City of Sault Ste. Marie

Capital Improvement Plan

2024-2030

City Commission Approved March 4, 2024

CITY OF SAULT STE. MARIE, MICHIGAN

6 YEAR RECOMMENDED CAPITAL IMPROVEMENT PLAN 2024-2030

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CITY OF SAULT STE. MARIE

2024-2030 STAFF RECOMMENDED CAPITAL IMPROVEMENT PLAN INTRODUCTION

Capital improvement expenditures represent significant policy decisions for local government. Outlined herein, is the City staff recommended six (6) year Capital Improvements Plan (CIP). The Capital Improvement Program is the process of identifying and planning for large-scale public expenditures, which are expected to have a relatively long life. The following are important reasons for completing a CIP.

> **BETTER PLANNING** – A CIP enables a community to plan now for future needs. It allows the City Commission, with input from reviewing boards and commissions, to examine alternatives available in relation to constraints, fiscal and otherwise, that exist. It allows for orderly project implementation and the most effective use of capital expenditures consistent with expected revenues.
>
> **PRIORITY DETERMINATION** – The new scoring criteria will rank projects based on their importance using the welfare of the entire community as the criteria.
>
> **COORDINATION OF CAPITAL AND OPERATING BUDGETS** – The systematic comparison of the capital budget with the operating budget affords the opportunity to coordinate the factors of timing and available funds. Also, analyzing all projects at once often reveals interrelationships of projects, which may be overlooked by isolated department directors.
>
> **ECONOMY** – No municipality has enough money to fund all the things it would like to do. The single most important reason for a CIP is to ensure that the available funds are spent wisely.
>
> **PARTICIPATION** – The process involves a broad group of participants including City Commission, Planning Commission, Downtown Development Authority, Economic Development Commission, Community Services Board, Airport Board, City Staff, and the public.

The CIP provides a baseline of the funding needed for major capital outlay. Expenditures such as regular vehicle replacement, projects mandated by state and federal statutes and projects intended to alleviate serious liability concerns and maintain existing infrastructure are included. Proposed funding sources, if known, are identified with the project or equipment.

In addition to the careful planning associated with the preparation of the CIP, the City's ability to implement the Plan once it is approved by the City Commission is critical for a successful capital improvement program. As of this writing, we are just completing the eighth month of the fiscal year 2023-2024. It is one of the goals of the CIP to balance the proposed recommended improvements with the capacity to implement projects in order to avoid delaying projects simply due to the lack of capacity to implement the project. Once a capital improvement is approved with sufficient budget, the goal and priority of City staff should be to get the project implemented.

Implementation of an approved and budgeted capital improvement is as much a responsible use of public funds as it is to properly identify and prioritize the needed improvement.

The CIP is reviewed and updated annually by Staff with review by the Planning Commission and City Commission with the Plan serving as a basis for the capital outlay budget for the next fiscal year.

A Capital Improvement is a project or cost, which generally meets the following criteria:

1. Has a useful life of at least three (3) years.
2. Costs $10,000 or more.
3. The cost does not reoccur annually unless it is an end-of-life cycle replacement for an existing item of like nature (patrol car replacing patrol car).
4. It is not an operating expense related to the maintenance of capital equipment or capital improvements.

THE CIP PROCESS

In December, Department Heads began reviewing their capital improvement projects and began working on new proposed projects. Correspondingly, various Boards & Commissions are asked to review their priority projects. Department Heads complete the CIP forms and turn them into Engineering. The booklet is then put together in draft form for review at department head meetings to later be presented to the Planning Commission and City Commission for final approval.

SCORING

The scoring system was revised in 2021 in order to reflect a clear reason for the project and or equipment. Past scoring did not show potential legal action or fines if measures were not in place as well as the additional cost of deferring a project or maintenance. Department heads now score their project out of a potential 200 points and then the City Manager also scores the project.

Criteria	Possible Scores			
	15	10	5	0
Conformity to Approved City Plan or Department Plan(s)	Implements a major project in a City Commission Approved City Plan. Received prior City Commission direction/approval	Significantly adds to the completion of an approved department plan	Minimally adds to the completion of an approved department plan	Does not contribute toward any approved or adopted plan
Financial Commitments and Leverage of Outside Funding	Financial commitments obtained and substantial	Financial commitments likely but amount is unclear	Financial commitments possible but amount is unclear	No identified funds
Mandates	Court decision or regulatory requirement	Pending legal action or strong evidence of potential legal action	Possible but uncertain legal action	Normal project liability
Public Health and Safety	Project will correct a highly probable safety or health issue which has highly sever consequences if not remedied	Project with less probable chance of a safety or health issue occurring but may have serve consequences without action	Project corrects a highly probable safety or health issue that has less than severe consequences without action	Project corrects no perceived safety or health issue
Implementation Feasibility	No implementation obstacles identified	Minor implementation obstacles identified	Major implementation obstacles identified	Implementation not likely
Operating Budget Impact	Significantly decreases operating/maintenance costs	Minimally decreases operating/maintenance costs	Net impact of zero	Increases operating/maintenance costs
Percentage of Population Served	100%	50-99%	10-49%	<10%
Project/Item Life	>20 years with no extraordinary maintenance	>20 years with routine maintenance	10-20 years	<10 years
Estimated Frequency of Use (Avg. Per Year)	7 days/week	Several days a week	Several days a month	Once a month or less
Service Level	Project will correct or have measurable and dramatic improvement on the level of service offered by department	Project will maintain the level of service criteria as measured by department	Project will enhance the already acceptable level of service or have minimal impact on service as measured by the department	No impact on service level
Linkages to Other CIP Projects or Other Organization	Continuation of project currently underway or satisfies arrangement made with outside organization	Critical that project is done in conjunction with another project underway or other organization	Potential for project to be done in conjunction with another project proposed CIP project list or other organization	No linkage to other projects or outside organizations
Infrastructure Investment/Protection	Exclusion of project will result in complete loss of prior investments or infrastructure	The project improves and/or protects the City's infrastructure	The project maintains the City's infrastructure	The project does not protect or preserve the City's infrastructure
Encouragement of Economic Development	The project will directly encourage increased economic development in the City's corridors.	Removal/non-inclusion of the project would deter economic development but inclusion would not increase economic development	The project will help to maintain the current level of economic development in the City	The project will not encourage increased economic development in the City

Role of the Planning Commission

As established in the Planning Enabling Act (PA 33 of 2008), the Planning Commission has the duty to prepare a coordinated and comprehensive program of public infrastructure and other improvements for the purpose of furthering the goals, objectives, and vision of the City's Master Plan.

The written comments of the Planning Commission are incorporated into the staff recommended CIP for submission to the City Commission.

BUDGET & FINANCING

It should be noted that prioritization of the projects and equipment is not tied to the availability of funds and while account balances and revenues for stable funding sources are considered, the City's analysis of potential available revenue sources is not necessarily related to how project proposals and requested equipment are ranked. Financing of capital improvements can be accomplished in a variety of ways and all funding sources should be considered.

Once the CIP is adopted, City staff will be directed to include the first-year projects into the next fiscal year proposed budget if funding is available. Additionally, the decision to acquire equipment or construct new capital projects should include the affordability of incremental operating costs associated with the new capital. Therefore, future operating costs need to be integrated into the operating budget.

A successful CIP review process is critical to ensure proper planning and projected funding to meet the City of Sault Ste. Marie's equipment and infrastructure needs. We would like to thank all City staff involved in the preparation of this document.

Respectfully Submitted,

Brian Chapman
City Manager

City of Sault Ste. Marie

Staff Recommended Capital Improvement Plans 2024-25

Dept.	Capital Type	Description	Score Max 200pts Dept	Score Max 200pts City Mgr	Funding Source	Year 1 (24/25)
AIRPORT						
Airport	Project	Airport Layout Plan (ALP)	95	95	Gen Fund/TIFA 3, State Grant	$ 270,000
					TOTAL AIRPORT	**$ 270,000**
COMMUNITY DEVELOPMENT						
CD	Project	Zoning Ordinance Update	120	110	Gen Fund/State Grant	$ 30,000
					TOTAL COMMUNITY DEVELOPMENT	**$ 30,000**
DPW & PARKS						
DPW	Project	Ashmun Bay Project	95	95	Gen Fund/Federal Grant	$ 450,000
DPW	Equipment	Malcolm Park Bleachers	95	95	Gen Fund	$ 45,000
DPW	Project	Sherman Park Erosion	95	95	Gen Fund/USACE Grant	$ 50,000
DPW	Equipment	Malcolm Park Fencing	90	90	Gen Fund	$ 50,000
DPW	Equipment	Single Axle Plow Truck w Wing	95	85	Stock & Equipment	$ 250,000
DPW	Project	Crushing of Millings (Material)	85	80	Stock & Equipment	$ 50,000
DPW	Equipment	Leafer	85	80	Stock & Equipment	$ 150,000
DPW	Equipment	Pickup Truck w Plow	80	80	Gen Fund	$ 65,000
DPW	Equipment	Production Mower	80	75	Gen Fund	$ 95,000
DPW	Project	Mission Street Boat Launch	75	75	Gen Fund/MI National Guard Grant	$ 120,000
DPW	Project	Historic Homes Roof Treatment	70	70	Gen Fund	$ 27,500
DPW	Equipment	Motor Grader w Wing	75	65	Stock & Equipment	$ 350,000
DPW	Equipment	Zamboni	70	65	Gen Fund	$ 200,000
DPW	Project	Kemp Marina Wave Attenuators	65	65	Gen Fund	$ 50,000
					TOTAL DPW & PARKS	**$ 1,952,500**

City of Sault Ste. Marie

Staff Recommended Capital Improvement Plans 2024-25

Dept.	Capital Type	Description	Score Max 200pts Dept	Score Max 200pts City Mgr	Funding Source	Year 1 (24/25)
ENGINEERING						
ENG	Project	Bridge Preventative Maintenance (7 bridges +culvert) (Annual)	130	130	Sault Tribe Gaming	$ 50,000
ENG	Project	Sidewalk Replacement Program #0643	125	125	Sault Tribe Gaming	$ 50,000
ENG	Project	Aerial Orthography	115	115	IT/GIS	$ 15,000
ENG	Equipment	Speed Trailer	65	65	Stock & Equipment	$ 25,000
ENG	Equipment	Wide format plotter - scanner	50	50	IT/GIS	$ 17,500
					TOTAL ENGINEERING	**$ 157,500**
FIRE						
FIRE	Equipment	800 mzh P25 Portable Radios (6 per year)	125	115	Gen Fund	$ 174,000
FIRE	Equipment	Ambulance (order amb ev. 3 years)	115	110	Gen Fund	$ 308,000
FIRE	Equipment	Lucas External Cardiac Compression Device (Exp 7 years)	120	105	Gen Fund	$ 21,000
FIRE	Equipment	Fire Pumper (Ev 5 years)	120	100	Gen Fund	$ 1,035,000
FIRE	Equipment	SCBA Air Cylinders (EO year)	105	90	Gen Fund	$ 12,000
FIRE	Equipment	Ambulance Power Load system (1 per amb)	100	90	Gen Fund	$ 136,000
FIRE	Equipment	Fire Command Vehicle	100	90	Gen Fund	$ 65,000
FIRE	Equipment	High Pressure Extrication Tools	110	80	Gen Fund	$ 30,000
FIRE	Project	Fire Hall Roof Replacement	90	80	Gen Fund	$ 75,000
					TOTAL FIRE	**$ 1,856,000**

City of Sault Ste. Marie

Staff Recommended Capital Improvement Plans 2024-25

Dept.	Capital Type	Description	Score Max 200pts Dept	Score Max 200pts City Mgr	Funding Source	Year 1 (24/25)
INFORMATION TECHNOLOGY						
IT	Equipment	Computer Replacement	35	35	IT FUND	$ 20,000
					TOTAL INFORMATION TECHNOLOGY	**$ 20,000**
POLICE						
POLICE	Equipment	In Car-Body Interview Room Camera System (Annual)	90	90	IT	$ 40,000
POLICE	Project	Women's Locker Room Renovation	70	70	Gen Fund	$ 100,000
POLICE	Project	Conference Room/Training Room Remodel	65	65	Gen Fund	$ 12,000
POLICE	Equipment	Police Detective Vehicles (Annual)	50	55	Gen Fund, S&E	$ 45,000
					TOTAL POLICE	**$ 197,000**
WATER TREATMENT PLANT (WTP) & WASTEWATER TREATMENT PLANT (WWTP)						
WTP	Project	West 25th Ave Force Main Lining Project	120	115	Water Cap Reserve/Bonding	$ 500,000
WTP	Equpment	Water Treatment Switch Replacement	105	100	Water Cap Reserves	$ 100,000
WTP	Equpment	Flash Mixer Replacement	95	90	Water Cap Reserves	$ 75,000
WWTP	Project	25th Lift Station Pump & Check Valve Replacement	95	90	Sewer Cap Reserves	$ 150,000
WWTP	Project	Park Place Muffin Monster Replacement	95	90	Sewer Cap Reserves	$ 25,000
WTP	Equpment	Steam Trailer	100	85	Water Cap Reserves	$ 85,000
WTP	Project	Manhole Structure Lining Project (Annual)	85	80	Water Cap Reserves	$ 50,000
WTP	Project	Radar Tank Cleaning & Mixer Install	85	75	Water Cap Reserves	$ 50,000
WWTP	Equpment	Hydraulic Dump Trailer	65	70	Sewer Cap Reserves	$ 40,000
WTP	Equpment	Water & Sewer Dept Flatbed Utility Truck	60	55	Water Cap Reserves	$ 85,000
					TOTAL WTP & WWTP	**$ 1,160,000**
					GRAND TOTAL - ALL DEPARTMENTS	**$ 5,643,000**

City of Sault Ste. Marie

Staff Recommended Capital Improvements Plan 2024

Dept.	Capital Type	Description	Score Max 200pts Dept	Score Max 200pts City Mgr	Funding Source	Year 1 (24/25)
					TOTAL WTP & WWTP	**$ 1,085,000**
					GRAND TOTAL - ALL DEPARTMENTS	**$ 5,488,000**

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Airport Layout Plan

Dept. Responsible: Airport

Submitted By: Nicole Radke

Fiscal Year funds will be used 2024-25

Project Description / Location / Details/ Current Age of Infrastructure:
Create an updated version of the Airport Layout Plan. Last one was created 2015 with some false infomation and mistakes on.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Updating the plan will allow the airport to be fall under NPIAS rules, regulations and funding.

Related Projects/Additional information - attach reports/studies if applicable.

INSERT IMAGE OR MAP	INSERT IMAGE OR MAP

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor =B4

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	0	Staffing	0
☐ Will Impact	Operations	0	Maintenance	0
	Maintenance	0	Supplies	0

Estimated Total Project Cost			$270,000.00
Cost if the project were carried out this year			$270,000.00
Cost if project was completed 5 yrs later			$297,000.00
Present Worth			
Cost	$270,000.00	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

2% inflation

Project Schedule	Start Date	Finish Date
Design	7/1/2024	12/1/2024
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**		
		GL # (if applicable)	101-595-801.012	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$27,000.00	TIFA III 10%
Engineering	b	*Developer Contribution*	$	
Design:	$270,000.00	*Debt Financing:*	$	
Bidding:	$	Gen'l Obligation	$	
Construction Mgt.:	$	Revenue Bonds	$	
Construction:	$	*Special Assessments*	$	
Equipment:	$	*State DOT Contribution*	$	
(List Details)	$	*State Grant*	$243,000.00	90% State Grant
Other:	$	*Federal Grant*	$	
(List Details)	$	*Federal Grant*	$	
		Other:	$	
Total Uses	$270,000.00	**Total Sources**	$270,000.00	

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	95	95	**Max 200 Points**	☐ Required/Mandated regardless of funding ☐ Move forward if funding available ☐ On hold until funding is available ☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Zoning Ordinance Update

Dept. Responsible: Community Development

Submitted By: Kelly Freeman

Fiscal Year funds will be used: 24-25

Project Description / Location / Details/ Current Age of Infrastructure:
Current zoning ordinance was initially adopted in 1965. Although updated on numerous occasions since that time, the time has come to seriously consider a wholesale replacement. The City has $6,100 remaining in technical assistance funding through the MEDC's Redevelopment Ready Communities program. The balance would come from General Fund sources.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
The current zoning ordinance is outdated and, in many respects, is no longer responsive to the needs of the community. A more responsive ordinance would better align with the goals and objectives of the Master Plan as well as the long-term vision for the City.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Zoning Ordinance Update

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
X Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$30,000.00
Cost if the project were carried out this year			N/A
Cost if project was completed 5 yrs later			$35,000.00
Present Worth			
Cost	$30,000.00	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$23,900.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$6,100.00
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$30,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	120	110	**Max 200 Points**	☐ Required/Mandated regardless of funding ☐ Move forward if funding available ☐ On hold until funding is available ☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Ashmun Bay Project

Dept. Responsible: Parks & Rec

Submitted By: Tyler Perron

Fiscal Year funds will be used: 2024-25

Project Description / Location / Details/ Current Age of Infrastructure:

USCG, USACE, WGLPA and 911 Dispatch are interested in making Ashmun Bay launch an emergency response waterway access ramp. Without funds for external design ENG put together an estimate for pavement and structure removal, excavation, erosion control, turbidity curtain, aggregage, concrete, precast ramp, and slope restoration for $450,000 based on current MDOT pricing. Western Great Lakes Pilots Association read our CIP plan when posted through FB to the link and wanted to be added to this project as a stakeholder. They currently have to access to launch west of the locks either.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

Great project location – highest risk location in the USCG Sector's area of operation.
Lots of "soft targets" - Tour boats, cruise ships, Lock's tourist area, etc.
They have a report that was done in 2016 that showed this gap in security coverage by not having a deep water launch closer than Whitefish Point
This would provide access to secure the west end of the Locks in the event they are shut down.
largest trailerable vessel in the area is CBP's and is 38'.
USCG uses Aune-Osborn boat launch for our 29' small boats and lift our 45' response boat out at Sector.
WGLPA boats are 36' long, 12' wide, and 5.3' deep

Related Projects/Additional information - attach reports/studies if applicable.

FEMA may have Port Security Grant Program (PSGP) funds available - June 2024 application. Also signed up for Area Maritime Security Committee info (AMSC). We have met with the partners and they want us to pursue grant funding for this ramp.

WGLPA - •B33/Gros Cap is a Federally mandated change point for Federal Pilots (https://www.ecfr.gov/current/title-46/chapter-III/part-401/subpart-D/section-401.450)
•We own five Pilot Boats, ranging from roughly 37' to 43' in length that change out pilots in the St. Mary's River
oThere are few/no boat launches capable of launching larger vessels West of the Soo Locks in the Sault Area
oWe currently sail one of our vessels from Brimley, MI to Barbeau, MI simply for an oil change

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use con Ashmun Bay Project

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**	
X Will Not Impact	Personnel	$	Staffing	No change
☐ Will Impact	Operations	$	Maintenance	No change
	Maintenance	$	Supplies	No change

Estimated Total Project Cost			$450,000.00
Cost if the project were carried out this year			$450,000.00
Cost if project was completed 5 yrs later			$600,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	**Start Date**	**Finish Date**
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$225,000.00
Engineering	$45,000.00	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$405,000.00	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$225,000.00
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$450,000.00	**Total Sources**	$450,000.00

INTERNAL OFFICE USE ONLY

	Dept.	**City Mgr**		**RECOMMENDATION**
SCORING Total	95	95	**Max 200 Points**	☐ Required/Mandated regardless of funding ☐ Move forward if funding available ☐ On hold until funding is available ☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Malcolm Park Bleachers

Dept. Responsible: Parks & Rec

Submitted By: Tyler

Fiscal Year funds will be used 24-25

Project Description / Location / Details/ Current Age of Infrastructure:

New portable aluminum bleachers for Kaunisto, Synett, Suggitt, and Bunker Fields, and a permanent bleacher set-up on the mound between Day and Nertoli Fields. Estimated cost per 24' long bleacher section is $8,000.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

Most fields have bleachers with rotted or bent steps and seats. Portable sets allow for expanded seating during tournaments.

Related Projects/Additional information - attach reports/studies if applicable.

Portable bleachers can also be used for other community events. Bleachers currently in use are a safety hazard.

INSERT IMAGE OR MAP

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Malcolm Park Bleachers

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$45,000.00
Cost if the project were carried out this year			$
Cost if project was completed 5 yrs later			$
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	General Fund
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$45,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:		*Special Assessments*	$
Equipment:	$45,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$45,000.00	**Total Sources**	$45,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	95	95	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Sherman Park Erosion

Dept. Responsible: Parks & Rec

Submitted By: Tyler

Fiscal Year funds will be used 24-25

Project Description / Location / Details/ Current Age of Infrastructure:

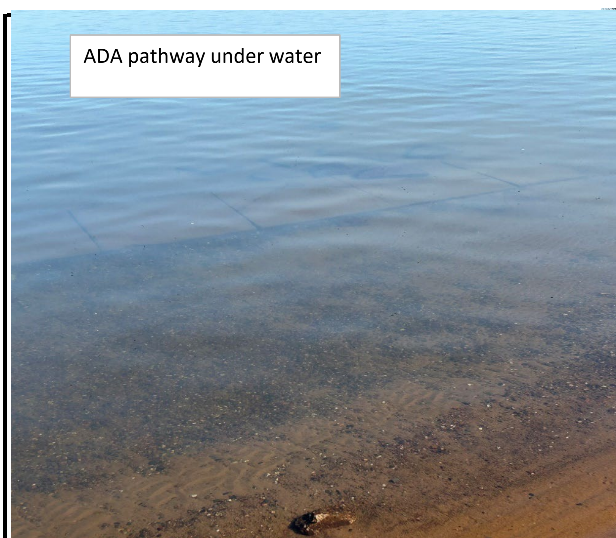
The City of Sault Ste. Marie has one beach, located at Sherman Park along the St. Mary's River, which provides the only public water access for community recreational swimming. The beach has been subject to erosion problems throughout its history. Preservation of the existing swimming beach at Sherman Park would help stabilize the area where the intake is located as well as provide recreational activities for the community. Sherman Park has 1665' of beach frontage on the upper St. Mary's River. This frontage is subject to erosion from high water, winds, and jetties currently present. The remedial action would include removal of a jetty that is contributing to the erosion, continuation of work to incorporate native plantings and bioswales to protect the shoreline, restore the beach sand through enrichment, as well as restore the ADA accessibility to the beach.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

Recognizing the need for Sherman Park enhancement, and expansion as cited in the City's Master Plan, the City hired an engineering firm in 1996 to provide a preliminary design for improvements to address both the erosion problem and to provide expanded public swimming access opportunities at Sherman Park. The resulting plan was the proposed Sherman Park Improvement Project, estimated at $600,000 in 1996, which would include beach improvements to enrich and expand the beach, a tiered timber wall with ramps to provide better access from the main park area to beach level, and a breakwater wall to address erosion. The City applied for a MDNR grant in 1998, but the grant application was not awarded. The high-water levels of 2020 exacerbated the erosion of the western beach and bluffs at Sherman Park. This erosion has removed 30 to 40 feet of the bluff, washed the sand on the beach downstream and destroyed the ADA access points. Grant funds could be available.

Related Projects/Additional information - attach reports/studies if applicable.

Capital Consultants, now C2AE, put together a master plan in 2006. The City used this master plan for the 2007-2008 Phase 1 work that was completed. The 2007-2008 work provided a new expanded parking area and ADA sidewalks to the beach. The remainder of their master plan and phases focused on developing the remainder of the parcel for camp site development. This master plan did not address the growing erosion issue. The Chippewa County Health Department received a grant in 2014 through the Great Lakes Restoration Initiative. This grant and site work addressed water quality issues related to stormwater and run off to reduce coliform and E. Coli outbreaks. The design included native plantings, bioswales and rain gardens to address stormwater and erosion issues. This approach worked for stabilization of the beach against erosion but only included the eastern portion of the beach. We recently applied for a USACE Part 165, Section 14 Grant which could help with this situation but we think it is a long shot.



CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Sherman Park Erosion

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**		
☐ Will Not Impact	Personnel	$	Staffing	$	
☐ Will Impact	Operations	$	Maintenance	$	
	Maintenance	$	Supplies	$	

Estimated Total Project Cost			$50,000.00
Cost if the project were carried out this year			$
Cost if project was completed 5 yrs later			$
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**		
		GL # (if applicable)		General Fund
Land/R-O-W Acquisition	$	*City Fund/Reserves*		$10,000.00
Engineering	$	*Developer Contribution*		$
Design:	$	*Debt Financing:*		$
Bidding:	$	Gen'l Obligation		$
Construction Mgt.:	$	Revenue Bonds		$
Construction:	$50,000.00	*Special Assessments*		$
Equipment:	$	*State DOT Contribution*		$
(List Details)	$	*State Grant*		$
Other:	$	*Federal Grant*	USACE	$40,000.00
(List Details)	$	*Federal Grant*		$
		Other:		$
Total Uses	$50,000.00	**Total Sources**		$50,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION	
SCORING Total	95	95	**Max 200 Points**	☐	Required/Mandated regardless of funding
				☐	Move forward if funding available
				☐	On hold until funding is available
				☐	Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Malcolm Park Fencing

Dept. Responsible: Parks & Rec

Submitted By: Tyler

Fiscal Year funds will be used 24-25

Project Description / Location / Details/ Current Age of Infrastructure:
Replace backstop fencing and various diamond fencing at the Malcom Park Ballfield Complex. As part of the Malcolm Park asset management plan, this fencing is rated in poor condition. High priority for replacement on Synette, Suggit and Gerrish fields.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Current fencing is more than 40 years old and is in disrepair in various areas. An estimate for replacement of one field was approximately $20,000.

Related Projects/Additional information - attach reports/studies if applicable.

INSERT IMAGE OR MAP	INSERT IMAGE OR MAP

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Malcolm Park Fencing

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$50,000.00
Cost if the project were carried out this year			$
Cost if project was completed 5 yrs later			$
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	General Fund
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$50,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$50,000.00	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$50,000.00	**Total Sources**	$50,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	90	90	**Max 200 Points**	☐ Required/Mandated regardless of funding ☐ Move forward if funding available ☐ On hold until funding is available ☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2028

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years):	Single Axle Plow Truck with Wing
Dept. Responsible:	Public Services - Streets
Submitted By:	Tyler Perron
Fiscal Year funds will be used	2024-25

Project Description / Location / Details/ Current Age of Infrastructure:
A single axle plow truck with front, underbody, and wing plows. Unit will be equipped with a re-furbished sand/salt spreader. This will replace one of the 3 older trucks in the fleet, which are 20+ years old.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
These are scheduled replacements for existing plow trucks. Increased efficiences with the added plow width. Less downtime and less maintenance costs.

Related Projects/Additional information - attach reports/studies if applicable.
An unfunded request was made for a plow truck in the 19-20, 20-21, and 21-22 fiscal years. A request for F.Y. 22-23 was approved. Build times of these trucks and equipment are 1-2 years out.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2028

Project Title (Use cor Single Axle Plow Truck with Wing

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$10,000	Supplies	$

Estimated Total Project Cost			$250,000.00
Cost if the project were carried out this year			$250,000.00
Cost if project was completed 5 yrs later			$300,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$10,000.00		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	Stock & Equipment
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$250,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$250,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$250,000.00	**Total Sources**	$250,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	95	85	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Crushing of Material

Dept. Responsible: DPW - Streets

Submitted By: Tyler Perron

Fiscal Year funds will be used 2024-25

Project Description / Location / Details/ Current Age of Infrastructure:
Crushing of recycled material into gravel.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
The DPW has been stockpiling suitable materials from recent road reconstruction projects that can be recylced and crushed into gravel, increasing our material stockpile at a greatly reduced cost of purchasing from other aggregate suppliers.

Related Projects/Additional information - attach reports/studies if applicable.
A 2021-22 capital project to crush millings was completed in the fall of 2021 and approximately 8,000 tons of material was stockpiled at a cost of $35,000. A 2022-23 capital project to crush material has been bid and awarded in the amount of $50,000 and will crush approximately the same amount of material that $35,000 got us the prior year. The material stockpile to be crushed has continued to grow with ongoing construction projects. This is still a favorable cost for the amount of usable material we can stockpile for our gravel road and alley maintenance.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Crushing of Material

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**		
☐ Will Not Impact	Personnel	$	Staffing	$	
☐ Will Impact	Operations	$	Maintenance	$	
	Maintenance	$	Supplies	$	

Estimated Total Project Cost			$50,000.00
Cost if the project were carried out this year			$50,000.00
Cost if project was completed 5 yrs later			$
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	**Start Date**	**Finish Date**
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	Stock & Equipment
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$50,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$50,000.00	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$50,000.00	**Total Sources**	$50,000.00

INTERNAL OFFICE USE ONLY

	Dept.	**City Mgr**		**RECOMMENDATION**
SCORING Total	85	80	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Leafer

Dept. Responsible: Public Services - Streets

Submitted By: Tyler Perron

Fiscal Year funds will be used: 2024-25

Project Description / Location / Details/ Current Age of Infrastructure:
Purchase of a chassis-mounted leaf vacuum with dump storage bin. Our main leafer is a 2007 and we have a much older and smaller unit that does not handle wet/snowy leaves well.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
This is a scheduled replacement of an existing unit. This will provide greater efficiency and less down time for seasonal leaf pickup. The older of the 2 existing units would be auctioned on GovDeals.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Leafer

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$1,000	Supplies	$

Estimated Total Project Cost			$150,000.00
Cost if the project were carried out this year			$150,000.00
Cost if project was completed 5 yrs later			$200,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$1,000.00		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	Stock & Equipment
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$150,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$150,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$150,000.00	**Total Sources**	$150,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	85	80	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Pickup Truck with Plow

Dept. Responsible: DPW

Submitted By: Tyler Perron

Fiscal Year funds will be used 24-25

Project Description / Location / Details/ Current Age of Infrastructure:
Scheduled replacement for a pickup truck in the Street Department.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
DPW will use this truck for routine street maintenance including plow city facilities, hauling cold patch and barricade trailers, tree trimming and removal, and clearing alleys.

Related Projects/Additional information - attach reports/studies if applicable.

INSERT IMAGE OR MAP

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Pickup Truck with Plow

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$65,000.00
Cost if the project were carried out this year			$65,000.00
Cost if project was completed 5 yrs later			$70,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$65,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$65,000.00

INTERNAL OFFICE USE ONLY					
	Dept.	**City Mgr**		**RECOMMENDATION**	
SCORING	80		**Max 200**	☐	Required/Mandated regardless of funding
Total			**Points**	☐	Move forward if funding available
				☐	On hold until funding is available
				☐	Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Production Mower

Dept. Responsible: Public Services - Parks

Submitted By: Tyler Perron

Fiscal Year funds will be used: 2024-25

Project Description / Location / Details/ Current Age of Infrastructure:

One (1) Groundmaster 4100 series with sun canopy, road package, 4 wheel drive and air ride seat. The current production mowers are a 2006 and 2009 that are having more frequent breakdowns. We took possession of our new 2022 model late in the fall 2022 season.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

For many years, large production grass mowers have been utilized in the parks to cut grass with more efficiency. Large production mowers have the ability to be driven from site to site in town without trailering and have proven to be efficient and cost effective. Current mowers were purchased in 2006, 2009, and most recently 2022. This new mower would replace the 2008 mower, with it either being kept as a back-up or sold on auction at GovDeals. The 2006 model is currently being kept as a back-up to the 2008 model. Purchase of this mower will increase usability and overall costs by reducing the winter maintenance costs associated with keeping the mowers fully functionable. Less downtime and breakdowns.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Production Mower

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$4,000	Supplies	$

Estimated Total Project Cost			$95,000.00
Cost if the project were carried out this year			$91,000.00
Cost if project was completed 5 yrs later			$115,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$4,000.00		
Salvage	$4,000.00		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	General Fund
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$95,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$95,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$95,000.00	**Total Sources**	$95,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	80	75	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Mission Street Boat Launch

Dept. Responsible: Parks and Rec.

Submitted By: Tyler Perron

Fiscal Year funds will be used 2024-25

Project Description / Location / Details/ Current Age of Infrastructure:
MI National Guard use of this ramp has decreased its useful life. Mission Boat Launch – Currently 1 ramp with 1 skid pier
Approach is 30' wide by 35' long and it's in bad shape. The rolled water pad is 53' long. 23' of that is out of water at existing water level after about 10 feet in the rest of this pad is nonexistent poor shape. Appears to be a cobbled together roll up pad.
Here will need a full replacement. Possibly regrading of parking lot to lessen the slope into the water.
This should be able to fit a double ramp detail.
Pave ramp apron

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
We applied for a MI Spark Grant and were rejected. We are working with the MI National Guard to secure funding but will still need a portion of City funds to complete. We already have quotes and data for this project as we gathered it for the MI Spark Grant submittal. 2 planks wide x 8 planks long. Existing drive to launch is paved. This will create an area of paved parking adjacent to the turnaround that is existing gravel. Plans were formulated using MDNR specs and MI National Guard specs.

Related Projects/Additional information - attach reports/studies if applicable.

Mission	Dimensions			
Description	Length (ft)	Width (ft)	Quantity	Units
Ramp Area	58	36	2088	SF
Plank Area	32	36	1152	SF
# Planks	-	-	16	EA
Total Excavation Area	-	-	1152	SF
HMA	100	200	2222	SY

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Mission Street Boat Launch

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$120,000.00
Cost if the project were carried out this year			$
Cost if project was completed 5 yrs later			$
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Ramp only

Project Schedule	**Start Date**	**Finish Date**
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**		
		GL # (if applicable)		
Land/R-O-W Acquisition	$	*City Fund/Reserves*		$60,000.00
Engineering	$	*Developer Contribution*		$
Design:	$	*Debt Financing:*		$
Bidding:	$	Gen'l Obligation		$
Construction Mgt.:	$	Revenue Bonds		$
Construction:	$120,000.00	*Special Assessments*		$
Equipment:	$	*State DOT Contribution*		$
(List Details)	$	*State Grant*		$
Other:	$	*Federal Grant*		$
(List Details)	$	*Federal Grant*		$
		Other:	MI National Guard	$60,000.00
Total Uses	$120,000.00	**Total Sources**		$120,000.00

INTERNAL OFFICE USE ONLY					
	Dept.	**City Mgr**		**RECOMMENDATION**	
SCORING	75	75	**Max 200**	☐	Required/Mandated regardless of funding
Total			**Points**	☐	Move forward if funding available
				☐	On hold until funding is available
				☐	Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Historic Homes Roof Treatment

Dept. Responsible: Parks and Rec

Submitted By: Tyler Perron

Fiscal Year funds will be used 24-25

Project Description / Location / Details/ Current Age of Infrastructure:

3 of the homes have cedar shakes that have not been maintained. In an effort to save the roofs of these homes we need to maintain them which after our research earlier in 2023, we have found that we could replace 2 roofs with shingles for just over $50,000. Homes up to $1900 sq feet are $4,000 and homes that are over are $5,000.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

It will be cheaper to treat the shakes and remove the moss and growth and halt bugs from entering the homes than replacing all 3 roofs. This treatment if done once every 8 years can extend the life of a roof for 20 years.

The Historic Structures Report completed by Gray & Pape in 1998 noted that the roofs needed attention.

Here is a video on the process: youtube.com/watch?v=onH70cwR6JM

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Historic Homes Roof Treatment

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$27,500.00
Cost if the project were carried out this year			$28,875.00
Cost if project was completed 5 yrs later			$
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	**Start Date**	**Finish Date**
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$27,500.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$27,500.00	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$27,500.00	**Total Sources**	$27,500.00

INTERNAL OFFICE USE ONLY

	Dept.	**City Mgr**		**RECOMMENDATION**
SCORING Total	70	70	**Max 200 Points**	☐ Required/Mandated regardless of funding ☐ Move forward if funding available ☐ On hold until funding is available ☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Motor Grader w/ Wing

Dept. Responsible: DPW - Streets

Submitted By: Tyler Perron

Fiscal Year funds will be used: 2024-25

Project Description / Location / Details/ Current Age of Infrastructure:
A motor grader with wing for snow removal and road maintenance. Replacement of a 2002 John Deere.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Graders are our most efficient snow removal equipment for plowing and pulling snow. This is a scheduled replacent for our oldest unit. Less maintenance costs and downtime will result as well as increased efficiencies of operations with a new model. New graders are 2+ years out upon order.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Motor Grader w/ Wing

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$350,000.00
Cost if the project were carried out this year			$
Cost if project was completed 5 yrs later			$
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	Stock & Equipment
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$350,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$350,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$350,000.00	**Total Sources**	$350,000.00

INTERNAL OFFICE USE ONLY					
	Dept.	**City Mgr**		**RECOMMENDATION**	
SCORING Total	75	65	**Max 200 Points**	☐	Required/Mandated regardless of funding
				☐	Move forward if funding available
				☐	On hold until funding is available
				☐	Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Zamboni

Dept. Responsible: Public Services - Parks

Submitted By: Tyler Perron

Fiscal Year funds will be used 2024-25

Project Description / Location / Details/ Current Age of Infrastructure:
A motorized ice conditioner for the Pullar Community Building to replace a 1998 unit.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
This is a scheduled replacement of an older unit. There was a request in 2020-21 FY, but was pushed back. This new unit would replace a 2011 unit as the full-time unit and the 2011 would become the backup unit. The 1998 unit would be auctioned. More frequent maintenance and breakdowns have been happening to the current unit.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Zamboni

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$5,000	Supplies	$

Estimated Total Project Cost			$200,000.00
Cost if the project were carried out this year			$200,000.00
Cost if project was completed 5 yrs later			$260,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$5,000.00		
Salvage			

Project Schedule	**Start Date**	**Finish Date**
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	General Fund
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$200,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$200,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$200,000.00	**Total Sources**	$200,000.00

INTERNAL OFFICE USE ONLY

	Dept.	**City Mgr**		**RECOMMENDATION**
SCORING Total	70	65	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Kemp Marina Wave Attenuators

Dept. Responsible: Parks & Rec

Submitted By: Tyler

Fiscal Year funds will be used 24-25

Project Description / Location / Details/ Current Age of Infrastructure:

The wave attenuators at Kemp Marina are in disrepair from wave and ice action. Much of the steel sheeting is loose and some have fallen off the boardwalk to the river bottom. Their current condition creates a nussaince noise to the boaters that stay at the marina for the summer season. They are also becoming less effective at deflecting the waves from entering the marina that can contribute to erosion.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

The wave attenuators keep the wave action inside the marina down from the passing of vessels in the river channel. They help keep the waters calmer and boats from rocking against the docks. Options are to remove and replace the steel sheeting or remove and install a floating type of attenuators. An estimate of the floating type for materials only is approximately $15,000. We have reached out to contractors for a labor estimate.

Related Projects/Additional information - attach reports/studies if applicable.

INSERT IMAGE OR MAP	INSERT IMAGE OR MAP

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Kemp Marina Wave Attenuators

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$50,000.00
Cost if the project were carried out this year			$
Cost if project was completed 5 yrs later			$
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	General Fund
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$50,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$50,000.00	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$50,000.00	**Total Sources**	$50,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	65	65	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Bridge Preventative Maintenance (7 bridges + culvert)

Dept. Responsible: Engineering

Submitted By: Dave Boyle, PE

Fiscal Year funds will be used: Annually

Project Description / Location / Details/ Current Age of Infrastructure:

Of the The City's 7 structures, two are arch structures (1 steel and 1 concrete), four are steel bridges, and 1 is a pre-stressed concrete bridge. The distribution of overall condition is: 3 (43%) are fair; and 4 (57%) are good. The City bridge inventory includes no structurally deficient bridges. A non-inventory structure is a one 3-sided concrete culvert in good condition. The distribution of the overall condition for all 8 structures is (33%) are fair; 5 (67%) are good.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

Determination of work is recent as we just completed our 2023 bridge inspections. DPW is doing a lot of work in house, but plates, and routine maintenance items are needed to stay on track for a larger overhaul in 2025-26. EOY costs are approximately $20,000. this includes Ayers to complete the EOY bridge inspections and use Cloverland's boat, then we have addtional OHM charges for our MDOT Bridge Asset Plan, MDOT Bridge Plan grant application, and then our internal maintenance (materials needed).

We are asking for $50 annually except for 2025-26 we will receive an MDOT grant to repair 3 structures at 95% for major preventative maintenance and repairs.

Related Projects/Additional information - attach reports/studies if applicable.

N:\TRANSPORTATION\BRIDGES\Ayres 2023 Bridge Inspection Reports

Most recent Bridge Asset Report for MDOT.

Johnston St.

Fort St. Expansion Joint

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Bridge Preventative Maintenance (7 bridges + tunnel + culvert)

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$50,000.00
Cost if the project were carried out this year			$50,000.00
Cost if project was completed 5 yrs later			$
Present Worth			
Cost	$50,000.00	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW	N/A	N/A
Construction		
Close out		
Other		

Uses of Funds		Sources of Funds	
		GL # (if applicable)	401.901-986.000-0604
Land/R-O-W Acquisition	$0.00	*City Fund/Reserves*	$50,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$50,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	130	130	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Sidewalk Replacement Program #0643

Dept. Responsible: Engineering

Submitted By: Dave Boyle, PE

Fiscal Year funds will be used: Annually

Project Description / Location / Details/ Current Age of Infrastructure:

See project condition map for replacement areas of deterioration. Sidewalk gap + Replacement

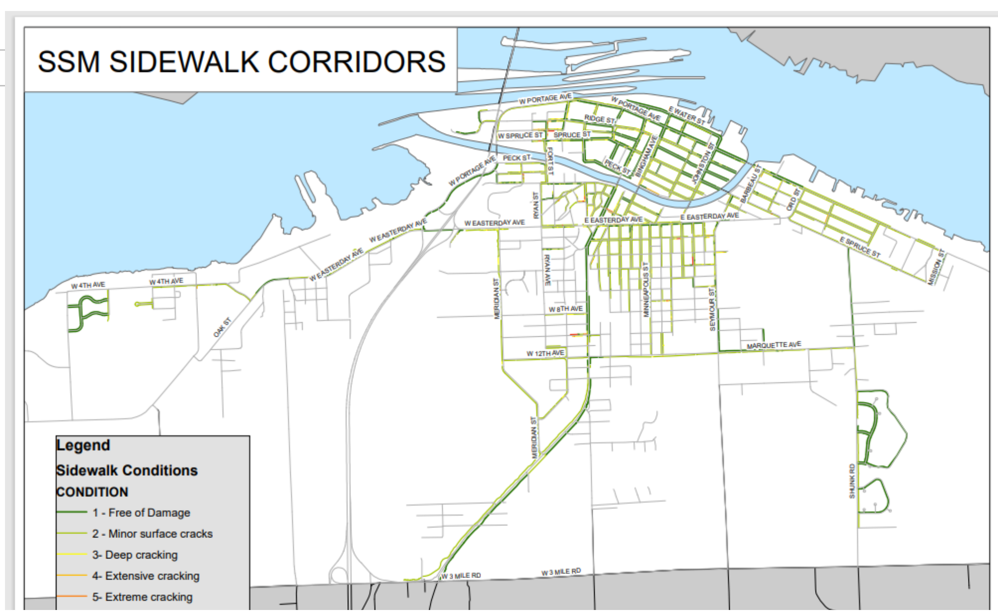
Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

$50k a year gets us 1,500 LF of 4" sidewalk given our policy on sidewalk replacement costs. This amount is even less if we have to replace sidewalk across driveway let alone curb ramps in which we pay at 100 percent. Funds are used to repair and replace sidewalk when it is the City's cost (not associated with a roadway construction project) but also when homeowners and businesses do repairs to our sidewalk, if done to our specs, is reimbursed at 50%. This program gained popularity in 2022-2023 and encourages property owners to participate in the program. We anticipate MORE users in the future.

Related Projects/Additional information - attach reports/studies if applicable.

Related project - Safe Routes to Schools-sidewalk gap/replacement. This is also the program where private property owners are reimbursed per our sidewalk ordinance for installation of new sidewalks: Sec. 22-21. - Rebate to owner or occupant after completion.

https://www.saultcity.com/engineering/page/sidewalk-engineering-program



CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Sidewalk Replacement Program #0643

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$50,000.00
Cost if the project were carried out this year			
Cost if project was completed 5 yrs later			$
Present Worth			
Cost		*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW	N/A	N/A
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	CIP Sidwalk Rep. Program
		GL # (if applicable)	401-901-986.000-0643
Land/R-O-W Acquisition	$0.00	*City Fund/Reserves*	$50,000.00
Engineering	$	*Developer Contribution*	$
Design:		*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:		Revenue Bonds	$
Construction:	$50,000.00	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$50,000.00	**Total Sources**	$50,000.00

INTERNAL OFFICE USE ONLY					
	Dept.	**City Mgr**		**RECOMMENDATION**	
SCORING Total	125	125	**Max 200 Points**	☐	Required/Mandated regardless of funding
				☐	Move forward if funding available
				☐	On hold until funding is available
				☐	Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Aerial Orthography

Dept. Responsible: Engineering

Submitted By: Joe Miller

Fiscal Year funds will be used: 2024-2025

Project Description / Location / Details/ Current Age of Infrastructure:

We are due for an aerial image update and want to do this again in keeping up with our records after the carbide dock and Easterday are complete in the fall of 2024. 6-inch flight in 2017 was $7,000.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

Acquisition of aerial orthography benefits all City departments for project planning, daily operation activity planning and historical archive purposes. Distribution of this to the public is also invaluable. We regularly do this and our last update was 2017 as part of a SAW project.

Related Projects/Additional information - attach reports/studies if applicable.

1940: Approx Scale 1” = 400’ 93 Still Images
1954: Approx Scale. 1”=500’ 223 Still Images
1975: Approx Scale 1” = 1320’ 33 Still Images
1986: Approx Scale: 1” = 400’ 169 Still Images
1986: Approx Scale 1” = 800’ 41 Still Images
We have digital .sid files for 1998 in B/W, Color for 2006, 2011, and 2017. I believe they are all 6 -inch. Our fee schedule is $250 for the whole dataset for each.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor =B4

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**	
X Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$15,000.00
Cost if the project were carried out this year			$10,000.00
Cost if project was completed 5 yrs later			$10,500.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	**Start Date**	**Finish Date**
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$15,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$15,000.00

INTERNAL OFFICE USE ONLY

	Dept.	**City Mgr**		**RECOMMENDATION**
SCORING Total	115	115	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Speed Alert Trailer

Dept. Responsible: Engineering & City Police Dept

Submitted By: David Boyle/Wes Bierling

Fiscal Year funds will be used: 2024

Project Description / Location / Details/ Current Age of Infrastructure:

Many complaints are turned into the City PD and Engineering regarding speeding. ENG logs complaints and turns them over to PD. Both departments see a use for a speed alert trailer. Trailer could be posted in these complaint areas and moved all over the CIty used year round. Allows for multiple message use, not just speed so could use for DPW purposes. Also part of this is a pole mounted spped indicator that could be moved to targeted streets for extended periods of time.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

Software can alert PD of speeders in real time on the app. Free training included with device.
Uses for ENG and PD:
• Conduct hassle-free traffic studies
• Quickly resolve speeding complaints
• Increase driver speed awareness
• Identify speeding hot spots and prioritize enforcement in high-risk areas

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor =B4

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$25,000.00
Cost if the project were carried out this year			$28,000.00
Cost if project was completed 5 yrs later			$31,250.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$25,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$25,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	65	65	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Wide format plotter-scanner

Dept. Responsible: Engineering Department

Submitted By: Joe Miller

Fiscal Year funds will be used 2024-25

Project Description / Location / Details/ Current Age of Infrastructure:
Our department oversees construction project plan development and approval but current equipment is nearing the end of service life.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
The procurement of this equipment will continue the department's ability to efficiently provide oversight into construction plan development and approval.
The equipment that we are looking to replace is indispensable and vital to the departments ability to maintain its current operational level on a day to day basis.

Related Projects/Additional information - attach reports/studies if applicable.

INSERT IMAGE OR MAP

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Wide Format Plotter Scanner

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$17,500.00
Cost if the project were carried out this year			$17,500.00
Cost if project was completed 5 yrs later			$19,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$17,500.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$17,500.00

INTERNAL OFFICE USE ONLY				
	Dept.	**City Mgr**		**RECOMMENDATION**
SCORING Total	50	50	**Max 200 Points**	☐ Required/Mandated regardless of funding ☐ Move forward if funding available ☐ On hold until funding is available ☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): 800 mzh P25 portable radios

Dept. Responsible: Fire Department

Submitted By: Edwin Miller

Fiscal Year funds will be used 2024/25
6 per year

Project Description / Location / Details/ Current Age of Infrastructure:

Purchase 6 Motorola APX8000XE P25 800mhz/all band portable radios to improve communication infrastructure within the department and our local resposne partners. Currently the fire department is on an old VHF radio system, not allowing for interoperability with PD, Army Corp of Engineers, Coast Guard and other first response agencies that are currently using the P25 800 mhz radio system. The P25 800 mhz radio system would be on the Michigan Public Safety Communications System, which allows for state wide interoperability. The system has been proven to provide a more consistant coverage within the city and our response areas. Our current VHF system has an old repeater at the water tower, acquired from Mackinaw county when they abandoned their VHF system to upgrade to the 800 mhz system. This is a multi year project, with the first year purchasing 6 radios, in total we are in need of 20 portable radios, this does not include vehicle mounted radios. We have tried grants to fund this project but have yet to be successful in our attempts. We will continue to apply for grants; but our need for radios is immediate, the next grant opprotunities would put us at least 2 years away from an implementation of a new radio system.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

The VHF radio system we currently use for the fire department is old, has been "narrow banded" and does not allow for complete coverage in the city or the other areas of response within the county. The current repeater is an old system that boosts the signal of our vhf radio, so it can be heard by dispatch, the issue is that our portables do not always hit the repeater. When we enter Soo Twp., or the Shallows, our current VHF radios do not have the power to connect with the repeater, leading to missed radio communications and a potential safety issue for our staff. The P25 radio system has multiple towers within the county, allowing our portable radios to connect to the closest tower, improving our ability to communicate. The P25 800 mhz system has been improved over the years to increase reliability, and as part of the MPSCS system, the State of Michigan maintains the infrastructure. Currently we do not have interoperable communications with PD, or other federal agencies within the area. We have proven, through recent drills, a significant issue with communications between the fire department and other response agencies in our area. Another example of the weakness of our current radio system was our fatal fire in the Shallows, we could not communicate with dispatch as the location did not allow for our radio transmissions to hit the repeater. PD and MSP, both on the P25 800 system were able to communicate to dispatch. This is a significant safety issue as we rely on dispatch to be a "second set" of ears to listen for critical radio traffic, such as a lost or trapped firefighter. Another critical failure point is Cascade Crossings, as soon as we enter those businesses, our radios are unable to transmit or recieve radio traffic. Those are just a couple of significant issues with our current portable radio system on the VHF radio frequency.

Related Projects/Additional information - attach reports/studies if applicable.
https://www.motorolasolutions.com/content/dam/msi/docs/products/apx/apx_radio_family_brochure_na.pdf

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title 800 mzh P25 portable radios

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$174,000.00
Cost if the project were carried out this year			$165,000.00
Cost if project was completed 5 yrs later			$252,500.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$174,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$174,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	125	115	**Max 200 Points**	☐ Required/Mandated regardless of funding ☐ Move forward if funding available ☐ On hold until funding is available ☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Fire-Ambulance

Dept. Responsible: Fire Department

Submitted By: Edwin Miller

Fiscal Year funds will be used 2024/25 ***1 ev 3 years***

Project Description / Location / Details/ Current Age of Infrastructure:

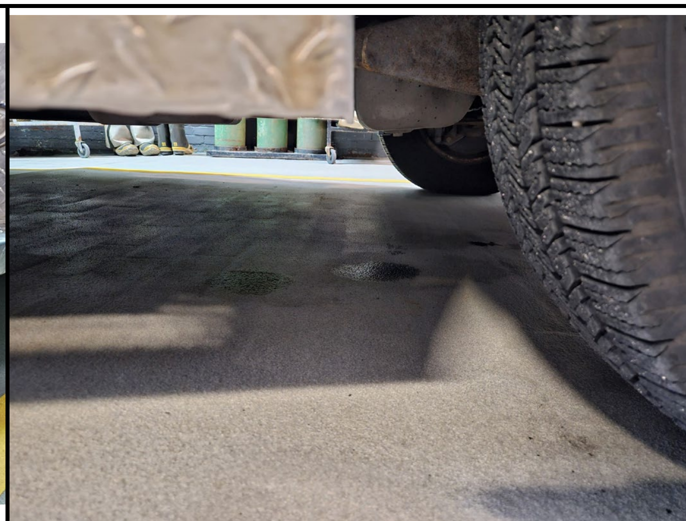
Replace current Ambulance A151 with a new transport ambulance. Our current A151 is a 2009 Ford E450 ambulance with a McCoy Miller Ambulance body. Current mileage on A151 is 138,024, which most of those miles were accrued when the fire department performed interfacility transfers for the hospital. New ambulance pricing and build times continue to be effected by the COVID crisis, any new ambulance ordered would not be recieved by the city for at least 1 to 2 years. Prices and chassis availabilty contiue to be a challenge and are expected to continue to increase in pricing at a rate higher than anticipated inflationary indicators. Other ambulances in our fleet are model years 2014, 2016 and 2019; in order to ensure a reliable fleet, we must order an ambulance to prepare for the future needs of the department and the availability of products to purchase.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

The current A151 is experiencing maintenance issues that will continue to effect our operating budget. Most recently we had to purchase a new siren control system and speakers which cost clost to $5,000.00 to stay operational. The diesel engine has not been running well, we have other electrical issues with warning lights and controls, while parts become more difficult to source. The current diesel engine has leaking valve covers, and other unidentified oil leaks that would require the engine to be removed from the chassis to be repaired. The ambulance has not been used as part of our normal rotation due to a lack of reliability. Normally a fire department like ours would be replacing ambulances on a 3 to 5 year schedule. If we were committted to an ambulance replacement plan, I feel we could reduce our fleet from 4 ambulances to 3 ambulances due to the reduced maintenance costs and risk of experiencing multiple out of service ambulances at one time. Most recently, we had 2 ambulances out of service, with A151 being one of the two. A capital project plan to replace ambulances regularly would also help stabilze our maintenance costs to support older ambulance outperations outside of their warranty period. If we commit to a 3 year purchase plan, we would always have at least one ambulance under a factory warranty.

