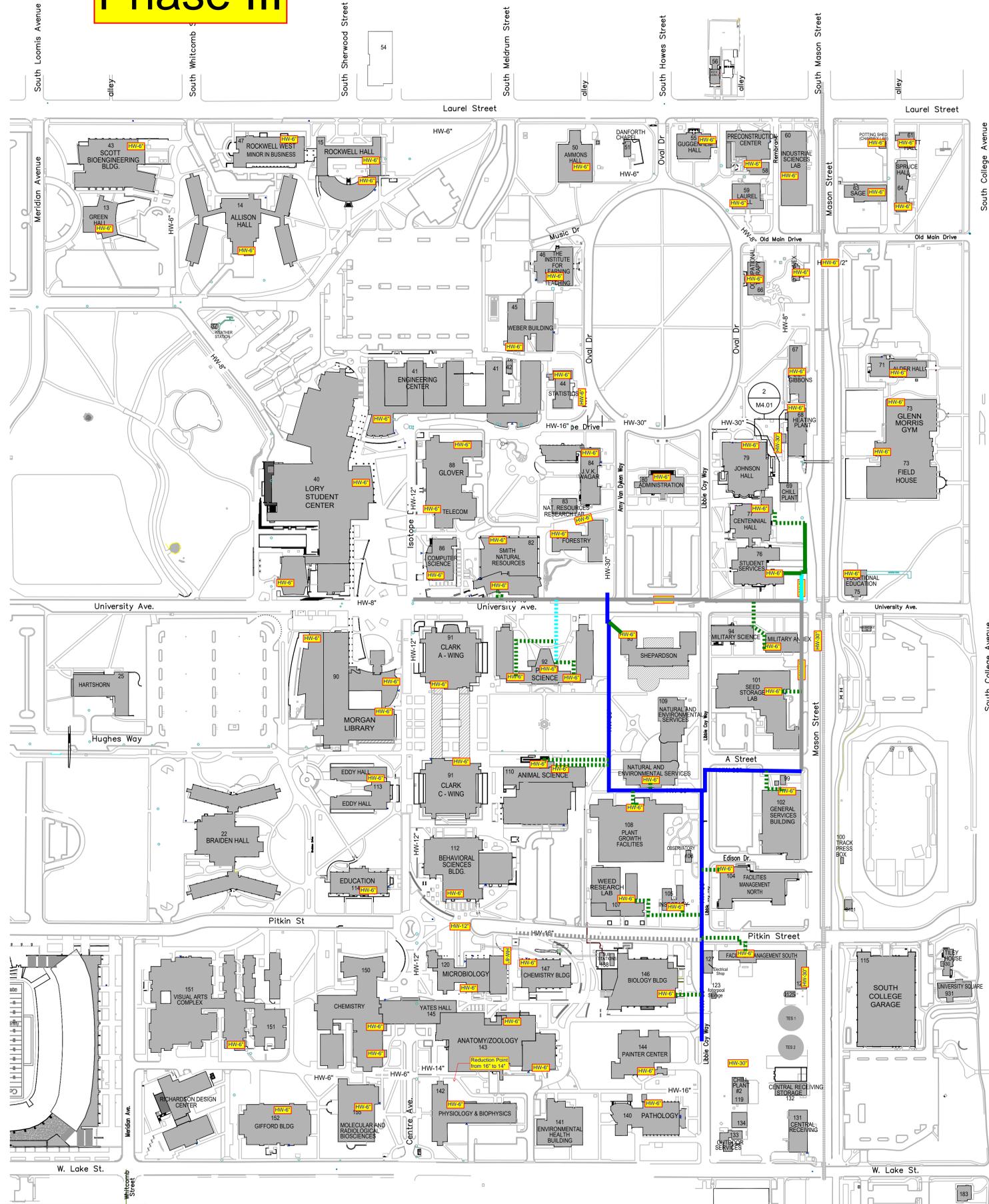
Phase 1	Phase 2	Phase 3	Phase 4
28%	21%	33%	18%

LEGEND:

PIPE SIZE	DIRECT BURY	TUNNEL
6"		
8"		
12"		
14"		
16"		
30"		

ASSUMPTIONS:

- All building feeds are 4" and smaller.
- All single lines shown represent HW supply and HW return.
- Assumed pipe sizes shown on drawings in yellow text boxes w/ blue lettering.



BUILDING OFFICIAL STAMP

DISTRICT ENERGY MASTER PLAN
 PROJECT NO:
 WORK ORDER NO:
 Sheet Title
HOT WATER DISTRIBUTION PHASING

Scale: 1" = 150'
 Date: XX/XX/2X
 Project No: 21440-00
 Sheet No: **M4.01**