Related Projects/Additional information - attach reports/studies if applicable.

More pictures are available on the fire department N drive Fire Apparatus Pictures/A151



CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Fire-Ambulance

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$308,000.00
Cost if the project were carried out this year			$308,000.00
Cost if project was completed 5 yrs later			$400,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$308,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$308,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	120	110	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Ambulance-Lucas External Cardiac Compression device (CPR M

Dept. Responsible: Fire Department

Submitted By: Edwin Miller

Fiscal Year funds will be used 2024/25 ***plus budget for 7 year replacement***

Project Description / Location / Details/ Current Age of Infrastructure:

Currently, the fire department has one Lucas Device, purchased approximately 4 years ago. The device is used to provide mechanical compressions during a cardiac arrest event with no interruptions in compressions typically found with human fatigue. Studies show that the continuous compressions tend to improve the survivability of a cardiac arrest event, provide more efficient artificial blood flow and oxygenation during its use. The typical life span for any FDA approved medical device is 7 years. With this date approaching, and the increase in our call volume, the request is being made to purchase a second Lucas Device, to ensure the equipment is available when needed. Often, the first out ambulance has the Lucas device and if another cardiac event is dispatched the patient would not benefit from the advanced care delivered by this piece of equipment.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

With increasing call volume and the incidents of concurrent calls for service, the need for additonal advanced care equipment has become evident. In a situation where a second call comes in as a cardiac arrest, we do not have enough personnel resources to provide assistance at a physically demanding scene. The use of the Lucas External Cardiac Compression (ECC) device gives our residents the best opprotunity to survive a cardiac arrest event with continuous compressions, allowing our limited staffing to perform required life saving techniques to increase the survivability our our patient. The current Lucas device has proven to be a beneficial tool, allowing not only a better delivery of compressions, but allows for our staff to be securely seated in the back of the ambulance while transporting the patient, compared to the less effective manual compressions performed by staff who are not restrained in the back of an ambulance.

Related Projects/Additional information - attach reports/studies if applicable.

https://www.lucas-cpr.com/clinical_evidence/#outcome_data

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Ambulance-Lucas External Cardiac Compression device (CPR Machine)

Impact on Operating Budget: Use of the device would cause the purchase of the disposable part that comes in contact with the patient. The part is currently part of our operational budget based on the amount of cardiac arrests we handle. The cost to replace the part is considered to be part ofthe ambulance reimbursement costs billed to insurance companies.

	Annual Cost Savings		**Additional Costs**	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will No Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$ 1,000.00

Estimated Total Project Cost			$21,000.00
Cost if the project were carried out this year			$21,000.00
Cost if project was completed 5 yrs later			$35,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$21,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$21,000.00

INTERNAL OFFICE USE ONLY				
	Dept.	**City Mgr**		**RECOMMENDATION**
SCORING Total	120	105	**Max 200 Points**	☐ Required/Mandated regardless of funding ☐ Move forward if funding available ☐ On hold until funding is available ☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR

DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Fire Pumper

Dept. Responsible: Fire Department

Submitted By: Edwin Miller

Fiscal Year funds will be used: 2024/25

1 every 5 years

Project Description / Location / Details/ Current Age of Infrastructure:

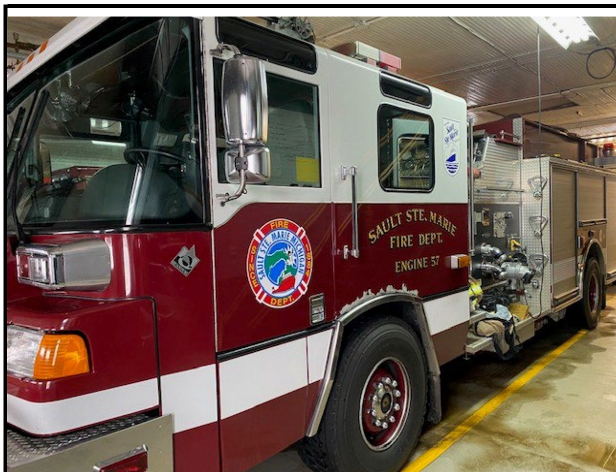
Replace current Engine 57 with a new rescue pumper that fits current day operations. The current Engine 57 is a 1998 Pierce Quantum pumper that has served the city well. The mileage is not accurate as the odometer is not functional. The current hour meter is 6129.2 hours The vehicle is in need of major repairs to the body, frame work and an increased cost of operation due to aged parts and rust. Some of these repairs will still need to be performed as the lead time for a new pumper to be built is up to 4 years due to supply chain issues. Due to the length in time for construction, pricing would be reviewed and updated at the pre-build conference. This new pumper will be built and designed to anticipate changing trends in service delivery and better suit the current mode of operations.

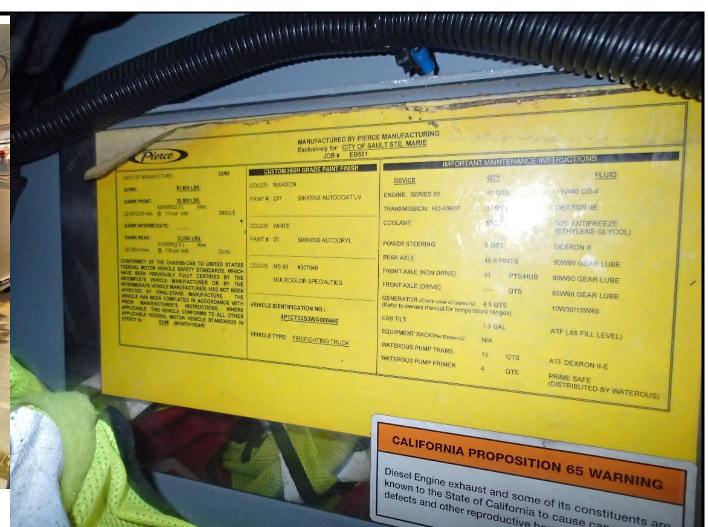
Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

The current Engine 57 has served the city well as a fire pumper and even was used to pump water to the municipal water system during the transition form the old pump house to the new one. The engine is starting to have issues due to age and operational costs are increasing. NFPA standards for fire apparatus have been exceeded with our current pumper. The expected lifespan of a fire pumper is 10 years front line, 10 years as a back up pumper then removed from service. Engine 57 has been in front line service for the past 24 years, with the 4 year lead time by the manufacturer the total service life will be 28 years. Financing options are available and would secure current day pricing and protect the city from the potential for price increases due to manufacturing and material costs. If this project is not approved, the current rate of price increase is eight to fourteen percent per year; however, due to new EPA requirements, the cost to replace E57 increased by 29% this year. The option to a full payment purchase is to finance the vehicle over 5 years which would make the payments around $180,000.00 per year. Due to a lack of accurate costs, it is anticipated that the purchase of a new pumper will reduce the yearly maintenance significantly in the first 5 years, with general preventative maintenance being the main cost. Right now there is a higher cost to maintain the vehicle as it is in constant need of replacement parts due to age and use.

Related Projects/Additional information - attach reports/studies if applicable.

full photo pictures are on fire hall drive, Fire Apparatus photos folder, E57





CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Fire Pumper

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$1,035,000.00
Cost if the project were carried out this year			$1,035,000.00
Cost if project was completed 5 yrs later			$1,500,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$1,035,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$1,035,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	120	100	**Max 200 Points**	☐ Required/Mandated regardless of funding ☐ Move forward if funding available ☐ On hold until funding is available ☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): SCBA Air Cylinders

Dept. Responsible: Fire Department

Submitted By: Edwin Miller

Fiscal Year funds will be used: 2024/25
Replacement EO year

Project Description / Location / Details/ Current Age of Infrastructure:

The fire department needs to replace 12 high pressure SCBA air cylinders which have meet their end of service life. End of service life is regulated by NFPA and DOT as these air cylinders are pressurized and on apparatus. Current air cylinders to be replaced were originally purchased under a grant which 18 were received.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

The air cylinders were not considered in previous budgets for replacement due to a lack of tracking of equipment that has a required "end of service" lifespan. We did purchase 6 air cylinders with our current SCBA CIP to offset some of the cost of the 18 cylinders that have meet their life expectancy. This project will fill the gap of 12 cylinders used in firefighting operations. The request is part of a department plan to have 1 spare cylinder for each functioning SCBA. In most fire departments this ratio works well, with some working towards 2 spare cylinders per air pack. A full air cylinder last personnel for approxiately 20 minutes under extreme stress or activity, the need to have spare cylinders is essentional to firefighting operations. In the future, the request for replacement cylinders will be managed as an operating expense with a smaller quantity budgeted regularly.

Related Projects/Additional information - attach reports/studies if applicable.

Equipment replacement to meet NFPA standards

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): SCBA Air Cylinders

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$12,000.00
Cost if the project were carried out this year			$
Cost if project was completed 5 yrs later			$15,600.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	**Start Date**	**Finish Date**
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$12,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$12,000.00

INTERNAL OFFICE USE ONLY

	Dept.	**City Mgr**		**RECOMMENDATION**
SCORING Total	105	90	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Ambulance Power Load system

Dept. Responsible: Fire Department-Ambulance

Submitted By: Edwin Miller

Fiscal Year funds will be used 2024/25

Project Description / Location / Details/ Current Age of Infrastructure:

Purchase and install one Stryker Power load systems to augment the power cots currently in two ambulances. This equipment would be mounted in A155 and work with the power cots to safely lift and place patients into the back of the ambulance. Project cost esimate includes installation in one of our four ambulances, with projections to complete this in all ambulances in an effort to reduce and prevent back injuries. IF CIP funds do allow, it would be recommended to do all four ambulances with the power load system for project amount of $136,000.00 this year. The request shows pricing for one, our submitted budget forecast shows the anticipated cost increase if the entire project is not funded this year. The cost increase from last years request was $3,500.00, we do anticipate the same rate of increase in the future.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

The Fire Department, through its constant review process, has determined that a power lift system, to work in conjunction with our power lift cots, would help reduce the potential for injuries commonly found in patient lifting, along with reducing the potential of cot dropping while in the process of being loaded. According to published study by Emergency Medical Services Authority E.M.S.A, the largest provider of pre-hospital emergency care in Oklahoma, the use of power lift systems for cots reduced their cot drop occurrences by 96% and experienced a decrease in neck, back and shoulder injuries by 66.7% in 2015 The fire department has applied for grants for this equipment and have not been successful; however, we will conitinue to look at alternative funding sources.

Related Projects/Additional information - attach reports/studies if applicable.

Power Load data Sheet: https://www.stryker.com/content/dam/stryker/ems/products/power-load/resources/PowerLOAD%20Spec_Sheet_MktLit-539.pdf
Power Load Research Document: EMSA https://emsaonline.com/wp-content/uploads/pdfs/Stryker_Power_Load_System_1.pdf

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Ambulance Power Load system

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	Red. in Claims	Staffing	Red. in Claims
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$136,000.00
Cost if the project were carried out this year			$136,000.00
Cost if project was completed 5 yrs later			$200,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$136,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$136,000.00

INTERNAL OFFICE USE ONLY				
	Dept.	**City Mgr**		**RECOMMENDATION**
SCORING Total	100	90	**Max 200 Points**	☐ Required/Mandated regardless of funding ☐ Move forward if funding available ☐ On hold until funding is available ☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Fire-Command Vehicle

Dept. Responsible: Fire Department

Submitted By: Edwin Miller

Fiscal Year funds will be used 2024/25

Project Description / Location / Details/ Current Age of Infrastructure:

Current command car is a 2013 Ford Expedition, with over 80,000 miles. The project would be to replace this vehicle to update the command car with accomodations to securely carry fire equipment, command boards and other necessary equipment to help manage emergency scenes. The current command car is not set up to act as a mobile office/command center. It does have emergency lighting and space for equipment, which is stored loosely in the rear cargo area. The vehicle has significant rust to the frame and substructure, has parasitic electrical draws which reduces it reliability to respond to emergencies and is starting to display other electrical issues. This is an emergency response vehicle, as much as it is a vehicle to convey staff to meetings in the area and at times around the state. The vehicle is at a point where repair/maintenance costs are expected to increase to try to maintain any sense of reliability as an

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

The command vehicle is the primary response vehicle of the fire chief and used at major incidents to help manage the scene. The vehicle would be designed to carry appropriate PPE, some firefighting equipment and scene management equipment to better operate at an emergency scene. The vehicle also is used for staff to attend meetings around the area and the state. The visibility of our fire deparment and city identity is represented by the care and condition of the vehicles we put on the road. The safety of emergency response would also improve with a new vehicle. The current vehicle has had some reliability issues with the battery draining issues, light bar short circuits and a significant vibration when driving at highway speeds The vehicle has significant rust issues and the frame/underbody is in poor condition, as well as being repaired for damage from a collision. The new vehicle would be outfitted with the latest lighting technology to match our focus on scene safety, be desgined to store equipment appropriatey and act as a proper command vehicle for management of emergency incidents.

Related Projects/Additional information - attach reports/studies if applicable.

Photos on the N drive, apparatus folder C50 file, could not upload pictures to this document.

INSERT IMAGE OR MAP	INSERT IMAGE OR MAP

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Fire-Command Vehicle

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$65,000.00
Cost if the project were carried out this year			$65,000.00
Cost if project was completed 5 yrs later			$90,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		Sources of Funds	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$65,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$65,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	105	90	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Hydraulic Extracation tools

Dept. Responsible: Fire Department

Submitted By: Edwin Miller

Fiscal Year funds will be used: 2024/25

Project Description / Location / Details/ Current Age of Infrastructure:

Replace the current hydraulic extrication tools (AKA Jaws of Life) with new set of equipment that would be battery operated. The current set of hydraulic equipment is tethered to a pump, this limits the use in remote areas. The current tools are 15 years old and are requiring more maintenance to support their operation. The current high pressure hydraulic system will need to have hoses replaced to ensure safe operation. The on-board hydraulic pump on Engine 52 is an electric motor (240 v 30 amp Single phase) system that is no longer made or servicable. Our portable pump, with a significant reduction in operating pressures, is a gas powered unit that is heavy to move to remote locations. The current system is tied to Engine 52, which poses a problem when the vehicle is out of service, which causes us to find space on other vehicles to continue our operational readiness.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

The project would be to replace our current hyrdaulic rescue tools with new technology, battery operated, hydraulic powered rescue tools. The new systems do not require a power plant, hoses or generators to power the tools. The new tools would be useful in remote operations, not just for vehicle extrications but for any situation where lifting, cutting or prying are required to remove or gain access to people. A good example would be the Locks project and all the heavy machinery around the site. If someone were to be trapped or pinned by equipment, we would struggle to move our portable hydraulic pump, hoses and tools to the site for use. The new battery powered units are lighter and not tethered, allowing easier access to the site. The poratbility of the tools offer a quicker response, as welll as mobility in and around an extrication scene, allowing for the tools to be more effective compared to our current tools. Technology with the new tools also address the use of high strength steel used in newer automobiles, our current tools do not produce enough prying or cutting force to counter the upgrades in vehicle design. Tools such as our hydraulic extrication tools, do need to be upgraded to meet the changes in technology, to ensure the ability to rescue people from entranglement or entrapment.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Hydraulic Extracation tools

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost	$30,000.00
Cost if the project were carried out this year	$30,000.00
Cost if project was completed 5 yrs later	$60,000.00
Present Worth	

Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$30,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$30,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	110	80	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Roof Replacement

Dept. Responsible: Fire Department

Submitted By: Edwin Miller

Fiscal Year funds will be used: 2024/25

Project Description / Location / Details/ Current Age of Infrastructure:

The roof of the fire department is in need of replacement. Currently the roof is an asphalt style shingle belived to be installed in the early 2000's. The roof has had some leaks over the year; however, with recent heavy rains in the fall, the roof had more than 7 different locations where water was penetrating the roof and 2nd floor ceiling. A contractor was contacted to temporarily manage the leaks and reported that the roof is in poor condition, missing flashing and visible open areas near roof/vent stacks. The contractor used over a case of caulk to temporarily slow down the leaks and recommended replacement of the roof. Current age of the roof is believed to be over 20 years, there is no documentation to confirm the actual year of install.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

The current roof has active leaks that are being managed with additional caulk, buckets to collect water in the attic and temporary replacement of damaged ceiling surfaces in the 2nd floor. With the new remodel project, we would hate to see damage occur to the new ceiling surfaces due to these leaks. The roof has been inspected by a contractor who stated the roof is at its end of life and needs to be replaced. The continued attempts to chase leaks will only cause futher damage and future costs associated with repairs. The structure was built in 1907, has served the fire department well over its time and is in need of much negelected maintenance to secure the use of the structure for the next 30 years.

Related Projects/Additional information - attach reports/studies if applicable.

INSERT IMAGE OR MAP	INSERT IMAGE OR MAP

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Roof Replacement

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$75,000.00
Cost if the project were carried out this year			$
Cost if project was completed 5 yrs later			$125,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$75,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$75,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	90	80	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Computer Replacement

Dept. Responsible: IT

Submitted By: Bonnie Raffaele

Fiscal Year funds will be used: 2024-2025

Project Description / Location / Details/ Current Age of Infrastructure:
Continue replacing older computers.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Try to keep a cycle of replacment going on computers.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use con Computer Replacement

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$20,000.00
Cost if the project were carried out this year			$20,000.00
Cost if project was completed 5 yrs later			$21,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other	Jul-24	Jun-25

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	636-902-977-000
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$20,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$20,000.00
Total Uses	$20,000.00	**Total Sources**	$20,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	80	35	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): In-Car-Body-Interview Room Camera System

Dept. Responsible: Police

Submitted By: Chief Wesley Bierling

Fiscal Year funds will be used 2024-2029 (Annually)

Project Description / Location / Details/ Current Age of Infrastructure:

Purchase (7) seven in-car cameras, (12) twelve body cameras, and the corresponding camera system for two interview rooms. In addtion to the units/hardware, project includes: software, upfitting-outfitting-install, charging-docking stations, cloud retention/storage, and warranties for five years. Current in-car and body camera system, (6) six in-car cameras and (12) twelve body cameras were purchased in 2016. Interview room camera system is approximately 3 years old. Matching or partial grant funding may be availible through competetive state & federal sources. $40,000 per year for 5 years for an estimate of $200,000.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

In-car and body camera technology and capabilities has advanced dramatically since 2016. Current models in service are outdated and have numerous shortfalls. All warranties have expired. Units and assessories are starting to fail and will continue to do with full price replacement costs. No integraded redaction software (audio, video, and video tracking). No nightvision, live GPS tracking, or remote-in/live stream capabilites. Old battery technology, inadequate battery life even with new batteries. In-car and body camera synchronization issues. Current in-car cameras can obstruct officer vision. FOIA requests will not decrease. Public policy demand for clear and concise footage during officer involved critical incidents. Prosecution and justice system reliance on in-car & body camera footage; jury's expect it. Critical for investigating complaints against officers and officer misconduct. New dashboard and work flow capabilites to update inter and intra department processes pertaining to video evidence. Move in-car, body camera, and interview room video footage to the same system, not separate systems that are not accessible to all approved staff. In-car cameras do not have license plate reader capabilities. Poor resolution. No bluetooth connectivty options for addition camera activation triggers; taser, firearms, voice, etc.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): In-Car-Body-Interview Room Camera System

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$200,000.00
Cost if the project were carried out this year			$232,000.00
Cost if project was completed 5 yrs later			$
Present Worth			
Cost	$200,000.00	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition		*City Fund/Reserves*	$200,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$200,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	90	90	**Max 200 Points**	☐ Required/Mandated regardless of funding ☐ Move forward if funding available ☐ On hold until funding is available ☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Women's Locker Room Renovation

Dept. Responsible: Police Department

Submitted By: Chief Wesley Bierling

Fiscal Year funds will be used: 2024-2025

Project Description / Location / Details/ Current Age of Infrastructure:

Renovate the current police department women's locker room. Current locker room is approximately 140 sq. feet and consists of (3) three lockers, a bathroom & shower area. New locker room would be approximately 177 sq. feet and consist of approximately (8) eight lockers and a bathroom & shower area. Building was built by Cloverland Electric circa 1940-1950 with a renovation completed in 2012 to accomidate the police department. New locker room would meet all ADA and other required standards.

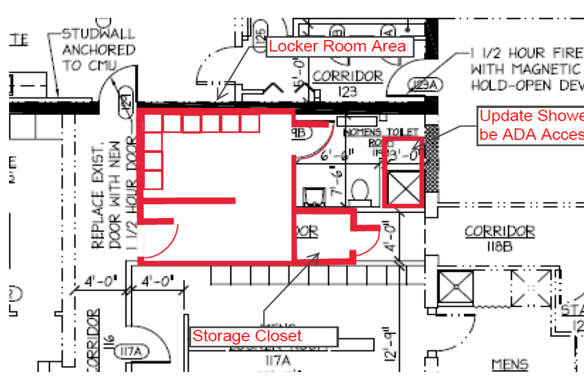
Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

The current bathroom out of compliance with ADA and other standards. The locker room has three lockers for the five female employees; (2) two records clerks, (1) one parking enforcement officer, two (2) two sworn police officers, and have hired a female recruit who is anticipated to joing the department in the summer of 2024. Due to the minimal sq footage, layout of the locker room, and building compliance standards, additional lockers cannot be installed in the current space. The police department anticipates hiring additional female employees/officers in the near future. Conversley, the current men's locker room provides a locker for each male employee.

Related Projects/Additional information - attach reports/studies if applicable.

Police Department with work with Engineering Department for design and constructon oversight.

Additional photos attached in PDF



CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Women's Locker Room Renovation

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$100,000.00
Cost if the project were carried out this year			$100,000.00
Cost if project was completed 5 yrs later			$160,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design	Jul-24	Oct-24
Land/ROW		
Construction	Oct-24	Jan-25
Close out	Jan-25	Mar-25
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$100,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$100,000.00	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$100,000.00	**Total Sources**	$100,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	70	70	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Police Department Conference/Training/Break Room Remodel

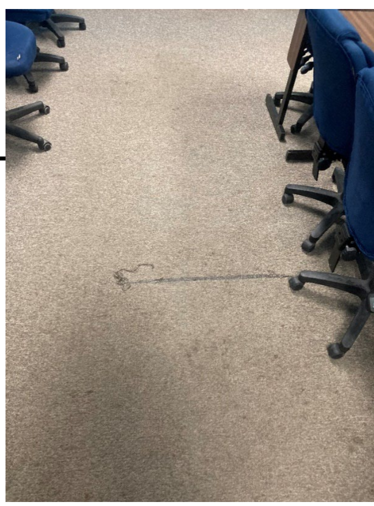
Dept. Responsible: Police Department

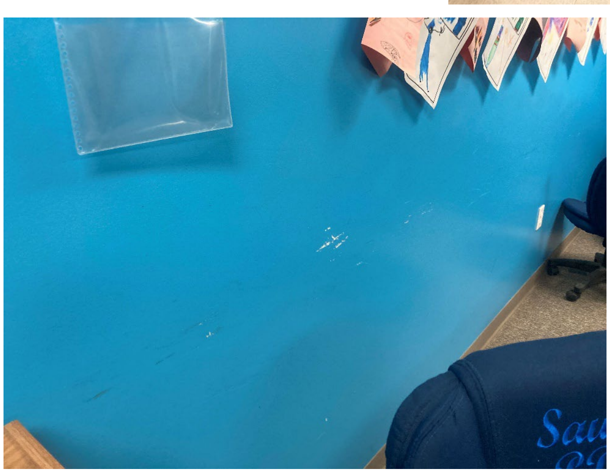
Submitted By: Chief Wesley Bierling

Fiscal Year funds will be used: 24-25

Project Description / Location / Details/ Current Age of Infrastructure:
23' X 26' room, 10' ceiling, utilized as conference/training/break room. Remove existing carpeting and replace with commercial grade laminate flooring. Repaint walls & install chair rail.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Current carpet is old, dirty, ridden with stains, and torn. Walls have scuff/scar marks and painted an ugly blue color. Eye sore to staff and visitors.




CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Police Detective Vehicles

Dept. Responsible: Police

Submitted By: Chief Wesley Bierling

Fiscal Year funds will be used: 2024-2027 Annually

Project Description / Location / Details/ Current Age of Infrastructure:

Replace (3) three detective vehicles; 2009 Ford Fusion with 70,000 miles, 2010 Ford Fusion with 80,000 miles, and 2011 Ford Fusion with 40,000 miles, with new non-pursuit rated all wheel drive mid-size SUVs. Project includes stripping the old vehicles and outfitting the new. Request is to budget $45,000 annually for 3 years for a total of $135,000.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

Replace the 2009 Ford Fusion in 2024-2025, the 2010 Ford Fusion in 2025-2026, and the 2011 Fusion in 2026-2027. Current vehicles lack cargo room and storage space for equipment & gear and, are lightweight and front wheel-drive which is problematic in ice/snow season.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Police Detective Vehicles

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$45,000.00
Cost if the project were carried out this year			$53,000.00
Cost if project was completed 5 yrs later			$
Present Worth			
Cost	$45,000.00	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		Sources of Funds	
		GL # (if applicable)	
Land/R-O-W Acquisition		*City Fund/Reserves*	$45,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$45,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	50	55	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years):	West 25th Ave Force Main Lining Project
Dept. Responsible:	DPW - Water & Sewer Department
Submitted By:	Kirk Tews
Fiscal Year funds will be used	24-25

Project Description / Location / Details/ Current Age of Infrastructure:

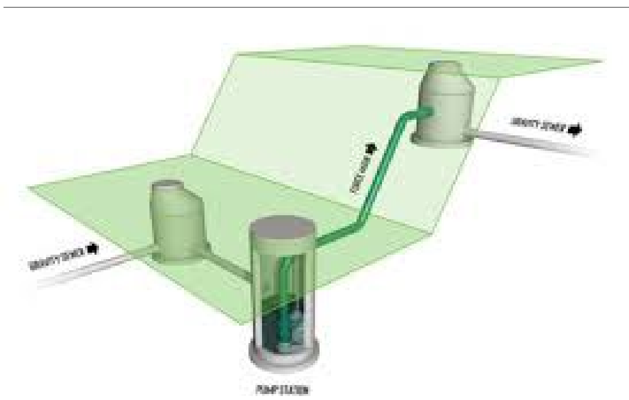
Line over 1/2 mile of force sewer main from the lift station on West 25th Ave to its terminus on the I-75 Business Spur. This project is a bondable project.

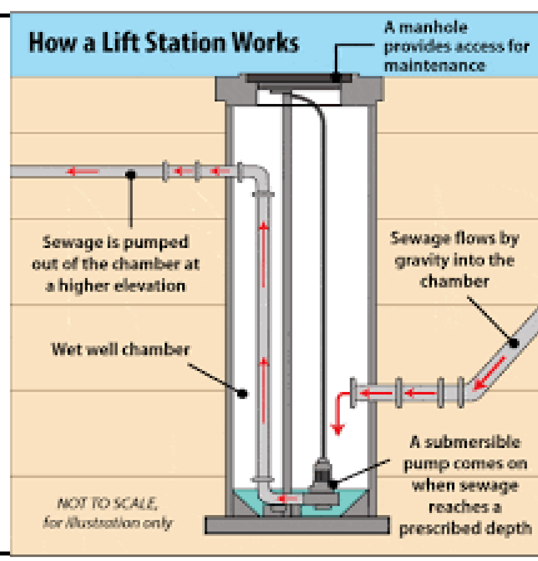
Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

The West 25th Ave sewer force main experienced 6 breaks in a 4 month period. The breaks were located in two segments of pipe. The pipe was showing extreme corrosion. It is recommended to line the pipe before the condition gets worse and requires complete excavation of the force main.

Related Projects/Additional information - attach reports/studies if applicable.

See Attached Print





CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

West 25th Ave Force Main Lining Project

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$500,000.00
Cost if the project were carried out this year			$500,000.00
Cost if project was completed 5 yrs later			$1,200,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction	7/1/2024	6/30/2025
Close out		
Other		

Uses of Funds		Sources of Funds	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$500,000.00
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$500,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	120	115	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2022-2028

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Water Treatment Facility Automatic Transfer Switch Replacement

Dept. Responsible: DPW - Water Treatment Facility

Submitted By: Kirk Tews

Fiscal Year funds will be used: 24-25

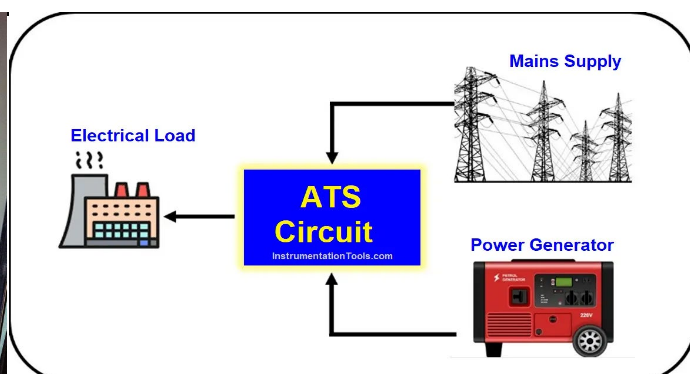
Project Description / Location / Details/ Current Age of Infrastructure:

Replacement of 2 automatic transfer switches at the Water Treatment Faclity.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

Automatic transfer switches transfer the power from the generator to the water plant in the event of a power loss. Cummins, the City's Generator Service Provider, has recommended that the transfer switches be upgraded as they are obsolete and parts are becoming limited. The new transfer switches can also switch power to the plant in such a way that the plant will not loose power. Currently, we have experienced power outages that will shut off a main pump and cause main breaks in the distribution system. This is a critical component to the Water Treatment Facility and should be replaced before a complete failure of the switches.

Related Projects/Additional information - attach reports/studies if applicable.



CAPITAL IMPROVEMENT REQUEST - CYCLE 2022-2028

Water Treatment Facility Automatic Transfer Switch Replacement

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$100,000.00
Cost if the project were carried out this year			$100,000.00
Cost if project was completed 5 yrs later			$125,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction	7/1/2024	6/30/2025
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$100,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$100,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	105	100	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR **DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED**

Project Title (Use consistent naming from previous years):	Flash Mixer Replacement
Dept. Responsible:	DPW - Pumphouse
Submitted By:	Kirk Tews
Fiscal Year funds will be used	24-25

Project Description / Location / Details/ Current Age of Infrastructure:

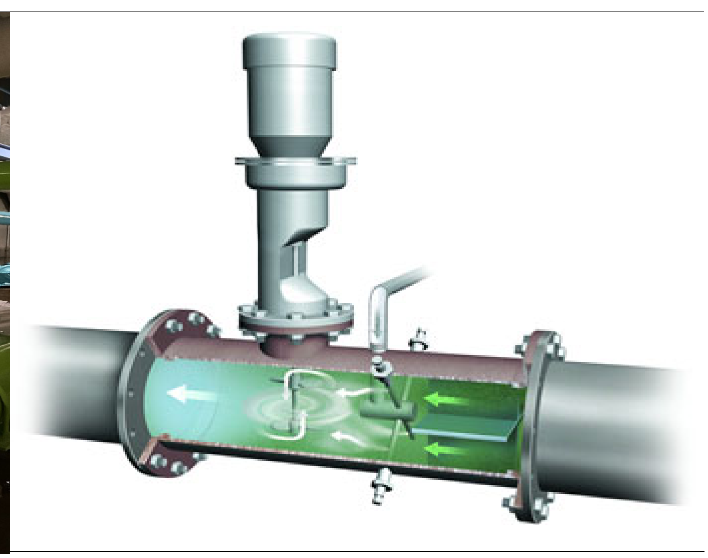
The Water Treatment Facility houses two inline flash mixers for process chemical addition.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

The mixers flash mix alum to increase its effectiveness. They are an essential part of the treatment process. The mixers are original to the plant in 1993. An upgrade would provide better mixing, less maintenance and less electricity to run.

Related Projects/Additional information - attach reports/studies if applicable.

Attached quote from mixer supplier. This would be a like for like replacement not requiring a PA 399 permit. Anderson Process is our vendor for lightning mixers.



CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Flash Mixer Replacement

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$75,000.00
Cost if the project were carried out this year			$70,000.00
Cost if project was completed 5 yrs later			$85,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction	7/1/2024	8/31/2024
Close out		
Other		

Uses of Funds		Sources of Funds	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*Water Capital Reserves*	$75,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$75,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	95	90	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): 25th Lift Station Pump and Check Valve Replacement

Dept. Responsible: WWTP

Submitted By: Brian Masterson

Fiscal Year funds will be used 24/25

Project Description / Location / Details/ Current Age of Infrastructure:
Replace both pumps and check valves at 25th street Lift Station

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Pumps are at the end of their useful life. Failure will result in sanitary sewer backups in homes and potential for SSO into the environment. While the pumps are being replaced the check valves that keep the sewage from returning to the Lift Station will be replaced also.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor 25th Street Lift Station pump replacement

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$150,000.00
Cost if the project were carried out this year			$150,000.00
Cost if project was completed 5 yrs later			$175,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction	7/1/2024	6/30/2025
Close out		6/30/2025
Other		

Uses of Funds		Sources of Funds	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$150,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:		*Special Assessments*	$
Equipment:	$150,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$150,000.00	**Total Sources**	$150,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	95	90	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Park Place Muffin Monster Replacement

Dept. Responsible: WWTP

Submitted By: Brian Masterson

Fiscal Year funds will be used: 24/25

Project Description / Location / Details/ Current Age of Infrastructure:
Replace Muffin Monster at Park Place Lift Station

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Replacing will help reduce the amount of down time the Lift Station will see and greatly reduce debris the pumps will have to pump. Having a spare on hand would also greatly reduce down time and potential for any backups.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Park Place Muffin Monster Replacement

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$25,000.00
Cost if the project were carried out this year			$25,000.00
Cost if project was completed 5 yrs later			$30,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction	7/1/2024	6/30/2025
Close out		6/30/2025
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$25,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:		*Special Assessments*	$
Equipment:	$25,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$25,000.00	**Total Sources**	$25,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	95	90	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Steam Trailer

Dept. Responsible: DPW - Water & Sewer Department

Submitted By: Kirk Tews

Fiscal Year funds will be used 24-25

Project Description / Location / Details/ Current Age of Infrastructure:

Purchase a low pressure steam trailer to thaw anything frozen.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

With the increase in plastic piping and the use of a welder becoming a larger liability a steam trailer would be beneficial to thaw service lines, mains, hydrants, valve boxes, sewers, culverts, and more.

Related Projects/Additional information - attach reports/studies if applicable.

See Attached Specifications Sheets

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Steam Trailer

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$85,000.00
Cost if the project were carried out this year			$85,000.00
Cost if project was completed 5 yrs later			$95,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$85,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$85,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	100	85	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Manhole Structure Lining Project

Dept. Responsible: DPW - Water & Sewer Department

Submitted By: Kirk Tews

Fiscal Year funds will be used 2024-2034

Project Description / Location / Details/ Current Age of Infrastructure:

Line manhole structures to stabilize and eliminate Inflow & Infiltration. Please note that the manhole lining is a 10 year request of $50,000 each year.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

The City recently completed a project with MDOT to line 93 manhole structures on E Portage Ave. This project was designed to stabilize the structures from further degradation. There was a noticeable benefit from this lining project to not only stabilize but to reduce inflow and infiltration from older structures. EGLE is onboard with any reduction of inflow & infiltration and supports the project.

Related Projects/Additional information - attach reports/studies if applicable.

This project would become and annual project lining a portion of manholes each year.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Manhole Structure Lining Project

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$50,000.00
Cost if the project were carried out this year			$50,000.00
Cost if project was completed 5 yrs later			$60,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$50,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$50,000.00

INTERNAL OFFICE USE ONLY					
	Dept.	**City Mgr**		**RECOMMENDATION**	
SCORING Total	85	80	**Max 200 Points**	☐	Required/Mandated regardless of funding
				☐	Move forward if funding available
				☐	On hold until funding is available
				☐	Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Radar Tank Cleaning and Mixer Install

Dept. Responsible: DPW - Pumphouse

Submitted By: Kirk Tews

Fiscal Year funds will be used: 24-25

Project Description / Location / Details/ Current Age of Infrastructure:

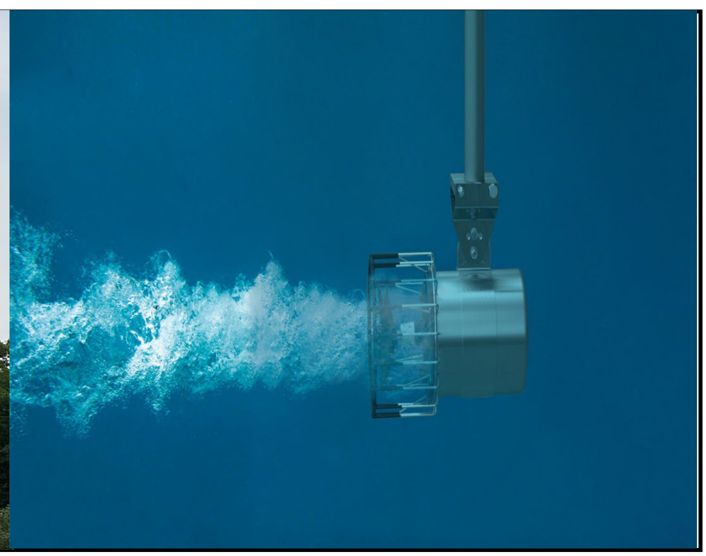
Radar Tower was overcoated in 2012. It is due for a cleaning inside and out. A mixer is also recommended to help with water quality and icing issues.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

Water towers require periodic maintenance to eliminate water quality issues. They also should be maintained on the outside to maintain public image that the tower is being upkept. A mixer will help with numerous water quality concerns and prevent icing in the tank.

Related Projects/Additional information - attach reports/studies if applicable.

See Radar Tank Inspection 12.30.2021 and Impacts of Mixing on Storage Tank Water Quality. Talked with NTEC on 11/7/2023 for an estimate. They reported back with a $50,000 price estimate for cleaning and installation of a mixer.



CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Radar Tank Cleaning and Mixer Install

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$50,000.00
Cost if the project were carried out this year			$52,500.00
Cost if project was completed 5 yrs later			$60,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$50,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$50,000.00

INTERNAL OFFICE USE ONLY					
	Dept.	**City Mgr**			**RECOMMENDATION**
SCORING Total	85	75	**Max 200 Points**	☐	Required/Mandated regardless of funding
				☐	Move forward if funding available
				☐	On hold until funding is available
				☐	Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Purchase of hydraulic dump trailer for biosolids handling and disposal

Dept. Responsible: WWTP

Submitted By: Brian Masterson

Fiscal Year funds will be used 24/25

Project Description / Location / Details/ Current Age of Infrastructure:
Purchase of two 10 to 15 yard hydraulic dump trailer for biosolids handling and disposal.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Purchase of a hydraulic dump trailer would allow the WWTP to eliminate the need of our load lugger (garbage truck) used to haul our biolslids to the land fill. The load lugger is getting old and the maintenance costs are starting in increase. Purchase of the trailers would allow us to load and unload biosolids much easier and without the need of a large vehicle. Maintenance and operation costs will decrease with this purchase.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Purchase of hydraulic dump trailer for biosolids handling and disposal

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$40,000.00
Cost if the project were carried out this year			$40,000.00
Cost if project was completed 5 yrs later			$50,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	**Start Date**	**Finish Date**
Design		
Land/ROW		
Construction	7/1/2024	6/30/2025
Close out		6/30/2025
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$40,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$40,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$40,000.00	**Total Sources**	$40,000.00

INTERNAL OFFICE USE ONLY

	Dept.	**City Mgr**		**RECOMMENDATION**
SCORING Total	65	70	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Water & Sewer Department Flatbed Utility Truck

Dept. Responsible: DPW - Water & Sewer Department

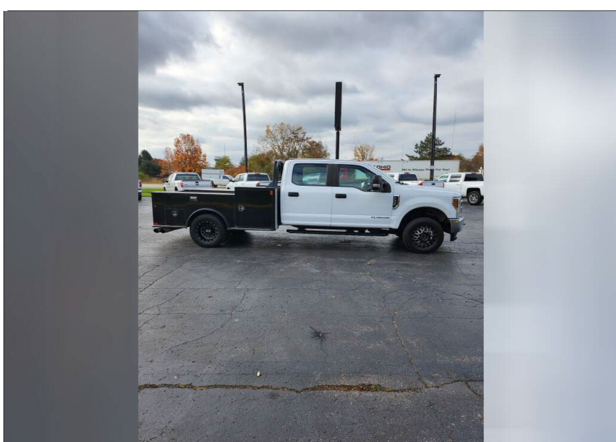
Submitted By: Kirk Tews

Fiscal Year funds will be used: 24-25

Project Description / Location / Details/ Current Age of Infrastructure:
Replacement of current flat bed truck with new truck.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
The current flat bed truck used by the water and sewer department has reached the end of its useful life and replacement is needed. The flat bed utility truck is used to transport sewer tools, bypass pump, and hoses. It is also used to haul water appurtenances to job sites.

Related Projects/Additional information - attach reports/studies if applicable.



CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Water & Sewer Department Flatbed Utility Truck

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$85,000.00
Cost if the project were carried out this year			$85,000.00
Cost if project was completed 5 yrs later			$92,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$85,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$85,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	60	55	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

City of Sault Ste. Marie

Staff Recommended Six Year Capital Improvements Plan 2024-2030 (By Department)

Dept.	Capital Type	Description	Score Max 200pts Dept	Score Max 200pts City Mgr	Funding Source	Year 1 (24/25)	Year 2 (25/26)	Year 3 (26/27)	Year 4 (27/28)	Year 5 (28/29)	Year 6 (29/30)
AIRPORT											
Airport	Project	Airport Layout Plan (ALP)	95	95	Gen Fund/TIFA 3, State Grant	$ 270,000					
Airport	Project	Taxiway Reconstruction/Extension Design	140	140	State Grant		$ 265,000				
Airport	Project	Taxiway Reconstruction/Extension Construction	150	150	Gen Fund/TIFA 3, State & Fed Grants			$ 3,500,000			
Airport	Project	Airport Lighting Upgrades	110	110	State & Fed Grants				$ 600,000		
					TOTAL AIRPORT	**$ 270,000**	**$ 265,000**	**$ 3,500,000**	**$ 600,000**	**$ -**	**$ -**
COMMUNITY DEVELOPMENT											
CD	Project	Zoning Ordinance Update	120	110	Gen Fund/State Grant	$ 30,000					
					TOTAL COMMUNITY DEVELOPMENT	**$ 30,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
DPW & PARKS											
DPW	Project	Ashmun Bay Project	95	95	Gen Fund/Federal Grant	$ 450,000					
DPW	Equipment	Malcolm Park Bleachers	95	95	Gen Fund	$ 45,000					
DPW	Project	Sherman Park Erosion	95	95	Gen Fund/USACE Grant	$ 50,000					
DPW	Equipment	Malcolm Park Fencing	90	90	Gen Fund	$ 50,000					
DPW	Equipment	Single Axle Plow Truck w Wing	95	85	Stock & Equipment	$ 250,000					
DPW	Project	Crushing of Millings (Material)	85	80	Stock & Equipment	$ 50,000					
DPW	Equipment	Leafer	85	80	Stock & Equipment	$ 150,000					
DPW	Equipment	Pickup Truck w Plow	80	80	Gen Fund	$ 65,000					
DPW	Equipment	Production Mower	80	75	Gen Fund	$ 95,000					
DPW	Project	Mission Street Boat Launch	75	75	Gen Fund/MI National Guard Grant	$ 120,000					
DPW	Project	Historic Homes Roof Treatment	70	70	Gen Fund	$ 27,500					
DPW	Equipment	Motor Grader w Wing	75	65	Stock & Equipment	$ 350,000					
DPW	Equipment	Zamboni	70	65	Gen Fund	$ 200,000					
DPW	Project	Kemp Marina Wave Attenuators	65	65	Gen Fund	$ 50,000					
DPW	Equipment	Wheel Loader	75	75	Stock & Equipment			$ 250,000			
					TOTAL DPW & PARKS	**$ 1,952,500**	**$ -**	**$ 250,000**	**$ -**	**$ -**	**$ -**

City of Sault Ste. Marie

Staff Recommended Six Year Capital Improvements Plan 2024-2030 (By Department)

Dept.	Capital Type	Description	Score Max 200pts Dept	Score Max 200pts City Mgr	Funding Source	Year 1 (24/25)	Year 2 (25/26)	Year 3 (26/27)	Year 4 (27/28)	Year 5 (28/29)	Year 6 (29/30)
ENGINEERING											
ENG	Project	Bridge Preventative Maintenance (7 bridges +culvert) (Annual)	130	130	Sault Tribe Gaming	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
ENG	Project	Sidewalk Replacement Program #0643	125	125	Sault Tribe Gaming	$ 50,000					
ENG	Project	Aerial Orthography	115	115	IT/GIS	$ 15,000					
ENG	Equipment	Speed Trailer	65	65	Stock & Equipment	$ 25,000					
ENG	Equipment	Wide format plotter - scanner	50	50	IT/GIS	$ 17,500					
ENG	Project	Bridge Preventative Maintenance MDOT Program (Match)	135	135	Sault Tribe Gaming/MDOT			$ 62,590			
ENG	Project	Riverside Drive Phase I & II	125	125	Sault Tribe Gaming/MDOT/Sault Tribe			$ 1,050,000			
ENG	Project	Marquette Ave - Ashmun to Shunk	120	120	Sault Tribe Gaming/MDOT/Sault Tribe			$ 1,350,000			
ENG	Project	W. 20th Street - 3 Mile to Oak St.	120	120	Sault Tribe Gaming/MDOT/Sault Tribe			$ 1,200,000			
ENG	Project	Minneapolis - Marquette to Easterday	120	120	Sault Tribe Gaming/MDOT/Sault Tribe				$ 1,050,000		
ENG	Project	3 Mile - Roundabout to Meijer + W. 14th St, I-75 West Exit/Entrance	120	120	Sault Tribe Gaming/MDOT					$ 1,250,000	
					TOTAL ENGINEERING	**$ 157,500**	**$ 50,000**	**$ 3,712,590**	**$ 1,100,000**	**$ 1,300,000**	**$ 50,000**

City of Sault Ste. Marie

Staff Recommended Six Year Capital Improvements Plan 2024-2030 (By Department)

Dept.	Capital Type	Description	Score Max 200pts Dept	Score Max 200pts City Mgr	Funding Source	Year 1 (24/25)	Year 2 (25/26)	Year 3 (26/27)	Year 4 (27/28)	Year 5 (28/29)	Year 6 (29/30)
FIRE											
FIRE	Equipment	800 mzh P25 Portable Radios (6 per year)	125	115	Gen Fund	$ 174,000	$ 191,400	$ 210,540	$ 231,594		
FIRE	Equipment	Ambulance (order amb ev. 3 years)	115	110	Gen Fund	$ 308,000			$ 400,000		
FIRE	Equipment	Lucas External Cardiac Compression Device (Exp 7 years)	120	105	Gen Fund	$ 21,000		$ 25,000		$ 30,000	
FIRE	Equipment	Fire Pumper (Ev 5 years)	120	100	Gen Fund	$ 1,035,000					$ 1,500,000
FIRE	Equipment	SCBA Air Cylinders (EO year)	105	90	Gen Fund	$ 12,000		$ 13,800		$ 15,600	
FIRE	Equipment	Ambulance Power Load system (1 per amb)	100	90	Gen Fund	$ 136,000					
FIRE	Equipment	Fire Command Vehicle	100	90	Gen Fund	$ 65,000					
FIRE	Equipment	High Pressure Extrication Tools	110	80	Gen Fund	$ 30,000					
FIRE	Project	Fire Hall Roof Replacement	90	80	Gen Fund	$ 75,000					
					TOTAL FIRE	**$ 1,856,000**	**$ 191,400**	**$ 249,340**	**$ 631,594**	**$ 45,600**	**$ 1,500,000**
INFORMATION TECHNOLOGY											
IT	Equipment	Computer Replacement	35	35	IT FUND	$ 20,000					
					TOTAL INFORMATION TECHNOLOGY	**$ 20,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
POLICE											
POLICE	Equipment	In Car-Body Interview Room Camera System (Annual)	90	90	IT	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000
POLICE	Project	Women's Locker Room Renovation	70	70	Gen Fund	$ 100,000					
POLICE	Project	Conference Room/Training Room Remodel	65	65	Gen Fund	$ 12,000					
POLICE	Equipment	Police Detective Vehicles (Annual)	50	55	Gen Fund, S&E	$ 45,000	$ 45,000	$ 45,000			
POLICE	Equipment	Police Patrol Vehicle (Annual)	65	65	Gen Fund, S&E		$ 73,000				
					TOTAL POLICE	**$ 197,000**	**$ 158,000**	**$ 85,000**	**$ 40,000**	**$ 40,000**	**$ 40,000**

City of Sault Ste. Marie

Staff Recommended Six Year Capital Improvements Plan 2024-2030 (By Department)

Dept.	Capital Type	Description	Score Max 200pts Dept	Score Max 200pts City Mgr	Funding Source	Year 1 (24/25)	Year 2 (25/26)	Year 3 (26/27)	Year 4 (27/28)	Year 5 (28/29)	Year 6 (29/30)
WATER TREATMENT PLANT (WTP) & WASTEWATER TREATMENT PLANT (WWTP)											
WTP	Project	West 25th Ave Force Main Lining Project	120	115	Water Cap Reserve/Bonding	$ 500,000					
WTP	Equpment	Water Treatment Switch Replacement	105	100	Water Cap Reserves	$ 100,000					
WTP	Equpment	Flash Mixer Replacement	95	90	Water Cap Reserves	$ 75,000					
WWTP	Project	25th Lift Station Pump & Check Valve Replacement	95	90	Sewer Cap Reserves	$ 150,000					
WWTP	Project	Park Place Muffin Monster Replacement	95	90	Sewer Cap Reserves	$ 25,000					
WTP	Equpment	Steam Trailer	100	85	Water Cap Reserves	$ 85,000					
WTP	Project	Manhole Structure Lining Project (Annual)	85	80	Water Cap Reserves	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
WTP	Project	Radar Tank Cleaning & Mixer Install	85	75	Water Cap Reserves	$ 50,000					
WWTP	Equpment	Hydraulic Dump Trailer	65	70	Sewer Cap Reserves	$ 40,000					
WTP	Equpment	Water & Sewer Dept Flatbed Utility Truck	60	55	Water Cap Reserves	$ 85,000					
WWTP	Equpment	Generator - 3rd Ave & 25th Ave Lift Stations	85	80	Sewer Cap Reserves		$ 120,000				
WWTP	Project	Digester #3 and #4 Cleaning	90	85	Sewer Cap Reserves			$ 100,000			
WWTP	Project	Digester #1 and #2 Cleaning	90	85	Sewer Cap Reserves				$ 80,000		
WWTP	Equpment	Generator - 25th Ave Lift Station	75	80	Sewer Cap Reserves						$ 60,000
					TOTAL WTP & WWTP	**$ 1,160,000**	**$ 170,000**	**$ 150,000**	**$ 130,000**	**$ 50,000**	**$ 110,000**
					GRAND TOTAL - ALL DEPARTMENTS	**$ 5,643,000**	**$ 834,400**	**$ 7,946,930**	**$ 2,501,594**	**$ 1,435,600**	**$ 1,700,000**

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Taxiway Reconstruction/Extension Design

Dept. Responsible: Airport

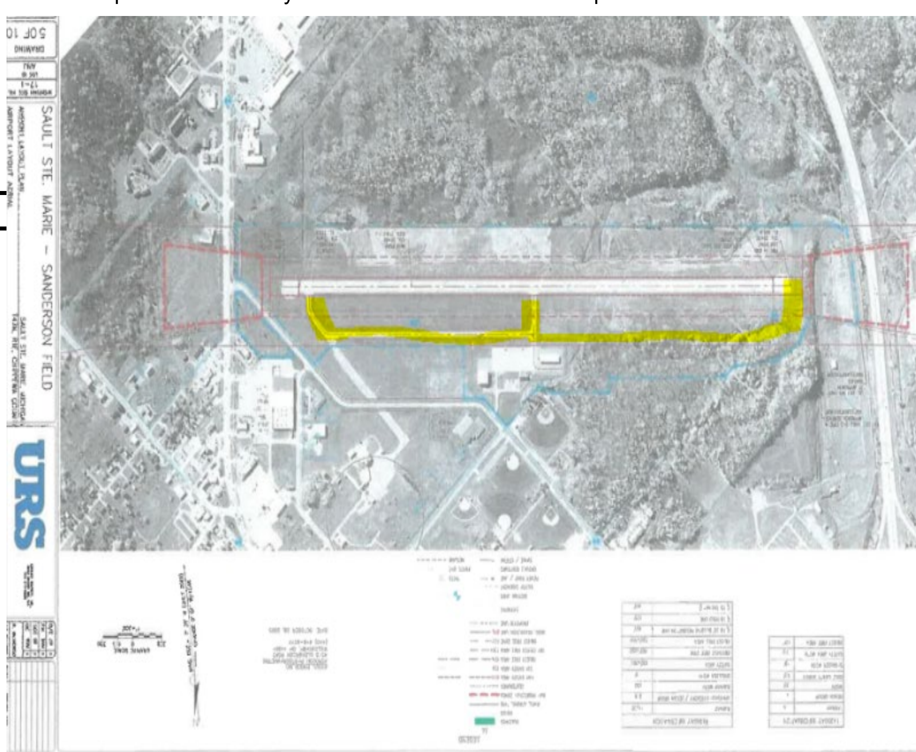
Submitted By: Nicole Radke

Fiscal Year funds will be used: 25-26

Project Description / Location / Details/ Current Age of Infrastructure:
Design would extend the taxiway to full runway lenth and to recontruct the current taxi-way. Current taxiway was constructed in 1998.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Design would extend the taxiway for safety purposes to prevent back taxing on runway 3 2 and reconstruct poorly rated current taxiway.

Related Projects/Additional information - attach reports/studies if applicable.
MDOT recently pavement inspection on taxiway which was rated 4/100. The report will be submitted to us at the beginning of 2024.



CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor =B4

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**		
☐ Will Not Impact	Personnel	0	Staffing	0	
☐ Will Impact	Operations	0	Maintenance	0	
	Maintenance	0	Supplies	0	

Estimated Total Project Cost			$265,000.00
Cost if the project were carried out this year			$265,000.00
Cost if project was completed 5 yrs later			$291,500.00
Present Worth			
Cost	$265,000.00	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

2% inflation

Project Schedule	**Start Date**	**Finish Date**
Design	7/1/2025	12/31/2025
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**		
		GL # (if applicable)	101-595-801.012	
Land/R-O-W Acquisition	$	*City Fund/Reserves*		
Engineering		*Developer Contribution*	$	
Design:	$265,000.00	*Debt Financing:*	$	
Bidding:	$	Gen'l Obligation	$	
Construction Mgt.:	$	Revenue Bonds	$	
Construction:	$	*Special Assessments*	$	
Equipment:	$	*State DOT Contribution*	$	
(List Details)	$	*State Grant*	$265,000.00	2 Years NPIAS
Other:	$	*Federal Grant*	$	
(List Details)	$	*Federal Grant*	$	
		Other:	$	
Total Uses	$265,000.00	**Total Sources**	$265,000.00	

Possible fedreal grant money from BIL for airports.

INTERNAL OFFICE USE ONLY

	Dept.	**City Mgr**		**RECOMMENDATION**
SCORING Total	140	140	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Taxiway Reconstruction/Extension Design

Dept. Responsible: Airport

Submitted By: Nicole Radke

Fiscal Year funds will be used: 25-26

Project Description / Location / Details/ Current Age of Infrastructure:
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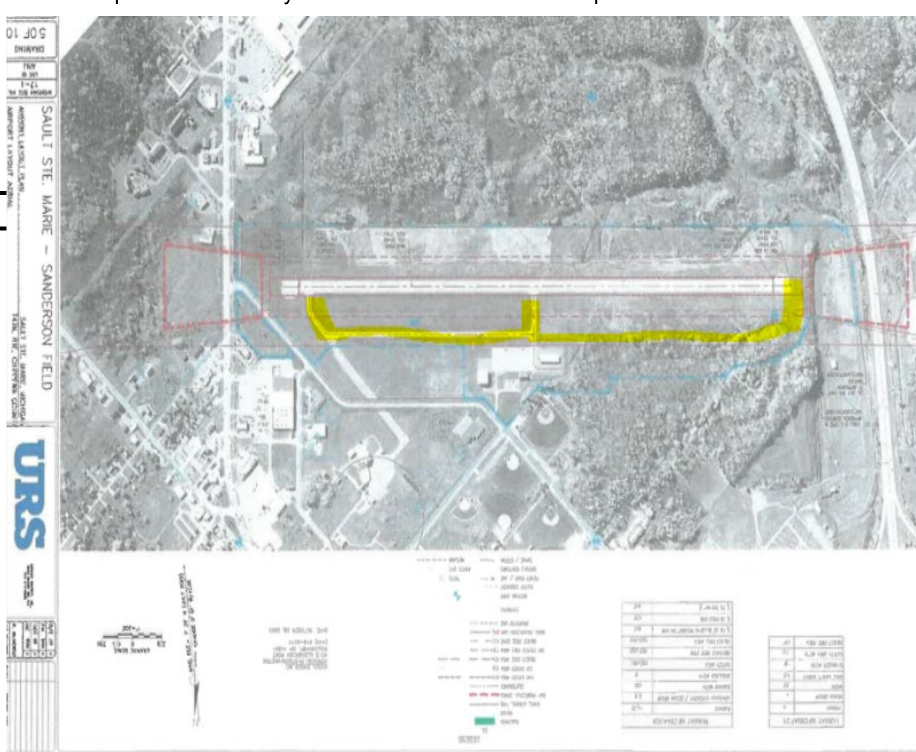
MDOT recently pavement inspection on taxiway which was rated 4/100. The report will be submitted to us at the beginning of 2024.



CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor =B4

Impact on Operating Budget

	Annual Cost Savings		**Additional Costs**		
☐ Will Not Impact	Personnel	0	Staffing	0	
☐ Will Impact	Operations	0	Maintenance	0	
	Maintenance	0	Supplies	0	

Estimated Total Project Cost			$265,000.00	
Cost if the project were carried out this year			$265,000.00	
Cost if project was completed 5 yrs later			$291,500.00	2% inflation
Present Worth				
Cost	$265,000.00	*Lifespan*	$	
Annual savings	$	*Interest*	$	
Annual maint.	$			
Salvage	$			

Project Schedule	**Start Date**	**Finish Date**
Design	7/1/2025	12/31/2025
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**		
		GL # (if applicable)	101-595-801.012	
Land/R-O-W Acquisition	$	*City Fund/Reserves*		
Engineering		*Developer Contribution*	$	
Design:	$265,000.00	*Debt Financing:*	$	
Bidding:	$	Gen'l Obligation	$	
Construction Mgt.:	$	Revenue Bonds	$	
Construction:	$	*Special Assessments*	$	
Equipment:	$	*State DOT Contribution*	$	
(List Details)	$	*State Grant*	$265,000.00	2 Years NPIAS
Other:	$	*Federal Grant*	$	
(List Details)	$	*Federal Grant*	$	
		Other:	$	
Total Uses	$265,000.00	**Total Sources**	$265,000.00	

Possible fedreal grant money from BIL for airports.

INTERNAL OFFICE USE ONLY				
	Dept.	**City Mgr**		**RECOMMENDATION**
SCORING Total	140	140	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Airfield Lighting Upgrades

Dept. Responsible: Airport

Submitted By: Nicole Radke

Fiscal Year funds will be used: 2027-28

Project Description / Location / Details/ Current Age of Infrastructure:
Replace runway lighting with LED lighting system for better efficancy and create better visability. Last done in 1995.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Current system is failing due to old transformers and wiring. It is hard to find replacement bulbs and transformers as is.

Related Projects/Additional information - attach reports/studies if applicable.
MDOT would start recommending new lighting system if bulbs could not be purchaced. Getting harder to find replacement bulbs.

INSERT IMAGE OR MAP	INSERT IMAGE OR MAP

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor =B4

Impact on Operating Budget

☐ Will Not Impact

☐ Will Impact

Annual Cost Savings		**Additional Costs**	
Personnel	0	Staffing	0
Operations	0	Maintenance	0
Maintenance	0	Supplies	0

Estimated Total Project Cost			$600,000.00
Cost if the project were carried out this year			$600,000.00
Cost if project was completed 5 yrs later			$660,000.00
Present Worth			
Cost	$600,000.00	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

2% inflation

Project Schedule	Start Date	Finish Date
Design	7/1/2027	6/30/2028
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**		
		GL # (if applicable)	101-595-801.012	
Land/R-O-W Acquisition	$	*City Fund/Reserves*		
Engineering	b	*Developer Contribution*	$	
Design:		*Debt Financing:*	$	
Bidding:	$	Gen'l Obligation	$	
Construction Mgt.:	$	Revenue Bonds	$	
Construction:	$600,000.00	*Special Assessments*	$	
Equipment:	$	*State DOT Contribution*	$	
(List Details)	$	*State Grant*	$600,000.00	NPIAS funding
Other:	$	*Federal Grant*	$	
(List Details)	$	*Federal Grant*	$	
		Other:	$	
Total Uses	$600,000.00	**Total Sources**	$600,000.00	

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	110	110	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Wheel Loader

Dept. Responsible: DPW - Streets

Submitted By: Tyler Perron

Fiscal Year funds will be used 2026-27

Project Description / Location / Details/ Current Age of Infrastructure:

A wheel loader for snow removal and road maintenance. Replacement of a 2005 loader.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

Loaders are used for loading materials and plowing/road maintenance. They are use for alley and parking lot plowing as well as operating the large loader mounted snow blowers used for pulling and hauling snow. This is a scheduled replacent for our oldest unit. Less maintenance costs and downtime will result as well as increased efficiencies of operations with a new model.

Related Projects/Additional information - attach reports/studies if applicable.

INSERT IMAGE OR MAP

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Wheel Loader

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$250,000.00
Cost if the project were carried out this year			$
Cost if project was completed 5 yrs later			$
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	Stock & Equipment
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$250,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$250,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$250,000.00	**Total Sources**	$250,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	75	75	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2023-2029

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Bridge Preventative Maintenance (4 bridges remain unfunded)

Dept. Responsible: Engineering

Submitted By: Dave Boyle, PE

Fiscal Year funds will be used: 2026-2027

Project Description / Location / Details/ Current Age of Infrastructure:

Of the The City's 7 structures, two are arch structures (1 steel and 1 concrete), four are steel bridges, and 1 is a pre-stressed concrete bridge.
Bridges to be submitted 90/10 split:
1675 Spruce St (2023 est $347,000)
#1678 Johnston St (2023 est $148,000)
#1677 Bingham Ave (2023 est $74,000)

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

Determination of work is recent as we just completed our 2023 bridge inspections. DPW is doing a lot of work in house, but plates, and routine maintenance items are needed to stay on track for a larger overhaul in 2025-26. EOY costs are approximately $20,000. this includes Ayers to complete the EOY bridge inspections and use Cloverland's boat, then we have addtional OHM charges for our MDOT Bridge Asset Plan, MDOT Bridge Plan grant application, and then our internal maintenance (materials needed).

We are asking for $50 annually except for 2025-26 we will receive an MDOT grant to repair 3 structures at 95% for major preventative maintenance and repairs. This means that we will continue to apply for MDOT bridge bundling funds until all are funded.

Related Projects/Additional information - attach reports/studies if applicable.

N:\TRANSPORTATION\BRIDGES\Ayres 2023 Bridge Inspection Reports

Most recent Bridge Asset Report for MDOT.

Document Name: DSCF0114.JPG
Category: Bearings
Span Number:
Comments: Typical tilted moveable bearing at north abutment.

Document Name: DSCF0107.JPG
Category: Channel
Span Number:
Comments: Typical erosion of scour countermeasures in front of abutments.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2023-2029

Project Title (Use consistent naming from previous years): Bridge Preventative Maintenance (7 bridges + tunnel + culvert)

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$625,900.00
Cost if the project were carried out this year			$569,000.00
Cost if project was completed 5 yrs later			$
Present Worth			
Cost	$625,900.00	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW	N/A	N/A
Construction		
Close out		
Other		

Uses of Funds		Sources of Funds	
		GL # (if applicable)	401.901-986.000-0604
Land/R-O-W Acquisition	$0.00	*City Fund/Reserves*	$62,590.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$563,310.00
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$0.00	**Total Sources**	$625,900.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	135	135	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Riverside Drive -Ferry Dock to 3 Mile (2 phases - $ is for entire project)

Dept. Responsible: Engineering

Submitted By: Dave Boyle, PE

Fiscal Year funds will be used 2025-2027

Project Description / Location / Details/ Current Age of Infrastructure:

Ferry Dock to Mission Creek Bridge/Past utility issues/Mission Creek Bridge to 3 Mile /Tribal trust land, Riverside Trailer Park, Sugar Island

Riverside was redone in 2018 past Aune Osborn Campground to the Sugar Island Ferry Dock. Mission Creek Bridge was completed in 2014. This 2 phase project would close out the remainder of the road.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

Potential for CAT F funds as major haul route and MDOT detour, direct access to Ferry, Armory Truck Traffic route

Related Projects/Additional information - attach reports/studies if applicable.

The water department is planning a watermain rehab project on this roadway in 2024-2025. This would take away a utility maintenance issue and allow the roadway to be reconstructed. This project has also been added to the Sault Tribe's TIF for funding.

Riverside Dr. near Ferry

Multiple utility issues

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Riverside Drive -Ferry Dock to 3 Mile (2 phases - $ is for entire project)

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$1,050,000.00
Cost if the project were carried out this year			
Cost if project was completed 5 yrs later			$
Present Worth			
Cost		*Lifespan*	
Annual savings	$	*Interest*	
Annual maint.			
Salvage			

Project Schedule	Start Date	Finish Date
Design		
Land/ROW	N/A	N/A
Construction	2025	2027
Close out		2027
Other		

Uses of Funds		**Sources of Funds**		
		GL # (if applicable)		
Land/R-O-W Acquisition	$0.00	*City Fund/Reserves*		$200,000.00
Engineering		*Developer Contribution*		$
Design:	$	*Debt Financing:*		$
Bidding:	$	Gen'l Obligation		$
Construction Mgt.:	$50,000.00	Revenue Bonds		$
Construction:	$950,000.00	*Special Assessments*		$
Equipment:	$	*State DOT Contribution*		$
(List Details)	$	*State Grant*		
Other: CONTINGENCY	$50,000.00	*School matching funds*		
(List Details)	$	*Federal Grant*	MDOT CAT F	$375,000.00
		Sault Tribe		$475,000.00
Total Uses	$1,050,000.00	**Total Sources**		$1,050,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	125	125	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Marquette Ave - Ashmun to Shunk

Dept. Responsible: Engineering

Submitted By: Dave Boyle, PE

Fiscal Year funds will be used: 2026

Project Description / Location / Details/ Current Age of Infrastructure:
Ashmun to Shunk in partnership w Sault Tribe and Safe Routes to School, additionally, the Sault Tribe was awarded a federal grant that included this roadway that well covered the entire project.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Small Urban funding $375,000 is approved for this fiscal year.

Related Projects/Additional information - attach reports/studies if applicable.
The tribe is planning on rehabing/reconstructing Shunk Road in 2024-25. Safe Routes to School will upgrade the sidewalks and ramps in 2024.

Marquette Hill safety issues w grade

Safe Routes to school ramp coordination

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Marquette Ave - Ashmun to Shunk

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$1,350,000.00
Cost if the project were carried out this year			
Cost if project was completed 5 yrs later			$
Present Worth			
Cost		*Lifespan*	
Annual savings	$	*Interest*	
Annual maint.			
Salvage			

Project Schedule	Start Date	Finish Date
Design		
Land/ROW	N/A	N/A
Construction	2026	
Close out		
Other		

Uses of Funds		Sources of Funds		
		GL # (if applicable)		
Land/R-O-W Acquisition		*City Fund/Reserves*		$150,000.00
Engineering		*Developer Contribution*		$
Design:	$	*Debt Financing:*		$
Bidding:	$	Gen'l Obligation		$
Construction Mgt.:	$50,000.00	Revenue Bonds		$
Construction:	$1,250,000.00	*Special Assessments*		$
Equipment:	$	*State DOT Contribution*		$
(List Details)	$	*State Grant*		
Other: CONTINGENCY	$50,000.00	*Sault Tribe*		$838,000.00
(List Details)	$	*Federal Grant*		
		Other:	Small Urban	$362,000.00
Total Uses	$1,350,000.00	**Total Sources**		$1,350,000.00

INTERNAL OFFICE USE ONLY					
	Dept.	**City Mgr**			**RECOMMENDATION**
SCORING Total	120	120	**Max 200 Points**	☐	Required/Mandated regardless of funding
				☐	Move forward if funding available
				☐	On hold until funding is available
				☐	Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): W. 20th Street - 3 Mile Road to Oak Street

Dept. Responsible: Engineering

Submitted By: Dave Boyle, PE

Fiscal Year funds will be used: 2026

Project Description / Location / Details/ Current Age of Infrastructure:
Secondary all season truck route on the west side of town 1.1 miles. Provides additional all season access to Sault Tribe's golf course. Continuation of MDOT primary and secondary truck routes.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Potential for CAT A or D funds as all season haul route, the project was also placed on the Tribe's current TIF.

Related Projects/Additional information - attach reports/studies if applicable.
Planning secondary and all season routes within the City. Looking to use available Tribal funding.

W. 20th and RR crossIng

Baker Road/3 Mile

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): W. 20th Street - 3 Mile Road to Oak Street

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$1,200,000.00
Cost if the project were carried out this year			
Cost if project was completed 5 yrs later			$
Present Worth			
Cost		*Lifespan*	
Annual savings	$	*Interest*	
Annual maint.			
Salvage			

Project Schedule	Start Date	Finish Date
Design		
Land/ROW	N/A	N/A
Construction	2024	2026
Close out		2026
Other		

Uses of Funds		Sources of Funds			
		GL # (if applicable)			
Land/R-O-W Acquisition	$0.00	*City Fund/Reserves*		$220,000.00	20% required
Engineering		*Developer Contribution*		$	
Design:	$	*Debt Financing:*		$	
Bidding:	$	Gen'l Obligation		$	
Construction Mgt.:	$50,000.00	Revenue Bonds		$	
Construction:	$1,100,000.00	*Special Assessments*		$	
Equipment:	$	*State DOT Contribution*		$	
(List Details)	$	*State Grant*			
Other: CONTINGENCY	$50,000.00	*School matching funds*			
(List Details)	$	*Federal Grant*	MDOT CATA/ D	$375,000.00	
		Other:	Sault Tribe	$605,000.00	
Total Uses	$1,200,000.00	**Total Sources**		$1,200,000.00	

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	120	120	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years):	Minneapolis - Marquette to Easterday
Dept. Responsible:	Engineering
Submitted By:	Dave Boyle, PE
Fiscal Year funds will be used	2028

Project Description / Location / Details/ Current Age of Infrastructure:
Marquette to Easterday in conjunction with Safe Routes to School

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Small Urban funding $375,000 is approved for this fiscal year.

Related Projects/Additional information - attach reports/studies if applicable.
This project is being considered to go along with the projects that will happen in the area - SRTS, Marquette Ave., Shunk Road, and Easterday Avenue.

Marquette to Minneapolis - sidewalk issues

Future roundabout change

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): Minneapolis - Marquette to Easterday

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$1,050,000.00
Cost if the project were carried out this year			
Cost if project was completed 5 yrs later			$
Present Worth			
Cost		*Lifespan*	
Annual savings	$	*Interest*	
Annual maint.			
Salvage			

Project Schedule	Start Date	Finish Date
Design		
Land/ROW	N/A	N/A
Construction	2026	
Close out		
Other		

Uses of Funds		**Sources of Funds**		
		GL # (if applicable)		
Land/R-O-W Acquisition	$0.00	*City Fund/Reserves*		$140,000.00
Engineering		*Developer Contribution*		$
Design:	$	*Debt Financing:*		$
Bidding:	$	Gen'l Obligation		$
Construction Mgt.:	$25,000.00	Revenue Bonds		$
Construction:	$1,000,000.00	*Special Assessments*		$
Equipment:	$	*State DOT Contribution*		$
(List Details)	$	*State Grant*		
Other: CONTINGENCY	$25,000.00	*Sault Tribe*		$525,000.00
(List Details)	$	*Federal Grant*		
		Other:	Small Urban	$385,000.00
Total Uses	$1,050,000.00	**Total Sources**		$1,050,000.00

INTERNAL OFFICE USE ONLY				
	Dept.	**City Mgr**		**RECOMMENDATION**
SCORING Total	120	120	**Max 200 Points**	☐ Required/Mandated regardless of funding ☐ Move forward if funding available ☐ On hold until funding is available ☐ Coordinate in a later year with adjacent project

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): 3 Mile - Roundabout to Meijer + W. 14th St, I-75 West Exit/Entra

Dept. Responsible: Engineering

Submitted By: Dave Boyle, PE

Fiscal Year funds will be used 2028

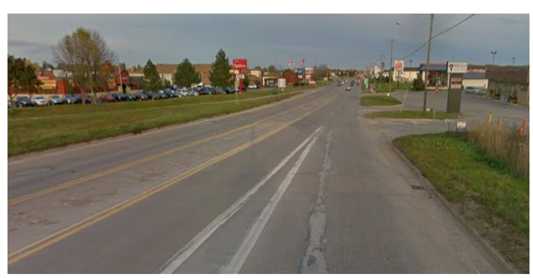
Project Description / Location / Details/ Current Age of Infrastructure:
Cat F Grant/Reconstruct 3 Mile Road W. 14th St. to I-75, build roundabout at Meijer to get rid of signalized intersection.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
This is a heavily traveled roadway, the road has a low paser rating and doesn't meet current dimensional standards.

Related Projects/Additional information - attach reports/studies if applicable.
The project utilizes CAT F funding, additonally we would look to MDOT and Sault Tribe for additonal monies.

Roundabout to Meijer

3 Mile looking East



CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consistent naming from previous years): 3 Mile - Roundabout to Meijer + W. 14th St, I-75 West Exit/Entrance

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$1,250,000.00
Cost if the project were carried out this year			
Cost if project was completed 5 yrs later			$
Present Worth			
Cost		*Lifespan*	
Annual savings	$	*Interest*	
Annual maint.			
Salvage			

Project Schedule	Start Date	Finish Date
Design		
Land/ROW	N/A	N/A
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$0.00	*City Fund/Reserves*	$875,000.00
Engineering		*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$50,000.00	Revenue Bonds	$
Construction:	$1,125,000.00	*Special Assessments*	$
Equipment:	$	*State DOT Contribution*	$
(List Details)	$	*State Grant*	
Other: CONTINGENCY	$75,000.00	*School matching funds*	
(List Details)	$	*Federal Grant*	
		Other: Small Urban	$375,000.00
Total Uses	$1,250,000.00	**Total Sources**	$1,250,000.00

INTERNAL OFFICE USE ONLY					
	Dept.	**City Mgr**			**RECOMMENDATION**
				☐	Required/Mandated regardless of funding
SCORING	120	120	**Max 200**	☐	Move forward if funding available
Total			**Points**	☐	On hold until funding is available
				☐	Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Police Patrol Vehicle

Dept. Responsible: Police

Submitted By: Chief Wesley Bierling

Fiscal Year funds will be used: 2025-2026

Project Description / Location / Details/ Current Age of Infrastructure:
Replace a 2021 Ford Police Interceptor (Car #9) with a new police vehicle. Project includes stripping the old vehicle and outfitting the new.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Car #9 will reach 100,000 miles within 2025-2026 budget year. Due to the nature of how police vehicles are driven, local roadway conditions, and climate, this vehicle should be replaced at 100,000 miles. Warranties will have ended. Cost of ownership can increase. May experience increased insurance-risk-liability costs.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use consi Police Patrol Vehicle

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance		Supplies	$

Estimated Total Project Cost			$73,000.00
Cost if the project were carried out this year			$73,000.00
Cost if project was completed 5 yrs later			$85,000.00
Present Worth			
Cost	$73,000.00	*Lifespan*	
Annual savings		*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction		
Close out		
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$73,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$73,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$73,000.00	**Total Sources**	$73,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	65	65	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Generator purchase for 3rd ave and 25th ave lift stations

Dept. Responsible: WWTP

Submitted By: Brian Masterson

Fiscal Year funds will be used 25/26

Project Description / Location / Details/ Current Age of Infrastructure:

Purchase emergency generators for both 3rd ave and 25th ave lift stations.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:

Install generator at each location eliminating the need to haul portable stanby generators during power outages. Currently we need to haul a portable generator to each location during a power outage. Purchasing the generators would eliminate that. Therefore we would not have any disruption in service. Both lift stations are critical to the operation of the citys sanitary sewer infrastructure. Any lapse in service has the potential of back ups and basement flooding.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Generator purchase for 3rd ave and 25th ave lift stations

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$120,000.00
Cost if the project were carried out this year			$110,000.00
Cost if project was completed 5 yrs later			$130,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction	7/1/2025	6/30/2026
Close out		6/30/2026
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$120,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$120,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$120,000.00	**Total Sources**	$120,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	85	80	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Digestor #3 and #4 Cleaning

Dept. Responsible: WWTP

Submitted By: Brian Masterson

Fiscal Year funds will be used 26/27

Project Description / Location / Details/ Current Age of Infrastructure:
Clean and inspect digestors 3 and 4. Repair methane gas line in #4.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Digestors should and need to be cleaned every 5 years. Especially with the amount of sand and rags that are currently introduced due to outdated grit removal system.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Digestor cleaning

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$100,000.00
Cost if the project were carried out this year			$100,000.00
Cost if project was completed 5 yrs later			$125,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction	4/1/2027	6/30/2027
Close out		6/30/2027
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$100,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$75,000.00	*Special Assessments*	$
Equipment:	$25,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$100,000.00	**Total Sources**	$100,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	90	85	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Digestor #1 and #2 Cleaning

Dept. Responsible: WWTP

Submitted By: Brian Masterson

Fiscal Year funds will be used 27/28

Project Description / Location / Details/ Current Age of Infrastructure:
Clean and inspect digestors 1 and 2.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Digestors should and need to be cleaned every 5 years. Especially with the amount of sand and rags that are currently introduced due to outdated grit removal system.

Related Projects/Additional information - attach reports/studies if applicable.

MAP

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Digestor cleaning

Impact on Operating Budget

	Annual Cost Savings		Additional Costs	
☐ Will Not Impact	Personnel	$	Staffing	$
☐ Will Impact	Operations	$	Maintenance	$
	Maintenance	$	Supplies	$

Estimated Total Project Cost			$80,000.00
Cost if the project were carried out this year			$80,000.00
Cost if project was completed 5 yrs later			$100,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	Start Date	Finish Date
Design		
Land/ROW		
Construction	4/1/2028	6/30/2028
Close out		6/30/2028
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$80,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$80,000.00	*Special Assessments*	$
Equipment:		*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$80,000.00	**Total Sources**	$80,000.00

INTERNAL OFFICE USE ONLY

	Dept.	City Mgr		RECOMMENDATION
SCORING Total	90	85	**Max 200 Points**	☐ Required/Mandated regardless of funding
				☐ Move forward if funding available
				☐ On hold until funding is available
				☐ Coordinate in a later year with adjacent project

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

PLEASE USE ONE FORM PER YEAR
DO NOT FILL OUT FOR PROJECTS THAT ALREADY EXIST OR HAVE BEEN BUDGETED

Project Title (Use consistent naming from previous years): Generator Install at 25th Ave Lift Station

Dept. Responsible: WWTP

Submitted By: Brian Mastserson

Fiscal Year funds will be used: 29/30

Project Description / Location / Details/ Current Age of Infrastructure:
Install back up generator at 25th ave Lift Station.

Project Purpose / Justification-Why Needed/What are the Benefits/Impact on Future Operations?:
Currently we have to bring a portable gen set to lift station during power outages. Install of one on site will eliminate this and will also eliminate any interuptions in service.

Related Projects/Additional information - attach reports/studies if applicable.

CAPITAL IMPROVEMENT REQUEST - CYCLE 2024-2030

Project Title (Use cor Generator Install at 25th Ave Lift Station

	Annual Cost Savings		**Additional Costs**		
☐ Will Not Impact	Personnel	$	Staffing	$	
☐ Will Impact	Operations	$	Maintenance	$	
	Maintenance	$	Supplies	$	

Estimated Total Project Cost			$60,000.00
Cost if the project were carried out this year			$60,000.00
Cost if project was completed 5 yrs later			$75,000.00
Present Worth			
Cost	$	*Lifespan*	$
Annual savings	$	*Interest*	$
Annual maint.	$		
Salvage	$		

Project Schedule	**Start Date**	**Finish Date**
Design		
Land/ROW		
Construction	7/1/2029	
Close out		6/30/1930
Other		

Uses of Funds		**Sources of Funds**	
		GL # (if applicable)	
Land/R-O-W Acquisition	$	*City Fund/Reserves*	$60,000.00
Engineering	$	*Developer Contribution*	$
Design:	$	*Debt Financing:*	$
Bidding:	$	Gen'l Obligation	$
Construction Mgt.:	$	Revenue Bonds	$
Construction:	$	*Special Assessments*	$
Equipment:	$60,000.00	*State DOT Contribution*	$
(List Details)	$	*State Grant*	$
Other:	$	*Federal Grant*	$
(List Details)	$	*Federal Grant*	$
		Other:	$
Total Uses	$60,000.00	**Total Sources**	$60,000.00

INTERNAL OFFICE USE ONLY					
	Dept.	**City Mgr**		**RECOMMENDATION**	
SCORING	75	80	**Max 200**	☐	Required/Mandated regardless of funding
Total			**Points**	☐	Move forward if funding available
				☐	On hold until funding is available
				☐	Coordinate in a later year with adjacent project

Appendix A
Road & Sidewalk
Ratings

The City of Sault Ste. Marie has 87.5 centerline miles (181.679 lane miles) of roads eligible for Act 51 funding under its jurisdiction which are divided into Major or Federal Aid roads and local roads. Federal Aid roads are roads that are fully eligible for federal Surface Transportation road funds and comprise 32% of the roads under our jurisdiction. These roads are functionally classified as Minor Arterial Roads or Major Collector Roads. Minor Arterial Roads interconnect with the State trunkline routes, augment the State trunkline routes and provide service to trips of moderate length. These routes should not penetrate identifiable local neighborhoods area. Major Collector roads provide access to residential, commercial and industrial areas of an urban setting and collect traffic from local neighborhood areas and channels it into the arterial system. Local roads on the other hand comprise the other 67% of our roads and are not fully eligible for federal Surface Transportation funds. Local roads serve primarily to provide direct access to abutting neighborhoods and provide access from local neighborhoods to roads of higher classification.

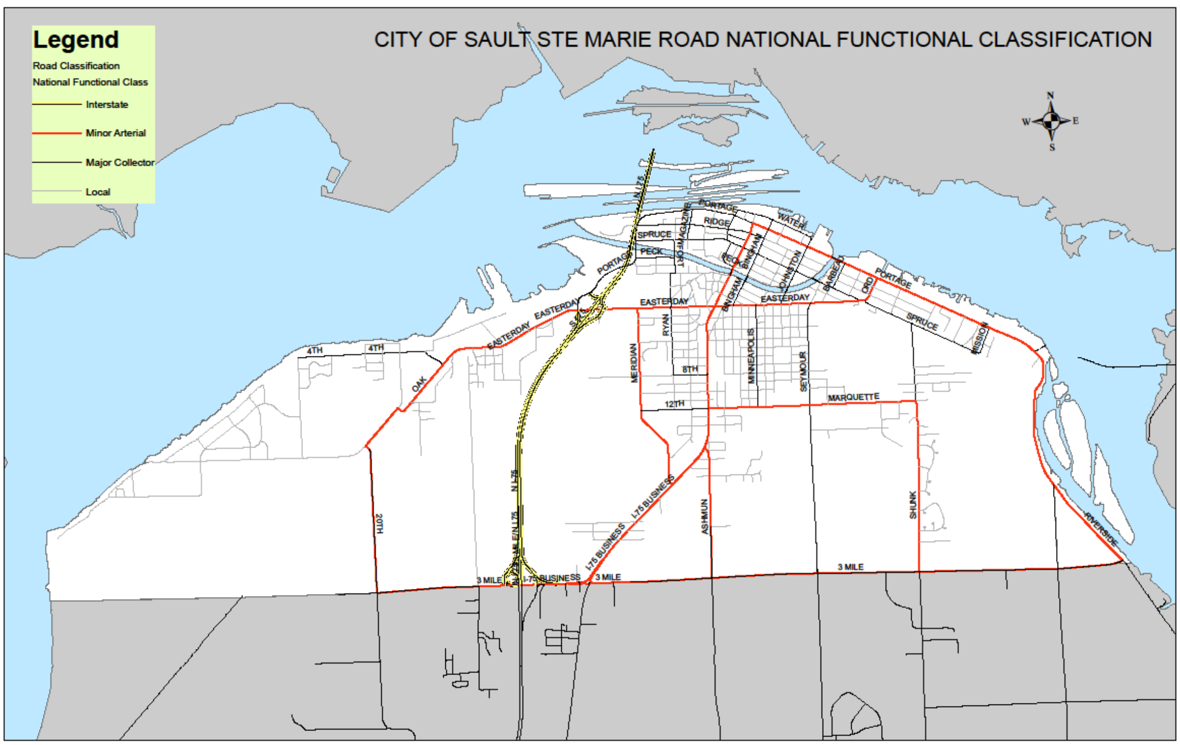


Figure 1 National Functional Classification of Sault Ste. Marie roads

The City of Sault Ste. Marie follows the Michigan Transportation Asset Management Council's state-wide recommendation of using the adapted version of the University of Wisconsin-Madison's Pavement Surface Rating (PASER) methodology for its assessment of roads under our jurisdiction for asset management purposes for non-gravel roads. Non-Gravel Roads contribute for 76 centerline miles (158.6 lane miles) of Act 51 roads under our jurisdiction. See Figure 2 for cost analysis of road rehabilitation itemized per PASER Rating, and Figures 3-6 for PASER Ratings of non-gravel roads within our jurisdiction.

A simplified breakdown of the PASER ratings is as follows:

PASER Rating 1: Complete failure of road structure. Road needs complete reconstruction ($1,197,636 per lane mile of rehabilitation; costs not including utility work)

PASER Rating 2: Severe deterioration. Needs reconstruction with extensive base repair. Pulverization of old pavement is effective (crush & shape rehabilitation)
($522,192 per lane mile of rehabilitation; costs not including utility work)

PASER Rating 3: Needs spot repair of subbase before major overlay. Milling and removal of deteriorated road surface extends surface life)
($429,570 per lane mile of rehabilitation; costs not including utility work)

PASER Rating 4: Significant aging and first signs of structural failure. Would benefit from a 2" or more structure overlay
($299,200 per lane mile of rehabilitation; costs not including utility work)

PASER Rating 5: Surface related aging present. Sound structural condition. Needs sealcoat or non-structural overlay of less than 2"
($174,150 per lane mile of rehabilitation; costs not including utility work)

PASER Rating 6: Showing signs of aging. Sound structural condition. Could extend life with sealcoat.
($42,570 per lane mile of rehabilitation; costs not including utility work)

PASER Rating 7: First signs of aging. Maintain with routing crack filling
($7,095 per lane mile of rehabilitation; costs not including utility work)

PASER Rating 8: Little to no maintenance required.

PASER Rating 9: Recent overlay Like New

PASER Rating 10: New Construction. Includes recent crush & shape rehabilitated road segment with added gravel base

The breakdown of the condition of Sault Ste. Marie roads with equivalent rehabilitation costs is as follows

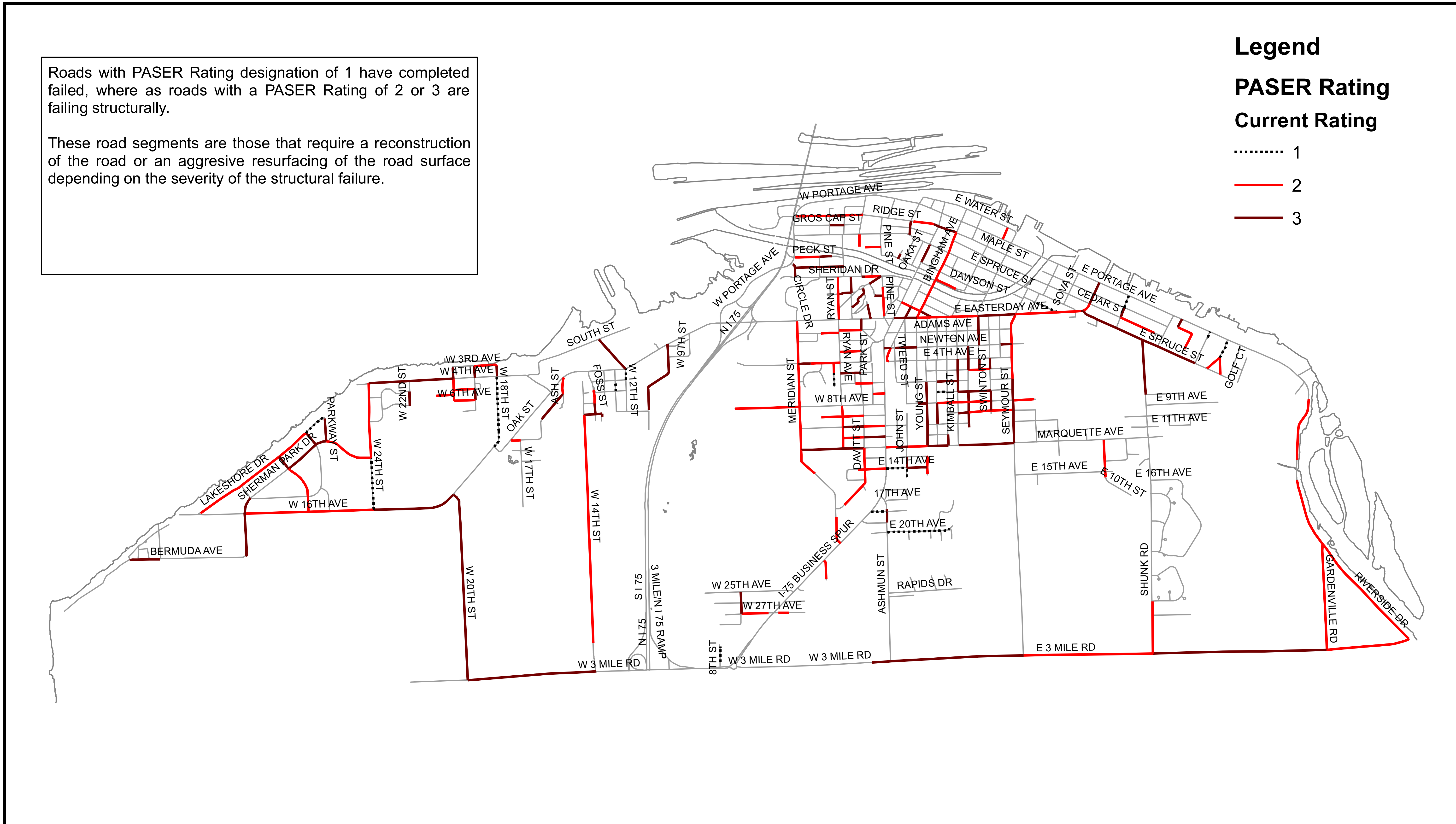
PASER RATING	Lane Miles (Major)	Lane Miles (Locals)	Lane Miles TOTAL	Percent of Non-Gravel	Rehab Cost (Major)	Rehab Cost (Local)
10	1.67	0.68	2.348	1.48%	N/A	N/A
9	0.44	1.94	2.38	1.50%	N/A	N/A
8	1.04	2.40	3.44	2.17%	N/A	N/A
7	9.37	3.58	12.95	8.16%	$86,424.20	$33,020.13
6	3.78	3.73	7.51	4.73%	$210,073.50	$207,294.75
5	6.32	19.64	25.96	16.36%	$1,430,816.60	$4,446,397.80
4	17.71	24.49	42.2	26.59%	$6,888,481.60	$9,525,630.40
3	11.9	13.48	25.38	15.99%	$6,645,447.90	$9,525,630.40
2	11.81	20.9	32.71	20.61%	$8,017,213.78	$14,187,956.64
1	0	3.8	3.80	2.39%		$5,916,321.84
					$23,278,457.37	$41,844,406.24

Figure 2 Tabulation of Rehabilitation Costs excluding utility work per PASER Rating

City of Sault Ste. Marie: Rating 1-3

Roads with PASER Rating designation of 1 have completed failed, where as roads with a PASER Rating of 2 or 3 are failing structurally.

These road segments are those that require a reconstruction of the road or an aggresive resurfacing of the road surface depending on the severity of the structural failure.



City of Sault Ste. Marie: Rating 4-5

0 0.5 1 2 Miles

Roads with a PASER Rating of 4 or 5 are failing structurally or show non-structural signs of wear due to age.

These roads are typically classifiied as Capital Preventative Maintenenace candiates and are rehabilitated by treatments that will extend the surface life of the road segment. This is done by overlaying the existing pavement. When structural defects to the road surface are found the overlaying of the pavement is accompanied by a removal of some of the existing pavement.

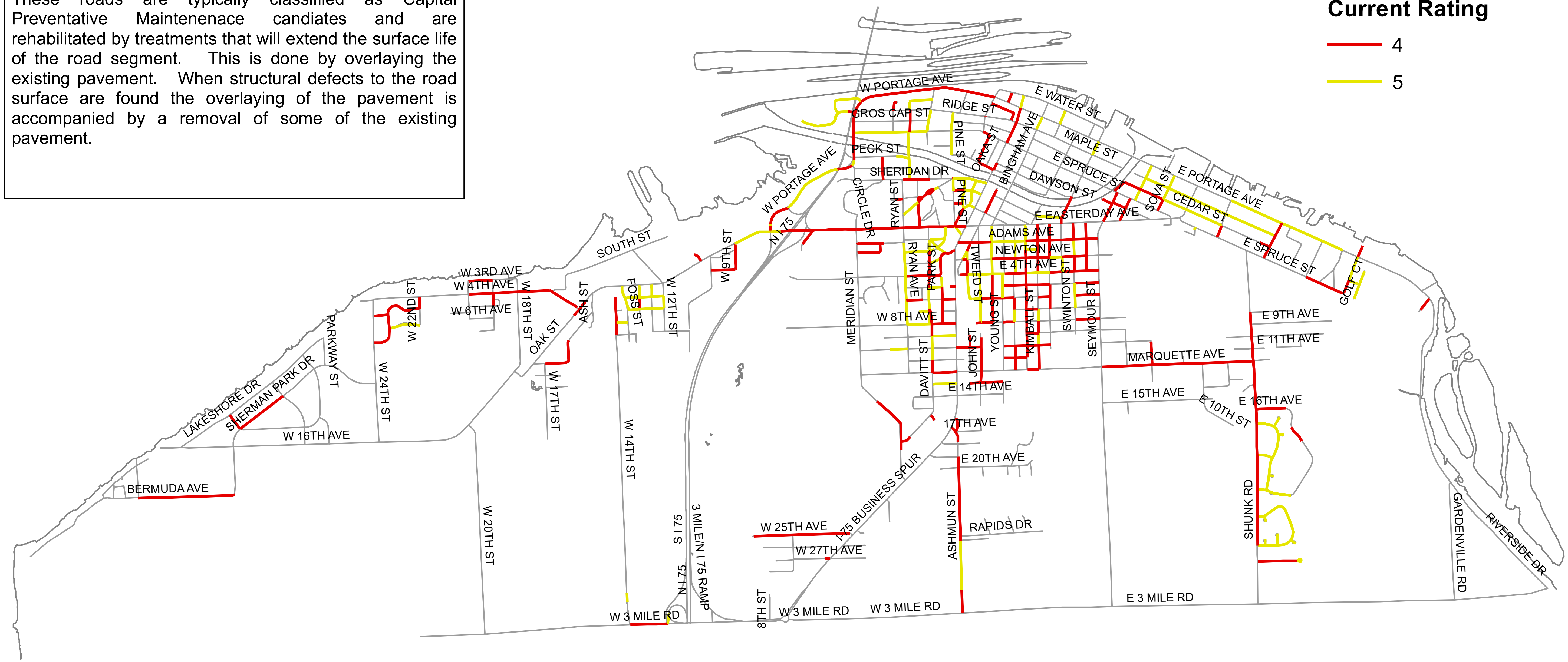
Legend

PASER Rating

Current Rating

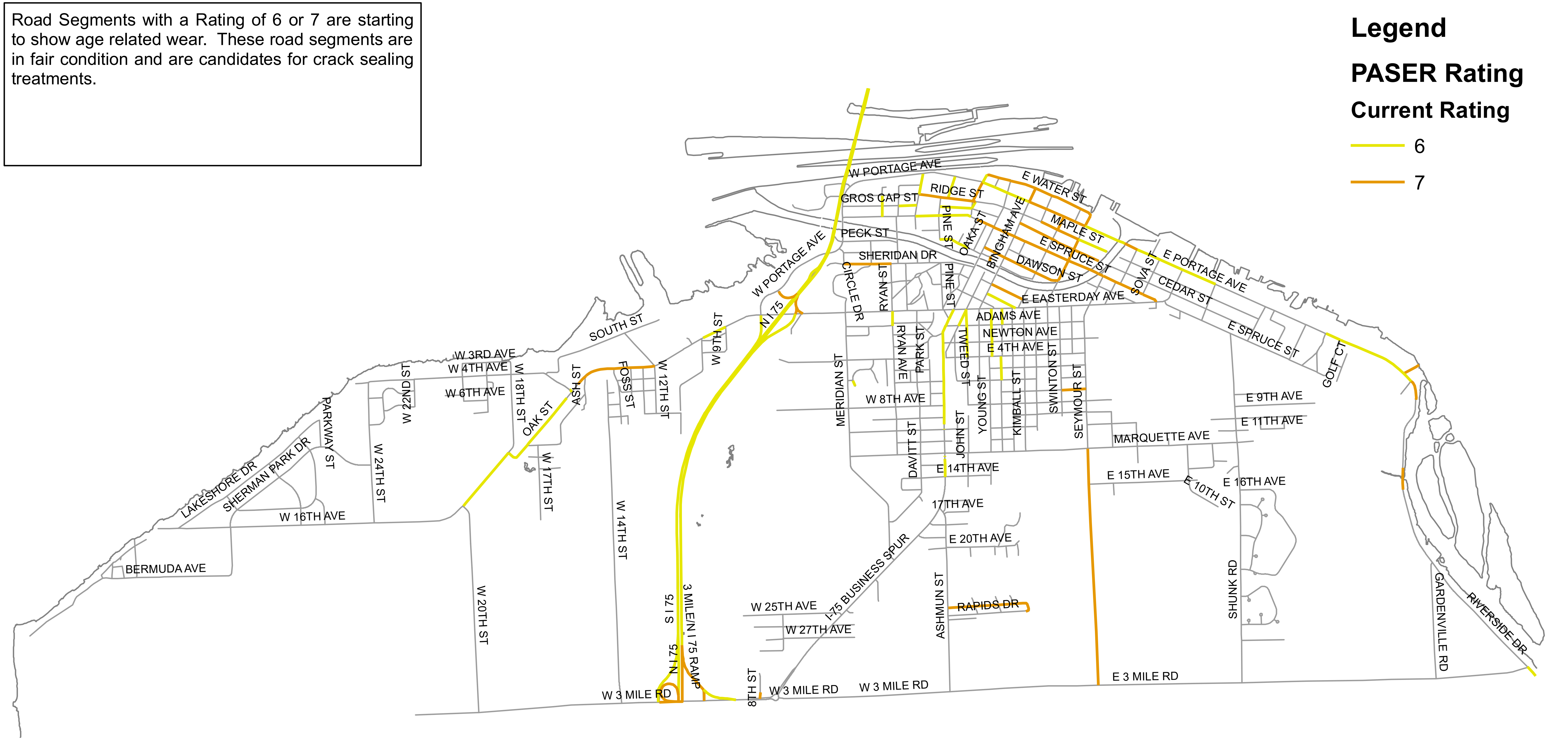
4

5



City of Sault Ste. Marie: Rating 6-7

Road Segments with a Rating of 6 or 7 are starting to show age related wear. These road segments are in fair condition and are candidates for crack sealing treatments.

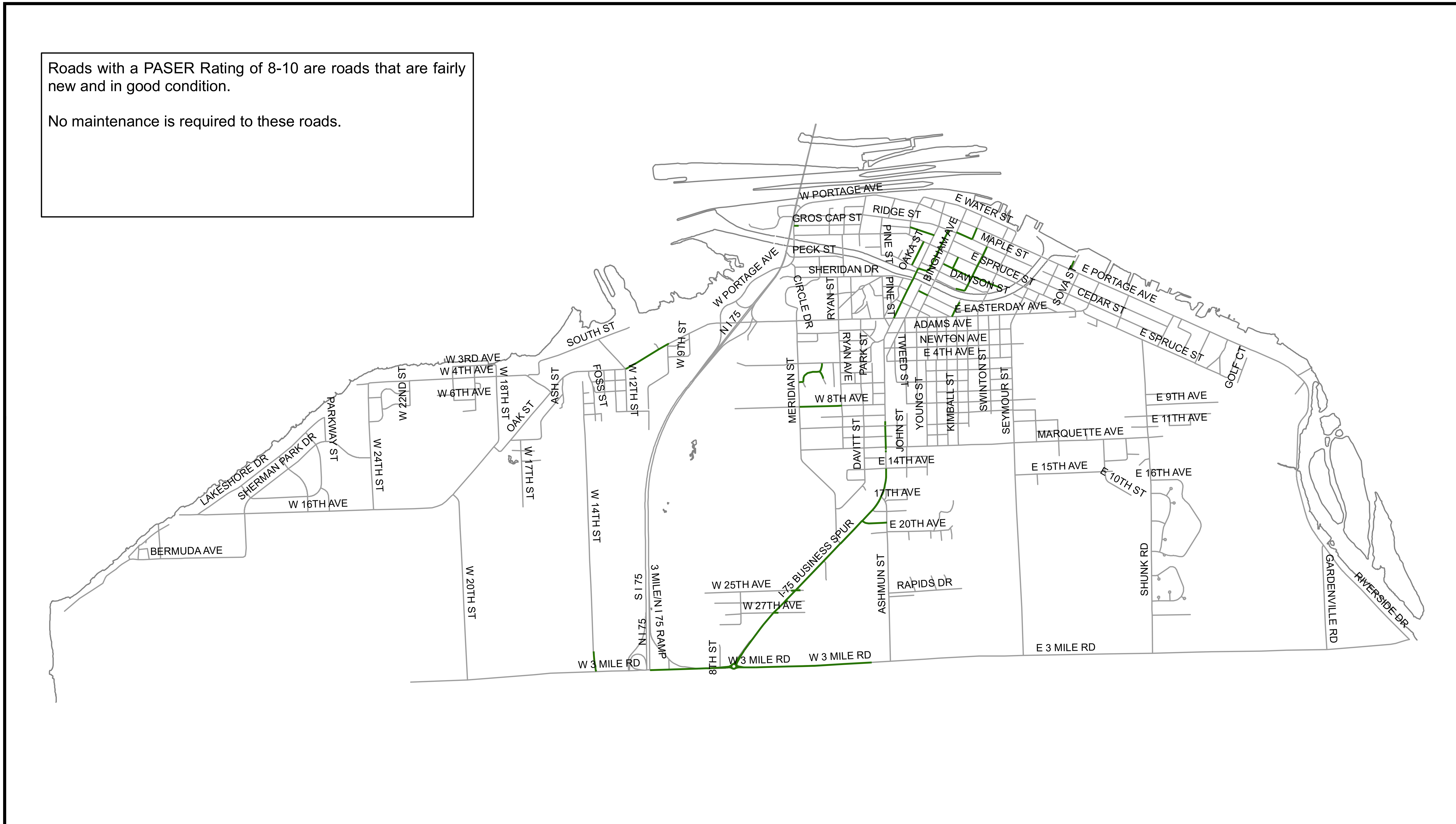


City of Sault Ste. Marie: Rating 8-10

0 0.5 1 2 Miles

Roads with a PASER Rating of 8-10 are roads that are fairly new and in good condition.

No maintenance is required to these roads.

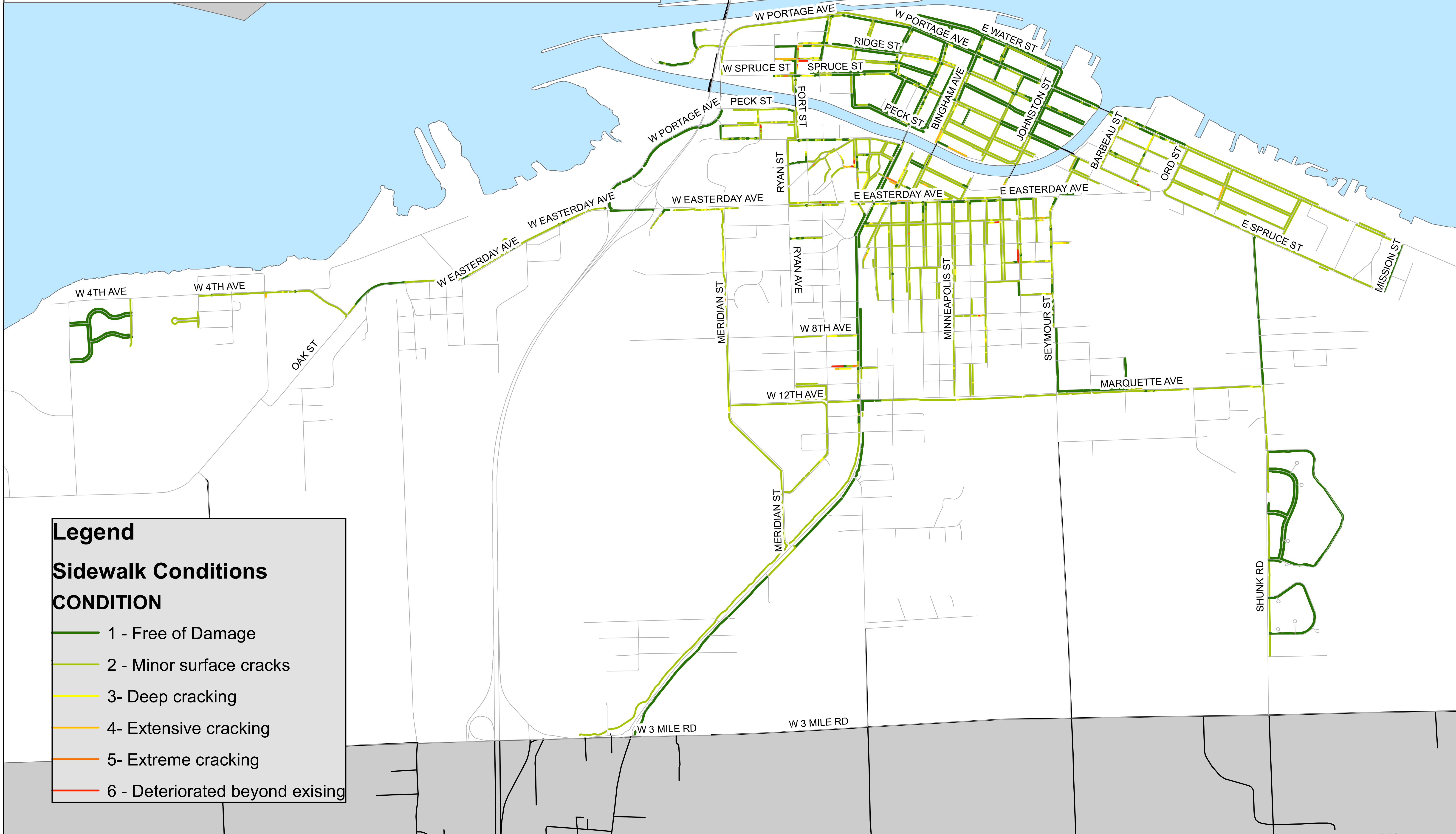


Overview of Road Selection for Capital Improvement Projects

The City of Sault Ste. Marie is utilizing output from annual PASER collection ratings to prioritize road reconstruction and preventative maintenance projects to be included within the Capital Improvement process. In recent previous years this prioritization is a result of a utility infrastructure meeting held between the City Manager, City Engineer, DPW Director, Assistant City Engineer, Street Superintendent, Parks Department Head, and GIS technician. Prioritization of roads is based on existing road conditions, street use and utility needs, and further programmed by the City Engineer based on the nature of construction, suitable grouping of streets for construction, and available grant funding. Further consideration is the development and interconnectivity of our recreation areas, and non-motorized assets (sidewalk, multi-use trails, etc.) with our road network.

This prioritization of roads has been beneficially implemented by asset management supported by storage of road and utility inventory related data into a geographic information system (GIS). The interrelated database storage elements and software platforms of a GIS have enabled us to produce illustrations and compiled datasets to spatially correlate and identify road segments of higher need. This is done by spatial analysis of road assets with surface deterioration and comparing them to water distribution elements that need replacement, waste collection distribution elements that need replacement and road drainage fully contained system elements that need replacement. This spatial analysis provides data-based recommendations that supports the input of City staff members.

SSM SIDEWALK CORRIDORS



Appendix B
Board & Committee CIP Input, Meeting Minutes & Suggestions

Historical Development Commission	*January 23, 2024 - Plan review*
Parks and Recreation	*January 30, 2024 - Plan review*
Planning Commission - Call for Projects	*January 25, 2024*
Planning Commission - Projects	*February 22, 2024*

Historical Development Commission
of the City of Sault Ste. Marie
MEETING MINUTES
January 23, 2024

1) **CALL TO ORDER**
The meeting of the Historical Development Commission was called to order by Chairperson, Mary June at 2:00 pm in the City Hall – 2nd Floor Conference Room

2) **ROLL CALL**

Present:	Mary June, Thomas Tocco, Deidre Stevens, Patty Olson, Ginny Cymbalist, Roger Blanchard
Absent:	Ruth Neveu
Also Present:	Tracey Laitinen, Engineer Staff Kristin Collins, Finance Director Steve Habusta, City Commission Liaison Kyler Reattoir, Harbor Master

Motion by Cymbalist, supported by Tocco to excuse those absent. Motion passed unanimously.

3) **FINANCIAL REPORT**
Collins gave an overview of the financials ending 11/30/23 as well as an explanation of this year's budget. Current fund balance is $55,862.27. Staff wages are at 80% so we will need to evaluate staffing and cruise reservations in the spring. Budget preparation will start in February with department head meetings in March. Laitinen will add this to the February agenda. Fund 106 – Osborn Trust Operating was reviewed showing $19,400 out to operations for the Historic Homes and $50,000 for repairs and maintenance.

Motion by Blanchard, supported by Tocco, to accept the financial report as presented. Motion passed unanimously.

4) **APPROVAL OF MINUTES**
Motion by Blanchard, supported by Cymbalist to accept the HDC minutes from the November 8, 2023, meeting. Motion passed unanimously.

5) **CHANGES OR ADDITIONS TO THE AGENDA:**
Under Old Business – June added SHPO

6) **PUBLIC COMMENTS:** None

7) **CITY COMMISSION UPDATE:** City Commission Liaison Habusta was introduced. June and Olsen explained the history of the HDC and Osborn Trust as well as past funded projects and how requests for funding are handled.

8) **DDA UPDATE:** Postponed as the DDA Director recently resigned

9) OLD BUSINESS:

a) CIP Review: The draft CIP book was distributed to the HDC and members gave input on upcoming proposed projects. Comments were recorded for 3 specific CIP items.

i) Ashmun Bay, Parks & Recreation Project – ramp improvements for emergency services – feedback was that the group wants to make sure the Treaty Rock is respected. There was also discussion on if this was a ship building location at one time. The Treaty Rock was identified in 1822 and marks the U.S. Government boundary from Ashmun Bay to the Little Rapids Creek. The group recommended possibly reaching out to the tribes for additional information, realizing the sensitivity of the subject. A historical sign was recommended for this location.

ii) Mission Launch, Parks & Recreation Project – ramp improvements in partnership with the National Guard as that is their main launch. The group discussed the historical significance of that area and noted a dock used to be located out in the water and recommended a historical sign for this location.

iii) Historic Homes Roof Treatment, Parks & Recreation Project – the group was happy to see this included to preserve 3 of the homes, mention was made to let St. Mary's Church know if this does become funded as they have a cedar shake roofing as well and maybe we could all save funds if we partner

b) SHPO: June inquired about the national historic register updates. Laitinen had not heard back from MDOT but will follow up again.

10) NEW BUSINESS:

a) Laitinen and Reattoir will work on a bid draft for the repair work using the contractor walk through items from last Fall and the updated list that Reattoir has compiled. If bids come in over budget we will have to do them in phases. Painting quotes from last year will also have to be reviewed. Cymbalist would like to have input on future vegetation and flower cutting and planting.

b) Cymbalist has been working with Jeanne Tubman to replicate the voyager map that is located in the River of History Museum. This smaller 4' x 6' map would be displayed in the Johnston House. The Chippewa Co. Historical Society would like to apply for the MACC Grant in the amount of $2100 and proposed that the HDC commit to the match of $2100 for total project costs of $4200. The project would not occur if the grant was not awarded. The artist could not develop the map until 2025 so this would be in the HDC FY25.

Motion by Olsen, supported by Stevens to commit $2100 from FY25 to the project pending grant funding. Motion passed unanimously.

11) **OTHER MATTERS:**

Olsen would like to see a celebration occur for the 200th anniversary (2027) of the Schoolcraft House.

Tocco appreciated the Jesuit Ring research and archeological reports.

Olson reported that Sault Schools would be holding a 100th anniversary celebration on May 12th and would have more information soon.

Reattoir reported that the first ship will be here on May 9th and that so far #15 are booked for this season.

Collins reported that the next Osborn Trust Board meeting is scheduled for Monday, February 12th at 9am on the 3rd floor in the Mayor's Chambers. All are welcome to attend.

12) **NEXT REGULAR MEETING DATE:**

The group proposed meeting at 2pm on the 3rd Tuesday of the month, skipping December. Laitinen will book the room and send out the calendar invite.

13) **ADJOURNMENT**

Motion by Tocco, supported by Blanchard to adjourn the meeting at 3:22 pm

Deidre A. Stevens

Deidre Stevens, Secretary

SAULT STE. MARIE PARKS AND RECREATION ADVISORY BOARD

3RD FLOOR COMMISSION CHAMBERS
225 E. Portage Ave., Sault Ste. Marie, MI 49783
(906) 632-3268 - tkiczenski@saultcity.com

MEETING MINUTES

Tuesday, January 30, 2024, at 6:00 pm

Present: Jason McLeod, Kim Smith, Tim McKee Jr., Fred Williams, Dani Filipek, Heidi Wilson, Public Services Director -Tyler Perron, Recreation Coordinator -Trisha Kiczenski, Engineering Project Specialist -Tracey Laitinen

Absent: Stephanie Petrow, Stephen Minta, Lindsay Koskenoja, Commissioner Jody Bosbous-Rath, Student Madison Mundy

CALL TO ORDER. The meeting was called to order by Jason McLeod at 6:00 pm.
ROLL CALL. Attendance was taken as noted.

PUBLIC COMMENT on Scheduled Agenda Items: Any person may reserve time to speak on any agenda item not to exceed five (5) minutes per person.

1. CONSENT AGENDA

- **a.** Acceptance of the 11/28/23 minutes passed unanimously.

2. DIRECTOR'S UPDATE

- i. Due to the unusually warm temperatures, Sault Seal Recreation Area may not open this season.
- ii. Improvements are being made to the Chalet. New siding, windows and doors have been installed and shutters are being built.
- iii. Kaines Rink had ice. Volunteer groups worked on that. A couple rentals were booked. Kaines Classic was held there Friday and Saturday, Feb 26 & 27th. Sunday the tournament was moved to the Pullar Stadium due to water on the ice.
- iv. Pullar Stadium boilers went out to bid. Two bids came back in under budget. It is going to the Commission for approval to award the bid to a company out of Escanaba. The concession area bid is still being worked on. We are looking at going with a ventless system using electric appliances.
- v. Sherman Park restrooms have been upgraded with new toilets and sinks.
- vi. We are working on budgeting for Parks Security. Police Auxiliary is an option. Cameras are also being researched.
- vii. Vandalism happened at Kaines the first weekend that it was opened to the public. The building will go back to being locked up and rented by the hour.
- viii. James Field experienced vandalism last week. A window at the concession building was broken. We were able to have the windowpane replaced. We may also add shutters to cover the windows there.

3. SPECIAL ORDERS OF BUSINESS

a. Appointments

- i. Heidi Wilson was appointed to the Parks and Recreation board last week.
- ii. Fred Williams was nominated and appointed Vice Chair of the Parks and Recreation board.

CITY OF SAULT STE. MARIE
PLANNING COMMISSION
January 25, 2024 (Thursday) 5:30 P.M.
3RD FLOOR CITY COMMISSION CHAMBERS

Pending approval from Planning Commission

1. CALL TO ORDER:

Joseph Gallagher, Chairman, called the meeting to order at 5:33 p.m.

2. ROLL CALL:

Present:	Joseph Gallagher, Chairman Angela Patterson, Secretary Charles McCready David Markham Tim McKee Jr.
Absent:	Steve Akkanen, Vice-Chairman Stephanie Roose Wendy Hoffman

Roll call was taken as noted above.

Staff Present:	Kelly Freeman, Community Development Director Melanie McBride, Community Development Administrative Assistant Tracey Laitinen, Engineering Project Manager (CIP Admin)
Public Present:	None

It was moved by Charles McCready, and supported by Angela Patterson, to excuse the absent members that notified staff of their absence. The motion carried.

3. APPROVAL OF MINUTES:

It was moved by Angela Patterson, and supported by Charles McCready, to approve the September 28, 2023, Planning Commission meeting minutes with the corrections to board member titles on page 1. The motion carried.

4. AGENDA: CHANGES, ADDITIONS, OR DELETIONS: There were none.

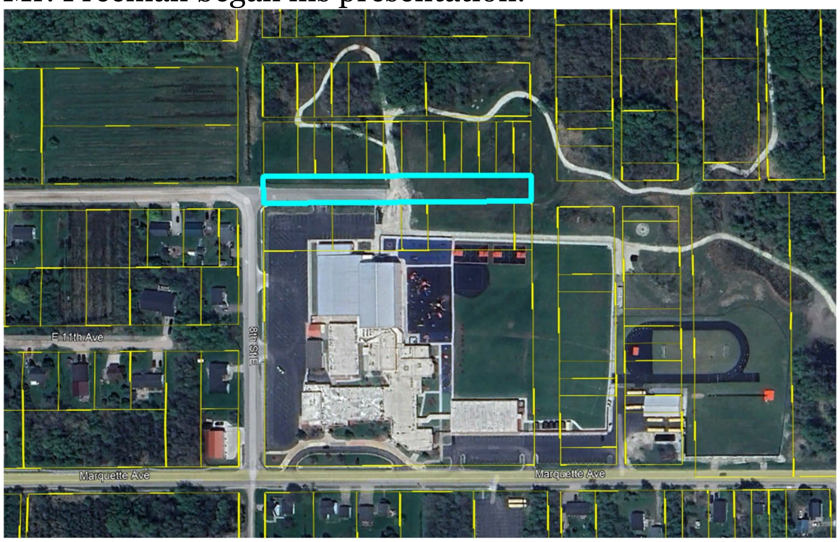
5. UNFINISHED BUSINESS: There was none.

6. PUBLIC HEARINGS: There were none

7. NEW BUSINESS:

a) <u>Request for Street Vacation –Everett & Eveland's Sub– PC Case #881:</u>

Mr. Freeman began his presentation.



The subject property is located in the area shown above which is E 10th Avenue, between 8th Street and 9th Street. It is 620 feet in length, and 60 feet in width.

The property is mostly unimproved, with a private paved roadway in the west end to serve the parking lot at the Northwest corner of the Joseph K. Lumsden (JKL) School campus.

There are no known utilities within the street.

The applicant received City permission to construct the existing improvements within the street. The Bureau of Indian Affairs has determined that agreement to be invalid making the requested vacation a reaction to that determination. The Sault Tribe of Chippewa Indians owns all land on the north and south sides of the street. Additionally, they are the primary landowner east of the vacated right-of-way as well.

There are no concerns about access being lost. Utility easements will be retained to ensure access to any future structures. There were no objections by utility providers, subject to the reservation of utility easements.

In regard to public comment, Mr. Freeman received one phone call from a neighbor across 8th Street with no concerns about the request.

Mr. Freeman's recommendation to the City Commission is that the full width and length of East 10th Street between Block B and Block C, Everett and Eveland's Addition, be vacated with the retention of utility easements.

Seeing no public in attendance, Joseph Gallagher opened the board discussion.

Charles McCready stated that this is a perfect example of land that is platted, probably around the 19th century, and not developed. It is a common problem for the City.

It was moved by Charles McCready, and supported by Angela Patterson, to recommend approval of the street vacation with the retention of utility easements to the City Commission. The motion carried.

Roll Call:

Angela Patterson	*Yes*
Joseph Gallagher	*Yes*
David Markham	*Yes*
Tim McKee Jr.	*Yes*
Charles McCready	*Yes*

b) <u>Discussion of Language Amendment – Removal of references to PA 207 of 1921 – PC Case #882:</u>

PC Agenda Item 7b
January 25, 2024
PC Case No. 882

PROPOSED ZONING ORDINANCE AMENDMENT: REMOVAL OF REFERENCES TO PUBLIC ACT 207 OF 1921, THE CITY AND VILLAGE ZONING ACT

In 1921, Public Act 207 (The City and Village Zoning Act) was signed into law to give cities and villages in Michigan the authority to establish local zoning regulations by ordinance. Quite often, these local ordinances reference the state laws from which authority is derived and the City of Sault Ste. Marie's zoning ordinance is no different.

The 1921 law was entirely superseded by PA 110 of 2006 (The Zoning Enabling Act) making any references in zoning ordinances to the previous law outdated. As part of the City's participation in the Michigan Economic Development Corporation's (MEDC) Redevelopment Ready Communities (RRC) program, the MEDC has identified three such outdated references in the City's zoning ordinance to the 1921 which need to be modified to reference the newer 2006 law.

One such outdated reference is found within the opening language of the ordinance which is associated with the title and the remaining two references are found within the Zoning Board of Appeals section (Sec. 10-1.2000 and Sec. 10-1.2002). To ensure that correct references are used within the City's Zoning Ordinance, staff recommends that the three references to the old law be replaced with references to the new law.

If the Planning Commission concurs that the proposed language is appropriate, staff requests that a public hearing be called for the February 22, 2024, meeting.

Mr. Freeman explained to the board that these discrepancies were found by the Michigan Economic Development Corporation's Redevelopment Ready Audit. The state identified three references to an obsolete planning law.

Mr. Freeman recommends the board set a Public Hearing for the language amendment on February 22, 2024.

No public was in attendance and no discussion was needed for this agenda item.

It was moved by Angela Patterson, and supported by Tim McKee, to schedule a Public Hearing on February 22, 2024, for a language amendment. The motion carried.

Roll Call:

Charles McCready	*Yes*
Joseph Gallagher	*Yes*
David Markham	*Yes*
Tim McKee Jr.	*Yes*
Angela Patterson	*Yes*

8. OTHER BUSINESS:

a) <u>Public call for projects – 2024-2030 Capital Improvement Plan (CIP):</u>

Mr. Freeman explained that at our February 22nd meeting we will be taking public comment regarding the CIP.

Joseph Gallagher asked how it will be advertised to the public. Mr. Freeman stated that there is information on the website as well as Facebook.

9. STAFF REPORTS:

Mr. Freeman gave an update on the Citizen Planner Training. If there are members who wish to do the in-person training, up to two sessions can be missed and made up online.

Mr. Freeman stated that he could possibly be out for a few meetings. If necessary, City Manager Brian Chapman will fill in.

10. MATTERS TO BE PRESENTED BY THE PUBLIC OR COMMISSION:

Charles McCready stated that a clean up with these platted alleys and streets is a good thing.

Joseph Gallagher agreed that it is good to look back.

Charles McCready asked Mr. Freeman to pass along a message to DPW regarding the dumpster that was placed next to his property at Harvey Marina.

11. ADJOURNMENT:

There was a motion by Charles McCready, and supported by Angela Patterson, to adjourn the meeting at 5:51 p.m. The motion carried.

Respectfully submitted,
Sault Ste. Marie Planning Commission

b. CIP

i. The Ashmun Bay Project. The City was contacted by the US Coast Guard regarding a deep water launch. Currently there is not a launch to accommodate larger vessels. The USCG said that it would be a good fit for a grant program. If awarded there would be dredging and possibly a sea wall to tie up to. Jason McLeod questions the cost. Tyler suggests it would possibly be $500,000 to 1,000,000.

ii. Bleachers at Malcolm Park. The bleachers we have are aging. We applied for a Spark Grant again. Our application included fencing, bleachers, ADA viewing areas, demo of old buildings, replacement of storage building on 8th and Meridian. The grant request totaled $945,000. The application deadline is 1/31/24. We were expected to hear back 2/23/24. In case we do not get the grant, we have the bleachers on CIP.

1. Funding for the bleachers would come from General Fund
2. Projects over $10,000 must be on CIP unless it is an emergency.

iii. Sherman Park Erosion, beach, sand nourishment. The west end of the beach area has been eroding. In 2014 there was erosion work. Then in 2019 there were high water problems. We expect to work on this project in-house.

iv. Malcolm Park Fencing: Gerrish field fencing has been added if grand funding doesn't come through. Some could be done with the operational budget.

v. Production Mower to replace a 2009 mower. These are run 5 days a week. Cost is approximately $90,000. Keeping with similar style.

1. City owns three of this style.

vi. Mission Street boat launch would be rehabbed. We may be doing a joint project with the National Guard. The City would need to buy the materials. Jason questions the plan to fill.

vii. Zamboni at the Pullar. Currently we own a 2010. The replacement is roughly $100,000. Electric Zambonis are roughly $50,000 more.

viii. Kemp Marina Wave Attenuators are in disrepair. Much of the steel sheeting is loose. We are looking at options to either fix what is there, or place plastic attenuators that all link together. They would be removed seasonally.

c. Adopt a Park Application

i. The updated application was shared with the board. This new application will be for larger scale adoption projects.

ii. Fred Williams states that he reviewed other Cities adopt a park applications. He said he will share items for review via email to add to the application draft.

4. MATTERS PRESENTED BY THE PUBLIC: (COMMENTS MAY NOT EXCEED FIVE MINUTES PER PERSON)

a. None

5. MATTERS PRESENTED BY THE MEMBERS

None

ADJOURN Jason McLeod motions to adjourn, Fred Williams supports. The meeting adjourned at 6:47 pm.

CITY OF SAULT STE. MARIE
PLANNING COMMISSION
February 22, 2024 (Thursday) 5:30 P.M.
3RD FLOOR CITY COMMISSION CHAMBERS

Pending approval from Planning Commission

1. CALL TO ORDER:

Joseph Gallagher, Chairman, called the meeting to order at 5:32 p.m.

2. ROLL CALL:

Present:	Joseph Gallagher, Chairman Angela Patterson, Secretary Charles McCready David Markham Tim McKee Jr. Stephanie Roose
Absent:	Wendy Hoffman

Roll call was taken as noted above.

Staff Present:	Brian Chapman, City Manager Melanie McBride, Community Development Administrative Assistant Steve Habusta, City Commission Liaison
Public Present:	David Ulrey Ben Zoppa Robert Thompson Bruce Burton Robyn Hungerford Craig Flickinger

It was moved by Charles McCready, and supported by Tim McKee, to excuse the absent members that notified staff of their absence. The motion carried.

3. APPROVAL OF MINUTES:

It was moved by Angela Patterson, and supported by Stephanie Roose, to approve the January 25, 2024, Planning Commission meeting minutes as written. The motion carried.

4. AGENDA: CHANGES, ADDITIONS, OR DELETIONS:

Staff had one item to address under agenda item 9.

5. UNFINISHED BUSINESS: There was none.

6. PUBLIC HEARINGS:

a) Request for Rezoning from R-1 to B-3 – Burton Land Holdings, LLC – PC Case #883

City Manager Brian Chapman began the presentation on the agenda item. The subject property consists of approximately 3.8 acres, inclusive of 0.28 acres of unvacated alleys. The property is occupied by a single-family residence and associated accessory buildings at its northwest corner. The remaining property is undeveloped but has been historically used as a soil/material storage and snow dump by Burton Excavating, which shares common ownership with the subject property.

Property location shown below:

Non-residential activities were curtailed in 2021 after a noise complaint, due to weekend operation of a powered soil screen and heavy equipment on-site.

The property owners sought a use variance from the Zoning Board of Appeals to continue the activity, however, their application was denied. The owners then submitted this application for rezoning to be able to establish self-storage uses on the property.

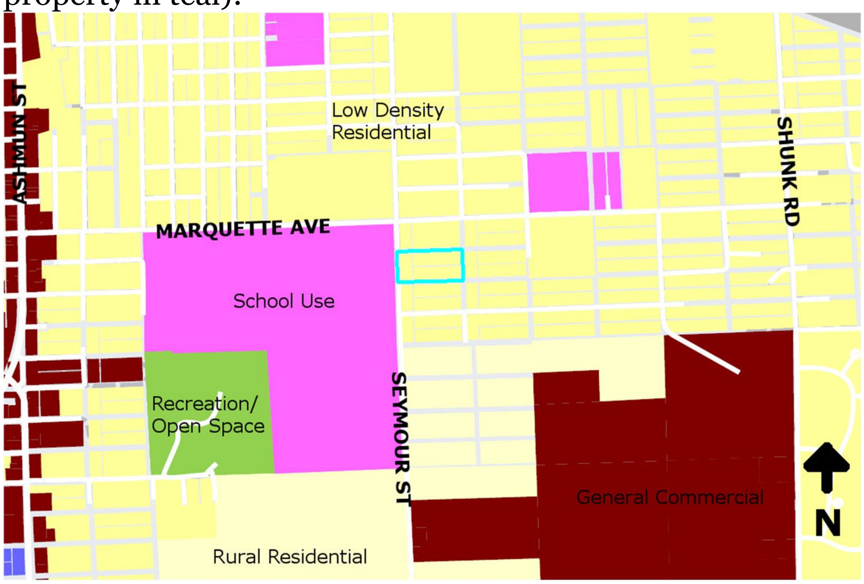
The applicant is requesting the following property be rezoned from R-1 to B-3:
Ainsworth's Addition, Block 3

Although the rezoning is being sought for a specific purpose, if approved, all uses in the new district become permissible on the subject property once zoning is changed. This review should take place in the context of what could happen under the new district, not just what is planned to happen. The staff review will be from that perspective.

Changes to zoning are essentially permanent and run with the land. The site has been residentially zoned since zoning was established in the City in the late 1920s. The dwelling on the subject property was built sometime between 1939 and 1954, based on aerial photos. The current R-1 zoning has been in place since 1965, and in the Burton family ownership since 1977.

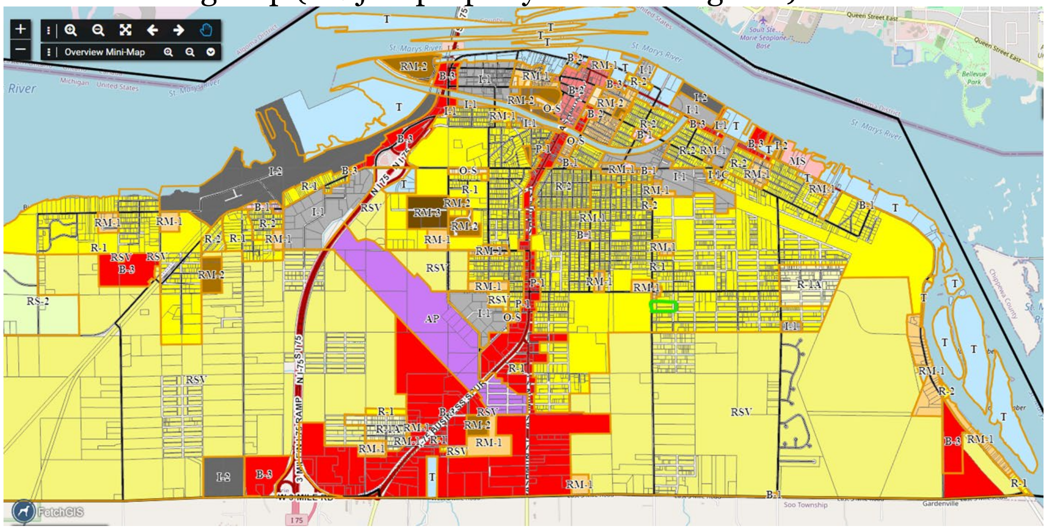
Reviewing the Future Land Use (FLU) Map is generally the starting point for determining if a rezoning request is consistent. The FLU Map calls for the subject property and those in its immediate surroundings to remain in residential use going forward. As such, the requested rezoning to B-3, a commercial zoning district, is not consistent with the FLU Map. The Master Plan and FLU Map are prepared with a significant amount of public engagement. It should not be disregarded without serious consideration. Decisions made which deviate significantly from what is called for in the FLU Map and Master Plan are generally open to court challenge.

FLU Map image of the property vicinity below (low density residential in yellow, subject property in teal):

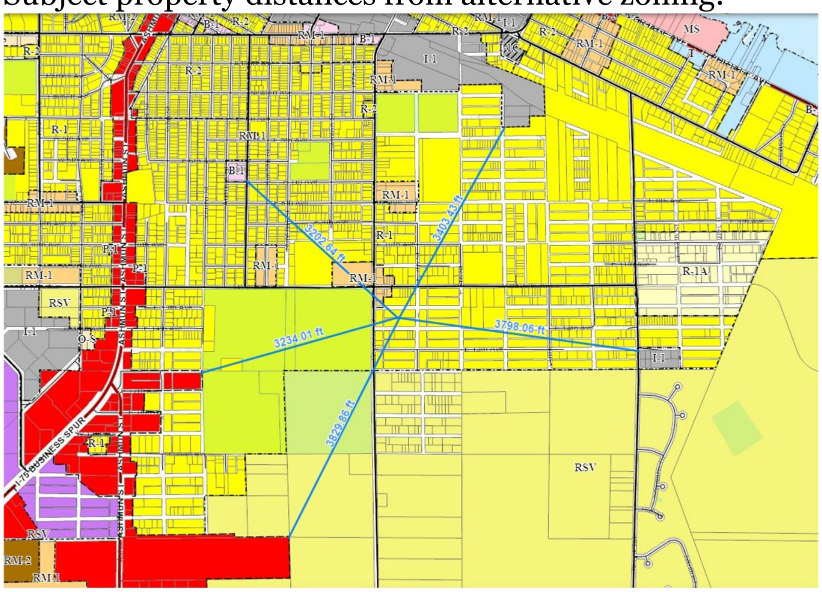


Another area of consideration is the compatibility of the uses in the requested district with those existing and likely to occur in the vicinity. The B-3 district is primarily focused on the retail-type uses in which the customer arrives by car. Associated with areas of greater traffic volume, late evening activity, and associated noise. B-3 additionally permits apartment complexes of four or more units, State-licensed mobile home parks, self-storage facilities, etc. The majority of uses within the B-3 district bring with them side-effects which are incompatible with residential uses.

Current zoning map (subject property outlined in green):



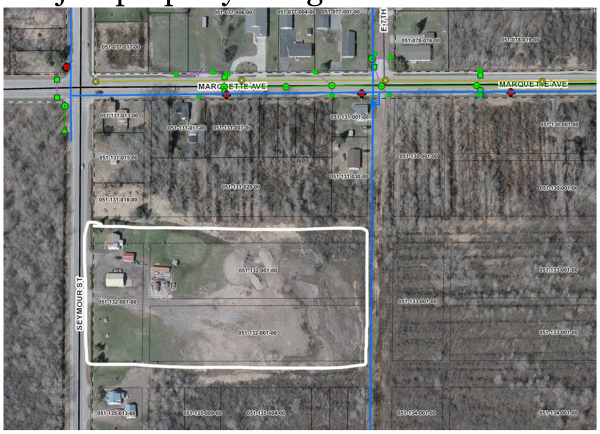
Subject property distances from alternative zoning:



Spot zoning is the term which is applied to the practice of creating a relatively small area of different zoning amongst a larger area of consistent zoning. It is generally reviewed against four characteristics, all of which should be present:

1. Small area compared to the size of surrounding districts.
2. New district allows for land uses inconsistent with those allowed in the vicinity.
3. New district would confer special benefit on the individual property owner not enjoyed by the owners of similar property.
4. Conflicts with the policies in the text of the master plan and Future Land Use (FLU) map.

Subject property along with current utilities in area:



In regard to public comment, Mr. Freeman had received four contacts to date. One approval from Mrs. Burton. Two in opposition to the rezoning request. One sought additional information on the request but offered no opinion.

Mr. Freeman's recommendation is to deny the request due to the following:

- Inconsistent with the adopted FLU Map and Master Plan
- Permitted uses within the B-3 district are incompatible with the established single-family uses in the surrounding area.
- It meets all criteria for what is generally regarded as spot zoning.

Brian Chapman concluded the presentation and turned the meeting back to the Chairman.

Joseph Gallagher opened the public hearing.

Robert Thompson, of Burton Land Holdings, provided Mr. Chapman with a PowerPoint Presentation to display to the members and audience. Additionally, a letter was provided to the members from Jim Knight as seen below:

KNIGHT PROPERTIES EUP, LLC

2953 RIVERSIDE DRIVE
SAULT STE. MARIE, MI 49783

February 20, 2024

To Whom It May Concern:

I owned 1140 Marquette Ave and 1906 E 7th Street, which abuts to the Burton's property, for several decades. I have spent many days there working over the years and never noticed any noise nor have any of my tenants ever mention to me that they were bothered by work going on behind them.

Sincerely,

James Knight

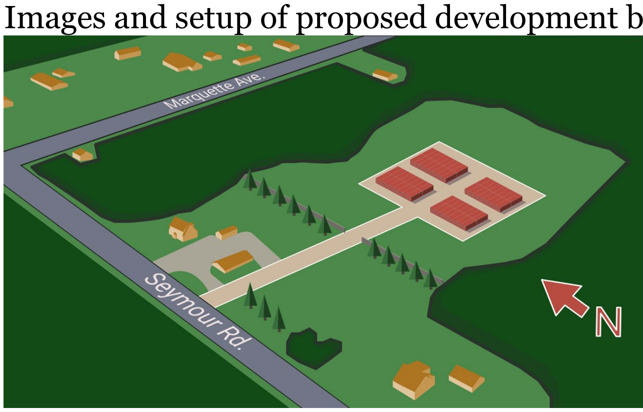
The following is from the PowerPoint provided and explained by Robert Thompson, of Burton Land Holdings. They are requesting the rezoning of 1864 Seymour Street in Sault Ste. Marie. There is an estimated 31 plotted lots (3.8 acres) with an average size of 41'x 125' per lot. Rezone from an R-1 (Residential) Zoning Classification to B-3 (Cold Storage Center) Zoning Classification. The existing property is currently zoned R-1. It is vacant land, which is not in use. There is a 16" water line available toward rear of property, but no sewer nearby, it would have to be engineered and developed. He met with Mr. Freeman to discuss options. There are a lot of limitations with developing this area into affordable housing. If they were to go to B-3 there are more possibilities. It is located off a main road (Seymour), and not too far from population. It would assist in the demand for storage in the area. Rob provided some background information on the property:

- 1977 Joe & Marilyn Burton purchase property from Church of God
- 2001- Quit Claim deed filed to move property under Burton Rentals, LLC
- 2013- Quit Claim deed filed to move property under Burton Landholdings, LLC
- 2021 Applied for variance for topsoil screening and snow storage.
- 2024 Apply for rezoning for cold storage.

The current zoning around the property consists of Single Residential (R-1) which is Single Family homes, Residential Reserve District (RSV) which is to preserve the natural features of the area, and Multi-Residential Homes (RM-1), which is Multiple family homes. Burton Land Holdings would like to make the following improvements to the property:

- They would start with removal of current debris on property.
- They will work with Sidock Engineering to develop a blueprint of a storage plan.
- Bring in proper base material, like gravel, to flatten and level grounds.
- Purchase and recondition 20'x8' storage containers for easy to set up and access.
- Enhance the entrance into the property ensuring a safe and aesthetic appeal.
- Purchase and set up privacy fencing for security and to have storage out of the view of passersby.
- Install trees and landscaping between road and fencing.

Images and setup of proposed development below:



The ability to utilize the land was changed after nearly forty years. Burton Land Holding's has tried to find ways to work with the City for development. The existing R-1 zoning does not support the proposed development; with current infrastructure, however the proposed B-3 does support this development of property and give a noiseless more appealing look. While there is Residential zoning is in the immediate area, there are B-3 and residentially zoned areas around the city that flow together. There would be limited hours of access along with certain criteria to be courteous to our neighbors. With Regards to Mr. Freeman's report, the refute the proximity to commercially zoned property shown as the casino over a half mile away. There is a parcel not far from their location that is used to remove snow. To address the noise and traffic concerns there are already two busy schools and will not add to it. Additionally, with the cold storage proposed, the Burton trucks will not be accessing the property. Mr. Freman's report also addresses that there is inadequate infrastructure to support development. Roads as well would need to be constructed to support more residential development. Rob provided and explained the letter from Jim Knight. Lastly, he brought up a Legal Case, Karen Connell v. Lima Township, 2021:

- A conditional rezoning involves a property owner's offer to impose certain conditions on the use of property in exchange for a rezoning to a new use classification. The Michigan Zoning Enabling Act (MZEA), MCL 125.3101 et seq., specifically allows a local unit of government to engage in conditional rezoning:
- An owner of land may voluntarily offer in writing, and the local unit of government may approve, certain use and development of the land as a condition to a rezoning of the land or an amendment to a zoning map.
- In approving the conditions under subsection (1), the local unit of government may establish a time period during which the conditions apply to the land. Except for an extension under subsection (4), if the conditions are not satisfied within the time specified under this subsection, the land shall revert to its former zoning classification.
- The local government shall not add to or alter the conditions approved under subsection (1) during the time period specified under subsection (2) of this section.
- The time period specified under subsection (2) may be extended upon the application of the landowner and approval of the local unit of government.
- A local unit of government shall not require a landowner to offer conditions as a requirement for rezoning. The lack of an offer under subsection (1) shall not otherwise affect a landowner's rights under this act, the ordinances of the local unit of government, or any other laws of this state. [MCL 125.3405.]

Burton Land Holdings has been working hard to find a solution regarding development. He has been working with Mr. Freeman. The previous variance was denied, and Mr. Freeman explained that they could ask for a rezoning.
Ending slide of PowerPoint presentation:

Robert concluded and stated that he would answer any questions of the board.

Charles McCready asked for clarification. The previous variance request was for a previous use of soil screening and snow storage, not self-storage. He wanted to be clear that the Zoning Board of Appeals was not asked about self-storage activity.

Robert Thompson confirmed that the variance request was for soil screening and snow storage.

Robyn Hungerford, of 1222 E. 15th Avenue, is the complainant that initiated the initial noise issue back in 2021. They were not using the property as a soil screening facility for decades; they used it for two years. She has lived at that property for 20 years, so she would have noticed. She didn't complain at first due to the pandemic and figured it would stop. She also did not complain about the snow storage, just the noisy shaking of the soil. She stated that she is in denial of the rezoning. Additionally, the nearby property that he is claiming is used for snow removal is tribal property, and there is no city right to do anything about it. She stated that her neighbor Paul Piiranen is also against this and wrote a letter to Mr. Freeman. If they would like to develop this property, they should work with the City to help with water and sewer development in the area. There are also houses in the area that would appreciate sewer service.

Robert Thompson asked to respond. The Chairman warned to not have a back and forth but allowed him to speak again if he could keep it short.

Robert Thompson explained that he has met with Kelly about residential development and obtaining utilities. The closest sewer is off of Marquette Avenue. The costs are astronomical. They have reached out to the EDC and are working with Nikki. They are trying, but the cost is hindering residential development. The property has sat vacant and they are looking for some way to use it.

Bruce Burton, from Burton Excavating, explained the issues with the size of the property and the use of it for homes. He wanted to make it clear that the City owes the areas platted for roadways and alleys. There are no actual roadways. The only way is to physically construct them to allow access. The property also has wetlands, which makes roads difficult. Additionally, it is a huge cost to run sewer service to the property. Changes in the requirements for drain fields now require more area and the lots would be too small to have a home plus a drain field. So they are trying to find solutions, and some kind of use for the property. Ms. Hungerford mentioned that she had no problem with the snow removal, they were not aware that the only issue was with the soil processing, or they would have continued with just the snow removal. They are looking for options that are not noisy and not creating dust. Just some way to utilize the property with the surrounding wetlands.

David Ulrey explained that he is waiting for another agenda item, but wanted to comment on the containers. His dad was a state Fire Marshall, and they can be dangerous due to what people can put in them.

Ben Zoppa, with Burton Excavating, wanted to address two items. The first on is the noise complaints. He did an acoustic noise analysis back in 2021 and the vast majority of the noise around the property is due to the schools. This usage is a solution which will have very little noise. The second item was that B-3 can mix with residential uses such as trailer parks. Those developments are zoned B-3 and are situated in the middle of residential zoning. He feels there has been a precedent set for that.

Robert Thompson wanted to address the tribal land being used for dumping snow removal. He does not believe the tribe has a right to do whatever they like on the property because it has not been placed into trust due to the designation on the GIS map. When the GIS says United States that is sovereign, otherwise it is not in trust. Multiple audience members then started to argue that point.

The Chairman stopped the back and forth regarding tribal rights and asked for any other public comment. Hearing none, he closed the public hearing and opened board discussion.

David Markham stated that he is a new member and asked what uses could possibly be done on this property if this were to be rezoned to B-3.

Angela Patterson stated that she has the same question.

Brian Chapman explained that the application is for rezoning from R-1 to B-3, not for this specific proposed use. Brian then read all the B-3 uses from the Zoning Ordinance, which also includes B-2 uses as well.

Angela Patterson asked if the property were to be sold, could anything on the B-3 zoning apply to the new owners without even coming to ask.

Brian Chapman confirmed that the whole B-3 zoning would apply to the property regardless of ownership.

Robert Thompson asked to speak again, Joseph Gallager explained that public comment was closed, but he allowed him a moment.

Robert Thompson stated that they can impose any kind of stipulations that they wanted. If they were to get the variance, it could go back to the original zoning if it was sold to someone else.

Angela Patterson interjected that this is not a variance, it a request to rezone the property.

Brian Chapman stated that a conditional rezoning would be contractual with the property owner, and the City. There is nothing in front of the Planning Commission tonight for them to approve a conditional rezoning. The only thing the Planning Commission is determining is the rezoning from R-1 to B-3. Brian added that it has been some time since he has even been involved with a conditional rezoning, so he would have to look into the procedure further.

Joseph Gallagher also explained that this is an advisory board which only give recommendations to the City Commission.

Joseph Gallagher asked the public if they understand or have any other questions. Hearing none, he closed public comment again.

Charles McCready stated that for the Burtons, residential development is difficult due to the wetlands and the small subdivided lots. From a city point-of-view, if they are looking to encourage development within the confines of the city. He asked when the master plan was last updated.

Brian Chapman stated that the master plan was updated in 2018.

Charles McCready stated that the city should look towards more than just this one area for development and find uses that will be harmonious to the area when the master plan is updated again.

Charles McCready explained that Burton's may wish to address this specific request with the Zoning Board of Appeals, instead of a spot rezoning of a parcel of land. The prior request was only for soil screening and snow storage use. They can ask for a use variance specifically for self-storage. Without predicting how the ZBA would rule, it is possible that they would have a better chance of that specific use, rather than a general rezoning to B-3 district which would allow anything permitted in that district.

Brian Chapman disagreed and read through the authority of the Zoning Board of Appeals. After some discussion and reading through the ordinance section, it was found that the Zoning Board of Appeals can hear a use variance request. Money cannot be used as a factor in determining whether a variance is granted.

Charles McCready added that this kind of request would be better suited for the Zoning Board of Appeals, rather than the Planning Commission. What was presented by the applicant was why the property would be used for self-storage instead of in general why the property would be better being a B-3 district.

Joseph Gallagher asked if there was more board discussion. Hearing none, he asked if anyone would like to make a motion.

It was moved by Angela Patterson, and supported by Charles McCready, to recommend denial of the rezoning from R-1 to B-3.to the City Commission. The motion carried unanimously.

Roll Call:

Stephanie Roose	*Yes*

Joseph Gallagher	*Yes*
David Markham	*Yes*
Tim McKee Jr.	*Yes*
Charles McCready	*Yes*
Angela Patterson	*Yes*

Joseph Gallagher thanked the public for participation. It will still go to the City Commission during the March 4th City Commission meeting.

Before moving onto the next item Charles McCready would like the city to look into ways to solve these development constraints, such as use requirements, wetlands, etc.

Joseph Gallagher asked if this is an item he would like brought back to the Planning Commission.

Charles McCready just stated that he wanted to go on record for the City Commission and staff to look at ways to help the development of these types of properties.

b) Consideration of Language Amendment – Removal of references to PA 207 of 1921 – PC Case #882

Brian Chapman stated that this is a text amendment update to the Zoning Ordinance. There are references to some outdated state statutes, and it has been recommended to take it out. Brian Chapman explained that this item stems from Redevelopment Ready Communities Audit. This is an item that needs to be updated.

The draft language amendment changes provided in packet:

PC Agenda Item 7b
February 22, 2024
PC Case No. 882

ATTACHMENT

Draft ordinance language

Underlined language is proposed for addition and stricken language is proposed for deletion.

* * * *

TITLE

AN ORDINANCE enacted under ~~Act 207, Public Acts of 1921 [MCL § 125.581 et seq., MSA § 5.2931 et seq.]~~ <u>Public Act 110 of 2006 [MCL § 125.3101 et seq.]</u>, as amended, governing the incorporated portions of the City of Sault Ste. Marie, Chippewa County, Michigan…

* * * *

SECTION 10-1.20. BOARD OF APPEALS[9]

2000. Creation and leadership.

There shall be established and appointed by the City Commission, in accordance with ~~Act 207 of the Public Acts of 1921 (MCL § 125.581 et seq.) as amended,~~ <u>Public Act 110 of 2006 [MCL § 125.3101 et seq.], as amended,</u> a Zoning Board of Appeals.

* * * *

2002. Appeals, how taken.

The Board of Appeals shall hear and decide appeals from a person aggrieved, or by an officer, department, board, or bureau of this state or the City, and review any order, requirements, decisions, or determinations, made by an administrative official or body charged with the enforcement of an ordinance adopted under ~~Act 207, Public Acts of 1921 (MCL § 125.581 et seq.).~~ <u>Public Act 110 of 2006 [MCL § 125.3101 et seq.], as amended.</u>

Joseph Gallagher opened the public hearing.

David Ulrey stated that he highly recommends that the city should abide by current laws.

Hearing no other public comment, Joseph Gallagher closed the public hearing.

There was no board discussion, and a motion was made.

It was moved by Tim McKee Jr., and supported by Stephanie Roose, to recommend adoption of the language amendment as drafted to the City Commission. The motion carried.

Roll Call:

Angela Patterson	*Yes*
Joseph Gallagher	*Yes*
David Markham	*Yes*
Charles McCready	*Yes*
Stephanie Roose	*Yes*
Tim McKee Jr.	*Yes*

7. NEW BUSINESS:

a) <u>Consideration of the 2024-2030 Capital Improvement Plan (CIP):</u>

Brian Chapman explained the process of Capital Improvement Plan. This is a Planning document that forecasts potential projects out six years. It is somewhat of a wish list for staff and implementation is dependent upon the financial ability of the City to get those done. This is for public input and then Planning Commission consideration for recommendation to the City Commission.

Joseph Gallagher opened public comment.

David Ulrey asked what the Capital Improvement Plan is and where is that document available.

Joseph Gallagher explained that the Capital Improvement Plan is a way to prioritize projects, because in a perfect world the City could fund everything. It is a group of ideas, projects, and equipment that look out to 2030. Those get ranked based upon need and funding availability. Additionally, some projects need to be in there regardless of funding, because if money becomes available with State and Federal Funding the project is ready to go.

David Ulrey asked if the union carbide dock project is in there and cruise lines.

Brian Chapman explained it would have been in the document, but current projects that are already under construction or underway have been taken out. When that project was being planned out, it was in the CIP. The Capital Improvement Plan contains anything $10,000 or more such as police car, road projects, equipment, the $35 million carbide dock, etc. We try to forecast and plan for six years, so we have an idea of funding needs. The Capital Improvement Plan is also a requirement by state law. When the City applies for grants and funding, they do look to see if these projects are in the Capital Improvement Plan. The draft Capital Improvement Plan was put on the City Website and advertised through the City Facebook Page.

David Ulrey asked if this was the determining body for the Historical Sites, the Valley Camp, Tower of History, Marina. The lease is up and they are in limbo. The captain says the Valley Camp is being scrapped.

Brian Chapman stated that he can follow up with Kelly when he returns.

Charles McCready wanted to address David Ulrey earlier question and added that hard copies of the Capital Improvement Plan can be obtained City Hall.

Joesph Gallagher asked if there was any other public comment. Hearing none, public comment was closed, and board discussions were opened.

There was no discussion, so the Chair asked if there is a motion.

It was moved by Angela Patterson, and supported by Tim McKee Jr., to accept public comments and recommend approval of the 2024-2030 Draft Capital Improvement Plan the City Commission. The motion carried.

Roll Call:

Stephanie Roose	*Yes*
Joseph Gallagher	*Yes*
David Markham	*Yes*
Charles McCready	*Yes*
Tim McKee Jr.	*Yes*
Angela Patterson	*Yes*

8. OTHER BUSINESS: There was none.

9. STAFF REPORTS:

Final call for Citizen Planner Training. Melanie McBride will start getting members signed up and paid during the first part of March, as the deadline is March 29th. We have two members wanting to take the online course, and two members wanting to do the in-person training.

10. MATTERS TO BE PRESENTED BY THE PUBLIC OR COMMISSION:

David Ulrey, licensed surveyor, gave City Manager Chapman a USB drive with files and old documents related to the title history of the City's waterfront property. David Ulrey explained that he formerly worked for Sidock Group. He has proof that the city does not have ownership of the Carbide Dock. Title pre-dates the state of Michigan. He believes we need to secure ownership of our valuable waterfront. He has previously brought this to the attention of the City Attorney Cannello, former City Engineer Linda Basista, and now has delivered the information to current City Engineer David Boyle. He will make himself available at no cost if the city would like assistance.

Steve Akkanen's passing was addressed, and he was recognized by the members for his service to the city. A sympathy card for Steve's family was to be passed around at the end of the meeting.

11. ADJOURNMENT:

There was a motion by Charles McCready, and supported by Tim McKee Jr., to adjourn the meeting at 6:39 p.m. The motion carried.

Respectfully submitted,
Sault Ste. Marie Planning Commission

Appendix C
CIP Project or Equipment Specs, Quotes, Supporting Documentation

INVENTORY -

Sanderson Field/Sault Ste. Marie Municipal Airport is located within the City limits of Sault Ste. Marie, Michigan, the largest municipality in Chippewa County. Chippewa County is the second largest county by area in the State of Michigan, and is in the Eastern Upper Peninsula section of the State. Location coordinates are 40-26-45.2N, 84-22-6.2W.

The runway, 14/32, is 5,234 ft. in length and 100 ft. wide, constructed in 1960 over the existing runway, reconstructed and extended to its current length in 1997. The critical aircraft, based on 2022 airport register figures, is a King Air 200 series (12,500 MTOW), AAC Category B, ADG Category II. The wingspan is 57 ft., 11 in., and the V_{fe} with flaps in the 14 degree approach position, per the TCDS, is 230 MPH/200 KTS.

Alpha taxiway is a 35 ft. wide partial parallel taxiway leading from the terminal area to the end of Runway 32, and is accessed by Bravo ramp (35 ft. wide) at the runway end, an exit to the apron area in front of a 100 ft. by 100 ft. hangar, and by conjoining with Charlie ramp (35 ft. wide), which extends from approximately the midpoint of the runway to the apron.

The apron area is a paved 540 ft. by 200 ft. area extending from the terminal/fuel farm/box hangar perimeter(s) westward, and from 10 ft. south of the box hangar to Charlie ramp. There are tiedowns located on the south and west sides of the apron, with a two located between the fuel farm and box hangar and two between the fuel farm and the terminal. Located roughly in the center of the apron is a compass rose.

To the north of the terminal is an 8 unit T-hangar building, also containing a small storage enclosure, with a paved area surrounding the building.

Runway 14/32 has Medium Intensity Runway Lights which replaced the former system in 1998. They are of the incandescent type. The runway also has RIEL and PAPI lights on both runway ends, also incandescent. A lighted wind cone is located roughly mid-point off the west side of the runway, and visible from both approaches. Another wind cone, unlighted, is east of RWY 32, some 300 ft from the runway surface and proximate to the abandoned taxiway.

Airport property and surrounding area consist of largely flat terrain, excepting a drop off commencing approximately 125 feet from the end of RWY 14 to a snowmobile racetrack and Interstate Highway 75. There is some patchy wetland vegetation north of the T-Hangar building.

FORECAST –

There are currently 14 single engine aircraft at the airport, six housed in the 100'x100' community hangar located south of the terminal and eight housed in the T-hangar building located to the north of the terminal.

There are currently 5 aircraft on the official waiting list for hangar space, and many other unofficial inquiries. The airport could easily fill another 8-bay T- or box hangar facility, as well as space in another community hangar.

We regularly house (and provide maintenance to) transient aircraft, and additional space is becoming a necessity.

In the calendar year 2022 there were 1,667 total operations at the airport, with 816 aircraft transiting. Of these transiting aircraft, 133 were resident, 301 were private non-resident, 330 were corporate aircraft, and 52 were government aircraft.

The airport is the only 24 hour, seven day aviation port of entry for U.S. Customs in the State of Michigan, and in 2022 there were 187 aircraft clearing Customs at the facility.

There were 92 medical evacuation flights from Sanderson Field in 2022.

Business aviation activity has been increasing exponentially, primarily due to the ongoing construction of a new lock installation on the St. Mary's River. This project is expected to be ten years in duration through its several phases.

The current FBO has expanded its aviation maintenance capabilities far beyond what had existed previously. There are two full time A&P mechanics on duty, one with Inspection Authorization. They are assisted by two GSE operators/mechanic helpers. Two other area A&P I/A mechanics are contracted on an occasional basis. The staff maintenance personnel have extensive experience on all aircraft types, from smaller general aviation to regional airline airframes.

The FBO is Part 135 maintenance compliant, with a registered drug and alcohol program under the FAA Drug Abatement Division. The FBO also developed a Part 139 Snow, Ice, and Vegetation control plan which is reviewed and updated on a semi-annual basis by the Snow and Ice Committee of the City Airport Advisory Board. These compliance initiatives were undertaken in anticipation of growth at the airport.

The FBO also participates in Michigan Works OJT programs and Sault Area Career Center Continuing Technical Education (CTE) programs, training area workers and students in aircraft and airfield maintenance and operations.

They currently are engaged in conducting annual inspections, repairs, and modifications on aircraft within a 100 mile radius. In 2022, in addition to work at Sanderson Field, they also were called out for repair and/or inspection services at the Drummond Island, Mackinac Island, St. Ignace, Newberry, Sault Ste. Marie, Ontario, and Two Hearted River airfields. They also are providing maintenance to turbo prop and executive jet aircraft, currently working a complete Phase Inspection and landing gear/propeller removal, overhaul, and reinstallation on a King Air aircraft.

This activity is projected to increase, especially as there is a current and forecasted shortage of aircraft maintenance personnel and facilities both regionally and nationally. A major factor inhibiting the ability of the Airport to meet this demand is the need for additional hangar space.

DEMAND/CAPACITY -

The development surrounding the airport land base precludes any major increases in capacity, however the anticipated demand is not expected to exceed current capacity insofar as new runway construction or expanded runway length is concerned.

As for the existing footprint, anticipated (and current) demand requires additional building infrastructure, existing taxiway reconstruction, as well as the extension of the taxiway to serve both ends of the existing runway.

FACILITY REQUIREMENTS –

The previous airport layout plan (2015) listed the King Air 90 type aircraft as the Critical Aircraft. Current traffic has caused a reevaluation resulting in the King Air B200 aircraft as the determined Critical Aircraft.

This aircraft requires, per the manufacturer, 2,111 feet of takeoff distance and 2,845 feet for landing. Weather conditions frequently require a greater length to be utilized.

There was a previous issue necessitating a displaced threshold (178 ft.) on RWY 32, as there were streetlights etc., impacting the approach. This has been remedied by the relocation of streets at that end of the runway, as well as elevation of the airfield at that end, resulting in the displaced threshold no longer being required.

RWY 14 has also been extended in the interim, thereby negating the need for a displaced threshold at that location as well.

In terms of crosswind runway construction, current land use in the area surrounding the airport precludes that being a possibility. However, the existing runway covers 94% of 15 MPH conditions.

NAVAIDs are currently adequate for the facility, but upgrading the lighting system to LED configurations is recommended.

The existing terminal building is at capacity for passenger and staff utilization and needs to be expanded and upgraded. A dedicated area for U.S. Customs and Border Protection use is among the desired upgrades.

Hangar space is definitely needed for both current and anticipated demand. At a minimum, current hangar space needs to be doubled.

Both RWY's 32 and 14 have 20:1 Non-Precision Instrument Utility Part 77 Approach Surfaces.

Both runways currently have LPV approach capability, with 350' Height Above Touchdown (HAT) within 1 statute mile visibility minimums. Runway 32 also has a VOR approach.

Airport Layout Plan drawings indicate existing wetland areas, some of which will impact the extension of the parallel taxiway to the north of the terminal, as well a possible future hangar construction. A categorical exclusion for this work is anticipated, but Environmental Assessments will have to be undertaken.

No current deviations from FAA Standards exist or are anticipated.

STATE OF MICHIGAN
DEPARTMENT OF TRANSPORTATION
AIRPORTS DIVISION
LANSING, MICHIGAN

SAULT STE. MARIE – SANDERSON FIELD

CHIPPEWA COUNTY
SAULT STE. MARIE, MI

AIRPORT LAYOUT PLAN

DEPARTMENT OF TRANSPORTATION

[illegible]

Mr. Oliver Turner, City Manager
Page 2
June 9, 2016

5. In making this determination, AERO (in consultation with the FAA) has considered matters such as the effects the proposal would have on existing or planned traffic patterns of neighboring airports, the effects it would have on the safety of persons and property on the ground, and the effects that existing or proposed manmade objects (on file with the FAA), and known natural objects within the affected area would have on the airport proposal.

6. The approval is not to be considered a commitment of state funding for the proposed development. AERO has concurred with the proposed development for planning purposes only based on current safety, utility, and efficiency standards. Future airport development depicted on the ALP include:

- [illegible] of Runway 14-32 to [illegible].
- Relocate [illegible] Street out of the runway approach surface.
- Development of a full parallel taxiway.
- Future hangar development.

We trust this letter provides a clear explanation of the conditions and terms of our approval. If you desire further clarification, please contact [illegible] at [illegible].

Sincerely,

Mark W. Noel, P.E., Manager
Planning and Development Section
Office of Aeronautics

cc: FAA-ADO

SAULT STE. MARIE – SANDERSON FIELD		
APPROVED		6/21/2016 DATE
APPROVED	CHAIRMAN	DATE

REVISION BLOCK

DATE	MODIFICATIONS	INITIALS

DESIGNERS & CONSULTANTS

URS GRAND RAPIDS, MI

APPROVED: ALLAN M. WARGNAKI, P.E. [illegible]

NOTE: SIGNATURE IN CONSULTANT BLOCK CERTIFIES ALP WAS PREPARED USING ALP CHECKLIST.

SHEET NUMBER		LATEST REVISION DATE
10	FAR PART 77 APPROACH SURFACES DRAWING	
9	AIRPORT PROPERTY PLAN	
8	TERMINAL AREA PLAN	
7	RUNWAY APPROACH ZONE DRAWING (RWY 32)	
6	RUNWAY APPROACH ZONE DRAWING (RWY 14)	
5	AIRPORT LAYOUT AERIAL	
4	AIRPORT LAYOUT PLAN (FUTURE)	
3	AIRPORT LAYOUT PLAN (EXISTING)	
2	AIRPORT DATA SUMMARY	
1	TITLE & APPROVAL SHEET	
	INDEX OF SHEETS	

AIRPORT TYPE – TRANSPORT

SITE NO. – 17-1

URS

SAULT STE. MARIE – SANDERSON FIELD
SAULT STE. MARIE, MICHIGAN
(INN, RTC, CHIPPEWA COUNTY)
AIRPORT LAYOUT PLAN
TITLE & APPROVAL SHEET

MICHIGAN SITE NO. 17-1
LOC ID ANJ

DRAWING
1 OF 10

12937611

SAULT STE. MARIE – SANDERSON FIELD

AIRPORT LAYOUT PLAN
AIRPORT DATA SUMMARY
SAULT STE. MARIE, MICHIGAN
T47N, R1E, CHIPPEWA COUNTY

URS

MICHIGAN SITE NO. 17-1 | LOC ID ANJ | DRAWING 2 OF 10 | 12937611

MODIFICATIONS TO FAA DESIGN STANDARDS

DATE OF FAA LETTER	DESCRIPTION

AIRPORT DATA TABLE

COUNTY: CHIPPEWA	TOWNSHIP: SOO	TOWN: T 47 N
MEAN MAXIMUM TEMPERATURE:	75.4°F JULY	RANGE: R 1 E
AIRPORT REFERENCE POINT (ARP):	LAT. 46°28'44.73" N.	LONG: 84°22'05.81" W
AIRPORT REFERENCE CODE:	ANJ	
	EXISTING	FUTURE
AIRPORT ELEVATION (MSL)	716'	716'
AIRPORT AND TERMINAL NAVAIDS	SEGMENTED CIRCLE, WINDCONE, ASOS	SEGMENTED CIRCLE, WINDCONE, ASOS
SERVICE LEVEL	GENERAL AVIATION	GENERAL AVIATION
AIRPORT ROLE	TRANSPORT	TRANSPORT
APPROACH CATEGORY	B	B
AIRPLANE DESIGN GROUP	II	II

RUNWAY AND APPROACH DATA

RUNWAY	14 EXISTING	14 FUTURE	32 EXISTING	32 FUTURE
RUNWAY LENGTH	5,234	5,001	5,234	5,001
RUNWAY WIDTH	100	100	100	100
DISPLACED THRESHOLD	100	--	178	--
EFFECTIVE LANDING LENGTH	--	--	--	--
EFFECTIVE TAKEOFF LENGTH	--	--	--	--
TORA	--	--	--	--
TODA	--	--	--	--
ASDA	--	--	--	--
LDA		--	--	--
STOPWAY	--	--	--	--
CLEARWAY	--	--	--	--
RUNWAY CATEGORY	UTILITY	UTILITY	UTILITY	UTILITY
RUNWAY GRADIENT	0.40%	0.40%	0.40%	0.40%
PAVEMENT TYPE	BITUMINOUS	BITUMINOUS	BITUMINOUS	BITUMINOUS
PAVEMENT STRENGTH GEAR/LOAD(X 1000)	DW 72	DW 72	DW 72	DW 72
RUNWAY LIGHTING	MIRL	MIRL	MIRL	MIRL
RUNWAY MARKING	BASIC	NON-PRECISION	BASIC	NON-PRECISION
NAVIGATIONAL AIDS	WINDCONE	WINDCONE, ROT. BEACON	WINDCONE	WINDCONE, ROT. BEACON
APPROACH LIGHTING	REIL, PAPI	REIL, PAPI	REIL, PAPI	REIL, PAPI
AIRCRAFT APPROACH CATEGORY	B	B	B	B
AIRPLANE DESIGN GROUP	II	II	II	II
CRITICAL AIRCRAFT	KING AIR 90	KING AIR 90	KING AIR 90	KING AIR 90
APPROACH	NON-PRECISION	NON-PRECISION	NON-PRECISION	NON-PRECISION
RPZ	500'x700' x1000'	500'x700' x1000'	500'x700' x1000'	500'x700' x1000'
FAR PART 77 CATEGORY *	C(NP) 34:1	C(NP) 34:1	C(NP) 34:1	C(NP) 34:1
LOWEST APPROACH VISIBILITY MINIMUMS	1 MILE-250' LPV	1 MILE-250' LPV	1 MILE-324' LP	1 MILE-250' LPV
RUNWAY END COORDINATE (NAD 83) LAT:	N 46°29'03.723"	N 46°29'02.45"	N 46°28'26.626"	N 46°28'27.01"
LONG:	W 84°22'32.273"	W 84°22'30.15"	W 84°21'40.217"	W 84°21'40.74"

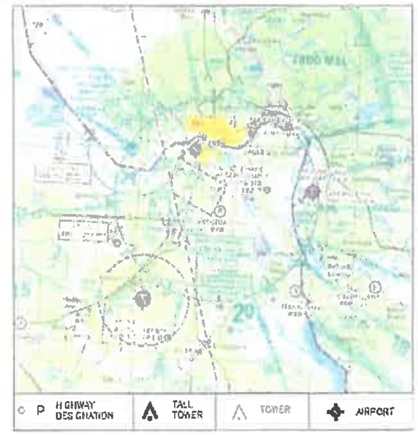
RUNWAY END COORDINATES ARE FROM WOOLPERT INC. SURVEY DATED AUGUST 2007.
* FAR PART 77 PROTECTION FOR CAT C AIRCRAFT

ALL-WEATHER WIND ROSE

RUNWAYS 14/32
15VPH 94.0% COVERAGE
12VPH 92.9% COVERAGE

LEGEND
— — — 12 MPH
——— 15 MPH

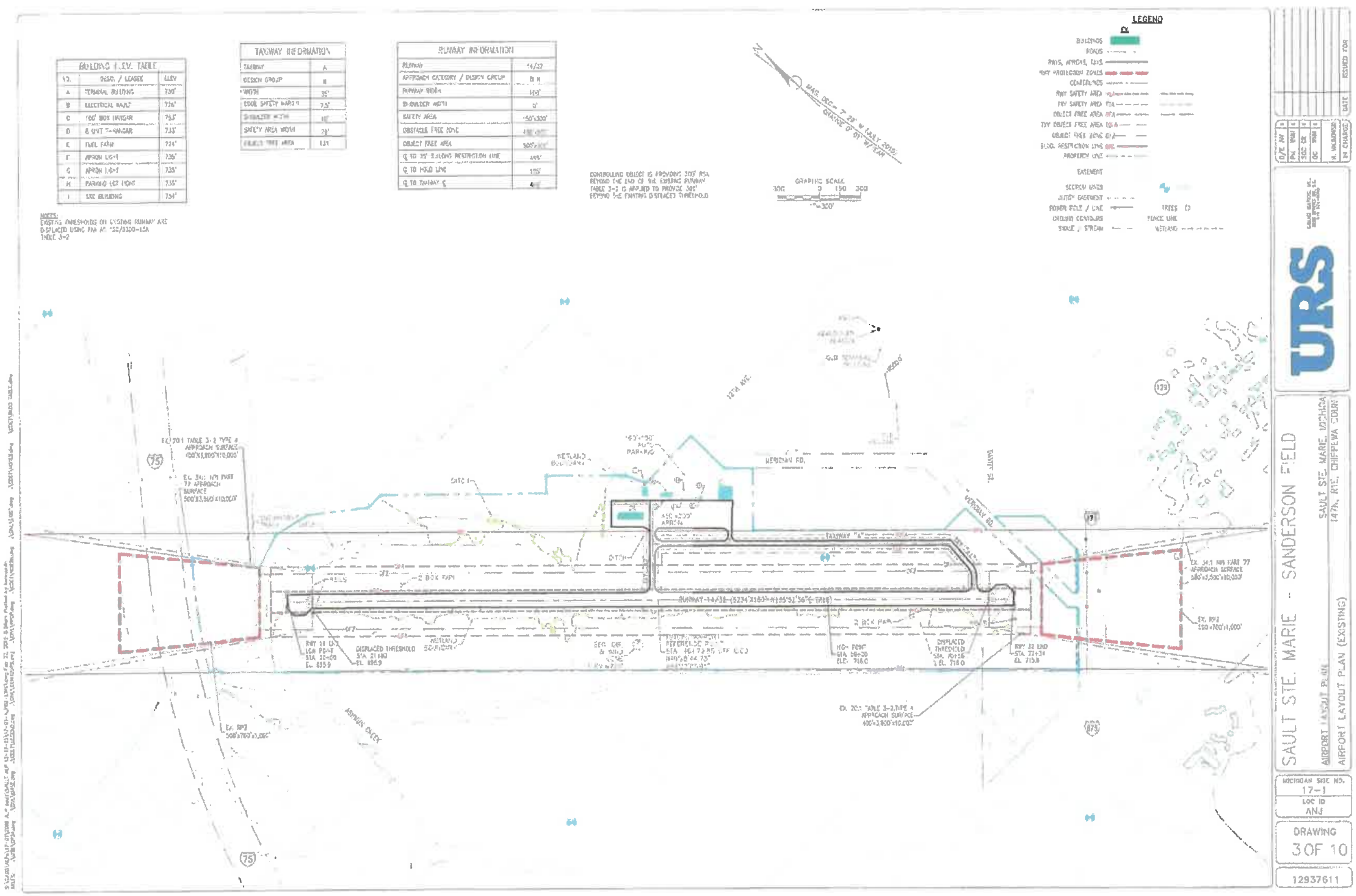
WIND DATA PERIOD NOV. 1935 – DEC 1942
SAULT STE. MARIE WEATHER STATION
ALL WEATHER OBS 14,870



LOCATION MAP
SCALE: 1"=5 MILES

VICINITY MAP
SCALE: 1"=2000

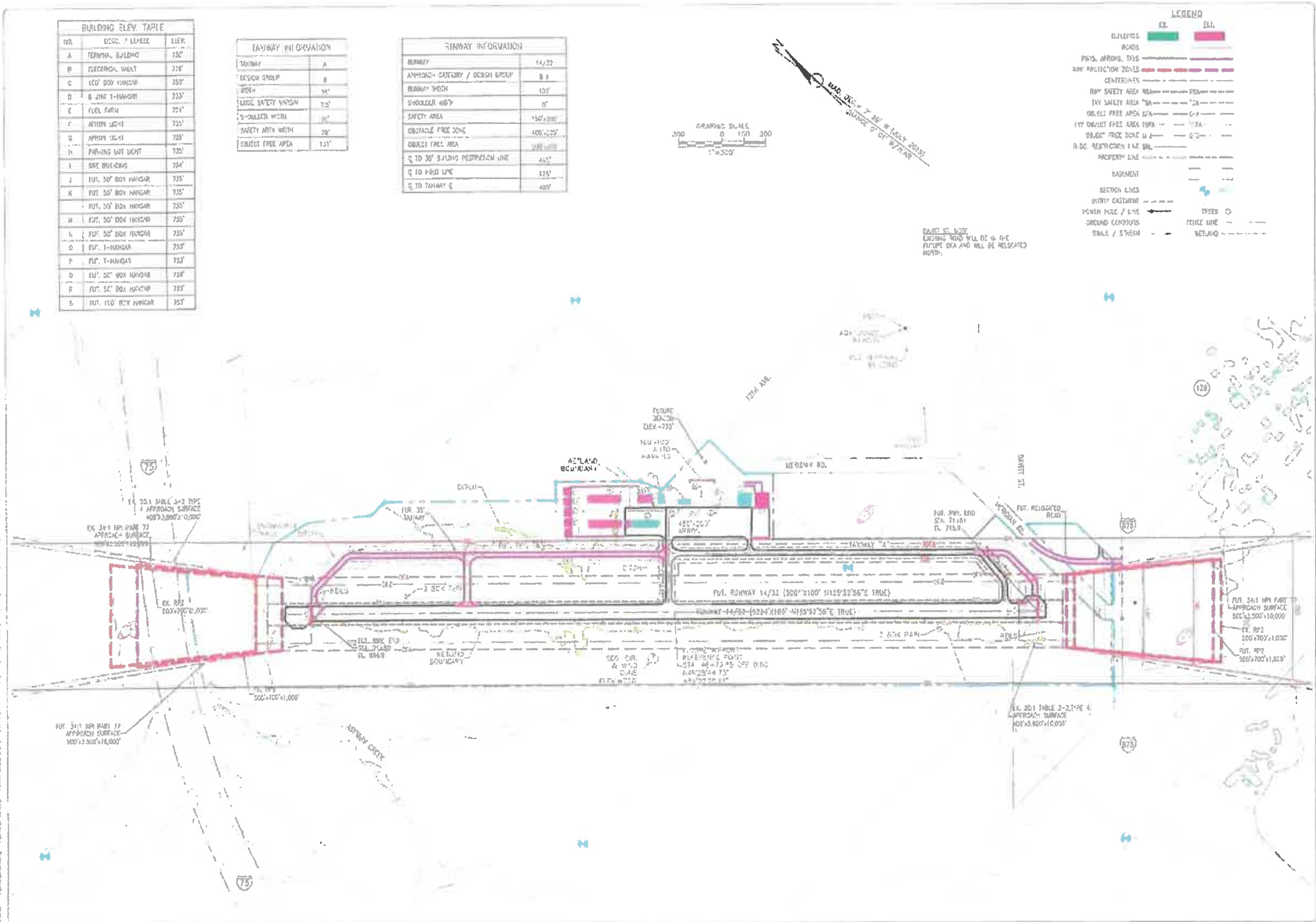
NOTES:
EXISTING THRESHOLDS OF EXISTING RUNWAY ARE DISPLACED USING FAA AC 150/5300-13A TABLE 3-2


SAULT STE. MARIE - SANDERSON FIELD
AIRPORT LAYOUT PLAN
AIRPORT LAYOUT PLAN (EXISTING)
SAULT STE. MARIE, MICHIGAN
14TH. RIE. CHIPPEWA COUNTY
URS
MICHIGAN SITE NO.
17-1
LOC ID
ANJ
DRAWING
3 OF 10
12937611
LEGEND
BUILDING INFORMATION
TAXIWAY INFORMATION
RUNWAY INFORMATION
RUNWAY 14/32
TAXIWAY "A"
GRAPHIC SCALE
NOTES:
MERIDIAN RD.
ASHMUN CREEK
WETLAND
2 BOX PAR

BUILDING ELEV. TABLE		
NO.	DESC. / USAGE	ELEV.
A	TERMINAL BUILDING	730'
B	ELECTRICAL VAULT	728'
C	100' BOX HANGAR	733'
D	6 UNIT T-HANGAR	733'
E	FUEL FARM	724'
F	APRON LIGHT	735'
G	APRON LIGHT	738'
H	PARKING LOT LIGHT	735'
I	SRE BUILDING	734'
J	FUT. 50' BOX HANGAR	735'
K	FUT. 50' BOX HANGAR	735'
	FUT. 50' BOX HANGAR	735'
M	FUT. 50' BOX HANGAR	735'
N	FUT. 50' BOX HANGAR	735'
O	FUT. T-HANGAR	733'
P	FUT. T-HANGAR	733'
Q	FUT. 50' BOX HANGAR	738'
R	FUT. 50' BOX HANGAR	733'
S	FUT. 100' BOX HANGAR	733'

TAXIWAY INFORMATION	
TAXIWAY	A
DESIGN GROUP	II
WIDTH	35'
EDGE SAFETY MARGIN	7.5'
SHOULDER WIDTH	10'
SAFETY AREA WIDTH	79'
OBJECT FREE AREA	131'

RUNWAY INFORMATION	
RUNWAY	14/32
APPROACH CATEGORY / DESIGN GROUP	B-II
RUNWAY WIDTH	100'
SHOULDER WIDTH	0'
SAFETY AREA	150'x[illegible]
OBSTACLE FREE ZONE	400'x200'
OBJECT FREE AREA	[illegible]
℄ TO 35' BUILDING RESTRICTION LINE	495'
℄ TO HOLD LINE	125'
℄ TO TAXIWAY ℄	400'



SAULT STE. MARIE - SANDERSON FIELD

SAULT STE. MARIE, MICHIGAN

T47N, R1E, CHIPPEWA COUNTY

AIRPORT LAYOUT PLAN

AIRPORT LAYOUT PLAN (FUTURE)

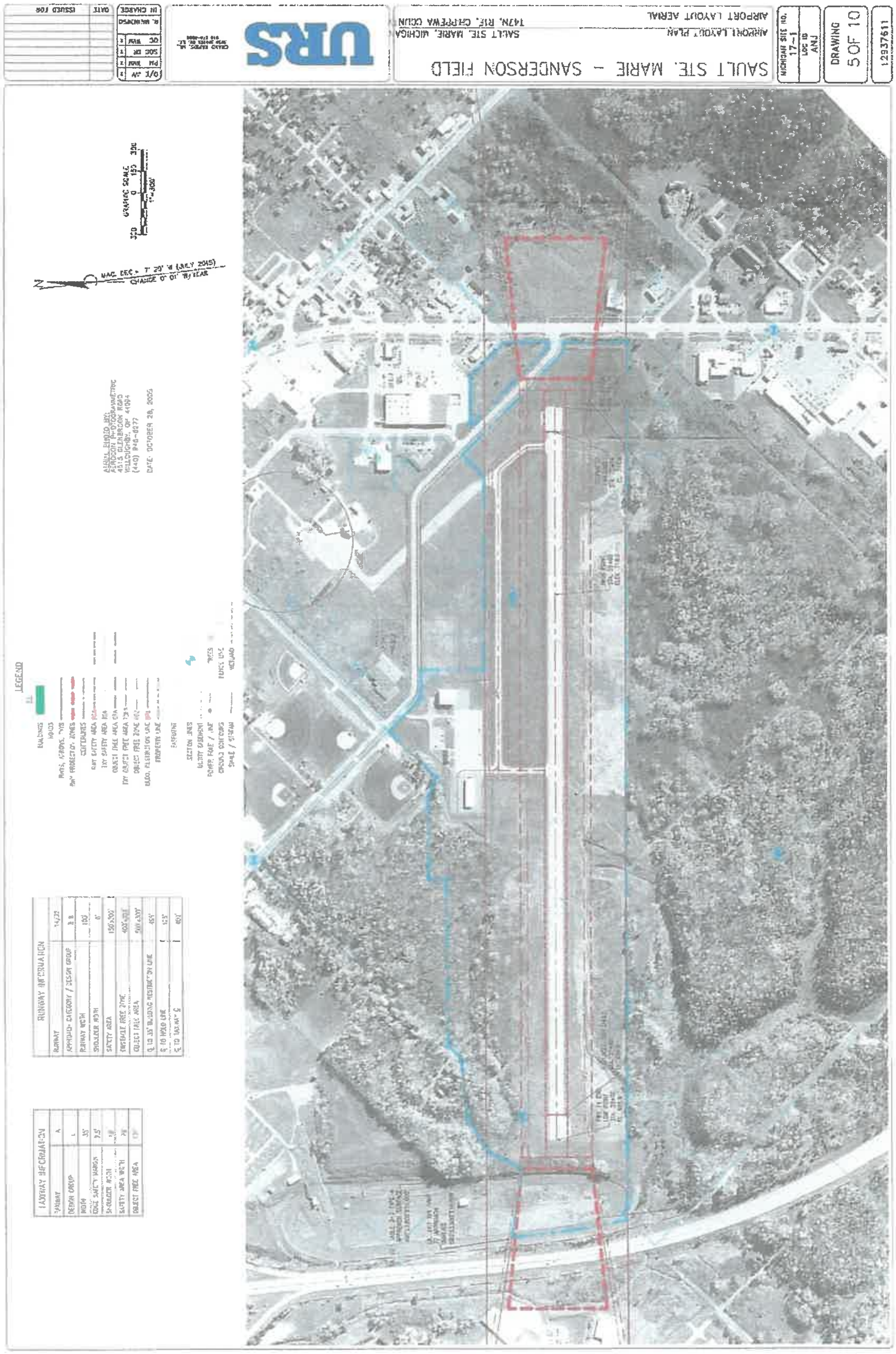
URS

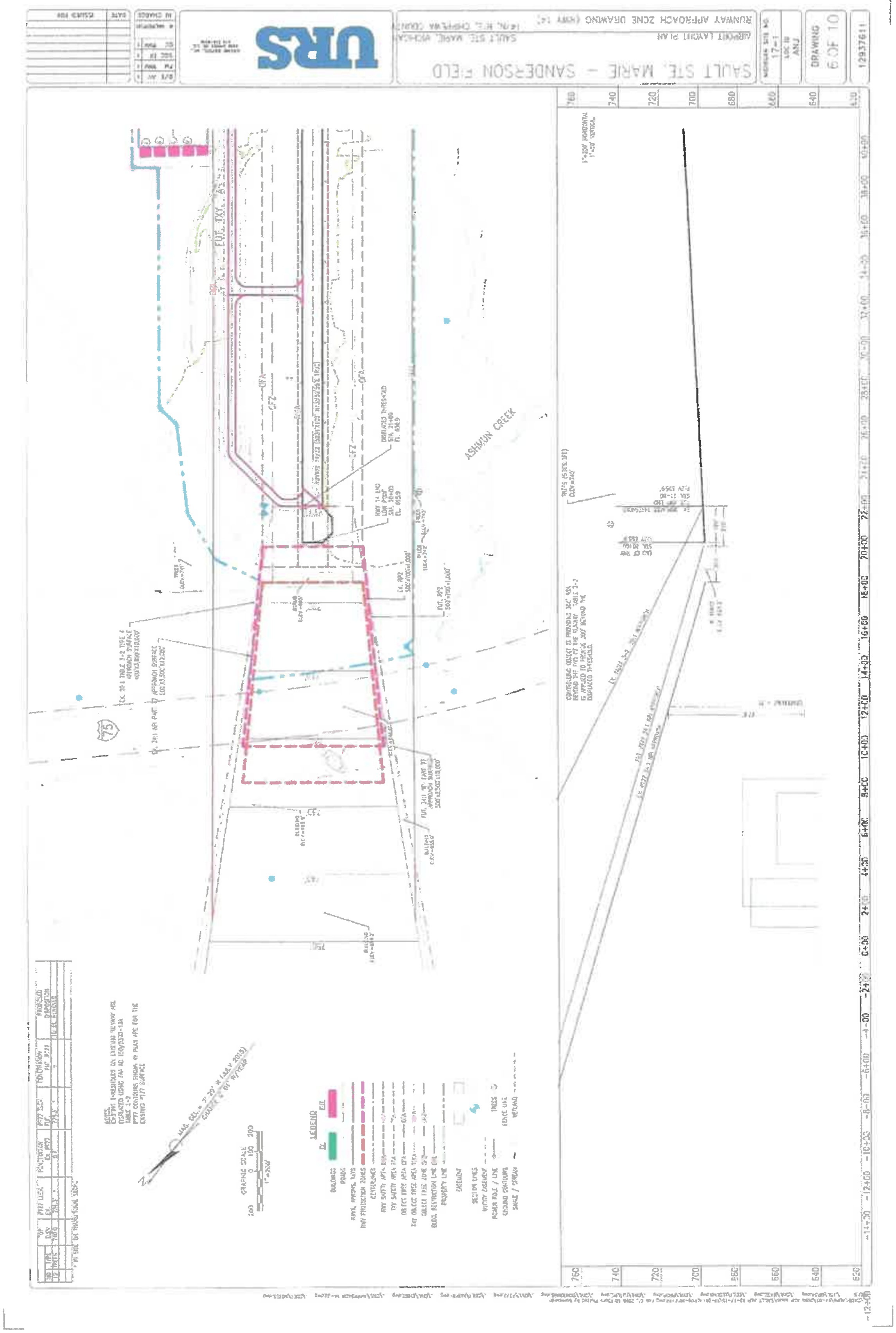
MICHIGAN SITE NO. 17-1

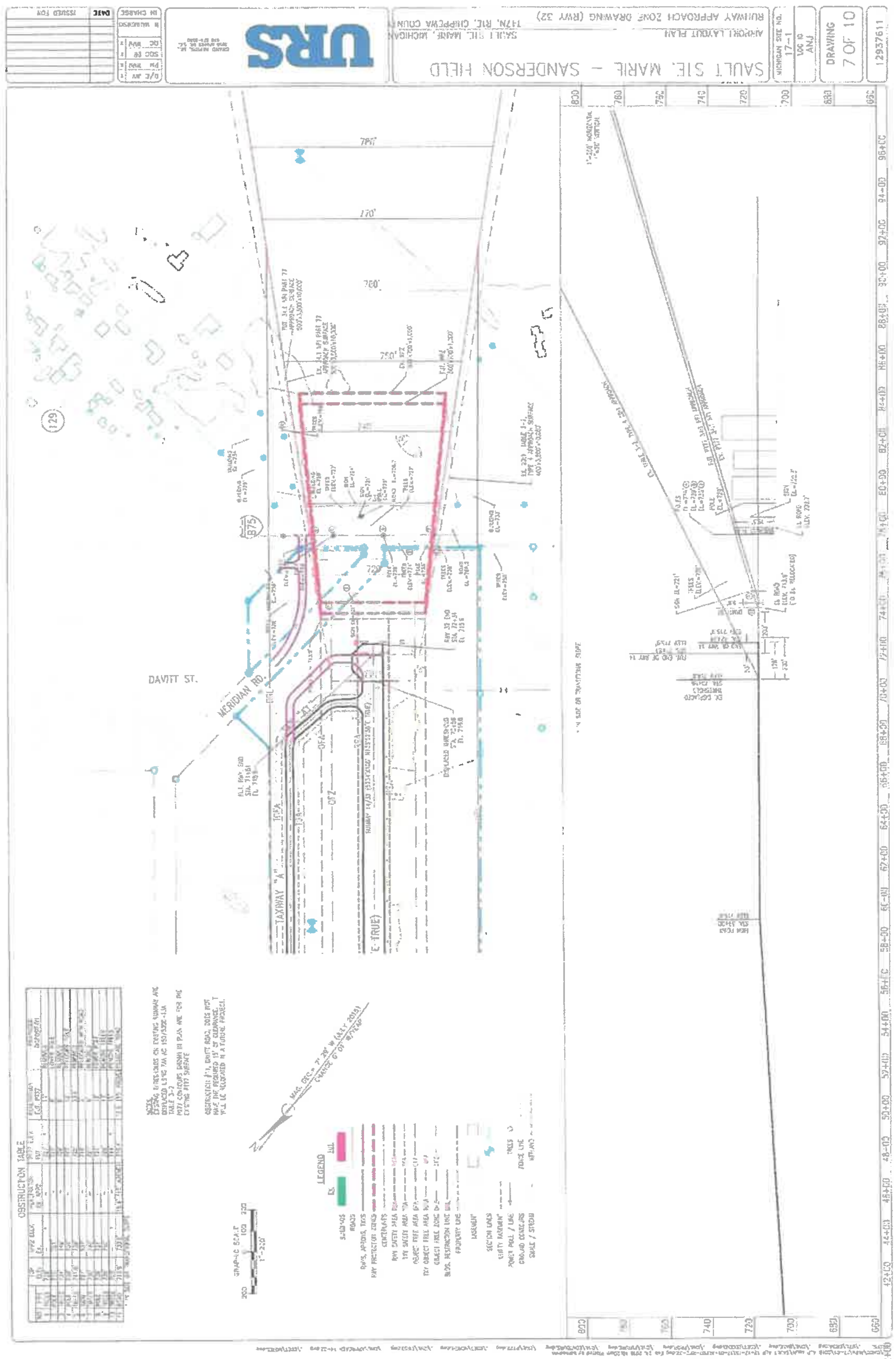
LOC ID ANJ

DRAWING 4 OF 10

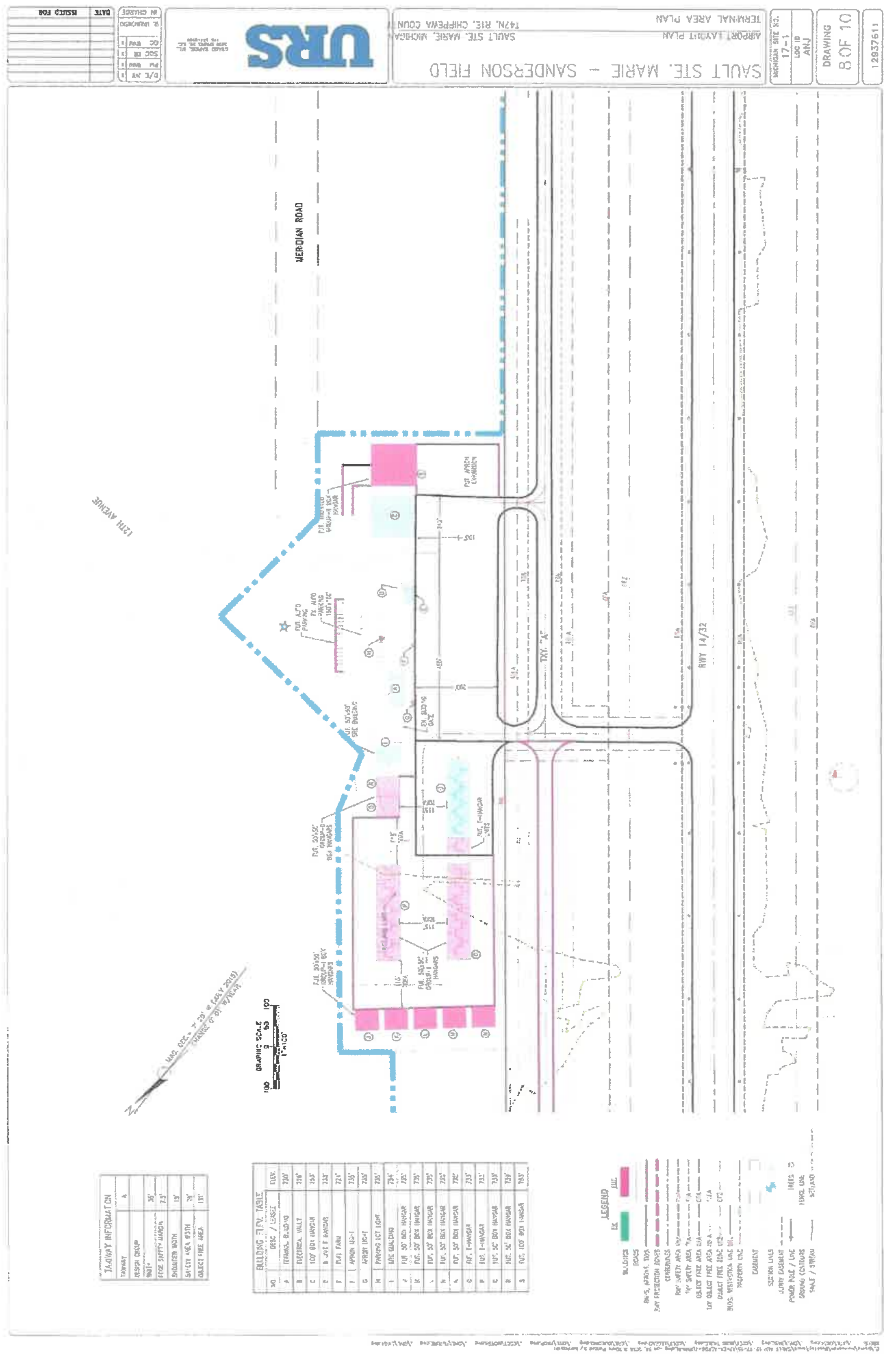
12937811

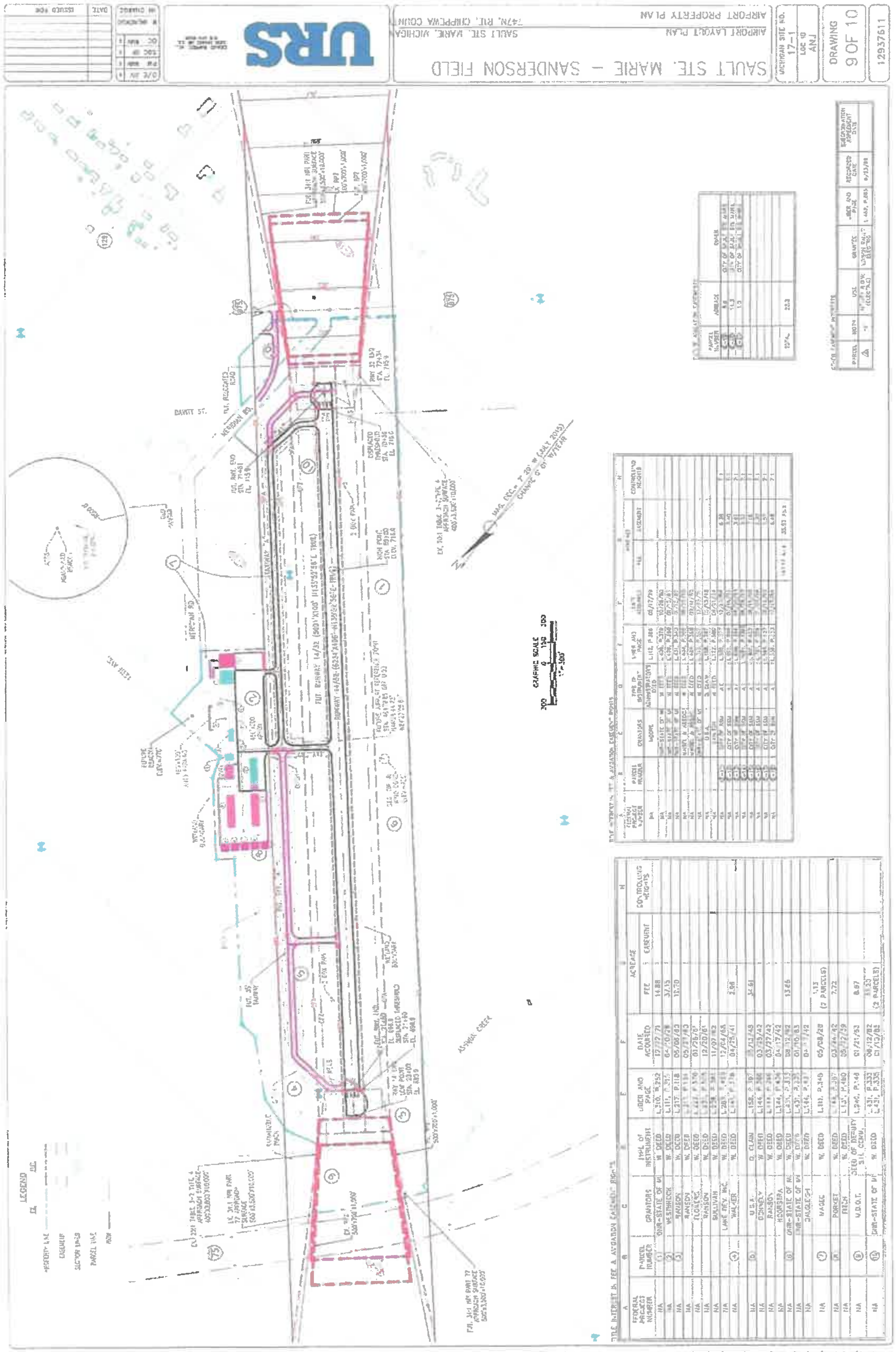

SAULT STE. MARIE – SANDERSON FIELD
AIRPORT LAYOUT PLAN
AIRPORT LAYOUT AERIAL
SAULT STE. MARIE, MICHIGAN
T47N, R1E, CHIPPEWA COUNTY
URS
DRAWING
5 OF 10
12937611

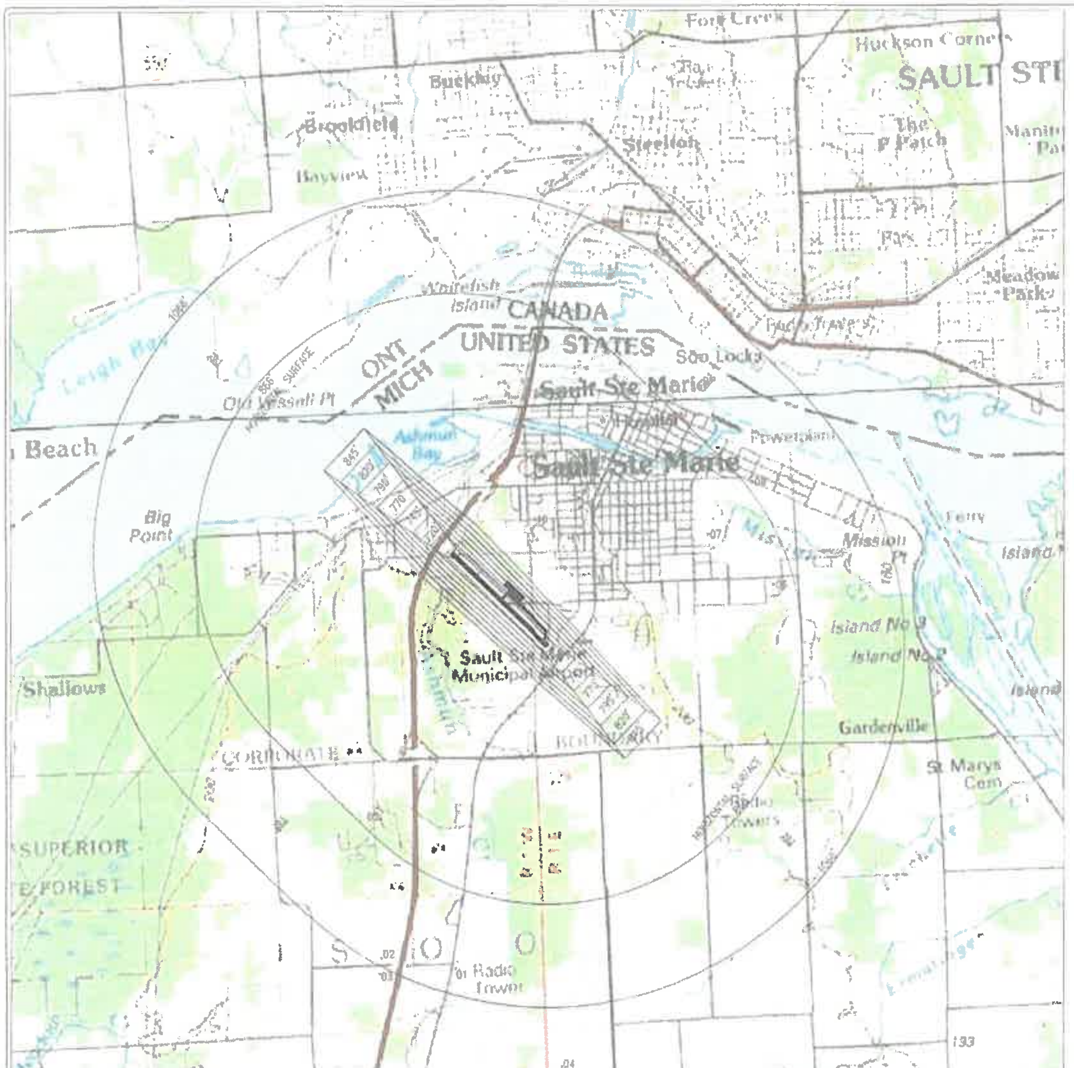

SAULT STE. MARIE – SANDERSON FIELD
AIRPORT LAYOUT PLAN
RUNWAY APPROACH ZONE DRAWING (RWY 14)
SAULT STE. MARIE, MICHIGAN
URS
DRAWING
6 OF 10
12937611
ASHMUN CREEK
LEGEND



SAULT STE. MARIE – SANDERSON FIELD
AIRPORT LAYOUT PLAN
RUNWAY APPROACH ZONE DRAWING (RWY 32)
SAULT STE. MARIE, MICHIGAN
T47N, R1E, CHIPPEWA COUNTY
URS
DRAWING
7 OF 10
OBSTRUCTION TABLE
LEGEND
GRAPHIC SCALE
DAVITT ST.
MERIDIAN RD.
TAXIWAY "A"

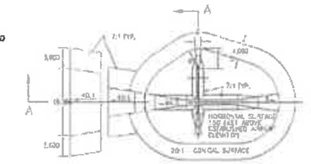

SAULT STE. MARIE - SANDERSON FIELD
SAULT STE. MARIE, MICHIGAN
AIRPORT LAYOUT PLAN
TERMINAL AREA PLAN
URS
DRAWING
8 OF 10
12937611
MERIDIAN ROAD
12TH AVENUE
RWY 14/32
TXY. "A"
GRAPHIC SCALE
TAXIWAY INFORMATION
BUILDING ELEV. TABLE
LEGEND


URS
SAULT STE. MARIE – SANDERSON FIELD
AIRPORT PROPERTY PLAN
AIRPORT LAYOUT PLAN
SAULT STE. MARIE, MICHIGAN
DRAWING 9 OF 10
12937611



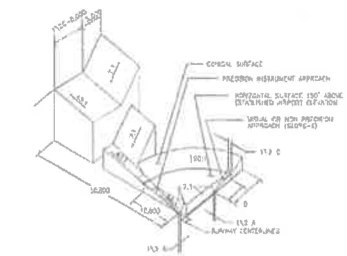
DRAWING SCALE
2000 0 1000 2000
1" = 2000'

MAG. DEC. = 7° 29' W (JULY 2010)
CHANGE 0° 01' W/YEAR



DIM	ITEM	DIMENSIONAL STANDARDS (FEET) VISUAL RUNWAY A	B	NON-PRECISION INSTRUMENT RUNWAY A	B C	B D	PRECISION INSTRUMENT RUNWAY
A	WIDTH OF PRIMARY SURFACE AND APPROACH SURFACE WIDTH AT INNER END	250	500	500	500	1,000	1,000
B	RADIUS OF HORIZONTAL SURFACE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		VISUAL APPROACH A	B	NON-PRECISION INSTRUMENT APPROACH A	B C	B D	PRECISION INSTRUMENT APPROACH
C	APPROACH SURFACE WIDTH AT END	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
D	APPROACH SURFACE LENGTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
E	APPROACH SLOPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	*

A = UTILITY RUNWAYS
B = RUNWAYS LARGER THAN UTILITY
C = VISIBILITY MINIMUMS GREATER THAN 3/4 MILE
D = VISIBILITY MINIMUMS AS LOW AS 3/4 MILE
* PRECISION INSTRUMENT APPROACH SLOPE IS 50:1 FOR INNER 10,000 FEET AND 40:1 FOR AN ADDITIONAL 40,000 FEET



ESTABLISHED AIRPORT EL. = 716'

AIRPORT REFERENCE POINT LAT: 46°28'45.18" N. LONG: 84°22'06.24" W

TALL STRUCTURES

#	ORS #	TYPE	AGL	AMSL
01	25 – 00026	TWR	208	913
02	25 – 05089	TWR	156	916
03	26 – 01912	TWR	200	905
04	26 – 02586	TWR	249	950
05	26 – 00279	TWR	120	913
06	26 – 27129	TWR	229	861
07	26 – 00267	TWR	305	925
08	26 – 01488	TWR	167	797
09	26 – 01189	BLG	234	846
10	26 – 00651	WT	200	922
11	26 – 00253	TWR	183	903

URS

SAULT STE. MARIE – SANDERSON FIELD
SAULT STE. MARIE, MICHIGAN
T47N, R1E, CHIPPEWA COUNTY
AIRPORT LAYOUT PLAN
FAR PART 77 APPROACH SURFACES DRAWING

MICHIGAN SITE NO. 17-1
LOC ID ANJ
DRAWING 10 OF 10
12937611

DATE | ISSUED FOR

Runway Lighting

Runway lighting, originally installed in 1953, was upgraded in 1976. In 1997, with the runway expansion project, 12 lights were replaced to accommodate the new grade. Currently there are 40 stake-type runway edge lights, 12 can base runway edge lights (installed 1997), 8 approach lights at each end, 8 threshold lights at each end, taxiway entrance markers, and strobes and PAPI lights at each end. All lights are the old incandescent types and are showing their age.

Typical Edge Light Installation at Sanderson Field

As other area airports have upgraded their systems to LED lighting and more modern fixtures, Sanderson Field has been able to access their older equipment to use in maintaining the lighting on the airport.

Eventually, as these systems are phased out, Sanderson will be unable to sustain their current lighting installations. Upgrade to LED lighting and more modern fixtures is essential.

Runway Painting/Marking

Having been rehabilitated in 2017, the runway (14/32) has an estimated PCI score currently of 93. The runway painting is currently 5 years old, however, and the severe snow and ice conditions prevalent in the Eastern Upper Peninsula impact the markings at a greater level than other locations.

ALL TRAFFIC
SOLUTIONS™

Connected Solutions for Better Traffic Safety Outcomes

SHIELD RADAR SPEED SIGN

AllTrafficSolutions.com

Resolving Speeding Complaints Has Never Been Easier.

All Traffic Solutions Shield radar speed signs lead the industry in quality, accuracy, and durability.

SIMPLE, RAPID DEPLOYMENT

Shield signs are lightweight and mountable by one person in under a minute on a portable post, pole, or vehicle hitch.

WEB-BASED REPORTING AND ACCESSIBILITY

All Traffic Solutions' patented TraffiCloud® software enables you to remotely manage and monitor your devices from anywhere using any internet-connected device.

Access real-time traffic data, generate ready-made speed and volume reports, and get email or text alerts for tampering, low batteries, and high-speed violators.

MAXIMIZE RESOURCES WITH REAL-TIME DATA

Use your web-enabled Shield radar speed sign to:

- Conduct hassle-free traffic studies
- Quickly resolve speeding complaints
- Increase driver speed awareness
- Identify speeding hot spots and prioritize enforcement in high-risk areas

RIGOROUSLY TESTED AND CERTIFIED

All Traffic Solutions Shield signs aced radar accuracy, power recovery, autonomous battery operation, and crash resistance tests.

They're shatterproof, graffiti-resistant, and can withstand 150-mph winds and inclement weather such as ice, snow, and heavy rain.

Shield 15

MADE IN THE USA

FLEXIBLE POWER OPTIONS

Achieve up to several weeks of run time. A dedicated compartment allows for all-weather battery replacement, and optional solar panels provide around-the-clock convenience and cost-efficiency.

MADE IN THE USA

All Traffic Solutions signs are manufactured at our State College, Pennsylvania production facility in compliance with the Buy American Act and Buy America Act.

WARRANTY AND FREE TRAINING

To ensure that our customers get the most out of our solutions, we offer the best product warranty on the market, world-class customer support, and unlimited free training from our US-based offices.

Shield 12

Product Specs			
Shield 12			
DIMENSIONS	13.5” H x 15.5” W x 2.6” D	WEIGHT	12 lbs. (incl. mount)
Shield 15			
DIMENSIONS	17” H x 24” W x 2.6 W	WEIGHT	18 lbs. (incl. mount)

Popular Options
Data logging, Bluetooth, Violator Alert, Metric, 3-digit display

Shield 12 and Shield 15 are available with optional yellow or white wrap.


YOUR
SPEED
45
4RUNNER

ALL TRAFFIC
SOLUTIONS

Connected Solutions for Better Traffic Safety Outcomes

SPEEDALERT 24 RADAR MESSAGE SIGN

AllTrafficSolutions.com

The Ultimate Multi-Purpose Tool.

SpeedAlert combines radar feedback with variable messaging for maximum versatility. Take SpeedAlert anywhere you want to resolve speed complaints, slow speeding, or share timely notifications.

SPEED-DEPENDENT MESSAGING

Give drivers immediate feedback by displaying custom messages specific to their speed, like “Slow Down”, “Too Fast!”, or any other message you choose to create. You have complete control over which messages are displayed, when they are displayed, and for how long.

FLASHING LED LIGHTS

Alert those who are traveling at high-risk speeds with flashing red and blue LED lights. You choose which speeds trigger the lights and can change the thresholds at any time.

EASY TO TRANSPORT AND DEPLOY

The ultra-portable SpeedAlert 24 can fold in half and is easily deployable by one person on a trailer, portable post, pole, or vehicle hitch. The trailer is lightweight and easy to maneuver, so you can take it wherever you need traffic calming or roadside messaging.

> “On a per-dollar basis, this might be one of the best expenditures we have.”
>
> – *Pasha Majdi, Vienna VA Town Council*

Web-Based Reporting and Accessibility

All Traffic Solutions' patented TraffiCloud® software enables you to remotely manage and monitor your devices from anywhere using any internet-connected device.

Access real-time traffic data, generate ready-made speed and volume reports, and get email or text alerts for tampering, low batteries, and high-speed violators.

MAXIMIZE RESOURCES WITH REAL-TIME DATA

Use your web-enabled SpeedAlert sign to:

- Conduct hassle-free traffic studies
- Quickly resolve speeding complaints
- Increase driver speed awareness
- Identify speeding hot spots and prioritize enforcement in high-risk areas

DURABLY MADE IN THE USA

InstAlert is shatterproof, graffiti-resistant, and built to last for over a decade in all weather conditions.

All Traffic Solutions products are manufactured in our State College, Pennsylvania production facility in compliance with the Buy American Act and the Buy America Act.

WARRANTY AND FREE TRAINING

To ensure that our customers get the most out of our solutions, we offer the best product warranty on the market, world-class customer support, and unlimited free training from our US-based offices.

Product Specs			
SpeedAlert 24			
DIMENSIONS	28" H x 60" W x 1.6" D	WEIGHT	43 lbs.
TEXT	2 or 3 digits; 24" H 1 line; 4 Characters; 24" H 2 lines; 8 Characters; 11" H 3 lines; 12 Characters; 7" H		

"SpeedAlert acts on our behalf when we can't be there—it's the tool in our back pocket."

– Sgt. Zach Finfrock, Clarendon Hills IL Police Department

For more information visit us online at AllTrafficSolutions.com

sales@alltrafficsolutions.com Call us at 866.366.6602

All Traffic Solutions. 12950 Worldgate Drive, Suite 310, Herndon, VA 20170

All Traffic Solutions products are made in the USA in compliance with both the Buy America Act and the Buy American Act. All Traffic Solutions is a BuyBoard vendor for the BuyBoard National Purchasing Cooperative. We can provide Sole Source documentation for any products connected to TraffiCloud. A complete list of purchase options can be found on our website. GSA contract number: GS-07F-6092R

Here is what the Speed Alert 24 Message Trailer will include:

- Speed Alert 24 Radar Message Sign - 28 x 60 display
- Radar- 24" display
- Message Board – 3-line message board with 12 characters per line and 6 screens. The message board can store up to 25 pre-programmed messages
- Speed Dependent Messages - will trigger a different message based on speed vehicle is traveling
- Scheduling - can do daily and weekly schedule
- Alerts - low battery (2 alerts), high-speed, and tamper
- Camera- can set to trigger for high speed and tamper alerts
- GPS
- Bluetooth
- TraffiCloud - software package that will give 6 reports from data collected from the trailer and allow remote messaging into the trailer
- Wireless Cloud access to trailer and reports for the first year -optional renewal after first year
- ATS 5 Trailer
- 4 - Deep Cycle Batteries (470 ah)
- 90-watt Solar Panel
- 3 year warranty
- Free Training Webinar for your staff
- Unlimited Tech support - at no charge
- 100% Made in USA (Pennsylvania)

Let me know if I could offer any additional information. Thank you and I look forward to hearing from you,

ALL TRAFFIC
SOLUTIONS
™

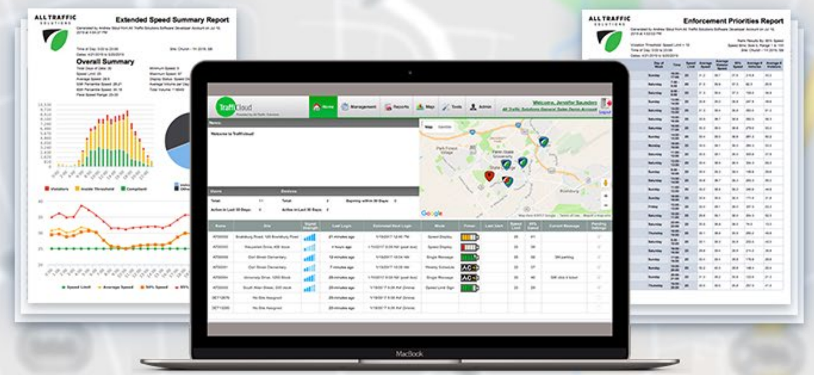
Connected Solutions for Better Traffic Safety Outcomes

TRAFFICLOUD: WEB-BASED DEVICE AND DATA MANAGEMENT

AllTrafficSolutions.com

Save Time and Maximize Resources with TraffiCloud.®

TraffiCloud is the secure, web-based platform that makes it easy to manage all your traffic data and safety devices remotely using any internet-connected device.



1. Save time by remotely accessing, monitoring, and programming all connected devices on a central platform.
2. View dashboards and generate ready-made PDF reports of all collected data or just one traffic device.
3. Improve workflows, optimize resources, and maximize efficiency.
4. Make better-informed decisions and prioritize enforcement based on data analytics from all your program components.

TraffiCloud®

"For us, the data is really priceless. It is truly a force-multiplier."

– Sgt. Cooley, Cedar Hill Police Department

MADE IN THE USA

See All Devices on a Central View

TraffiCloud® intuitive visual interface lets you see your entire program at a glance. Interactive maps provide a window to all device information.

Remotely Manage Traffic Devices

Stop wasting time driving to and from your traffic safety equipment only to monitor or update it. With TraffiCloud, you can do the following remotely, from anywhere, using any internet-connected device:

- Ensure that devices are on, properly functioning, and have adequate battery levels
- Change and update settings on all devices
- Design and deploy custom messages to one sign or multiple signs at once
- Schedule different messages for specific days and times
- Review, edit, print, and act on any useful images captured by devices

Set Alerts

Set up automatic text or email alerts for incidents like low battery levels, high speeds, tampering, and more. You have complete control over which situations warrant alerts and who will receive the notifications.

Generate Ready-Made Reports

TraffiCloud makes resolving complaints and sharing data easier than ever.

TraffiCloud automatically uploads new data into a centralized SAS70-certified environment daily, and you can quickly generate ready-made reports in an easily-sharable PDF format.

Create reports on-demand at any time or schedule them for regular delivery to your email inbox for maximum convenience.

Premier Care Warranty

With your TraffiCloud subscription, you'll also get a perpetual Premier Care warranty on all your All Traffic Solutions products.

Premier Care gives you:

- Remote diagnostics and hardware defect repairs for the entire product lifespan
- 50% discount on repairs due to accidental damage or vandalism
- 50% off additional accessories for devices (brackets, batteries, etc.)

> "TraffiCloud has been invaluable to us. It's the tool we will always use. Everybody's town is different, and there are many ways to use TraffiCloud for your particular traffic challenges."
>
> *– Sgt. Finfrock, Clarendon Hills Police Department*

ALL TRAFFIC SOLUTIONS

For more information visit us online at AllTrafficSolutions.com

sales@alltrafficsolutions.com Call us at 866.366.6602

All Traffic Solutions. 12950 Worldgate Drive, Suite 310, Herndon, VA 20170

ALL TRAFFIC SOLUTIONS

Mail Purchase Orders to:
3100 Research Dr.
State College, PA
16801

All Traffic Solutions Inc.
14201 Sullyfield Circle,
Ste 300
Chantilly, VA 20151
Phone: 814-237-9005
Fax: 814-237-9006
DUNS #: 001225114
Tax ID: 25-1887906
CAGE Code: 34FQ5

QUOTE Q-75269

DATE: 03/16/2023

PAGE NO: 1

Questions contact:
MANUFACTURER:
All Traffic Solutions
Julie Styskin
(866) 366-6602
x 250
jstyskin@alltrafficsolutions.com

Independent Sales Rep:

BILL TO:
City of Sault Ste. Marie
2601 Minneapolis St
Sault Ste. Marie MI 49783

Billing Contact:

SHIP TO:
City of Sault Ste. Marie
2601 Minneapolis St
Sault Ste. Marie MI 49783
Attn: David Boyle

PAYMENT TERMS: Net 30

CUSTOMER: City of Sault Ste. Marie

CONTACT:(906) 632-5733

ITEM NO:	DESCRIPTION:	QTY:	EACH:	EXT. PRICE:
4000863	Shield 12B Speed Display; base unit w/ mounting bracket, Can be Upgraded to TraffiCloud	1	$2,295.00	$2,295.00
4000743	LFP Power kit, 11.5Ah battery (2), internal power controller, charger w/connector	1	$651.00	$651.00
4001299	3 Year Warranty	1	$0.00	$0.00
4000641	Shipping and Handling Common Carrier	1	$50.00	$50.00

Special Notes:

SALES AMOUNT:	$2,996.00
TOTAL USD:	$2,996.00

Duration: This quote is good for 60 days from date of issue.
Shipping Notes: All shipments shall be FOB shipper. Shipping charges shall be additional unless listed on quote.
Taxes: Taxes are not included in quote. Please provide a tax-exempt certificate or sales tax will be applied.
Warranty: Unless otherwise indicated, all products have a one year warranty from date of sale. Warranty extensions are a component of some applications that are available at time of purchase. A Finance Charge of 1.5% per month will be applied to overdue balances. GSA GS-07F-6092R

Authorization: By Signing below, I indicate that my organization does not require a purchase order and I am authorized to commit my organization to this order.

Signature: ______________________ Date: ______________________

Print Name: ______________________ Title: ______________________

ALL TRAFFIC SOLUTIONS

Mail Purchase Orders to:
3100 Research Dr.
State College, PA
16801

All Traffic Solutions Inc.
14201 Sullyfield Circle,
Ste 300
Chantilly, VA 20151
Phone: 814-237-9005
Fax: 814-237-9006
DUNS #: 001225114
Tax ID: 25-1887906
CAGE Code: 34FQ5

QUOTE Q-75267

DATE: 03/16/2023

PAGE NO: 1

Questions contact:
MANUFACTURER:
All Traffic Solutions
Julie Styskin
(866) 366-6602
x 250
jstyskin@alltrafficsolutions.com

Independent Sales Rep:

BILL TO:
City of Sault Ste. Marie
2601 Minneapolis St
Sault Ste. Marie MI 49783

Billing Contact:

SHIP TO:
City of Sault Ste. Marie
2601 Minneapolis St
Sault Ste. Marie MI 49783
Attn: David Boyle

PAYMENT TERMS: Net 30

CUSTOMER: City of Sault Ste. Marie

CONTACT:(906) 632-5733

ITEM NO:	DESCRIPTION:	QTY:	EACH:	EXT. PRICE:
4000745	SpeedAlert 24 Radar Message Sign (RMS); base unit (select mount separately)	1	$9,215.00	$9,215.00
4000647	App, Traffic Suite (12mo); Equip Mgmt, Reporting, Image Mgmt, Alerts, Mapping and PremierCare	1	$1,500.00	$1,500.00
4000874	All Options Activation: Bluetooth, Traffic Data, Violator Alert, Pictures, ($3000 Value, requires Traffic or Message Suite)	1	$0.00	$0.00
4000173	Trailer, ATS-5 (select power separately)	1	$4,325.00	$4,325.00
4100557	hrns, Power cord, iA w/ quick connects for trailer	1	$60.00	$60.00
4000879	Violator Strobe, Red and Blue for ATS-5 for use with SA24	1	$800.00	$800.00
4001299	3 Year Warranty	1	$0.00	$0.00
4000750	App, Mobile User Interface perpetual license (only 1 req'd per account)	1	$100.00	$100.00
4001626	VZW communications prep	1	$0.00	$0.00
4000636	Trailer Battery kit for ATS-5, 470Ah deep cycle batteries w/cover, hold down, cables& hdwr (iA24, SA24)	1	$990.00	$990.00
4000740	Trailer Certificate of Origin	1	$0.00	$0.00

4000754	USB cable, 16ft, extra long for trailer or pole	1	$32.00	$32.00
4000838	Solar panel, 90W: includes bracket for ATS-5 trailer and harness	1	$940.00	$940.00
4000641	Shipping and Handling Common Carrier	1	$1,100.00	$1,100.00
4001190	Discount - New Purchase	1	($250.00)	($250.00)

Special Notes:	**SALES AMOUNT:**	$18,812.00
	TOTAL USD:	$18,812.00

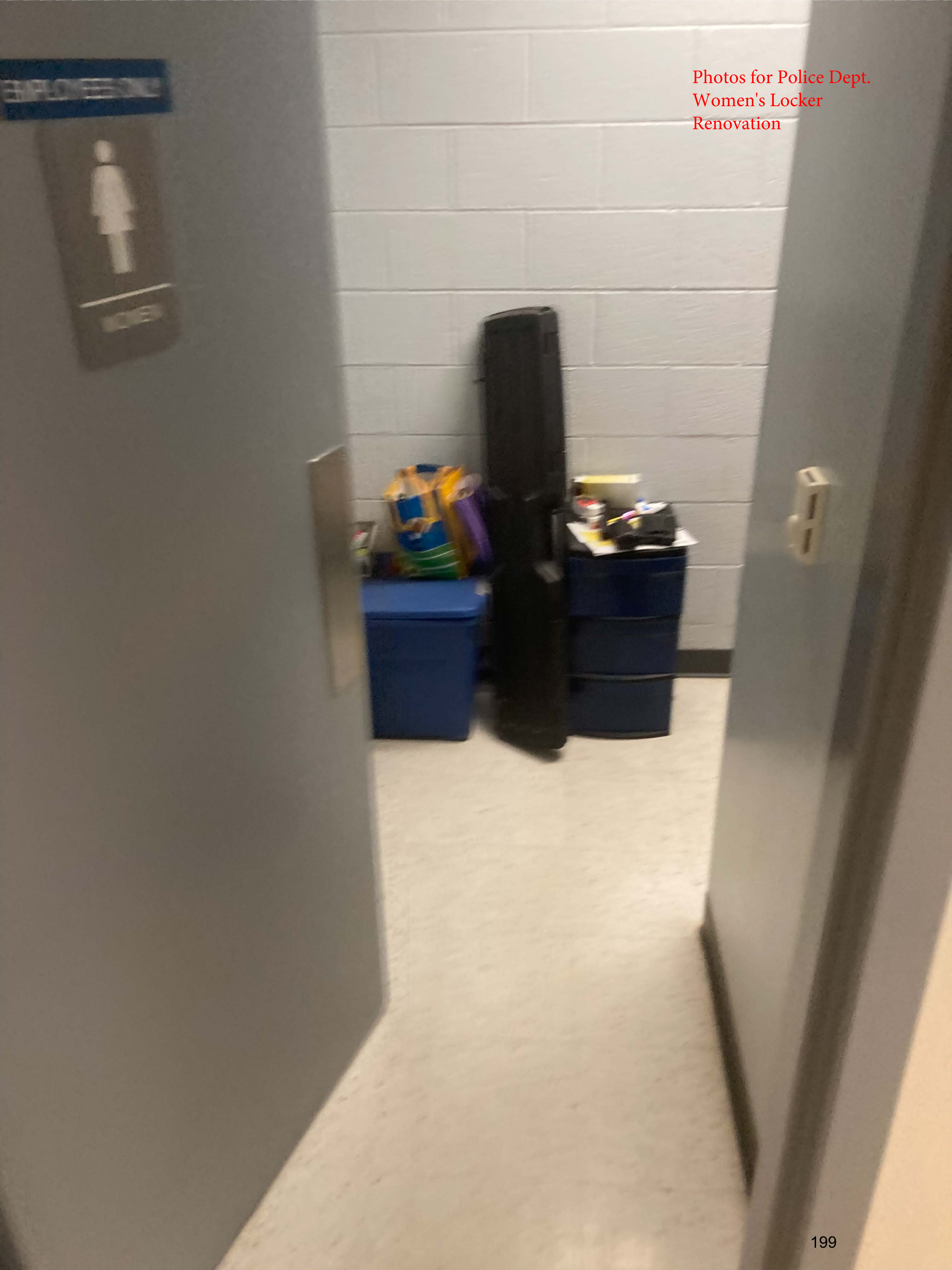
Duration: This quote is good for 60 days from date of issue.
Shipping Notes: All shipments shall be FOB shipper. Shipping charges shall be additional unless listed on quote.
Taxes: Taxes are not included in quote. Please provide a tax-exempt certificate or sales tax will be applied.
Warranty: Unless otherwise indicated, all products have a one year warranty from date of sale. Warranty extensions are a component of some applications that are available at time of purchase. A Finance Charge of 1.5% per month will be applied to overdue balances. GSA GS-07F-6092R

Authorization: By Signing below, I indicate that my organization does not require a purchase order and I am authorized to commit my organization to this order.

Signature: ______________________________ Date: ________________________

Print Name: ______________________________ Title: ______________________________

Photos for Police Dept.
Women's Locker
Renovation




#116
POLICE
DEPT.


JBL


Bedford

Anderson Process
21365 Gateway Curt
Brookfield | Wisconsin | 53045 | United States
Phone: 262-784-3340 |

Attention: **Date:** 1/12/2024

Anderson Process
21365 Gateway Court
Brookfield, Wisconsin 53045-5110 United States
Phone: 262-781-4500

Project Name: Sault Ste. Marie line blender upgrade **Quote Number:** 272205390

Parts for Model Number(s): 9-LBVC-300
Reference Serial Number(s): 191400 / 401
Reference Order Number(s): 13071

Proposal Summary

Primary Solution

Item	Size/Description/Scope of Supply	Price	Qty.	Sub Total
1	Lightnin current Mixer Model 9-LBC-300, similar to existing reference units.	$67,602.00	1	$67,602.00
			Total (US Dollars)	$67,602.00

Note: Minimum value of an order must be $200. Add additional items or the difference will be added.

Commercial Terms / Terms of Delivery

Note: In the absence of any specifications, we reserve the right to review any additional requirements and amend our offer accordingly

Commercial Terms

Unless otherwise expressly agreed to in writing by SPX FLOW, this quote and any resulting order shall be governed solely and exclusively by the SPX FLOW Standard Terms and Conditions of Sale attached hereto (and also available at ')http://www.spxflow.com/terms-conditions'). SPX FLOW hereby expressly rejects the applicability of any and all terms and conditions of Buyer.

Available to Ship In:	35 Weeks after receipt of order
Delivery Terms*:	Free Carrier Sellers Facility
Freight Terms:	Freight Collect
Terms of Payment:	60 Days from Invoice Date
Quote Expiration Date:	1/13/2024

Estimated lead times quoted are based on current production capacity, are subject to stock materials remaining unsold and will be calculated from receipt of clear and actionable order (approval time -if any - is excluded)

Tariffs

The quoted price has been based on the cost of materials and components (**"Materials"**) at the date of this proposal. If, due to the imposition of any tariffs (regardless of the country imposing said tariffs), the cost to SPX FLOW of performing its obligations under any Order arising from this proposal increases between the date of this proposal and the date of Order, the quoted price shall be increased.

Such increase shall be determined by SPX FLOW taking into account the applicable tariff imposed on Material(s) as at the date of the Order.

Supply Chain and Operational Disruptions

Due to prevailing market conditions, it is difficult for SPX FLOW and its sub-suppliers to ascertain cost and delivery time with certainty. As such, all prices and dates for execution/delivery are quoted by SPX FLOW based on the costs and availability of materials and labor at the date of quotation. If the actual cost to SPX FLOW of executing the order increases by more than 5% between the date of the quotation and the date of completion of the order, such increase shall be added to the price of the order. SPX FLOW may also demonstrate such increase by applying a price index chosen by SPX FLOW in good faith and applied to all or part of the price. Further, SPX FLOW shall not be responsible for any delays beyond its reasonable control due to a shortage/lack of availability of materials (including increased lead times by its sub-suppliers), staff shortages or transportation disruptions.

Supplemental Terms and Conditions

The following terms and conditions supplement SPX FLOW's Standard Terms and Conditions of Sale (2 Nov. 2017) for all orders for Lightnin, Philadelphia, Plenty, Stelzer, and Uutechnic branded products. To the extent there is any conflict between the following terms and SPX FLOW's Standard Terms and Conditions of Sale, the following terms shall govern.

- All orders over one hundred thousand dollars ($100,000 USD) or the local currency equivalent shall be subject to the following milestone invoicing terms:
  (1) twenty percent (20%) at the time of order acceptance;
  (2) forty percent (40%) upon the later of:
    (a) sixty (60) business days after order acceptance; or
    (b) for orders having approval drawings, ten (10) business days after acceptance of approval drawings; and
  (3) forty percent (40%) upon shipment.
- After order acceptance, any change to the scope of a quotation or to the design of a product or part thereof may be subject to a change order. The change order will be quoted to the Buyer within ten (10) business days of receipt of the change request.
- Acceptance of approval drawings, if applicable, shall occur within twenty (20) business days of drawing issuance or in accordance with the schedule set forth in SPX FLOW's order acceptance. If acceptance of approval drawings does not occur within the specified period, SPX FLOW may: (i) extend the shipment date by an amount of time determined in SPX FLOW's sole discretion; and/or (ii) requote the order.
- Any extension of the shipment schedule caused by the Buyer, including, but not limited to, failure to arrange transport or not providing a confirmed delivery location, will be subject to a storage charge to be determined in SPX FLOW's sole discretion and quoted to the Buyer at least ten (10) business days prior to taking effect.

Order Placement

Please Address Purchase Order To:

For Lightnin Mixers:

SPX Flow US, LLC

135 Mt Read Blvd

Rochester, NY 14611

And email it to me for processing dtighe@andersonprocess.com

Thank You,

Dan Tighe 262.439.2320

Primary Solutions

Product Details

Item	Size/Description/Scope of Supply	Price	Qty.	Sub Total
1	Lightnin Mixer Model 9-LBVC-300	$67,602.00	1	$67,602.00

OTHER DATA	
Other RFQ Specials	Quoted current standard 9-LBC-300 with 1200 RPM motor, shaft with dual A310 impellers and the vessel and mounting as per original drawing # 307191-1. Std Lightnin green paintg. STUFFING BOX (TYPE 2T) COMBO 50 PKG SHAFT 316SS with CHROME PLATING AND - 3/4" diameter shaft

These Terms and Conditions of Sale ("Terms") shall govern all quotations, orders and contracts for the sale of goods and services of SPX FLOW to Buyer. These Terms supersede and exclude any prior written or oral agreement, understanding, representation or promise, and any pre-printed or standard terms and conditions contained in Buyer's request for quote, purchase order, invoice, order acknowledgement, contract or other similar document. These Terms may not be amended, supplemented, changed or modified except by concurrent or subsequent written agreement, signed by an authorized representative of SPX FLOW and Buyer. SPX FLOW's acknowledgement of Buyer's order shall not constitute acceptance of any terms and conditions contained therein, regardless of how such terms and conditions may be prefaced or described.

1. DEFINITIONS: "SPX FLOW" means the SPX FLOW, Inc. entity named in the order which is providing the goods and/or services. "Buyer" means the company who accepted SPX FLOW's offer or is named in the order.

2. PRICES: Unless otherwise mutually agreed to in writing, prices are net, Free Carrier (INCOTERM 2010) SPX FLOW facility. Stenographic, clerical and mathematical errors are subject to correction. Prices are exclusive of expenses related to special packaging or procedures to cover unique circumstances of shipment or storage unless specifically noted. Until acceptance of order on these Terms, quoted prices are subject to change.

3. DELIVERY AND PERFORMANCE: Unless otherwise specifically agreed in writing by the parties, all goods shall be delivered Free Carrier (INCOTERM 2010) SPX FLOW facility. Title shall pass to the Buyer upon delivery, or upon payment in full, whatever is later, provided that the only rights that SPX FLOW retains in relation to title are those enabling recovery of the goods in the event of Buyer's default on payment. Dates for the furnishing of services and/or delivery or shipment of goods are approximate only and are subject to change, and SPX FLOW shall use commercially reasonable efforts to meet such dates; provided, however, that SPX FLOW shall not be liable in damages or otherwise, nor shall Buyer be relieved of its performance hereunder, because of SPX FLOW's failure to meet them. If liquidated damages or a penalty have been agreed for delay, such liquidated damages or penalty shall only become due if the delay is solely due to the fault of SPX FLOW, the Buyer suffers damage due to this delay, and the Buyer has notified SPX FLOW in writing after the expiry of the time during which delivery could have been reasonably expected. Unless specifically agreed otherwise, it shall be calculated based on the value of the delayed part of the delivery, and the aggregate liability of SPX FLOW for all liquidated damages/penalties shall be limited to 5% of the total order value. Such liquidated damages/penalty shall be the Buyer's sole remedy and SPX FLOW's sole liability in case of delay. For the avoidance of doubt, if the order is subject to the laws of the Netherlands, "liquidated damages" or "penalty" shall mean a contractual penalty which is meant to be a compensation for damages. Additionally, SPX FLOW shall not be liable, directly or indirectly, for any delay in or failure to perform caused by carriers or suppliers; labor difficulties, shortages, strikes or stoppages of any sort; difficulty in obtaining materials; Buyer requested order changes; fires, floods, storms, accidents, or acts of God; any statute, sanction, injunction or other governmental restraint or prohibition or political unrest; or other causes beyond SPX FLOW's reasonable control. In the event of any such delay, the date of delivery shall be extended for a length of time at least equal to the period of the delay. All goods for which SPX FLOW does not receive notice of rejection for within seven (7) days after receipt, will be deemed accepted.

4. SHORTAGE, DAMAGE, ERRORS IN SHIPMENT: SPX FLOW's responsibility ceases upon making the goods available for pickup at SPX FLOW's facility. Buyer shall note receipt for goods that are not in accordance with bill of lading or express receipt and Buyer shall make claim against such carrier for any shortage, damage or discrepancy in the shipment promptly. Partial and transshipments are allowed.

5. TAXES: The quotation and order price excludes all assessments, taxes, levies and charges of whatsoever nature present or future, due or becoming due. This exemption shall include but not be limited to value added tax, income tax, withholding tax, profits tax, turnover tax, goods and services tax and any other consumption or environmental taxes applicable, tax payable on the income of expatriate employees, port dues, import and custom duties on the components and services and all export duties payable on the repatriation of any SPX FLOW components at the end of an order, where applicable. On the basis that an order is tax exclusive SPX FLOW reserve the right to invoice by way of an addition to such order price, such taxes as may be applicable under the relevant jurisdiction's tax regulations, together with SPX FLOW's external costs of dealing with these taxes.

6. CREDIT AND PAYMENT: Unless otherwise agreed in writing by SPX FLOW, payment of goods shall be net thirty (30) days, in the currency of the country of SPX FLOW. For orders in excess of two hundred and fifty thousand dollars ($250,000 USD) or the local equivalent payment terms shall be as follows: (a) twenty percent (20%) down payment, (b) forty percent (40%) upon SPX FLOW's purchase of raw materials/components, and (c) forty percent (40%) at the time of delivery. Down payment shall be due within five (5) of SPX FLOW's acceptance of the order, with the remaining two payments being net thirty (30) days. Prorated payments shall become due with partial shipments, and Buyer shall not be entitled to any retention or holdback; provided, however, if SPX FLOW agrees in writing to a retention or holdback, SPX FLOW may provide such retention or holdback in the form of a bond, letter of credit or bank guarantee in no event to extend more than thirty (30) days beyond expiry of the warranty period. SPX FLOW retains all remedies for Buyer's insolvency including, but not limited to, the right to stop delivery, reclaim any goods delivered, or withhold delivery except for cash. Failure to pay invoices at maturity date, at SPX FLOW's election, makes all subsequent invoices immediately due and payable and SPX FLOW may withhold all subsequent deliveries until the full account is settled and SPX FLOW shall not, in such event, be liable for non-performance of contract in whole or in part. Buyer agrees to pay, without formal notice, one and one-half percent (1.5%) per month of the amount not paid when due, or, if such rate is in excess of applicable governing law, Buyer agrees to pay the maximum permitted rate. No deduction, whether by way of set-off, counterclaim or otherwise, shall be made by Buyer. If prerequisites for any payment (such as delivery, completion or formal acceptance) cannot be satisfied due to Buyer's breach, such payment shall nevertheless become due and payable at the time agreed to and SPX FLOW's further right to seek damages shall remain unaffected.

7. CANCELLATIONS AND CHANGES: All orders are binding upon acceptance. In the event that SPX FLOW, in its sole discretion, agrees to cancellation of an order by Buyer, Buyer shall be liable for a cancellation charge equal to the greater of (i) twenty-five percent (25%) of the purchase price and (ii) any loss or cost incurred by SPX FLOW, including, but not limited to, cost of materials, labor, engineering, reconditioning and a reasonable profit margin. Buyer is responsible for all reasonable storage, insurance, and all other expenses incurred by SPX FLOW as a result of Buyer's cancellations and/or changes. No changes to the specification or the order are accepted without the prior written consent of both parties. In the event Buyer requests a change, SPX FLOW will provide a quotation to Buyer within a reasonable time of no less than ten (10) working days detailing the corresponding change in delivery, price, materials, and similar. SPX FLOW shall not be obligated to implement the requested change until the quotation is agreed by the parties.

8. LIMITED WARRANTY: Unless otherwise mutually agreed to in writing, (a) SPX FLOW goods, auxiliaries and parts thereof are warranted to the Buyer against defective workmanship and material for a period of twelve (12) months from date of installation or eighteen (18) months from date of delivery, whichever expires first, and (b) SPX FLOW services are warranted to Buyer to have been performed in a workmanlike manner for a period of ninety (90) days from the date of performance. If the goods or services do not conform to the warranty stated above, then as Buyer's sole remedy, SPX FLOW shall, at SPX FLOW's option, either repair or replace the defective goods or re-perform defective services. If Buyer makes a warranty claim to SPX FLOW and no actual defect is subsequently found, Buyer shall reimburse SPX FLOW for all reasonable costs which SPX FLOW incurs in connection with the alleged defect. Third party goods furnished by SPX FLOW will be repaired or replaced as Buyer's sole remedy, but only to the extent provided in and honored by the original manufacturer's warranty. Unless otherwise agreed to in writing, SPX FLOW shall not be liable for breach of warranty or otherwise in any manner whatsoever for: (i) normal wear and tear; (ii) corrosion, abrasion or erosion; (iii) any good or services which, following delivery or performance by SPX FLOW, has been subjected to accident, abuse, misapplication, improper repair, alteration (including modifications or repairs by Buyer, the end customer or third parties other than SPX FLOW), improper installation or maintenance, neglect, or excessive operating conditions; (iv) defects resulting from Buyer's specifications or designs or those of Buyer's contractors or subcontractors other than SPX FLOW; or (v) defects resulting from the manufacture, distribution, promotion or sale of Buyer's products; (vi) damage resulting from the combination, operation or use with equipment, products, hardware, software, firmware, systems or data not provided by SPX FLOW, if such damage or harm would have been avoided in the absence of such combination, operation or use; or (vii) Buyer's use of the goods in any manner inconsistent with SPX FLOW's written materials regarding the use of such product. In addition, the foregoing warranty shall not include any labor, dismantling, re-installation, transportation or access costs, or other expense associated with the repair or replacement of SPX FLOW goods. THE WARRANTIES CONTAINED HEREIN ARE THE SOLE AND EXCLUSIVE WARRANTIES AVAILABLE TO BUYER AND SPX FLOW HEREBY DISCLAIMS ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ANY PERFORMANCE OR PROCESS OUTCOME DESIRED BY THE BUYER AND NOT SPECIFICALLY AGREED TO BY SPX FLOW. THE FOREGOING REPAIR, REPLACEMENT AND REPERFORMANCE OBLIGATIONS STATE SPX FLOW'S ENTIRE AND EXCLUSIVE LIABILITY AND BUYER'S EXCLUSIVE REMEDY FOR ANY CLAIM IN CONNECTION WITH THE SALE AND FURNISHING OF SERVICES, GOODS OR PARTS, THEIR DESIGN, SUITABILITY FOR USE, INSTALLATION OR OPERATIONS.

9. INTELLECTUAL PROPERTY: In the event of a successful infringement claim by a third party, at SPX FLOW's option, SPX FLOW shall either (i) modify the goods sold hereunder so that they perform comparable functions without infringement, (ii) obtain a royalty-free license for Buyer to continue using the infringing goods or (iii) refund to Buyer the then-depreciated fair market value of the infringing component. SPX FLOW shall have no obligation under this Article to the extent a claim is based upon (a) the combination, operation or use of the goods with equipment, products, hardware, software, systems or data that was not provided by SPX FLOW, if such infringement would have been avoided in the absence of such combination, operation or use, or (b) Buyer's use of the product in any manner inconsistent with SPX FLOW's written materials regarding the use of such product or (c) infringement resulting from

Buyer's specifications or designs or those of Buyer's contractors or subcontractors other than SPX FLOW. This Section states SPX FLOW's entire liability and Buyer's exclusive remedy with respect to any actual or alleged infringement arising from the use of the goods or services sold hereunder or any part thereof and is subject to the other limitations contained in these Terms.

10. LIMITATION OF LIABILITY: NOTWITHSTANDING ANYTHING TO THE CONTRARY SET FORTH HEREIN: (A) IN NO EVENT SHALL SPX FLOW BE LIABLE FOR ANY EXEMPLARY, PUNITIVE, INCIDENTAL, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES WHATSOEVER (COLLECTIVELY DEFINED AS "CONSEQUENTIAL DAMAGES"), WHETHER FORESEEABLE OR NOT, INCLUDING WITHOUT LIMITATION, THIRD PARTY CHARGES AND COSTS, LOST PROFITS (WHETHER DIRECT OR INDIRECT), PRODUCT, PRODUCTION, BUSINESS OR BUSINESS OPPORTUNITY, REGARDLESS OF THE CAUSE, INCLUDING WITHOUT LIMITATION, THE NEGLIGENT ACTS OR OMISSIONS, BREACH OF CONTRACT, WARRANTY (EXPRESS OR IMPLIED) OR DUTY (STATUTORY OR OTHERWISE) OR STRICT LIABILITY OF SPX FLOW GROUP OR ANY OTHER THEORY OF LEGAL LIABILITY; AND (B) SPX FLOW'S AGGREGATE LIABILITY ARISING FROM OR IN CONNECTION WITH ALL ORDERS AND CONTRACTS FOR GOODS AND SERVICES UNDER THESE TERMS SHALL (SAVE FOR LIABILITIES WHICH CANNOT BE LIMITED BY APPLICATION OF LAW) NOT EXCEED THE CONTRACT PRICE FOR THE GOODS AND/OR SERVICES FOR WHICH LIABILITY IS CLAIMED. ANY ACTION FOR BREACH OF CONTRACT BY BUYER MUST BE COMMENCED WITHIN 30 DAYS OF THE EXPIRY OF THE WARRANTY PERIOD. BUYER SHALL BE SOLELY RESPONSIBLE FOR ANY AND ALL AGREEMENTS MADE WITH THIRD PARTIES THAT ARE OUTSIDE THE SCOPE OF THESE TERMS AND WHICH ARE CONTRARY TO THE LIMITATIONS OF LIABILITY AND/OR WARRANTY INCLUDED HEREIN.

11. GOODS FOR EXPORT: Buyer acknowledges that the goods may be subject to export restrictions, and that Buyer will comply with all such applicable laws and regulations. If the goods are intended for export, Buyer shall designate country of destination on its order. In the event that Buyer purchases goods for export without so notifying SPX FLOW, SPX FLOW reserves the right to cancel the order at no penalty or liability for breach in the event that SPX FLOW objects to the ultimate destination of the goods. Buyer will have sole liability and shall defend, indemnify and release SPX FLOW for any loss or damage (including without limitation, claims of governmental authorities) arising from the export or import of such goods, including, without limitation, those related to packaging, labeling, marking, warranty, contents, use, or documentation of the goods. Buyer has sole responsibility for obtaining any required export licenses. Buyer will not take, and will not solicit SPX FLOW to take, any action which would violate any anti-boycott or any export or import statutes or regulations applicable to the order, of any governmental authorities, and shall defend, indemnify, and reimburse SPX FLOW for any loss or damage arising out of or related to such actions. To the extent SPX FLOW is required to obtain an export license for any goods: (1) SPX FLOW obligation to fulfill an order with goods requiring such a license will be directly subject to the granting of the license; (2) SPX FLOW will use commercially reasonable effort to obtain such license; (3) Buyer shall make available all necessary information and documentation required for SPX FLOW to obtain such license; and (4) Buyer shall reimburse SPX FLOW for its reasonable expenses incurred in connection with obtaining such license.

12. PROPRIETARY INFORMATION: SPX FLOW shall retain title to all engineering and production prints, drawings, technical data, and other intellectual property, information and documents that relate to the goods or services sold to Buyer. All such information and documents disclosed or delivered by SPX FLOW to Buyer: (i) are to be deemed proprietary to SPX FLOW; (ii) shall not be disclosed to any third party for any reason without the express prior written consent of SPX FLOW; and (iii) shall be used by Buyer solely for the purpose of inspection, installation, use and maintenance of the goods and services sold to Buyer under these Terms.

13. APPLICABLE LAW; VENUE; DISPUTE RESOLUTION: <u>For sales of goods sold or to be delivered or services to be performed within the United States:</u> The rights and duties of the parties hereunder shall be governed by the laws of the State of North Carolina, United States of America, excluding its conflicts law and choice of laws principles. Any action or proceeding with respect to any dispute or controversy involving or arising out of this order, at SPX FLOW's sole discretion, (i) shall be brought in any State court in Mecklenburg County, North Carolina or the Federal courts of the Western District of North Carolina, United States of America, and Buyer and SPX FLOW submit to and accept generally and unconditionally the jurisdiction of those courts with respect to such party's person and property, or (ii) shall be settled by arbitration administered by the American Arbitration Association in accordance with its Commercial Rules, which award shall be final and binding on the parties and may be entered and enforced in any court having jurisdiction. Buyer and SPX FLOW hereby irrevocably waive any objection to the laying of venue of any action or proceeding in the above-described courts. <u>For sales of goods sold or to be delivered or services to be performed outside of the United States:</u> The rights and duties of the parties hereunder shall be governed by and construed in accordance with the law of the jurisdiction of the SPX FLOW entity providing the goods or services for this order. The United Nations Convention on Contracts for the International Sale of Goods and the conflict rules of international private law shall not apply. Any action or proceeding with respect to any dispute or controversy involving or arising out of this order, at SPX FLOW's sole discretion, (i) shall be brought in any competent court of the jurisdiction in which the SPX FLOW entity providing the goods or services is located, or (ii) shall be finally settled under the Rules of Arbitration of the International Chamber of Commerce by one or more arbitrators appointed in accordance with said Rules, with English serving as the language of the arbitration proceeding and award. Notwithstanding any other limitations contained in these Terms, SPX FLOW reserves the right to initiate proceedings in any court of competent jurisdiction, and Buyer shall indemnify SPX FLOW for all costs, fees and expenses (including reasonable attorneys' fees) SPX FLOW incurs in connection with enforcing its rights pursuant to this order.

14. RESALE: Buyer further agrees that upon resale of the goods, it will include in the contract for resale provisions which limit recoveries against SPX FLOW in accordance with these Terms. If Buyer fails to include such provisions in any such contract for resale, (a) SPX FLOW may reject Buyer's order related to such contract for resale, and (b) Buyer shall indemnify, defend and hold harmless SPX FLOW against any claim, liability, loss, cost, damage, or expense (including reasonable attorneys' fees) arising out of or resulting from such failure.

15. BUYER CAUSED DELAYS; WAIVER OF RIGHTS: If Buyer fails to perform any of its obligations under an order, SPX FLOW shall be entitled to suspend its performance under the order until such time as Buyer performs such obligations, and any dates for the delivery of goods or performance of services shall be extended for an amount of time determined in SPX FLOW's discretion.

Delays caused by Buyer which prevent SPX FLOW from achieving the original order performance requirements includes but is not limited to: (a) the construction of buildings, structures or other parts of the site within which SPX FLOW's goods are to be located; (b) changes in scope of an order introduced by Buyer; (c) completion of approvals, consents or delivery of critical information by Buyer beyond the periods provided in an order; (d) any specified site facilities and working conditions not being maintained by Buyer; (e) failure of Buyer to arrange carriage of the goods under an order, where Buyer has such obligation, or any other inability or refusal of Buyer to accept delivery in accordance with order delivery dates; (f) delays in obtaining customs clearance (where applicable) of the order deliveries; and (g) delay by Buyer in providing any required security to SPX FLOW in the form of a letter of credit, bank guarantee or otherwise. In the event of such Buyer delays, SPX FLOW shall in addition to an extension of remaining milestones, be entitled to an increase in the total order price to reflect the increase in cost to SPX FLOW directly caused by Buyer delays. Additionally, SPX FLOW shall be entitled to submit invoices for any order milestone for which completion has been frustrated due to Buyer delays. Such invoices shall be paid within 30 days of the date of SPX FLOW’s invoice.

Any engineering, technical or other submittal drawings submitted by SPX FLOW to Buyer which are not expressly rejected in writing within ten (10) business days of Buyer’s receipt, will be deemed accepted by Buyer. Buyer's right to conduct any agreed upon pre-shipment inspections (i) which Buyer does not schedule within ten (10) business days of receipt of notice of readiness to inspect from SPX FLOW or (ii) which Buyer delays for more than ten (10) business days from the date originally scheduled, will be waived, so long as SPX FLOW certifies in writing that the goods successfully passed SPX FLOW's standard pre-shipment inspection. Where Buyer delays taking shipment of any goods or otherwise fails to engage or otherwise dispatch a freight forwarder or transit company within ten (10) business days of notification that the goods are ready to ship, SPX FLOW shall be entitled to change the delivery term to Ex Works (INCOTERM 2010) SPX FLOW facility.

16. NO OTHER CONTRACT PROVISIONS; OTHER: No dealer, broker, branch manager, agent, employee or representative of SPX FLOW has any power or authority except to take orders for SPX FLOW goods or services and to submit the same to SPX FLOW for SPX FLOW's approval and acceptance on the terms herein or rejection. There are no representations, agreements, obligations, or conditions, expressed or implied, statutory or otherwise, relating to the subject matter hereof, other than contained herein. For the avoidance of doubt and not in limitation of the foregoing, SPX FLOW shall not be bound by the terms of any contract between Buyer and any third party or other flow down provisions, regardless of whether Buyer notifies SPX FLOW of such terms unless SPX FLOW expressly agrees to be bound by such terms in writing by an authorized representative of SPX FLOW. If any provision hereof is invalid or not enforceable under applicable law, the remaining provisions shall remain in full force and effect.

SPX FLOW reserves the right to transfer or assign its obligations, rights and responsibilities hereunder, so long as such successor or assign agrees to these Terms. Any assignment of Buyer's rights hereunder without SPX FLOW's consent (which shall not be unreasonably withheld) shall be void. SPX FLOW's failure to require Buyer's performance of any of these Terms shall not serve as a waiver of or diminish SPX FLOW's rights to require strict performance of these Terms.

EFFECT OF STORAGE TANK MIXING ON WATER QUALITY

Prepared By:

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South Dakota State University, Brookings, SD 57007

Sponsored by:
Regional Water System Research Consortium

ABOUT THE Regional Water System Research Consortium.

The Regional Water System Research Consortium (RWSRC) was formed to support research and development projects to develop management and operational tools to sustain the development and service life of regional rural water systems. RWSRC is supported by funds contributed by South Dakota regional rural water systems, the South Dakota Association of Rural Water Systems, and several water development districts in South Dakota. Administrative support and project management are provided through the Water and Environmental Engineering Research Center in the College of Engineering at South Dakota State University.

ABOUT this report.

This report is the second of two reports examining water quality in water storage facilities installed in South Dakota's regional rural water systems. The first report, authored by Christopher Olson and Delvin DeBoer, examined the effects of tank operation and design characteristics on water quality in distribution system storage tanks. This report focuses on the impacts of mixing on water quality in storage tanks. The reports were completed in two consecutive years of field studies of storage tank water quality. This report also served to meet the Master of Science thesis requirements for Andy Lemke, graduate research assistant in the Civil and Environmental Engineering Department at South Dakota State University.

ACKNOWLEDGEMENTS:

The assistance of personnel from the following systems is gratefully acknowledged: Randall Community Water District, Aurora Brule Rural Water Supply System, Clay Rural Water System, Brookings-Deuel Water System, Bon Homme-Yankton Rural Water System, and Lincoln Pipestone Water System.

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LIST OF ABBREVIATIONS

H:D Ratio	Height to diameter ratio
^{0}C	Degrees Celsius
ft/s	Feet per second
gpm	Gallons per minute
ft.	Feet
ft/s^2	Feet per second squared
$slug/ft^3$	Slug per cubic foot
ft^3/s	Cubic feet per second
BTU	British thermal unit
lb/ft^3	Pounds per cubic foot
ft-s/lb	Feet-second per pound
lb-ft/s	Foot pounds per second
$lb\text{-}s/ft^2$	Pound-second per square foot
sec	Second
s^{-1}	Per second
CFD	Computational fluid dynamics
TTHM	Total trihalomethanes
HAA5	Haloaecetic acid
NDMA	*N*-Nitrosodimethylamine
ng/L	Nanograms per liter
EPA	Environmental Protection Agency
SCADA	Tank system control and data acquisition
mg/L	Milligrams per liter
mg/L as N	Milligrams per liter expressed as nitrogen
MCL	Maximum contaminant level
DBP	Disinfection byproduct
AOB	Ammonia oxidizing bacteria
NOB	Nitrite oxidizing bacteria
NOM	Natural organic matter
Mgal	Million gallons
WEERC	Water and Environmental Engineering Research Center
SDSU	South Dakota State University

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

EFFECT OF STORAGE TANK MIXING ON WATER QUALITY

2012

Storage tanks are used by water systems to maintain pressure in the distribution system and to meet the varying water demands of the system. The design and operation of the storage tanks affect their mixing characteristics which affect the water quality. Poor mixing can lead to stratification in the tanks, which can lead to low chlorine residual causing microbial growth and nitrification.

This thesis presents the results of the study of seven storage tanks used in South Dakota's rural water systems. The tanks were chosen to represent varying height to diameter ratios, varying types of disinfectant, and to study passive mixing systems. The study used temperature data from all of the tanks and water quality data from five of the tanks. Temperature and water sampling apparatus were installed into each of the five tanks to examine the tanks' behavior at varying heights.

Hydraulic parameters including volumetric exchange, densimetric Froude number, and the dimensionless mixing parameter (Roberts et al. 2006) were examined to determine if they could predict the tanks' mixing capabilities by comparing the actual values with theoretical values required for mixing the tank. Chlorine decay modeling was completed using the CompTank program. The model results were compared with actual data obtained during the study to determine the models capability to predict chlorine decay.

The data showed that thermal stratification occurred in a few of the tanks resulting in water quality stratification and depleted chlorine residual in the upper zone of the tanks. High height-to-diameter storage tanks were more susceptible to stratification. To remediate stratification in one tank, the water system drained a large portion of the tank volume into its distribution system and refilled the tank with fresh water. A second system with a stratified tank chose to overflow the storage tank. Both methods were successful in restoring the chlorine residual.

Passive mixing systems were installed in two tanks to prevent stratification. As a result of the passive mixing systems, both tanks were properly mixed, indicating that passive mixing systems can be effective in mixing storage tanks.

Chorine residual measurements in two tanks throughout the study were used to develop chlorine decay coefficients used for the CompTank model. When the resulting decay coefficients were inserted into the model, the model substantially fit the chlorine decay that occurred in the upper zone of the stratified tanks.

CHAPTER 1: INTRODUCTION

1.1 Background

South Dakota rural water systems use water storage tanks throughout their systems to meet the varying demands of the customers. Storage tanks can be categorized into elevated towers, standpipes, ground storage tanks, and below grade storage tanks. Fill and draw cycles in the storage tanks are controlled by pump controls and system demands. Water systems keep storage tanks nearly full to be able to supply peak demands in the system.

Design of storage tanks effects mixing in the tanks. Many storage tanks were designed without consideration of mixing. Storage tanks have been designed with high height to diameter ratio, single inlet/outlet, or other characteristics that promote poor mixing. Mixing in storage tanks depends on water movement during the filling cycle, unless the tank has artificial mixing. Poor mixing in storage tanks can lead to stagnant water, which can lead to declining disinfectant residuals. Low disinfectant residuals could permit nitrification in chloraminated systems.

Water quality issues, such as low chlorine residuals and nitrification events, have caused water system operators and managers to question the mixing characteristics of their storage tanks and to seek advice in how operational changes could help promote mixing in the storage tanks.

1.2 Objective and Scope

The hypothesis of the study was that the mixing characteristics of a storage tank can affect the quality of water stored in the tank. The objective of the study was to determine the effects of mixing characteristics of a storage tank on the quality of the water in storage tanks, and to model chlorine decay in a storage tank. The scope of the study included a literature review, collection of water quality and temperature data from tanks, collection of operational data from tanks, evaluation of water quality data based on hydraulics and operations, and modeling chlorine decay in a storage tank.

A literature review was performed to summarize previous work from others who studied tank mixing and water quality in water reservoirs. The literature review provided data to compare with the experimental data from the study and provide a basis for interpreting the results.

Tanks chosen for the study represented a wide range of tanks used in regional rural water systems. Five tanks were selected for long term study, while two tanks were chosen for short term study. Water quality and temperature data were collected for the long term tank study whereas only temperature data were collected for the short term tank study. The collected data was correlated with operational data and design characteristics gathered from the water systems.

Tank hydraulic parameters were calculated and compared to storage tank water quality data. Also, chlorine decay was modeled and compared to storage tank water quality data collected from thermally stratified tanks. If the hydraulic parameters and the chlorine decay model were effective in predicting mixing and water quality, then the information could be used by water systems to optimize their tank operation.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

A literature review was completed to provide background information for the project. Effects of distribution storage on water age and water quality are introduced. Methods of predicting mixing and modeling chlorine decay are summarized.

2.2 Factors Affecting Mixing in Storage Tanks

High water age can be a problem in storage tanks. Poor mixing and location in low demand areas can lead to high water age in storage tanks. If a tank is poorly mixed, dead zones may be formed where water remains for substantial time leading to high water age. High water age can also be created by dead zones created from temperature differences between the filling water and the temperature of the water volume in the tank. Design and operation of storage tanks can factor into high water age. High height to diameter ratio, inlet location and orientation, and location within the system are some design parameters that can affect water age. Daily operations of the tank such as daily turnover and volume added during the filling cycle also affect water age.

2.2.1 Thermal Stratification

Causes of thermal stratification in storage tanks are introduced in the following sections. Also, hydraulic parameters to model the impact of ambient temperature on temperatures of the water in the storage tank are introduced.

2.2.1.1 Causes of Stratification

Stratification in storage tanks occurs when the density of the water in the tank is different than the density of the filling water. Density of water is a function of temperature. Therefore, stratification can occur when the water in the storage tank is different than the temperature of the filling water. Other factors that can affect stratification are a tank's inlet orientation, momentum of the filling water, and the type of buoyancy.

Unless a storage tank has an artificial mixing device, the water movement from the filling water is the only means of mixing in the tank. When the filling water enters the inlet, the water forms a jet. Even if the momentum of the jet is able to mix the tank, temperature or density differences in the filling water and the water in the tank can cause stratification in the storage tank (Grayman et al., 2004).

Figure 2.1 illustrates two different alternatives of how stratification can occur within a storage tank. A negatively buoyant jet is created when the filling water is colder than the water in the tank, which causes the new water to remain at the bottom of the tank leaving aging water in the upper zone. A positively buoyant jet is created when the filling water is warmer than the water in the tank. The new water rises to the top of the tank (Grayman et al, 2004).

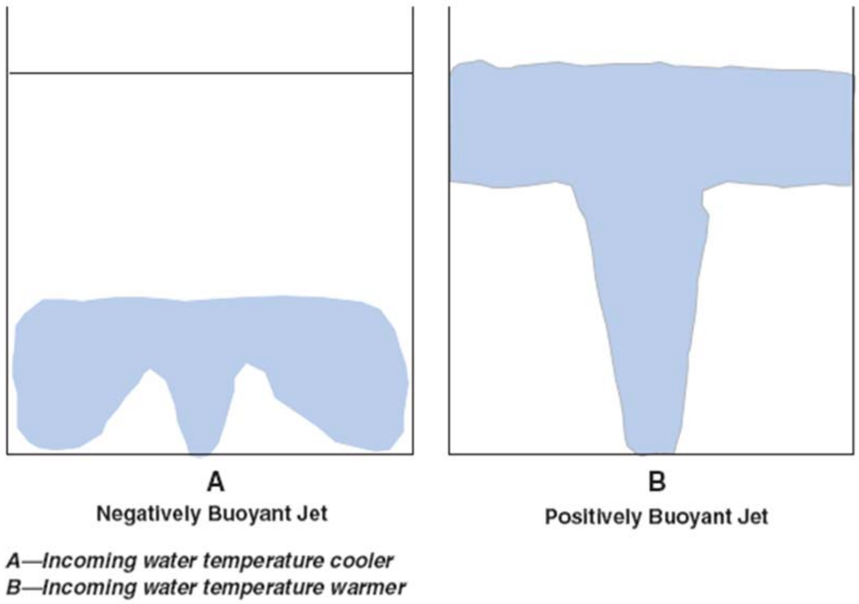


Figure 2.1: Dead zones created from negatively and positively buoyant jets (Adapted from Grayman et al., 2004).

Mahmood et al. (2005) used computational fluid dynamic software to model a comparison of negatively buoyant jets and isothermal conditions. Figure 2.2 is the result of a computational fluid dynamics (CFD) model of a standpipe with a vertical inlet. On the left image, the filling water is 1 ˚C colder than the water in the tank. When the filling water was colder, the water jet mixed less than a third of the tank. The right picture illustrates isothermal conditions when the inflow water and the water in the tank have the same temperature. Under isothermal conditions, the water jet was able to reach the top of the tank and mix the tank. A small change in temperature between the filling water and the water in the tank impacts mixing.

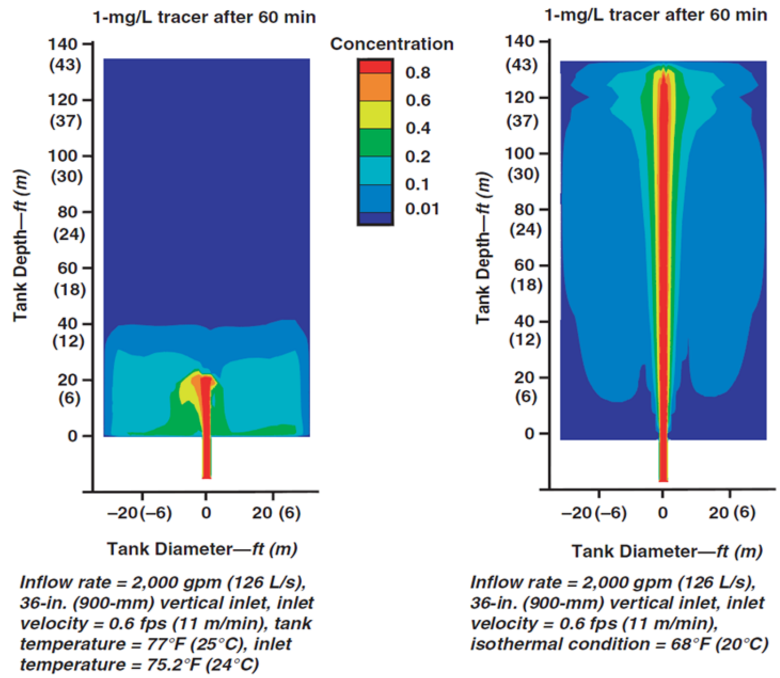


Figure 2.2: Effects of negatively buoyant jet on tank mixing (Mahmood et al., 2005)

2.2.1.2 Predicting Stratification in Storage Tanks

This section introduces hydraulic parameters that can be used to predict tank mixing. The densimetric Froude number can be calculated and compared to a theoretical value developed by Rossman and Grayman (1999) to determine if the tank should mix. A dimensionless mixing parameter developed by Roberts et al. (2006) can also be used to predict tank mixing.

The densimetric Froude number is the inflow's inertial force divided by the buoyant force (Rossman and Grayman, 1999). The buoyant force is created as the filling water and the water in the tank have different temperatures therefore different densities. Fischer et al. (1979) predicted stratification in unconfined bodies of water for negatively buoyant conditions, while Lee and Jirka (1981) examined positively buoyant conditions. Both studies concluded that the occurrence of stratification is related to the densimetric Froude number. Rossman and Grayman (1999) expanded on the work of Fischer et al. (1979) and Lee and Jirka (1981) to study stratification in storage tanks by performing a series of scale tracer studies. Equation 1 was defined by Rossman and Grayman (1999) for the densimetric Froude number:

$$F_d = \frac{u}{\sqrt{g'd}} \qquad (1)$$

where F_d = densimetric Froude number; u = the vertical inflow velocity, ft/s; d = pipe diameter, ft.; and $g' = g(\rho_f - \rho_a)/\rho_a$ where g = acceleration of gravity, ft/s^2; ρ_f=density of inflow, slug/ft^3; ρ_a=density of the ambient water, slug/ft^3. The density of the water can be found using standard tables or approximated using equation 2, which was used by White (2008) to obtain the density +/- 0.2%.

$$\rho \approx \frac{1}{515.379}(1000 - 0.0178|T - 4|^{1.7}) \qquad (2)$$

In Equation 2, ρ = density (slug/ft^3); and T = temperature (˚C).

The experiment completed by Rossman and Grayman (1999) consisted of filling the scale storage tanks with deionized water. Conductivity meters were suspended at varying depths in the tank. After the meters readings stabilized, tap water was pumped into the tank. Inflow characteristics and conductivity were monitored during the experiment. The resulting densimetric Froude number was plotted against the water height/inlet diameter. A line was created that separated the mixed and stratified tanks and the slope of the line (C) was determined. Table 2.1 lists the resulting C values (Rossman and Grayman, 1999).

Table 2.1. Slopes of densimetric Froude number as a function of water height/inlet diameter determined by Rossman and Grayman (1999).

Inlet Orientation	**Inflow Buoyancy**	**C**
Vertical	Negative	0.8
Vertical	Positive	1.5
Horizontal	Negative	1.5
Horizontal	Positive	0.8

Rossman and Grayman (1999) determined an equation that could be compared to the actual densimetric Froude number to predict whether the tank would be mixed. Equation 3 shows the comparison. If the densimetric Froude number (Equation 1) is greater than the right side of Equation 3, then the tank should be mixed:

$$F_d > C\frac{H}{d} \qquad (3)$$

where F_d= densimetric Froude number; C = slope from Table 2.1; H = water height, ft.; d = diameter of inlet, ft.

Roberts et al. (2006) studied jet induced mixing in storage tanks. They derived a dimensionless mixing parameter that was a function of inflow momentum, buoyancy force, and water depth. The dimensionless mixing parameter was related to the occurrence of stratification in tanks. A 3-dimensional laser induced fluorescent tracer system was used to test the relationship. A simple criterion to tell whether water with negative buoyancy should mix in a tank was created by Roberts et al. (2006) and is presented in Equation 4:

$$\frac{M^{0.5}}{B^{\frac{1}{3}}*H^{\frac{2}{3}}} > 0.85 - 0.05n \quad (4)$$

where M = inflow momentum, ft^4/s^2; B = Buoyant Force, ft^4/s^3; H = water depth, ft.; and n = number of inlets. The buoyant force can be found using Equation 5 from Roberts et al. (2006):

$$B = g\left(\frac{\rho_a - \rho_f}{\rho_a}\right)Q \quad (5)$$

where g = 32.2 ft/s^2; ρ_a = density of the water in the tank volume; ρ_f = density of the filling water; and Q = flow rate (cfs). The density of the water can be found using standard tables or approximated using equation 2. If the left side of Equation 4 is greater than the right side, the tank should be mixed.

Roberts et al. (2006) conducted other tracer tests to examine the effects of inlet orientation, negative buoyancy, and positive buoyancy. Olson (2011) summarized the data from Roberts et al. (2006) as shown in Table 2.2.

Table 2.2: Summary of tracer study with single inlet and buouancy effects from Roberts et al. (2006)(Olson, 2011).

Tank Geometry	Buoyancy Type	Inlet Configuration	Result of Study
H:D Ratio ≤ 1.0	Positive	Vertical, single inlet	No scale model tanks became mixed as a result of new water rising to the surface and forming a layer on top of the initial volume
H:D Ratio ≤ 1.0	Positive	Horizontal, single inlet	Tanks whose value of $M^{1/2}/(B^{1/3}H^{2/3}) > 1.3$ became mixed
0.25<H:D<2.5	Negative	Horizontal, single inlet	No scale model tanks became mixed as a result of new water hitting the sidewall, losing momentum, and forming a layer at the bottom of the tank

Roberts et al. (2006) results support the findings of Rossman and Grayman (1999). The characteristics of the tanks that did not mix in Roberts et al. (2006) corresponded with similar characteristics of the tanks that received the highest C-value in Rossman and Grayman (1999), which supports the conclusion that these tanks are more susceptible to stratification. Rossman and Grayman (1999) found stratification occurred more readily in tanks with positive buoyancy and vertical single inlet (C=1.5). Roberts et al. (2006) was unable to mix a tank with these conditions, supporting the results of Rossman and Grayman (1999). Tanks with a horizontal inlet were more susceptible to stratification with negative buoyancy (C=1.5) (Rossman and Grayman, 1999), which was again supported by Roberts et al. (2006) when they were unable to mix a tank under these conditions.

2.2.1.3 Heat Transfer in Storage Tanks

Heat transfer can occur through both convection and conduction. Moran et al. (2003) describes both. Convection has two different types - forced convection occurs when an outside factor forces water movement, whereas free convection occurs when there is a difference in density between a portion of water and the surrounding water. Both of these types of convection occur in water storage tanks. An example of free convection is when the water near the outside of the tank is heated and the warmer water rises to the top of the storage tank. Forced convection would occur if a mechanical mixer was installed into the tank forcing movement of water in the tank.

According to Moran et al. (2003) conduction occurs between two points of different temperatures. The warmer point will heat the other. Conduction occurs in a water tank when water in the tank is heated through the tank wall by warmer temperature outside the tank.

Mills (1995) describes a third type of heat transfer, solar radiation. Solar radiation is described as electromagnetic waves produced from the sun, which travel to Earth. Many factors affect the strength of the radiation on a storage tank on Earth, including time of year, time of day, weather, cover from the sun, and location on Earth. Some of the radiation will be reflected from the storage tank instead of being absorbed. Factors affecting absorbance include the material used in constructing the storage tank and the color of the storage tank. Darker colors absorb more than lighter colors. Equation 6 describes the rate of heat transfer (Moran et al., 2003):

$$q_x = UA(T_1 - T_2) \tag{6}$$

in which q_x = heat transfer rate, BTU/hr; U = overall heat transfer coefficient, BTU/(ft^2×˚F×hr); A = surface area of the wall, ft^2; T_1 = warmer temperature, ˚F; and T_2 = cooler temperature, ˚F. Moran et al. (2003) determined Equation 7 to find U:

$$U = \frac{1}{[(1/h_1)+(L/K)+(1/h_2)+(1/h_{rad})]} \tag{7}$$

where U = overall heat transfer coefficient, BTU/(ft^2×˚F×hr); h_1 = convective heat transfer coefficient outside of the tank, BTU/(ft^2×˚F×hr); h_2 = convective heat transfer coefficient inside of the tank, BTU/(ft^2×˚F×hr); L = thickness of the tank wall, in; K = thermal conductivity of the tank wall, BTU×in/(ft^2×˚F×hr); and h_{rad} = radiation heat transfer coefficient. $h_1$and h_2 are affected by the movement of water inside the tank and air outside of the tank. The tank's shape also affects these coefficients. K is affected by the type of material used to construct the storage tank.

2.2.2 Effects of Tank Design on Mixing

The design of a storage tank has an impact on mixing in the tank. Design characteristics such as the height to diameter ratio (H:D) and the inlet characteristics affect mixing in a storage tank. Water systems can install artificial mixing into a storage tank to promote mixing.

2.2.2.1 Effect of Inlet Characteristics on Mixing

Two inlet characteristics that affect mixing include the orientation of the inlet and the inlet's diameter. A storage tank's ability to mix depends on the characteristics of the jet of water formed by the inlet during the filling cycle. The jet's momentum affects the mixing of the storage tank, and the momentum is related to the inlet diameter and the flow rate. The proper tank mixing time is a function of the inflow momentum, geometry, and the volume of water.

The inlet configuration affects mixing in storage '. Grayman et al. (2004) states that a jet is formed when water enters the storage tank through the inlet. Ideally, a vertical inlet will create a jet that has enough momentum to reach the water surface and circulate mixing the tank. A horizontal inlet will ideally have enough momentum to reach the opposite tank wall and circulate to mix the tank. Figure 2.3 illustrates ideal mixing in a storage tank with both a vertical and horizontal inlet orientation.

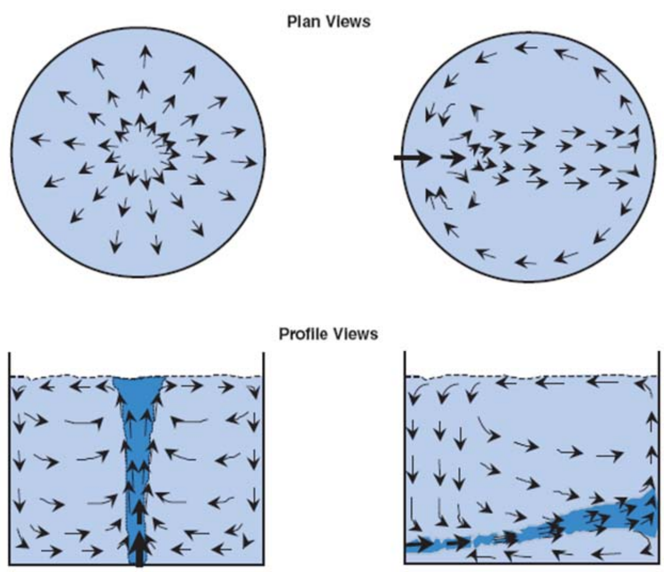


Figure 2.3: Ideal mixing for vertical and horizontal inlet orientations adapted from Okita and Oyama (1963) (Grayman et al. 2004).

The tank's mixing time effects mixing in storage tanks. Rossman and Grayman (1999) determined a tank's mixing time using a scale study. The tank's mixing time was the time needed to obtain 95% uniformity in the conductivity probe readings. Several empirical equations were developed in the chemical engineering profession to determine the tank's mixing time; however, these equations were for tanks that used recirculation pumps and the tank volume remains constant. Rossman and Grayman (1999) modified some of the equations to better describe a storage tank and the fluctuating volume. Using the results of the tracer study and dimensional analysis Rossman and Grayman (1999) derived an equation for the mixing time required to mix a storage tank, which is presented as Equation 8:

$$t_m = \tau_m \frac{V^{2/3}}{M^{1/2}} \quad (8)$$

where t_m = time to completely mix the tank, seconds; τ_m = dimensionless mixing time = 10.2; V=tank volume, ft^3; and M= momentum, ft^4/s^2. The temperature of the filling water and the water in the tank volume are assumed to be equal.

Rossman and Grayman (1999) performed a tracer study in full a scale storage tank to validate Equation 8. The experimental t_m was 4.7 hours, while the calculated t_m was 4.3 hours. The result of the study verifies that Equation 8 can be used for full scale systems.

The work done by Rossman and Grayman (1999) was used by Roberts et al. (2006) to include standpipes. A 3-dimensional laser induced fluorescence system was used to analyze tank mixing in the tracer studies performed by Roberts et al. (2006). More accurate description of water movement was determined from the laser system than the submerged probes used in the tracer study completed by Rossman and Grayman (1999). Roberts et al (2006) used Equation 8; however, the dimensionless mixing time was modified to be a function of the H:D ratio. Equation 9 shows the modifications to the dimensionless mixing time:

$$\tau_m = 10.0 \; for \; \frac{H}{D} \leq 1.0 \quad (9)$$

$$\tau_m = 10.0 + 3.5\left(\frac{H}{D} - 1\right) \; for \; \frac{H}{D} > 1.0$$

where τ_m= dimensionless mixing time; H = tank height, ft; and D = tank diameter, ft.

Roberts et al. (2006) performed multiple tracer studies to determine the dimensionless mixing time of storage tanks with different inlet orientation, different inlet location, and different number of inlets. The data from the tracer studies was presented by Roberts et al. (2006). Olson (2011) summarized the data by finding the average dimensionless mixing time for each inlet scenario. Table 2.3 lists the results of the tracer studies.

The inflow momentum of the filling water is an important factor in mixing a storage tank. Increasing the inflow momentum can be accomplished by increasing the flow into the tank or decreasing the inlet diameter. Equation 8 describes the relationship between inflow momentum and the time required for mixing. An increase in momentum will lead to a smaller mixing time (Rossman and Grayman, 1999).

Table 2.3. Dimensionless mixing times to mix tank in standpipes from Roberts et al. (2006) summarized by Olson (2011).

Inlet Configuration		**Average Dimensionless Mixing Time**
	One port, bottom, side, horizontal	18.4
	One port, bottom, side vertical	15.4
	One port, bottom, center, horizontal	15.4
	Two ports, horizontal	10.6
	Seven ports, horizontal	13
	One port, center, vertical, with draft tube	Did not mix under isothermal condition

Mahmood et al. (2005) completed experiments that analyzed the effect of the inflow momentum on mixing in standpipes. One experiment showed the effect of inlet diameter. A standpipe's characteristics were 24 inch diameter horizontal inlet and flow of about 2000 gpm. The tank had a filling time of 3 hours, but the tank did not mix due to low inflow momentum. The inlet was changed to 12 inches in diameter and vertical orientation, which would increase the momentum. The tank was mixed well after only an hour of fill time. Mahmood et al. (2005) recommended an inflow momentum between 20-30 ft^4/s^2 for standpipes to mix properly and that vertical inlets were better for mixing.

Grayman et al. (2004) concluded that the inlet's orientation affects mixing in a storage tank. Due to the water height in standpipes, standpipes are more susceptible to being poorly mixed; therefore, more susceptible to stratification. Figure 2.4 illustrates inlet configurations that Grayman et al. (2004) found to prevent mixing.

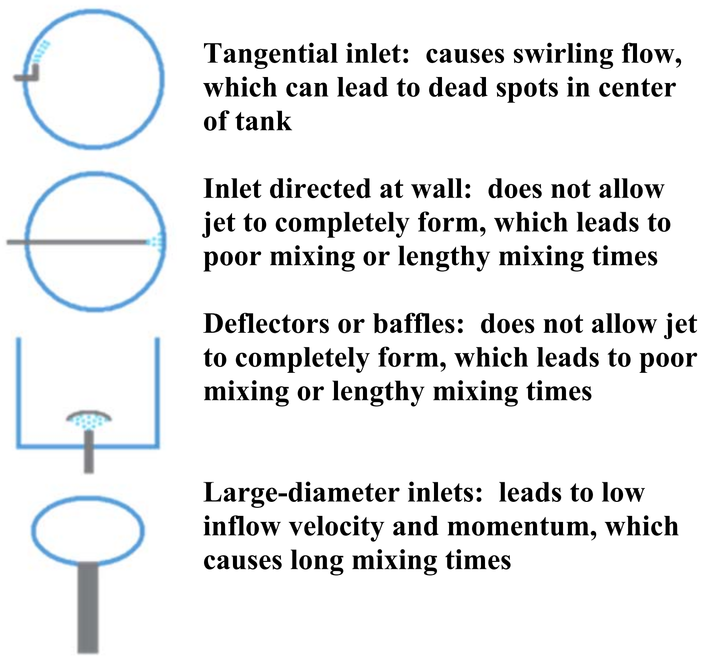


Figure 2.4. Inlet configurations that do not promote mixing (Adapted from Grayman et al. 2004).

The inflow velocity and momentum are also factors in the densimetric Froude number and the dimensionless mixing parameter from Roberts et al. (2006). Both of these parameters are also impacted by buoyancy forces created by density differences in the filling water and the water inside the tank. Increased buoyancy forces cause an increase in difficulty for mixing the tank. Increased buoyancy forces will lead to greater inflow momentum and inflow velocities to be needed in order to mix a storage tank as shown in Equation 1 and Equation 4. Increasing the velocity and the momentum of the inflow can be accomplished by decreasing the inlet diameter or by increasing the flow into the tank.

2.2.2.2 Effects of Tank Geometry on Mixing

Kennedy et al. (1993) used full-scale tracer studies to describe the effect of tank geometry on mixing. Standpipes were found to be the most susceptible to stratification. Due to the high height to diameter ratios, inflow water cannot reach the upper zone (dead zone) of the tank causing poor mixing and stagnant water in the upper zone (Kennedy et al. 1993).

The required densimetric Froude number (Equation 3), dimensionless mixing parameter from Roberts et al. (2006) (Equation 4), and the required mixing time (Equation 8) are all affected by the H:D ratio. An increase in H:D ratio causes an increase in the required densimetric Froude number, a decrease in the dimensionless mixing parameter (Roberts et al. 2006), and a longer filling time. Therefore, taller standpipes are more susceptible to poor mixing and stratification.

2.2.2.3 Effects of Artificial Mixers on Mixing

Mechanical mixing in a storage tank is similar to mixing tanks of water in water treatment plants. The velocity gradient (G) is the measurement of the amount of agitation in a mixing tank (Qasim et al. 2000) and Equation 10 is a method for calculating the velocity gradient:

$$G = \sqrt{\frac{P}{(V\mu)}} \tag{10}$$

where G = velocity gradient, 1/s; P = power imparted to the water, lb×ft/s; V = volume, $ft^{3;}$ μ = absolute viscosity, lb×s/ft^2.

The effect of mechanical mixing on storage tanks was studied by Giguere and Fiske (2010). According to Giguere and Fiske (2010) a simple way to observe the effect of active mixing in a storage tank is to install a mechanical mixer in a storage tank that is thermally stratified and observe the time for the tank volume to become a uniform temperature. Two tanks were studied by installing submersible temperature sensors at varying depths within the tank. The mechanical mixer was turned on and the temperatures were monitored to determine the amount of time to create uniform temperature throughout the tank volume. A 500,000 gallon storage tank that was thermally stratified by 5 ˚C between the top and bottom of the storage tank was studied by Giguere and Fiske (2010). After turning on the mechanical mixer, 4 hours elapsed before the tank volume's temperature was uniform at 15 ˚C. The power needed to mix the tank was 223 Watts. Using Equation 10 the velocity gradient for the tank was approximately 10.1 s^{-1}. The other tank studied was a 2.75 million gallon square storage tank with a 10 ˚C difference between water in the bottom of the tank and the top of the tank. After 5 hours of turning on the mechanical mixer, the temperature in the tank volume became uniform at about 23 ˚C. The power required for the tank was not provided in the study; therefore, the velocity gradient cannot be calculated.

2.2.3 Effects of Tank Operation on Mixing

How a water system operates a storage tank affects mixing in the tank. Rossman and Grayman (1999) determined that the volumetric exchange in a storage tank affects mixing in the tank. Equation 8, required mixing time to mix a tank, was extended by Rossman and Grayman (1999) to derive an equation for the required volumetric exchange during the fill and draw cycle to mix a storage tank. Equation 11 is a comparison of the actual volumetric exchange and the required volumetric exchange. If the left side of the equation is greater than the right, than the storage tank should be mixed.

$$\frac{\Delta V}{V} = \frac{9d_i}{V^{1/3}} \tag{11}$$

In Equation 11, ΔV= volume added to the tank during a fill cycle, ft^3; V=minimum tank volume, ft^3; d_i=inlet diameter, ft. The temperature of the filling water and the tank volume are assumed to be the same for the volumetric exchange parameter. Mahmood et al. (2009) completed full-scale temperature studies of storage tanks that were also analyzed using Equation 11. The results confirmed Equation 11 as storage tanks that stratified did not meet the required volumetric exchange.

Rossman and Grayman (1999) derived Equation 11 from Equation 8 to relate the volumetric exchange required during a fill cycle to mix the tank. Olson (2011) showed a generalized derivation of Equation 8. Equation 12 is the generalized derivation of Equation 8 for the required volumetric exchange.

$$\frac{\Delta V}{V} > \frac{(\pi)^{1/2}\tau_m d_i}{2V^{1/3}} \tag{12}$$

In Equation 12, ΔV = volume of water added during fill, ft^3; V= minimum tank volume, ft^3; τ_m = constant; and d_i = inlet diameter, ft. Equation 12 also assumes no difference in temperature between the filling water and the water in the tank.

Kennedy et al. (1993) studied the effect of volumetric exchange on storage tanks. A full scale study was completed with two storage tanks. One 12-hour fill cycle was analyzed. One tank exchanged 10% of the tank's volume, while the other tank exchanged 64% of the tank's volume. The tank that exchanged 10% of the tank's volume lost 50% of the tank's chlorine residual, while the other tank only lost 30% of the tank's chlorine residual. Kennedy et al. (1993) concluded that water systems should try and meet the required volumetric exchange for mixing to prevent poor water quality.

2.3 Modeling of Mixing in Storage Tanks

Mixing in a storage tank and disinfectant residuals can be modeled by using systematic models, computation fluid dynamics, or scale models. Each of these methods should be calibrated using field data to ensure proper modeling technique.

2.3.1 Systematic Modeling

Systematic models are simplified models used to describe physical situations. Grayman et al. (2000) states that systematic models are based on statistics and empirical equations. Systematic modeling creates a model that depicts a physical process in a highly conceptual manner. Systematic models divide a tank into zones, in which each zone is completely mixed and flow between each zone occurs (Grayman et al. 2000). Mau et al. (1995) performed a study to describe different systematic models. In the study, several parameters were assumed including constant inflow and outflow rates, similar flow rates between zones, and uni-directional flow. Clark et al. (1996) expanded on the work of Mau et al. (1995) by studying time-varying flow rates using polynomials. Olson (2011) summarized the different systematic models from the previous studies. Table 2.4 lists and describes the systematic models.

Table 2.4 Systematic Models for Mixing in Storage Tanks (Olson 2011).

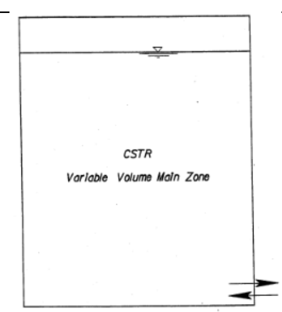
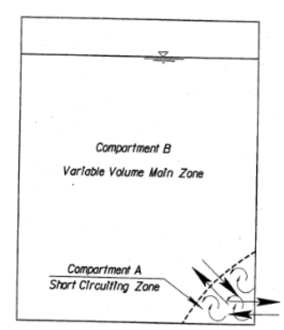
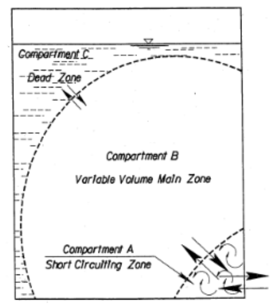
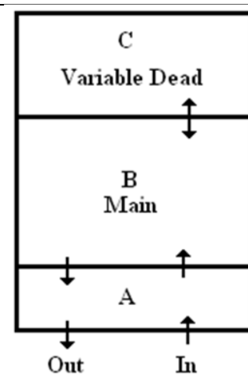
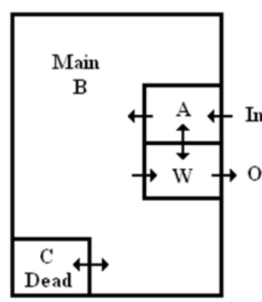
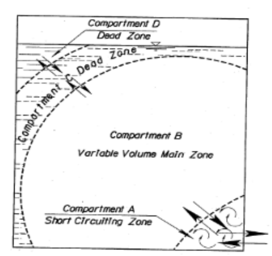
Name of Model	**Description of Model**	**Figure**	**Reference**
Plug flow model	A Plug flow reactor (PFR) is also known as a first in-first out (or last in last out). In an ideal plug flow case, no mixing occurs within the tank, and each fluid particle remains independent of surrounding fluid particles. Plug flow reactors are most commonly found in treatment plants, rather than storage facilities in the distribution system.		
Mixed Flow Model	A mixed flow model assumes that the tank is constantly mixed at all times. It can be described as a continuously stirred tank reactor (CSTR).		Mau et al. (1995)
Two-compartment model	In a two-compartment model, the tank is divided into two regions, compartments A and B. Both of these compartments are modeled as individual CSTRs. The volume of compartment A is fixed, while B is variable. The inflow to the tank enters compartment A, while compartment B either increases in volume, receiving flow from A, or transfers water to A depending on the flow conditions.		Mau et al. (1995)

Table 2.4 (Continued) Systematic Models for Mixing in Storage Tanks (Olson 2011).

<table>
<tr><td>Three-compartment model</td><td>In a three-compartment model, a third region (compartment C) is added to the two-compartment model to represent a dead storage zone in the tank. The volume of compartments A and C are assumed to be constant, while B is variable. The addition of the third compartment adds a fixed flow between B and C to the model.</td><td></td><td>Mau et al. (1995)</td></tr>
<tr><td>Stratified three-compartment model</td><td>An additional three-compartment model was developed to better represent a study with stratified reservoirs. The only difference between this and the original three-compartment model is the variable zone is changed from compartment B to compartment C.</td><td></td><td>Mau et al. (1995)</td></tr>
<tr><td>Three-and-one half-compartment model</td><td>The three- and-one-half model was developed to represent a continuous inflow/outflow condition. The name for this model was created to prevent confusion with a four-compartment model developed by Mau et al. (1995). Compartment B is considered the variable zone, while all others are fixed, with the following image showing all the flows between compartments. Compartment C is set as the dead zone.</td><td></td><td>Grayman et al. (2000)</td></tr>
<tr><td>Four-compartment model</td><td>The four-compartment model was developed to provide a representation for tanks containing extreme dead storage. This is represented by adding an additional compartment as a buffer zone between the main compartment and the dead storage area.</td><td></td><td>Mau et al. (1995)</td></tr>
</table>

A software package for modeling storage tanks called CompTank was included with Grayman et al. (2000). CompTank can model 9 different mixing models for a storage tank. The 9 mixing models are:

- Fill and Draw – Complete Mix
- Fill and Draw – Plug Flow
- Fill and Draw – Last in/First out (LIFO)
- Fill and Draw – 3 Compartment
- Fill and Draw – Stratified, 3 Compartment
- Continuous Flow – Complete Mix
- Continuous Flow – Plug Flow
- Continuous Flow – Last in/First out (LIFO), and
- Continuous Flow – 3 ½ Compartment

The simplification of these models creates a greater need for calibration according to Grayman et al. (2000). Calibration is best conducted by comparing field data collected to the model results. If no field data are available, the effectiveness of the model is dependent on the user's knowledge.

2.3.2 Computational Fluid Dynamic Modeling

Computational Fluid Dynamic (CFD) modeling is used to describe the movement of gases and liquids (Grayman et al., 2000). According to Grayman et al. (2000), three different processes for representing a physical product occur in CFD modeling. The three processes are the mathematical representation, the numerical representation of the mathematical model, and the computational method for solving the numerical representation. The equations for the conservation of energy, mass, and momentum are used to describe the movement of fluid in CFD modeling (Grayman et al., 2000). CFD modeling can be an asset in the design and the operation of a storage tank. In design, a CFD model can illustrate the effects of different inlet configurations on the storage tank to find the best possible orientation and diameter of the inlet to promote mixing. In operations, CFD models can show the effect of increasing the inflow rate on mixing in the storage tank. CFD models create more accurate representation of mixing in a storage tank than a systematic model because of the computer models ability to calculate complex mathematical equations (Grayman et al., 2000).

Determining whether to use CFD modeling comes down to a few factors - the cost of the software, the computer resources, and the training required to use the program. Grayman et al. (2000) describes two different types of software. FIRE is a commercial program that can be used to model compressible or incompressible fluids in different situations. HydroTank is a program that is designed to examine common water storage tank geometries with one inlet and outlet. Although HydroTank is not as comprehensive as FIRE, HydroTank is more affordable and does not require as much training as FIRE requires (Grayman et al., 2000). Similar to systematic modeling, calibration should be done to any CFD model created.

2.3.3 Scale Modeling

Scale modeling uses a smaller physical model that behaves similarly to an actual storage tank or a prototype of a storage tank. According to Grayman et al. (2000), scale models have been used for centuries in the hydraulic structure field. Rossman and Grayman (1999) used a scale model study to determine the mixing time to predict mixing in a storage tank (Equation 8) that was previously discussed in section 2.2.2.1. Roberts et al. (2006) also used scale models to determine the dimensionless mixing times in various storage tanks as discussed in section 2.2.2.1.

2.3.4 Testing Models

A systematic, CFD, or scale model can be tested by gathering field data from a full scale system. The most common types of tests are water quality, temperature, and tracer tests. Although sampling can occur at the inlet, outlet, or inside of the tank; the most effective sampling method is to sample all of the locations. These types of studies are useful in identifying mixing and water quality issues.

Interior sampling is an effective method to determine a storage tank's mixing characteristics and water quality characteristics. Interior sampling can be accomplished in a few ways. Grayman et al. (2000) described two different methods. Sampling taps could be installed at varying depths of the storage tank, or a sampling apparatus could be constructed and lowered into the storage tank with sampling locations at varying depths of the tank. The data obtained from interior sampling studies can illustrate problem areas in a storage tank. Mahmood et al. (2005) used an interior temperature apparatus in full-scale tanks to confirm the CFD models created in the study. Figure 2.5 is an illustration of the temperature apparatus used by Mahmood et al. (2005). The apparatus consisted of temperature sensors attached to a chain at varying depths of the tank. The apparatus was weighted to be sure the chain remained straight throughout the study. A data logger was used to store the temperature data obtained by connecting the temperature sensors to the data logger.

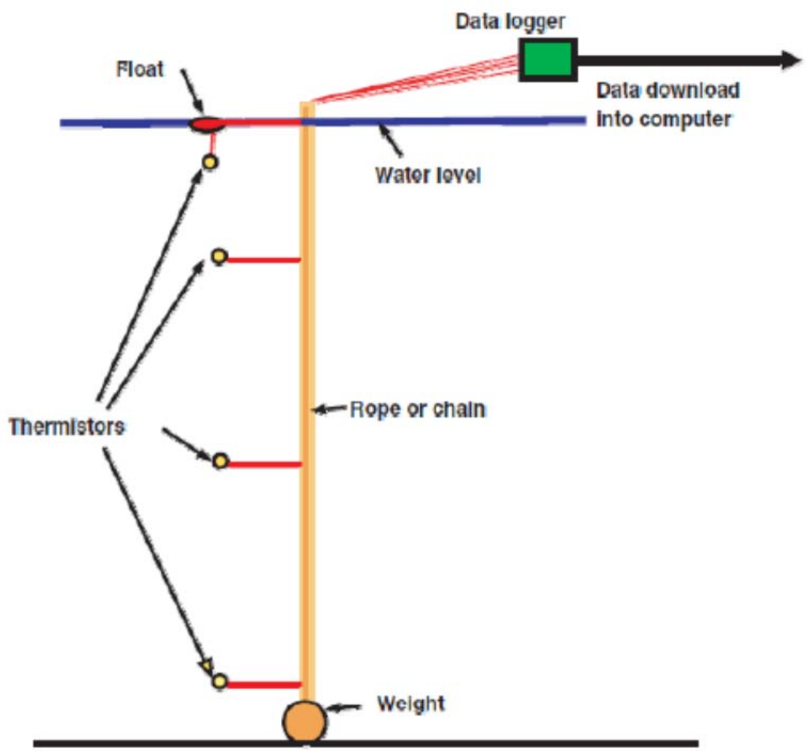


Figure 2.5: Temperature collection apparatus used by Mahmood et al. (2005)

Exterior sampling is not as affective in determining problem areas in storage tanks as interior sampling. Monitoring the inflow and the outflow does not accurately portray the storage tank's mixing characteristics. Issues such as stratification and short circuiting could cause a difference in water quality between the bottom of the tank and the upper zone of the tank. Collecting samples from the outlet will not show the water quality issues in the upper zone.

2.4 Effects of Mixing on Water Quality

The ability for a storage tank to mix can affect the water quality in the storage tank. If a storage tank does not mix properly, disinfectant decay can occur in portions of the storage tank. Disinfectant decay occurs when the chemicals used for disinfection react with other substances. A loss in disinfectant residual can lead to microorganism growth, nitrification, and formation of disinfection by-products. Disinfection, disinfectant decay, nitrification, microbial growth, and drinking water regulations are discussed in this section.

2.4.1 Disinfection

Drinking water needs to be disinfected to prevent harmful organisms from being transferred to the customers. Disinfection at a water treatment plant serves two purposes.

Primary disinfectants kill the harmful organisms in the water, while secondary disinfectants maintain a proper chlorine residual throughout the distribution system.

2.4.1.1 Free Chlorine

Free chlorine is an ideal disinfectant because chlorine is soluble in water, easily measured, and compared to other disinfectants chlorine is less expensive (Qasim et al., 2000). Qasim et al. (2000) explains use of chlorine gas and hypochlorite salts for disinfection. The disadvantages to free chlorine are that compared to combined chlorine the residual decays quickly and the reaction with organic material can lead to disinfectant by-products.

2.4.1.2 Combined Chlorine

The combined chlorine residual is created when chlorine reacts with ammonia to form chloramines. In the chloramine form, chlorine is a weak disinfectant; however, chloramine provides a stable residual in the distribution system. Chloramine also does not produce trihalomethanes (Qasim et al., 2000). Chloramines exist in three different forms in the distribution system: monochloramine (NH_2Cl), dichloramine ($NHCl_2$), and trichloramine (NCl_3). Qasim et al. (2000) lists the three forms and the chemical reactions required to produce each.

$$NH_3 + HOCl \leftrightarrow NH_2Cl + H_2O$$
$$NH_2Cl + HOCl \leftrightarrow NHCl_2 + H_2O$$
$$NHCl_2 + HOCl \leftrightarrow NCl_3 + H_2O$$

To form chloramine, ammonia is added to chlorinated water. According to Qasim et al. (2000), the appropriate chlorine-to-ammonia weight ratio is 3:1 to 4:1 and breakpoint chlorination occurs at 5:1.

2.4.2 Disinfectant Decay

Disinfectant decay occurs when the disinfectant reacts with organic material, organisms, and surfaces in the distribution system such as pipe walls. These reactions cause a decrease in disinfectant residual. If the disinfectant residual becomes too low; microbial growth can occur and nitrification can occur in chloraminated systems.

2.4.2.1 Free Chlorine Decay

Free chlorine decays when chlorine reacts with organic material in the water and when chlorine reacts with the pipe walls. When chlorine reacts with organic matter, disinfectant by-products such as TTHMs and HAA5s can be formed. The health risks of TTHMs and HAA5s were studied by Boorman et al. (1999). The study found that the main concern with TTHMs and HAA5s is cancer.

Boulos et al. (1996) states that free chlorine decay can be described as a first order equation. The first order equation used is shown in Equation 13:

$$C_t = C_0 e^{-kt} \quad (13)$$

where C_t = the concentration at time "t", mg/L; C_0 = the concentration at time "0", mg/L; k = decay coefficient, d^{-1}; and t = time, days. Equation 13 can be solved for the decay coefficient:

$$k = -\frac{\ln(\frac{C}{C_o})}{t} \quad (14)$$

where k = decay coefficient, d^{-1}; C = final chlorine concentration, mg/L; C_o= initial chlorine concentration, mg/L; and t = time, days. The decay coefficient is dependent on temperature. At higher temperatures, the decay coefficient is greater. An equation to adjust the decay coefficient was stated by Gowda (1978):

$$k_2 = k_1 * \theta^{T_2 - T_1} \quad (15)$$

where k_1 = decay coefficient at T_1, d^{-1}; k_2 = decay coefficient at T_2, d^{-1}; T_1= initial temperature, ˚C; T_2 = correcting temperature, ˚C; and θ is a constant. Gowda (1978) performed calculations to find the θ value at varying temperatures and pH. The range of θ calculated was 1.025 to 1.031. Gowda (1978) used θ = 1.03.

2.4.2.2 Chloramine Decay

Chloramine reactions with materials in the distribution system will lower the combined chlorine residual. During these reactions, ammonia is released into the system, which can lead to nitrification. Regan et al. (2007) lists four reactions in which chloramines release ammonia into the water system. Table 2.5 lists the four reaction that produce ammonia.

Table 2.5 Chloramine decay reactions that release ammonia (Regan et al. 2007)

Reaction	Stoichiometry
Chloramine auto-decomposition	$3NH_2Cl \rightarrow N_2 + NH_4^+ + 3Cl^- + 2H^+$
Oxiditation of organic matter by chloramine	$0.1C_5H_7O_2N + NH_2Cl + 0.9H_2O \rightarrow 0.4CO_2 + 0.1HCO_3^- + 1.1NH_4^+ + Cl^-$
Reaction of chloramine with corrosion products at pipe walls	$0.5NH_2Cl + H^+ + Fe^{2+} \rightarrow Fe^{+3} + 0.5NH_4^+ + 0.5Cl^-$
Oxidation of nitrite by chloramine	$NH_2Cl + NO_2^- + H_2O \rightarrow NH_3 + NO_3^- + HCl$

Chloramine decay has been modeled using a first order equation similar to the free chlorine decay equation (Equation 13). Gyürék and Finch (1998) used the first order equation to model the decay of chloramines. However, Valentine et al. (1998) developed a second order equation to model the decay of chloramine. Equation 16 is the second order equation developed by Valentine et al. (1998):

$$\frac{1}{[NH_2Cl]} - \frac{1}{[NH_2Cl]_0} = k_{OBS}t \tag{16}$$

where $[NH_2Cl]$ = monochloramine concentration at t, moles/L; $[NH_2Cl]_0$ = monochloramine concentration at t = 0, moles/L; t = reaction time, hr; and k_{OBS} = second order rate constant. k_{OBS} is the slope of $\frac{1}{[NH_2Cl]}$ versus t if plotted.

Valentine et al. (1998) performed a full-scale study of a water system to compare the field data with the second order model. The results of the second order model and the full scale study fit well, illustrating that the second order equation could be used for modeling purposes. Valentine et al. (1998) ignored the presence of natural organic material when creating the second order equation. When samples included natural organic material, the model was not as successful in predicting the chloramine decay.

Regulated disinfectant by-product concentrations (TTHMs and HAA5s) decrease when chloramines are used as disinfectant. However, *N*-Nitrosodimethylamines (NDMAs) can form. Wilczac et al. (2003) states that NDMAs formation is increased when water systems over dose polymer or recycle the filter backwash water because a source of residual cationic polymer is provided. Wilczac et al. (2003) found NDMA to be carcinogenic. NDMA formation can be reduced by allowing free chlorine contact time of 1 to 4 hours before the ammonia addition (Wilczac et al., 2003). Even with the studies showing the danger of NDMA, no maximum contaminant level (MCL) has been set by the federal government (Crittenden et al., 2005).

2.4.3 Nitrification

In a chloraminated system, nitrification can occur when the chlorine residual is lost. Wilczac et al. (1996) describes nitrification as the oxidation of ammonia to nitrite and then the oxidation of nitrite to nitrate. The bacteria responsible for these reactions are ammonia-oxidizing bacteria (AOB) and nitrite-oxidizing bacteria (NOB). Wilczac et al (1996) performed experiments that showed the ability for AOB to survive in water with chloramine residuals of 1.2 mg/l to 8 mg/l. Nitrification produces nitrite and nitrate. Both nitrite and nitrate are regulated in drinking water.

2.4.4 Microbial Growth

The loss of disinfectant residual can lead to microbial growth in a water system. Water contaminated with microorganisms can be a risk to the consumers' health. Microbial growth can be monitored by testing for heterotrophic organisms or coliforms, which can be analyzed by heterotrophic plate count and total coliform tests, respectively.

2.4.4.1 Heterotrophic Plate Count

Heterotrophic Plate Count (HPC) is a method used to estimate the number of heterotrophic organisms in a water sample (WHO et al., 2003). HPC testing does not distinguish the type of heterotrophic organisms present in the water sample. Heterotrophic organisms are organisms that use organic carbon as an energy source for cell synthesis (Qasim et al. 2000). Standardized methods for HPC analyses are available; however, no universal method is accepted throughout the water treatment field. HPC testing can be completed with many variations including different media, plating techniques, incubation temperature, and incubation duration (WHO et al., 2003). With multiple variations in methodology, a wide range of results are obtained. To find the number of colony forming units (CFUs), the colonies formed during the incubation are simply counted (APHA et al., 1998).

Prevost et al. (1998) stated that HPC numbers can range from less than 1 CFU/ml to 10,000 CFU/ml in water distribution systems, which shows that contamination or microbial growth occurs in some distribution systems. Contamination can occur during contact with part of the distribution system such as pumps, storage tanks, and piping. Internal microbial growth can occur due to biofilms within the distribution system (Van der Wende et al., 1989). Microorganisms that pass through the treatment process without being removed can cause growth within the distribution system (Momba et al., 2000).

The growth of heterotrophic organisms can be affected by many different factors. Studies by LeChevallier et al. (1991), McCoy and Olson (1986), Neden et al. (1992), Skadsen (1993), and Niquette et al. (2001) have determined some key factors in heterotrophic organism growth. The factors include temperature, detention time in distribution system, source water, pipe material, the disinfectant residual, and the organics in the water. These factors can influence the heterotrophic organisms' growth.

HPC analyses are not used by regulatory agencies to determine the quality of water. However, a water system could use the HPC analyses to observe the microbial characteristics in a distribution system. According to the EPA, HPC results are successful in describing the bacteriological quality of drinking water (USEPA, 1975).

2.4.4.2 Total Coliform

Total coliform analysis became the method used to determine the safety of the drinking water after E. Coli was found to be more resistant to disinfectants than other organisms (Percival et al., 2000). The Total Coliform Rule (TCR) was adopted to regulate fecal contamination by testing for total coliforms since total coliforms are an indicator of fecal contamination. A water systems population served determines the amount of sampling required to comply with the TCR. 95% of the samples tested for total coliforms are required to be negative for coliform growth to comply with the TCR. If a sample tests positive for coliforms, another sample from the same location should be obtained and analyzed. If the new sample also tests positive for coliforms, the sample should be tested for E. Coli. A violation needs to be reported if the E. Coli test is positive (USEPA, 1989).

Geldreich et al. (1972) performed a study that showed high HPC can interfere with the total coliform results. Coliform formation and counting was less efficient when the HPC was 500 CFU/ml or greater. Geldreich et al. (1978) confirmed the previous findings, concluding that high HPC will interfere with coliform testing. LeChevallier and McFeters (1985) performed an experiment with water that was spiked with coliform bacteria and concluded that congestion and interactions with heterotrophic organisms factored into the interference of coliform tests.

2.4. Water Quality Regulations

Drinking water is regulated to maintain a safe standard in water quality. Loss of disinfectant residual throughout a water distribution system can lead to disinfectant by-product formation and nitrification. Water systems are regulated to maintain certain water quality by the Stage 1 and Stage 2 Disinfectant and Disinfection By-Product Rule.

2.4.5.1. Safe Drinking Water Act

The federal government created the Safe Drinking Water Act to regulate certain drinking water standards. A chloraminated water system needs to prevent nitrification because the primary drinking water standards regulate the amount of nitrite and nitrate in the water. Nitrite's standard is 1 mg/l as N, while nitrate's standard is 10 mg/l as N.

2.4.5.2 Disinfectants and Disinfection By-Product Rule

Disinfectant by-products (DBPs) are formed when disinfectants react with materials in the system. Chlorinated systems can form trihalomethanes (TTHMs) and haloaecetic acids (HAA5s). As discussed in section 2.4.2.1, TTHMs and HAA5s have a risk of causing cancer. The risk caused the EPA to adopt the Stage 1 Disinfectant and Disinfection By-Product Rule (D/DBP Rule) (USEPA, 1998). The D/DBP Rule set MCL for TTHMs at 0.08 mg/l and HAA5s at 0.06 mg/l. The D/DBP Rule also set the maximum disinfectant residual levels (MDRLs). Free chlorine system's MDRL is 4 mg/l measured as free chlorine. Chloraminated system's MDRL is 4 mg/l measured as total chlorine. The Stage 2 D/DBP Rule was adopted by the EPA because certain areas in distribution systems did not meet the MCLs, but passed the Stage 1 D/DBP Rule because the bases of the MCLs were system wide running annual averages. Compliance for TTHM and HAA5 for the Stage 2 D/DBP Rule is based on locational annual running averages rather than a system wide average. (USEPA, 2009).

CHAPTER 3: MATERIALS AND METHODS

3.1 Introduction

Data were collected from water tanks that were chosen based on the past study done and the South Dakota rural water survey completed by Olson (2011). The tanks were selected based on characteristics of the tanks that made them unique from each other such as the size of tank and type of disinfectant used.

This section will introduce the equipment used to obtain temperature data and water quality data from each tank. The method of sampling, preservation, and testing of the samples for water quality are also introduced. The thermal stratification data analyses and the data analyses for showing proper tank mixing are reviewed. This section also introduces the chlorine decay modeling process and the microbial testing processes.

3.2 Tank Selection for Study

The scope of this project required tank selection for long term temperature data collection and multiple samplings for water quality data and microbial tests. There were many factors contributing to selecting which tanks to use in the long term study.

One of the key factors was the tank's geometry. The height to diameter ratio was used to group the tanks into five different groups (0-0.5, 0.5-1, 1-2, 2-4, and >4). Olson's study included a tank that theoretically should have fallen into the 1-2 H:D category, however; the operational water levels in the tank caused the H:D ratio fall into the 0.5-1 H:D ratio (Olson, 2011). To provide data for the 1-2 H:D range, two of the tanks that were chosen during this study were from tanks in the 1-2 H:D range (Tank F and G).

Another factor that was considered was the type of disinfectant. The two tanks that were chosen in the 1-2 H:D range (Tank F and G) also used free chlorine instead of chloramines for disinfection. The other three tanks were from chloramine disinfection systems.

Three of the long term tanks were the same used in Olson's study. These tanks showed stratification during the cooling down period of the year (Olson, 2011). The effect of the warming period on stratification was one of the goals of this project. Two of these tanks also have a mechanical mixers installed (Tank D and E) with the main purpose to prevent freezing during the cold months. Table 3.1 shows the characteristics of the selected long term tanks.

Table 3.1: Tanks Selected for Long Term Study

H:D Category	Tank Name	Capacity (gal)	Height (ft)	Dia. (ft)	H:D Ratio	Common Inlet/Outlet	SCADA for Water Level	Artificial Mixer Installed
1-2	C	65000	28	20	1.41	Y	Y	N
2-4	D	175,000	75	20	3.75	Y	Y	Y
>4	E	140,000	86	14	6.14	Y	Y	Y
1-2	F	55,000	34	17	2.00	N	Y	N
1-2	G	140,000	44	24	1.83	N	Y	N

Two additional tanks with passive mixing systems were chosen for a short term study. The passive mixing system consisted of piping the influent water up to a certain height in the tank. One of these tanks was also studied previously (Short term tank 4) before the passive mixing system was installed, which would enable comparison of data to see the effectiveness of the passive mixing system.

3.2.1 Long Term Tank C

Tank C's H:D ratio was 1.41. The tank height was 28 ft. and the tank diameter was 20 ft. The capacity of the tank was 65,000 gallons. At a height of 28 feet, the tank was the shortest of the five selected tanks. The common inlet and outlet pipe at the base of the tank was 6 inches in diameter. Equipment used for the tank consisted of a string of thermocouples and sampling tubes at 1.5, 6.5, 11.5, 16.5, 21.5, and 26.5 feet from the bottom of the cable. Figure 3.1 is a picture of long term tank C.

Figure 3.1: Long Term Tank C

3.2.2 Long Term Tank D

Tank D's capacity was 175,000 gallons. The height of the tank was 75 feet and the diameter was 20 feet, therefore the H:D ratio was 3.75. The common inlet/outlet at the base of the tank was 6 inches in diameter. A mechanical mixer was installed in the tank to prevent the water from freezing during the winter months. The water system agreed to operate the mixer to benefit the study. The equipment for the tank consisted of a string of thermocouples and sampling tubes spaced at 7 foot increments that covered 75 feet of depth. The thermocouple data and water quality data points were at 1.5, 8.5, 15.5, 29.5, 43.5, 57.5, 64.5, and 71.5 feet from the base of the cable. A picture of long term tank D is shown in Figure 3.2.

Figure 3.2: Long Term Tank D

3.2.3 Long Term Tank E

Tank E's capacity was 140,000 gallons. The height was 86 feet and the diameter was 14 feet, therefore the H:D ratio was 6.14. A single inlet/outlet at the base of the tank was 6 inches in diameter. An artificial mixer was used in this tank to prevent freezing during the cold months. The system agreed to run the mixer during the study. Equipment for this tank consisted of a string of thermocouples and sampling tubes at 7 foot intervals covering 85 feet of depth. Thermocouple data and water quality samples were collected from 1.5, 8.5, 22.5, 29.5, 43.5, 50.5, 64.5, and 71.5 feet from the bottom of the cable. Figure 3.3 shows a picture of long term tank E.

Figure 3.3: Long Term Tank E

3.2.4 Long Term Tank F

Tank F was 34 feet tall and 17 feet in diameter. Tank F's capacity was 55,000 gallons and the H:D ratio was 2. The tank does not have a common inlet and outlet. The inlet was 4 inches in diameter and was located to the side of the tank's floor, while the outlet was 4 inches in diameter and was located in the center of the bottom of the tank. Adjacent trees caused the tank to be in the shade for part of the day. Equipment used consisted of a string of thermocouples and sampling tubes spaced at 7 foot increments covering 40 feet of depth. The resulting thermocouple points and sampling points were 1.75, 5.25, 8.75, 15.75, 22.75, and 29.75 feet from the bottom of the cable. A picture of long term tank F is shown in Figure 3.4.


Figure 3.4: Long Term Tank F

3.2.5 Long Term Tank G

Tank G's dimensions were 44 feet tall and 24 feet in diameter. Tank G's capacity was 140,000 gallons and the H:D ratio was 1.83. The inlet was on the north side of the tank floor and was 8 inches in diameter, while the outlet was on the east side of the tank bottom and had a diameter of 8 inches. The tank was painted a light blue color. Equipment in the tank consisted of a string of thermocouples and sampling tubes spaced at 6 feet intervals over 45 feet of depth. Figure 3.5 shows a picture of long term tank G.


Figure 3.5: Long Term Tank G

3.2.6 Short Term Tank 4

Tank 4's capacity was 100,000 gallons. The height was 120 feet and the diameter was 12 feet, therefore the H:D ratio was 10. A passive mixing system was installed in the tank by the water system, which consisted of a 6 inch riser pipe from the floor to 80 feet level, where the pipe diameter was reduced to 2.5 inches. An additional 2 foot length of 2.5 inch pipe created a jet to force the water upward. Thus the influent water enters the tank at 82 feet above the floor. A check valve at the base of the riser pipe enables water to leave the tank. Equipment used included temperature sensors and pressure sensors. Sensors were placed at 16.5, 25, 42, 59, 75, 104 feet above tank bottom, and one on a float to stay with the water level as it changes. Pressure sensors were at 104 feet and in the open space at the top of the tank. A picture of short term tank 4 is shown in figure 3.6.

Figure 3.6: Short Term Tank 4

3.2.7 Short Term Tank 9

Tank 9 was 75 feet tall and 25 feet in diameter. The H:D ratio was 3 and the capacity was 240,000 gallons. A passive mixing system was installed by the water system, which consisted of piping the influent water up 15 feet in an 8 inch pipe and then

5 more feet in a 3 inch pipe. The influent water entered the tank 20 feet above the floor of the tank. Water was released from the tank through a check valve at the base of the riser pipe. Temperature sensors and pressure sensors were used to gather data from the tank. The temperature sensors were placed 1.5, 10, 20, 30, 40, 50 feet above the tank bottom, and one on a float to stay at the highest water level as it changed. Pressure sensors were at 20 ft. and in the empty space at the top of the tank. A picture is shown of short term tank 9 in figure 3.7.

Figure 3.7: Short Term Tank 9

3.3 Equipment to Measure Temperature and Water Quality

The temperature was measured at various depths in the tanks. Measuring temperature was a simple and cost effective method to show the nature of mixing in the tank. Tanks in systems using surface water sources were included in the tank inventory to examine effects of seasonal temperatures of the surface water on the stratification of tanks. Water quality samples were also collected and analyzed from the various depths in the tank.

3.3.1 Long Term Study Equipment

The study required equipment for measuring the temperature of the water and for obtaining samples from the tanks at varying depths. For the temperature data collection, type T thermocouples were used. Thermocouples were spaced evenly down a length of steel cable and then covered with a vinyl covering. For sample gathering, a ¼-inch polyethylene tubing was used. The open end tube was positioned at its respective thermocouple to obtain a sample from each location. The tubes exited the top of the storage tank in accordance to the water system's preference and were attached to the ladder to reach ground level. A thermocouple lead wire was also bundled with the tubing as it exited the tank and was attached to the ladder. At ground level, the lead wire was attached to an OCTTEMP data logger, which recorded the temperature data obtained from the thermocouples. A temperature sensor in the OCTTEMP data logger collected the ambient temperature data. The OCTTEMP data logger would store the information until the data was downloaded to a computer. Figure 3.8 shows the sampling and data logging system. Figure 3.9 shows a picture of the OCTTEMP data logger.

Every ten minutes a temperature reading was recorded by the data logger. The temperature data was downloaded to a computer every time SDSU personnel arrived on the site. A schematic showing how the data logger is connected to a computer is shown in Figure 3.10.

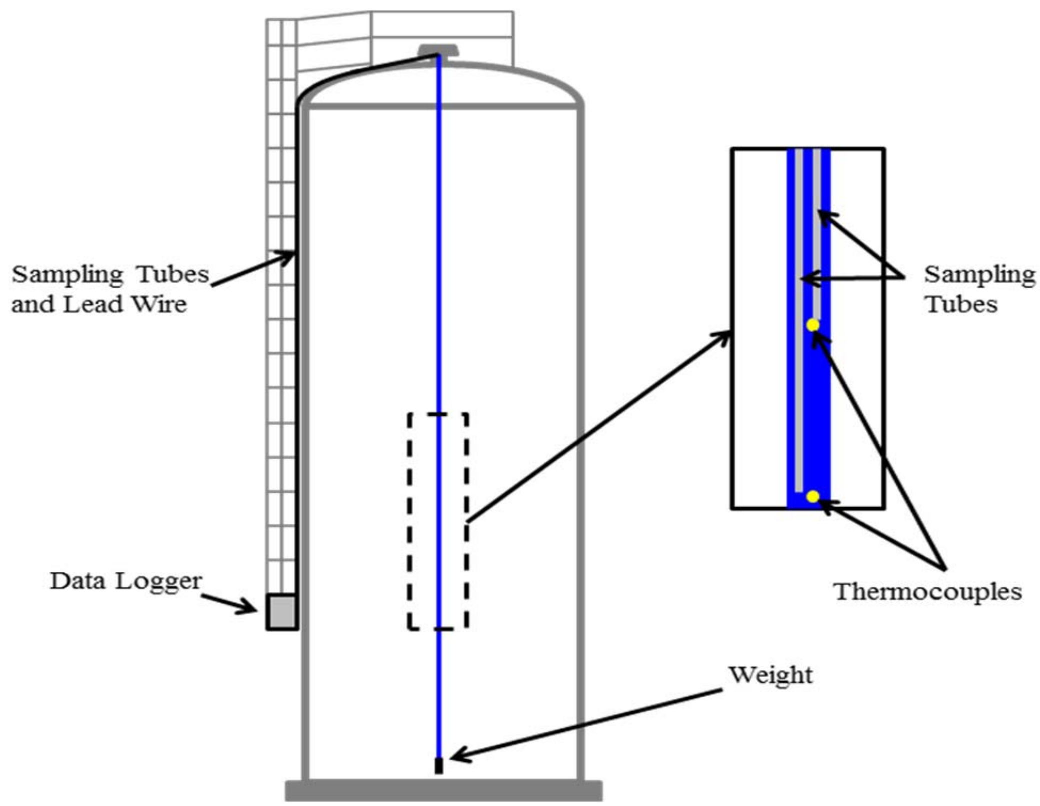


Figure 3.8: Visual representation of the data logging and sampling system. (Olson,2011)

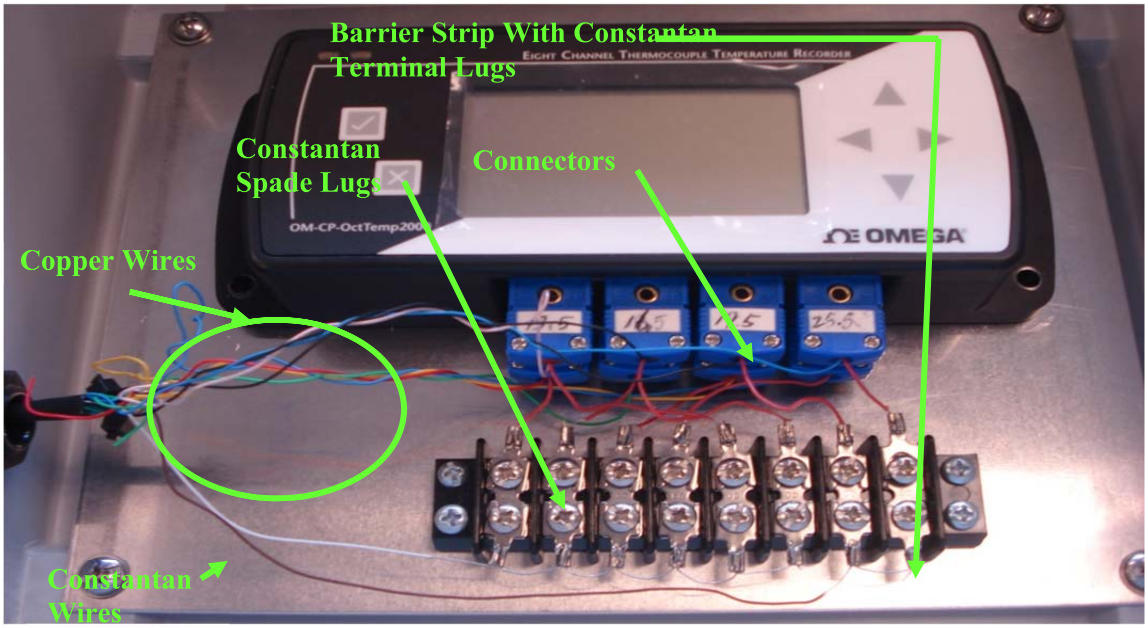


Figure 3.9: Photograph of the OCTTEMP data logger (Olson, 2011)

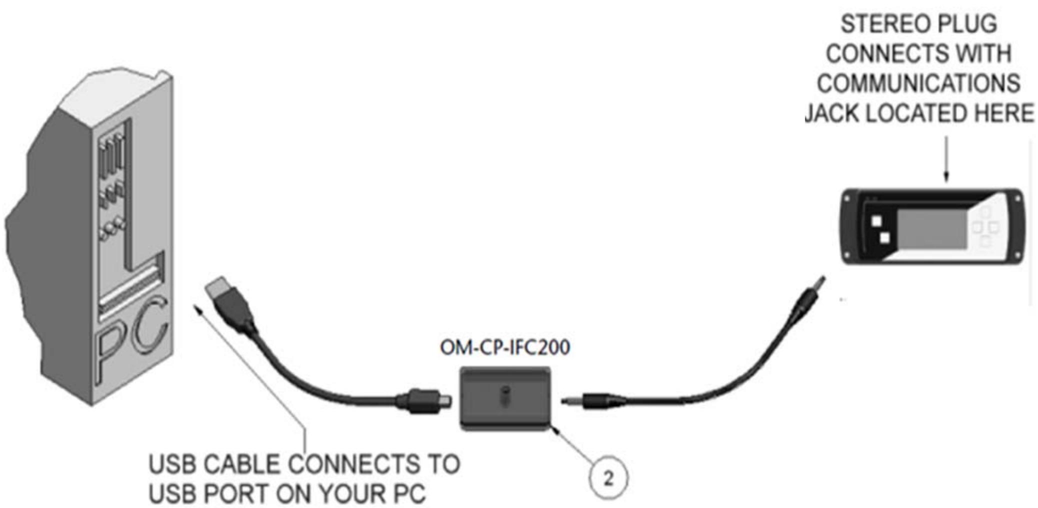


Figure 3.10: Computer Interface Connecction (www.omega.com)

3.3.2 Short Term Tank Equipment

The short term tank study required temperature data at varying depths in the tanks. Sensors that only measured temperature were used along with two sensors that measured both temperature and pressure. The pressure was measured to obtain the water elevation in the tank. Each sensor stored the information in the sensor itself. Seven sensors were used for each tank with one being the pressure sensor. One sensor was attached to a float in order to measure the temperature at the top of the water as the water level fluctuated. One additional pressure sensor was attached in the headspace of the tower to find water elevation in each tank. The sensors were zip tied to loops made in the

1/16-inch stainless steel cable. Each loop was made so the sensor was at the desired height in the tank. A weight was attached to the end of the wire to make the wire sink to the bottom. The equipment used in the short term tank study is shown in Figure 3.11.

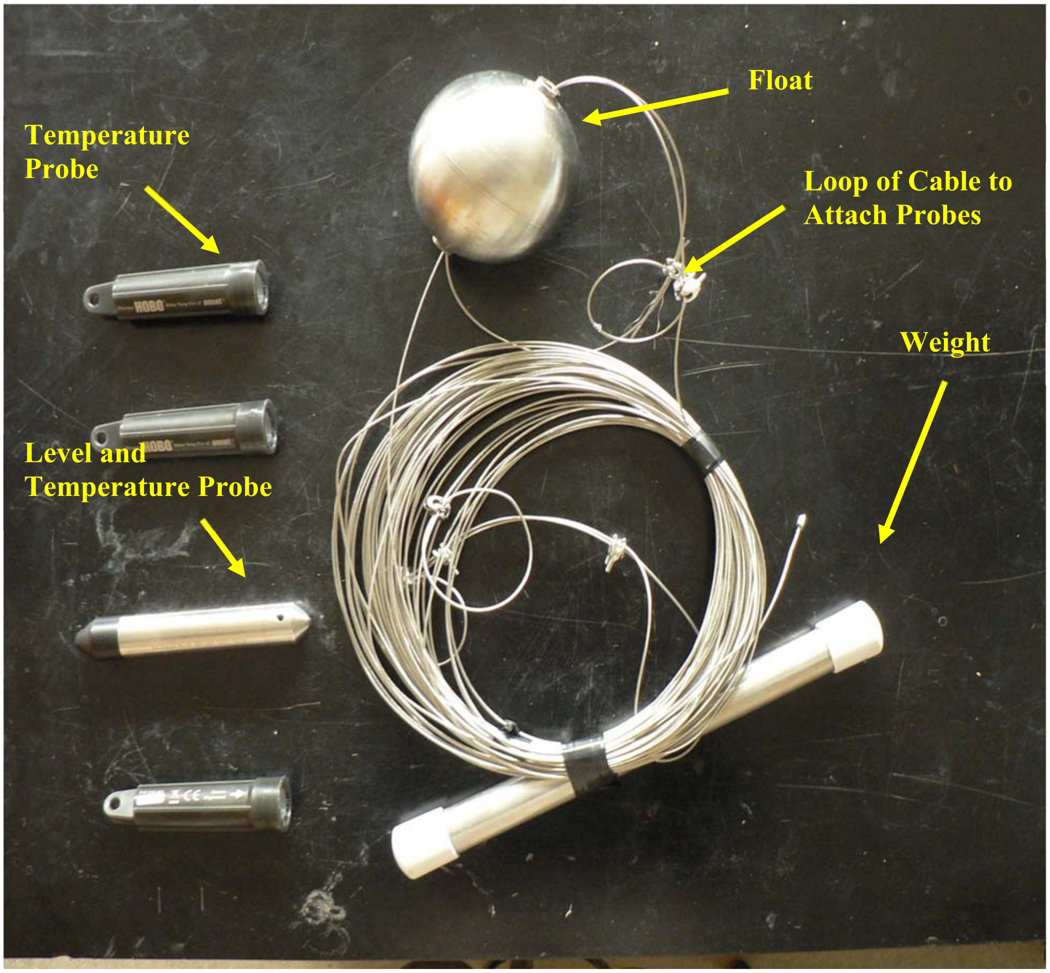


Figure 3.11: Short Term Tank Equipment (Olson, 2011)

The cable would exit the tank through a vent or hatch in the roof. Then the cable would be attached to the top of the roof by looping the wire around a part of the tank on the roof. Wire clamps were used to attach the wire to the tank. Figure 3.12 shows a picture of how the equipment was attached to the top of the short term tanks.

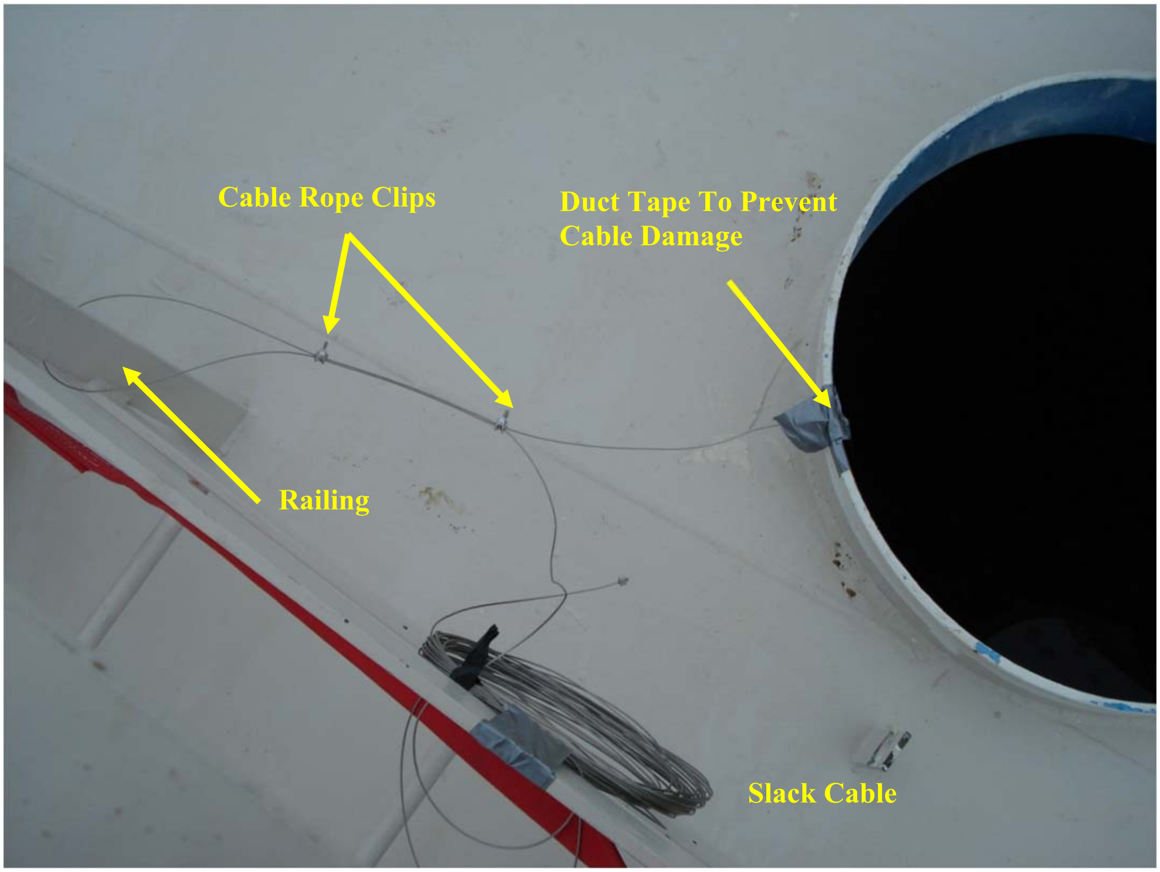


Figure 3.12: Photograph of how cable was attached to tank. (Olson, 2011)

At the end of the study, the equipment was removed from the tank. Then the sensors were removed from the wire, and the data from the sensors was downloaded onto a computer. The separate sensors and the method of attaching them to the wire lends itself well for multiple tank study since the equipment can easily be redone to fit another tank.

3.4 Sample Collection and Preservation

In order to obtain samples, a siphon was created using a peristaltic pump, which was powered by a car battery through a power inverter. Water was allowed to drain from the sampling tubes for at least 15 minutes to make sure the sample was representative of the tank at each elevation sampled. Equipment used to start the siphon in order to collect samples is shown in Figure 3.13.

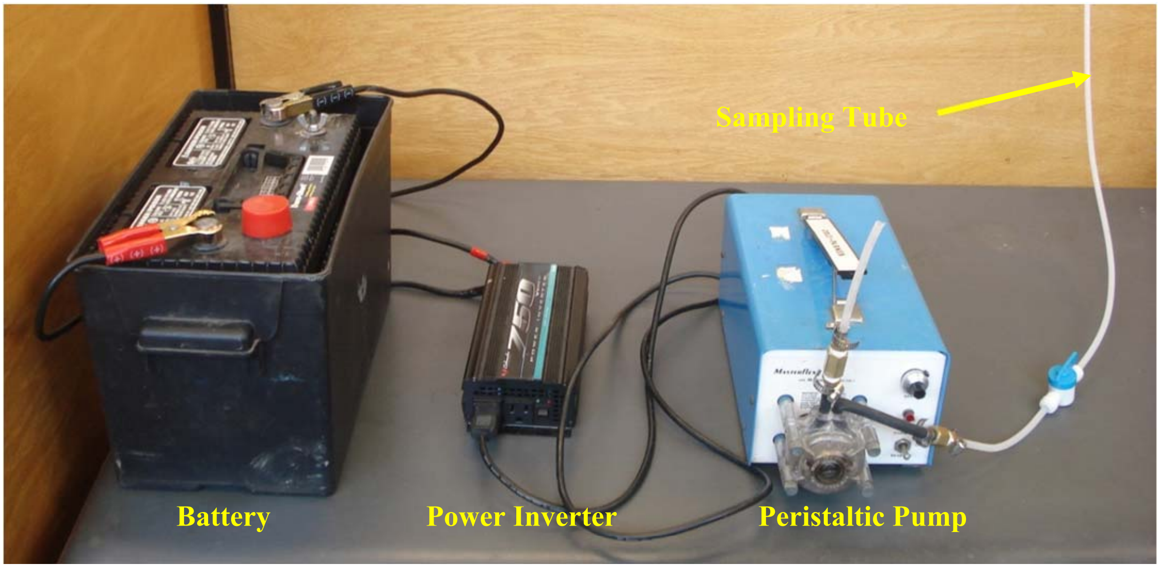


Figure 3.13: Picture of equipment used to obtain samples. (Olson, 2011)

For the chloraminated systems, the samples were tested on-site for total chlorine, monochloramine, free ammonia, and nitrite. A sample was also collected in a 250 mL plastic bottle for each sampling point in the tank for later analysis for nitrate at the Water and Environmental Engineering Research Center (WEERC) laboratory at SDSU. For the free chlorine systems, samples were tested on-site for total and free chlorine.

For all long term tanks, samples from varying depths were collected in sterile bottles containing sodium thiosulfate to dechlorinate the water. The samples were labeled, transported back to WEERC laboratory, and analyzed for total coliform and HPCs. A picture of the sampling bottles used is found in Figure 3.14.

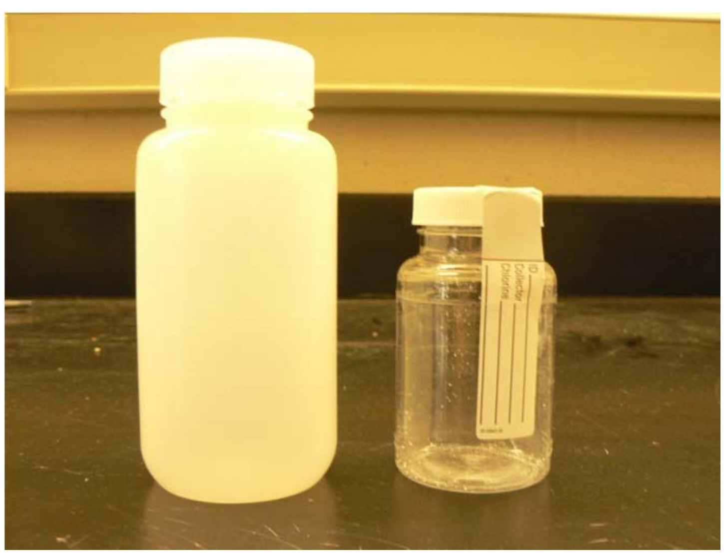


Figure 3.14: 250 mL sample bottle and a sterile sampling bottle with sodium thiosulfate

After the on-site analyses were complete and the samples collected, the sampling tubes were purged by pressing a nozzle of an air tank to the end of the sampling tube and blowing compressed air into the sampling tube. The end of the sampling tubes were then crimped and tied with a zip tie to ensure that the siphons did not restart.

3.5 Water Quality Measurements

Water quality samples were analyzed for several parameters. The parameters tested depended on the type of disinfectant used in the water system.

3.5.1 Temperature Measurements

The temperature was collected using the equipment described in section 3.3.1 for long term tanks and section 3.3.2 for short term tanks. The data logger or the sensors recorded the temperature data every ten minutes. The data would later be downloaded to the computer. Figure 3.15 shows a sample of the raw data that was collected from the long term tanks.

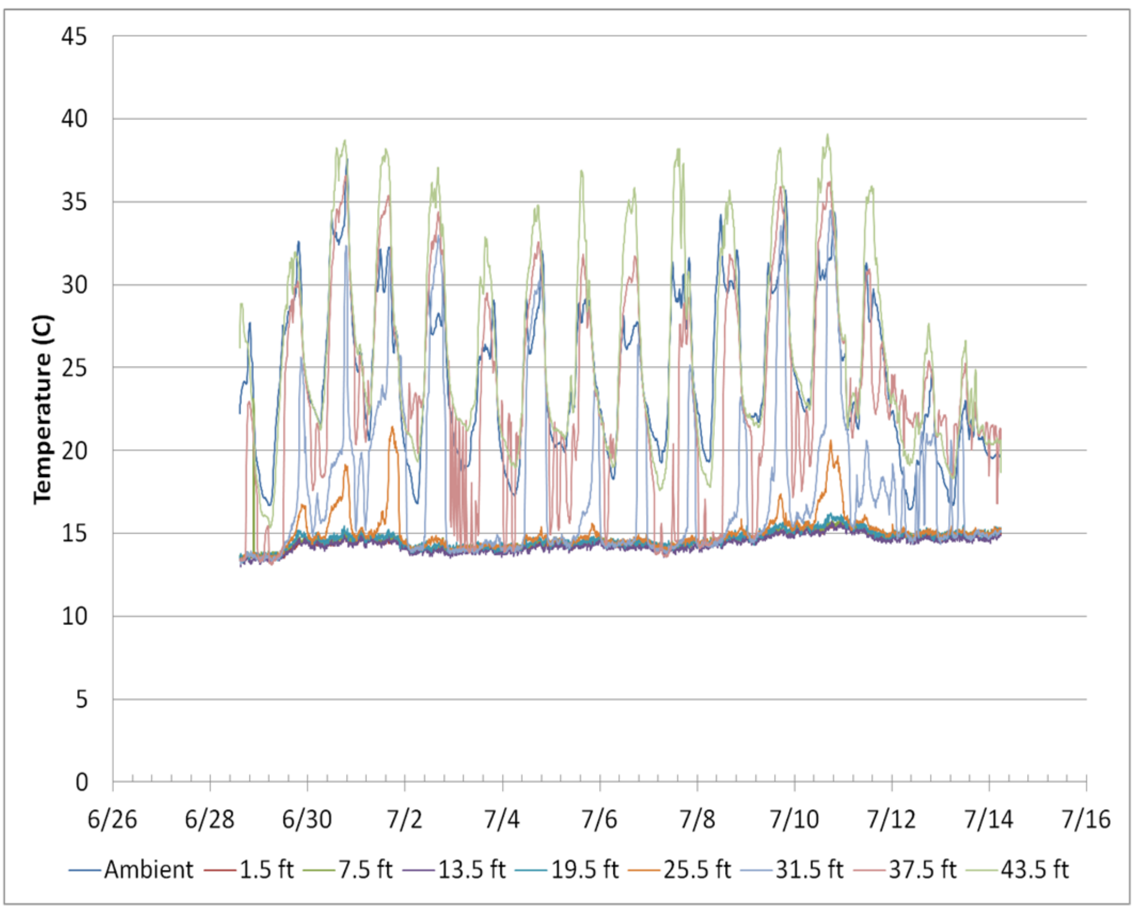


Figure 3.15: Raw temperature data

Due to the fluctuating water level in the tank, some of the top thermocouples were not always in the water. Spikes in the temperature data appeared that do not represent the actual temperature of the water in the tank. These spikes in data can be removed by reviewing the water elevation data and removing the temperature data of the thermocouples when they are out of the water. Removal of these temperature spikes makes the data a better representative of the tank temperature and it makes the data less confusing and easier to understand. Figure 3.16 shows the same tank during the same time span with the thermocouple data removed when they were out of water.

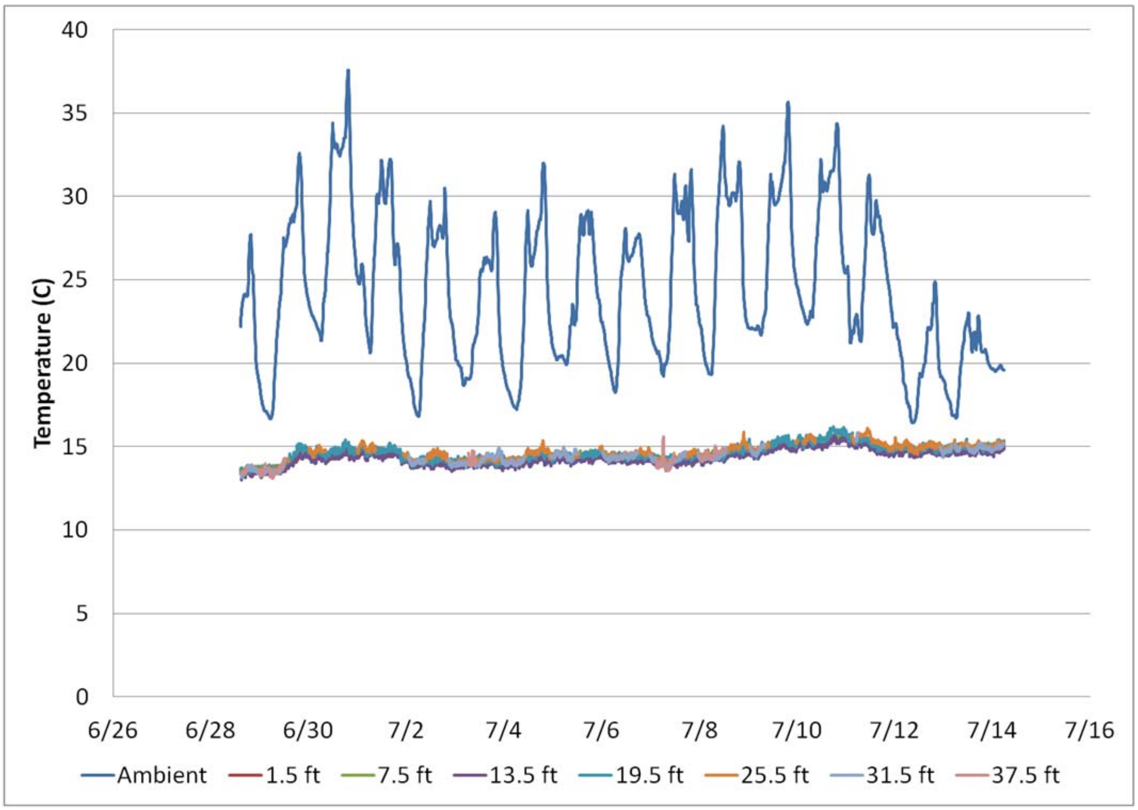


Figure 3.16: Filtered temperature data

3.5.2 On-site Measurements

The parameters that were measured in the field were determined by the type of disinfectant the water system used. Total chlorine and free chlorine were analyzed for tanks that used free chlorine as the disinfectant. Tanks that used chloramine as their disinfectant were tested for monochloramine, free ammonia, and nitrite. Long term tank C, D, and E used chloramine for disinfectant while tanks F and G used free chlorine.

All of the on-site tests were conducted with a HACH DR/890 colorimeter. Figure 3.17 shows the HACH DR/890 colorimeter and Table 3.2 shows the HACH method and reagent used for each test.

Figure 3.17: HACH DR/890 colorimeter (Olson, 2011)

Table 3.2 Methods and reagents used for on-site water quality testing

Constituent	HACH Method Number	Reagents Used	Range (mg/L)
Total Chlorine	8167	DPD – Total Chlorine Reagent (10 mL sample)	0.0-2.0
Free Chlorine	8021	DPD – Free Chlorine Reagent (10 mL sample)	0.0-2.0
Monochloramine	10020	Monochlor F Reagent	0.0-4.5
Free Ammonia	10020	Monochlor F reagent + hypochlorite solution	0.0-0.5
Nitrite	8507	Nitriver 3 Reagent	0-0.35

3.5.3 Analysis Performed in WEERC Laboratory

Samples from each tank were transported back to the WEERC laboratory at SDSU for additional tests as described below.

3.5.3.1 Nitrate

The samples were analyzed for nitrate by following the EPA method 300.0 (Determination of Inorganic Anions by Ion Chromatography).

3.5.3.2 Total Coliform

Samples from long term tanks were analyzed for total coliform. The total coliform test was performed following Standard Method 9222 B. Standard Total Coliform Membrane Filter Procedure using m-endo broth (APHA et al., 1998). First, the mEndo broth was prepared and 2 milileters of broth were dispensed on a sterile pad in each Petri dish. Using sterilized forceps, the filter was placed on the filtering apparatus. The 100 mL sample was filtered and the filter was placed in a Petri dish with sterilized forceps. The Petri dishes were incubated in a water bath at 35˚C for 24 hours. Between each sample the filtering apparatus was rinsed with a bleach solution to kill any bacteria left over and then rinsed with distilled water to remove the bleach solution. The shiny gold colonies were counted to find the CFU/100 mL. Figure 3.18 shows the materials needed and the apparatus used to run the total coliform test.

3.5.3.3 Heterotrophic Plate Count (HPC)

Every long term tank was analyzed for HPC. The samples were collected from 6 sample points in a sterile bottle with sodium thiosulfate. The samples were transported back to the WEERC laboratory for analysis. The HPC test was completed using IDEXX SimPlate for HPC method (IDEXX, 2009). First, the media was hydrated by adding 100 mL of sterile water to the media vessel. Then 1 mL of sample and 9 mL of media was

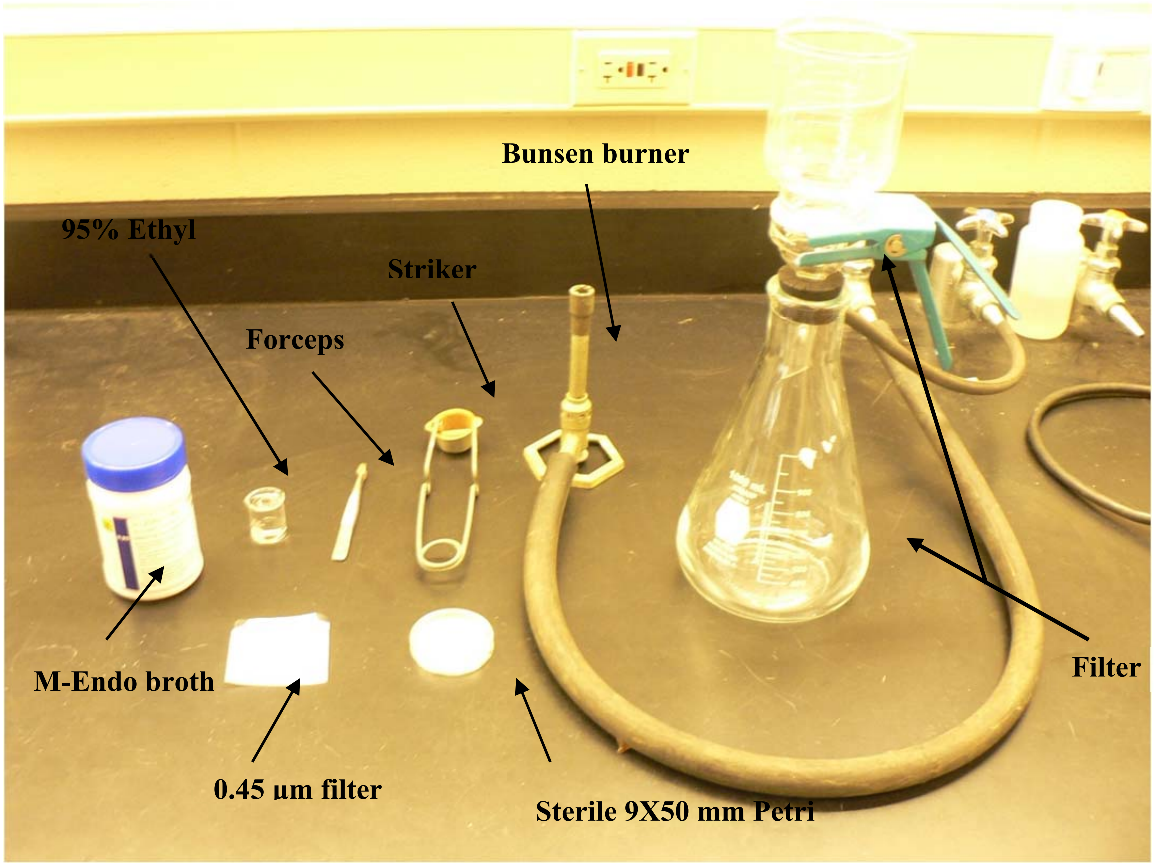


Figure 3.18: Total coliform materials and setup

added to the plate. The plate was covered and swirled to distribute the sample and media around the plate. Next, the plates were inverted and incubated in a water bath at 35˚C for 48 hours. Counting the plates consisted of using a 6-watt, 365nm, UV light about 5 inches above the plates. Count the fluorescent wells and refer to the MPN tables provided with the Simplates. The pipettes used were rinsed with bleach solution to kill bacteria and then rinsed with sterile water to remove the bleach between each sample. The materials needed to run the SimPlate test for HPC are shown in Figure 3.19.

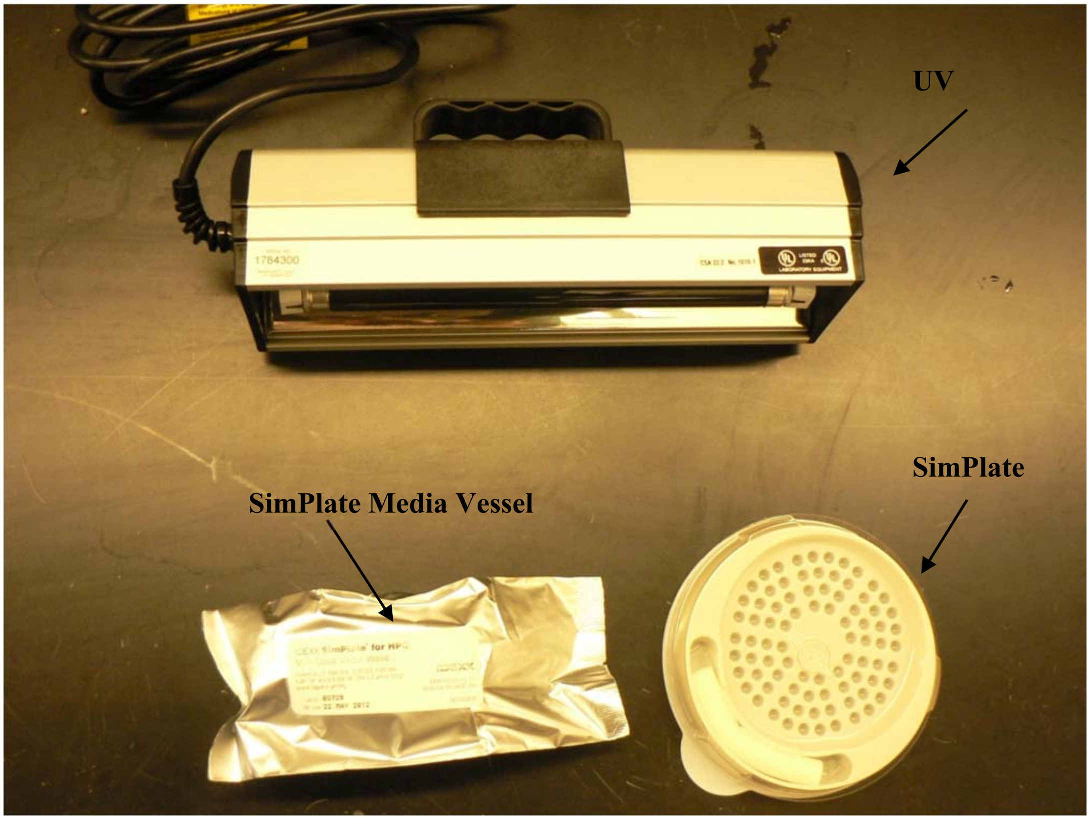


Figure 3.19: Materials for SimPlate test for HPC

3.6 Analysis of Mixing Characteristics

There are several parameters that were calculated that affect the mixing in the tanks from the data collected throughout this study. Examples of all calculations are found in Appendix A.

3.6.1 Determining the Fill and Draw Cycles

The fill and draw cycles were needed to calculate the hydraulic parameters. For the long term tanks, water elevation in the tanks was obtained from the water systems. For short term tanks, the pressure sensor in the tank was used to find the water elevations during the time in the tank. Elevation data was analyzed, and the fill and draw cycles were found by finding the lowest and highest elevations in each cycle. The water elevation change was not the only significant piece of data found. The time interval for each fill and draw cycle was important. Temperatures at the start and stop of each cycle were also needed. The temperatures used were the temperature at the bottom of the tank and the temperature of the upper most thermocouple that was submerged in the water.

3.6.2 Height to Diameter Ratio

The actual H:D ratio was found for each cycle. Change in the water level in the tank, causes the H:D ratio to change. The average ratio was found during the time that each tank was studied.

3.6.3 Flow Rate During Fill Cycle

The flow rate during each fill cycle was determined for each tank and was used in the calculations. The flow rate was calculated using the inlet diameter, water level, and the amount of time for the fill cycle to be completed.

3.6.4 Velocity of Inflow during Fill Cycle

The velocity of the inflow was calculated for each fill cycle in each tank. The velocity was found using the inlet pipe area and incoming water flow rate. The calculation was done so the value could be used in later calculations.

3.6.5 Volumetric Exchange

The volume of water needed to be exchanged in order for the tank to be considered well mixed was determined along with the actual volumetric exchange that the tank achieved. A comparison of these numbers could show if a tank was mixed and what could be done in the operation of the tank to help promote mixing. As discussed in the literature review, if Equation 12 was true, the tank should be mixed (Rossman and Grayman, 1999). The temperature of the influent and the temperature of the water in the tank were assumed to be the same in this calculation:

$$\frac{\Delta V}{V} > \frac{(\pi)^{1/2}\tau_m d_i}{2V^{1/3}} \tag{12}$$

where: ΔV = volume of water added during fill (ft^3); V=tank volume (cubic feet); τ_m = constant; and d_i = inlet diameter.

3.6.6 Densimetric Froude Number

The densimetric Froude number was calculated for every cycle in each tank by using Equation 1 (Rossman and Grayman, 1999):

$$F_d = \frac{u}{\sqrt{g'd}} \tag{1}$$

in which u = the vertical inflow velocity; d = pipe diameter; and $g' = g(\rho_f - \rho_a)/\rho_a$ where g = acceleration of gravity; ρ_f=density of inflow; ρ_a=density of the ambient water.

The densimetric Froude number was compared to a calculated value based on tank geometry. If the in-tank densimetric Froude number was greater than the value given by Equation 3, then the tank should not stratify (Rossman and Grayman, 1999). Equation 3 shows the comparison:

$$F_d > C\frac{H}{d} \qquad (3)$$

where F_d= densimetric Froude number; C = slope of plot; H = water height; d = diameter of inlet.

3.6.7 Dimensionless Mixing Parameter

The dimensionless parameter shows the required momentum to overcome stratification in the tank. The calculation was made for each cycle in each tank. Equation 4 shows the comparison made to determine if the momentum is enough to overcome stratification (Roberts et al., 2006):

$$\frac{M^{0.5}}{B^{\frac{1}{3}} * H^{\frac{2}{3}}} > 0.85 - 0.05n \qquad (4)$$

where M = inflow momentum; B = Buoyant Force; H = water depth; and n = number of inlets.

3.7 Chlorine Decay Modeling

The chlorine decay was modeled in the tanks that stratified. The model relied on the concentration of chlorine in the influent water, the data for the fill and draw cycles, and the decay coefficient (k).

3.7.1 Decay Coefficient (k)

The decay coefficient was found by comparing the chlorine concentration of one visit (initial concentration) with the chlorine concentration of the next visit. The chlorine concentrations used were the average concentrations in the upper zone of the stratified tank. Equation 14 shows the formula used (Boulos et al., 1996):

$$k = -\frac{\ln(\frac{C}{C_o})}{t} \qquad (14)$$

where k = decay coefficient; C = final chlorine concentration; C_o= initial chlorine concentration; and t = elapsed time between samples.

The decay coefficient was also corrected for temperature using Equation 15 (Gowda, 1978):

$$k_2 = k_1 * \theta^{T_2 - T_1} \qquad (15)$$

where k_1 = decay coefficient at T_1; T_1= Initial temperature; T_2 = Correcting temperature

3.7.2 Modeling of Tanks

The tanks were modeled using a computer program called CompTank. The influent chlorine concentration was used along with the inflow velocities throughout a time period. An average decay coefficient was calculated during the study and was used in the program. The data used for the chlorine decay coefficient are in Appendix C and a sample calculation is in Appendix A. Long term tanks D and E where the focus of the modeling since both where stratified. The stratification allowed for the decay coefficient to be calculated. Each tank was modeled as a stratified 3 compartment tank since the data showed stratification in these tanks. The computer read outs were then compared to the data that was obtained throughout the study to see if this type of model was effective.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

The study focused on the effects of distribution systems' water storage facilities mixing characteristics on water quality. Storage facilities were studied in regional water systems in South Dakota. Tanks were selected based on the survey of water systems and the previous study performed by Olson (2011). The tanks that were chosen included tanks that varied in size to show the effect of tank geometry on mixing and water quality. The effect of passive mixing systems was studied in two tanks in which the water systems installed passive mixing systems.

Long term tanks were analyzed for temperature at varying depths throughout the tank. Water quality samples were collected from the same points as were temperature readings to analyze for certain water quality parameters. The parameters tested were based on the type of disinfectant the water system used. In chloraminated systems, parameters were measured to show whether nitrification had occurred. All of the samples were analyzed for total coliform and heterotrophic plate count.

Short term tanks had temperature collecting sensors at varying depths in the tank. Water quality data were not collected in short term tanks. A passive mixing system was installed by the water system in each tank. One of the tanks studied was also studied during Olson's research; however, the water system installed the passive mixing system after Olson's research (Olson, 2011). Both sets of data were compared to show the effect of the passive mixing system on water quality.

All of the tanks were analyzed for hydraulic parameters that are used to characterize mixing in the tanks. The hydraulic parameters included the densimetric Froude number, the volumetric exchange, and the dimensionless mixing parameter. A comparison between the hydraulic parameters and the actual behavior in the tanks was done in order to show whether the hydraulic parameters correctly predicted the mixing behavior.

4.2 Long Term Tank Study

Long terms tanks were analyzed for both temperature and water quality parameters at varying depths in the tanks. The temperature was recorded once every 10 minutes. The water quality parameters that were tested for each tank depended on the type of disinfectant used by the water system. Each tank was also tested for total coliform and heterotrophic plate count at varying depths of the tank. Hydraulic parameters for each tank were calculated to show whether the tank should mix properly.

4.2.1 Long Term Tank C

The temperature profile for long term tank C is shown in Figure 4.1. Around the sampling event on June 8, the operation of the tank changed when the pump that filled the tank stopped working. After the pump failed, the tank was filled by using water from a storage tank next to tank C. The data in Figure 4.1 indicate thermal stratification occurred throughout the study, exhibiting as much as 10 degree Celsius difference between the bottom of the tank and the top of the tank.

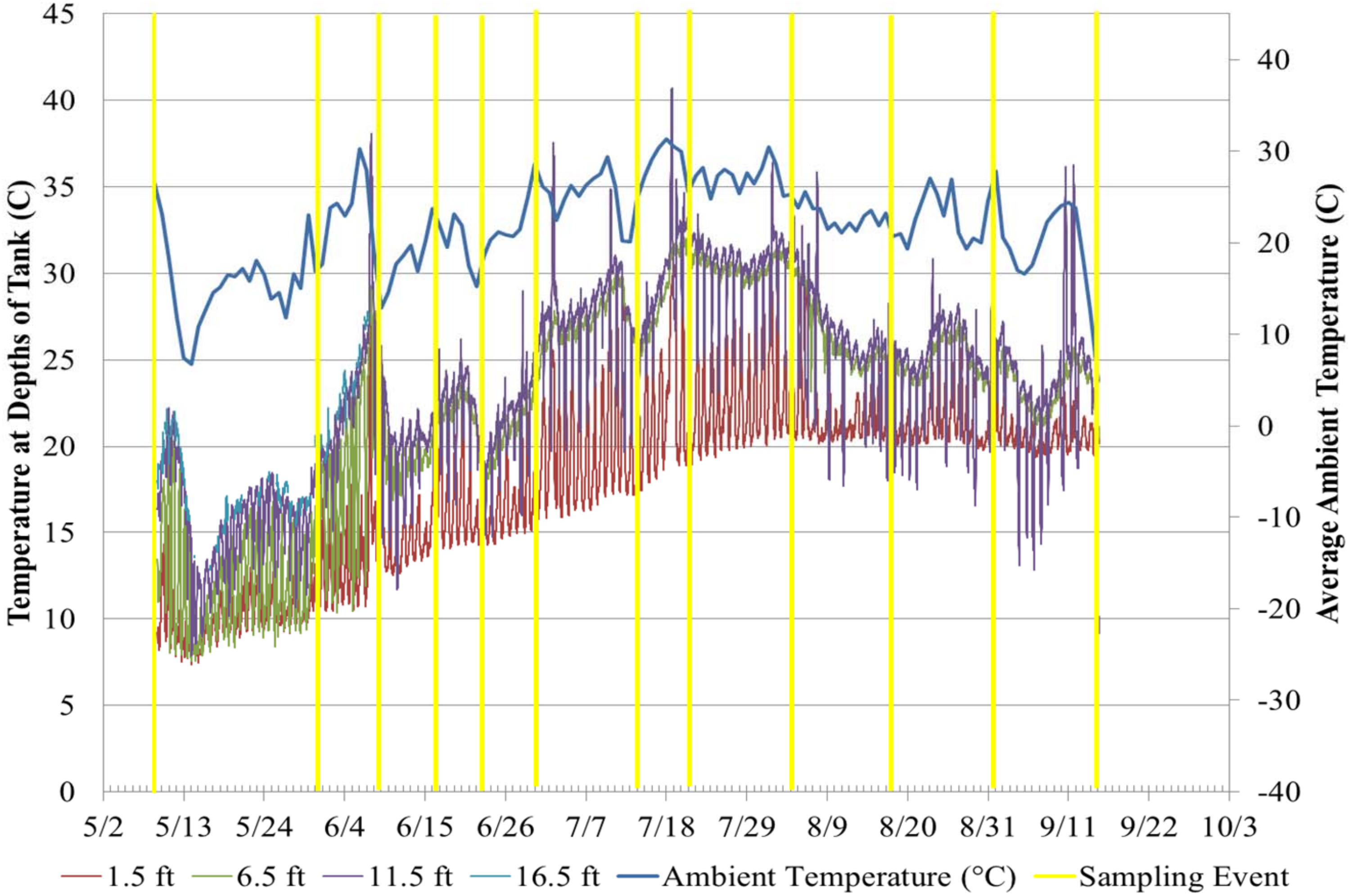


Figure 4.1: Long term tank C temperature and sampling times.

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Water quality was tested before and after the change in the tank's operation. Figure 4.2 shows the water quality data on May 31 and Figure 4.3 shows the water quality data on June 16. On May 31, the total chlorine residual remains around 2.5 mg/L throughout the tank. On June 16, the total chlorine residual was 2.24 mg/L at the lower portion of the tank and 2.16 mg/L in the upper portion of the tank. Throughout the study the water quality parameters did not show stratification.

In Figure 4.4, the temperatures in the tank are shown along with the water depth, which shows the fill and draw cycles. Comparing the fill and draw cycles to the temperature indicates whether or not the temperatures are influenced by the filling water temperature. Figure 4.4 shows that the lower thermocouples are influenced by the influent water. During the fill cycle, the temperature at 1.5 ft. decreases and then increases during the draw cycle as warm water lowers due to the draw. Before the pump quit working, the temperatures at 1.5 ft., 6.5 ft., and 11.5 ft. were influenced by the filling water. The temperatures indicate stratification was occurring; however, the mixing occurring during the fill and draw cycles was sufficient to maintain a consistent disinfectant residual throughout the tank.

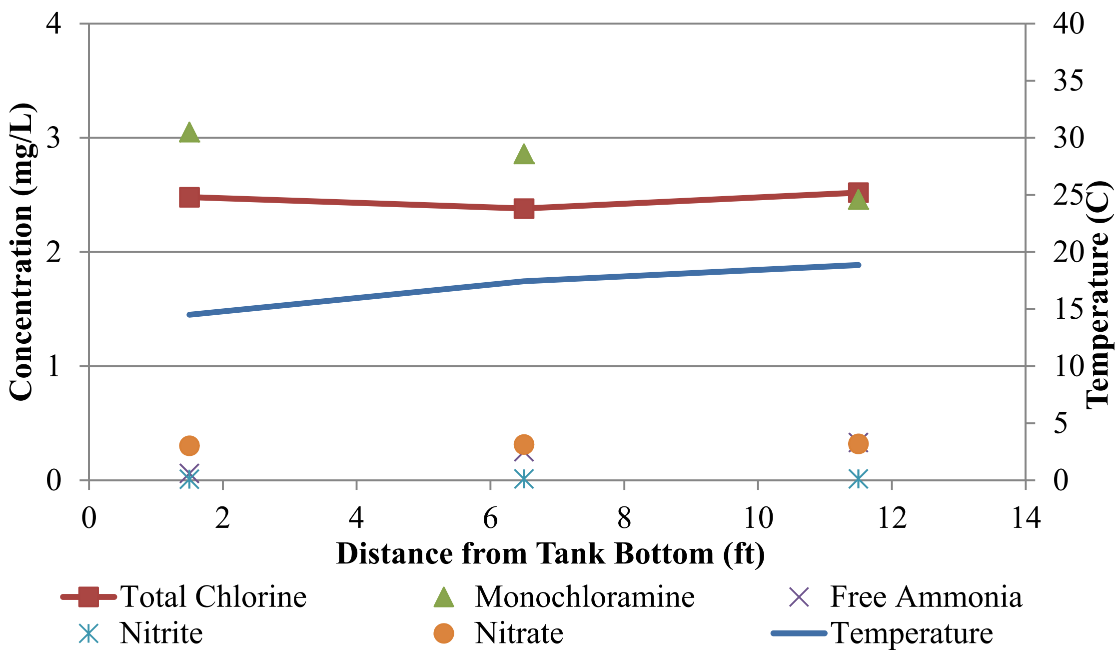

Figure 4.2: Water quality data for long term tank C on May 31.

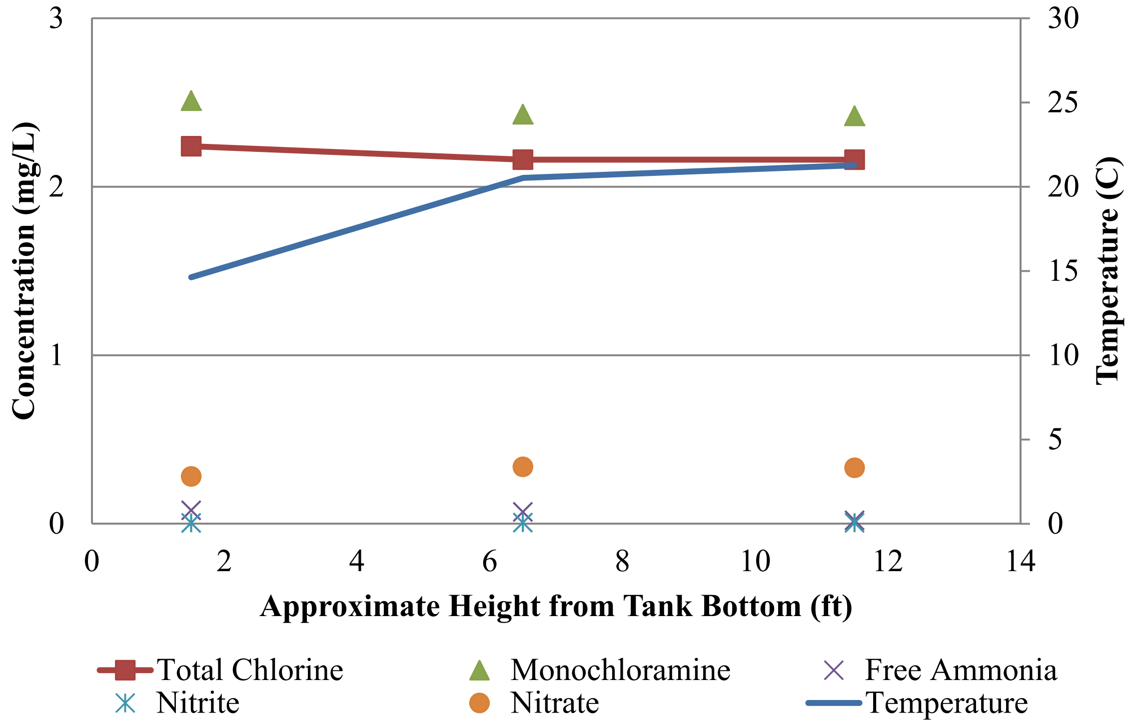

Figure 4.3: Water quality data for long term tank C on June 16.

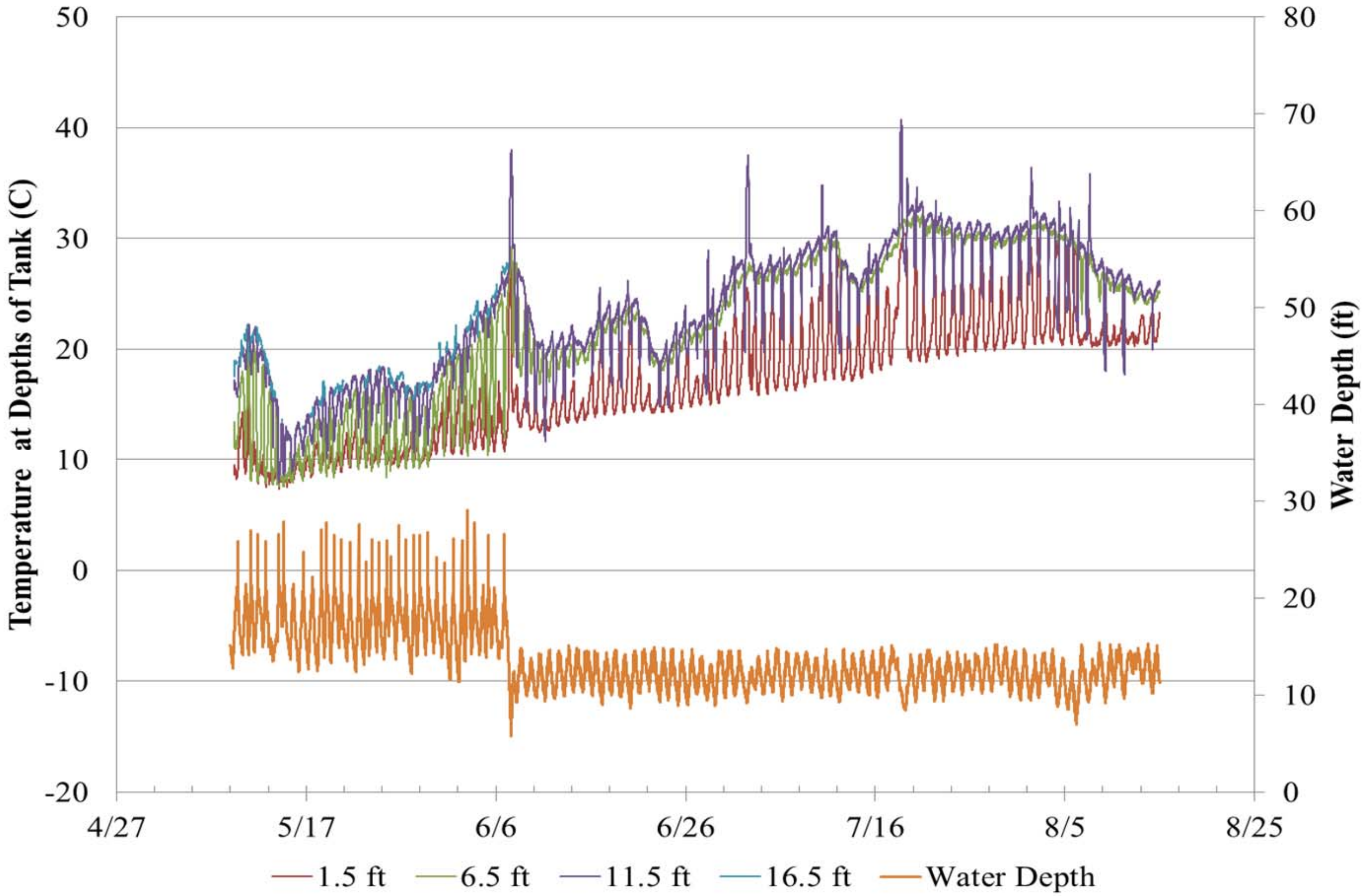

Figure 4.4: Long term tank C tank temperatures and water depth.

Hydraulic parameters were calculated and compared to required values to show whether the tank should mix properly or not. Figure 4.5, Figure 4.6, and Figure 4.7 show the densimetric Froude number, volumetric exchange, and dimensionless mixing parameter respectively. Calculations used in finding the hydraulic parameters are presented the Appendix A.

Both the densimetric Froude number and the dimensionless mixing parameter show that the tank operation does not obtain the required value for the tank to be properly mixed; however, the volumetric exchange in the tank was greater than that required for mixing, indicating the tank should be mixed. The proper volumetric exchange could be the reason that the tank did not stratify in terms of water quality. The disinfectant residual remained at an appropriate level (greater than 2 mg/L) throughout the tank even though the temperature data showed stratification.

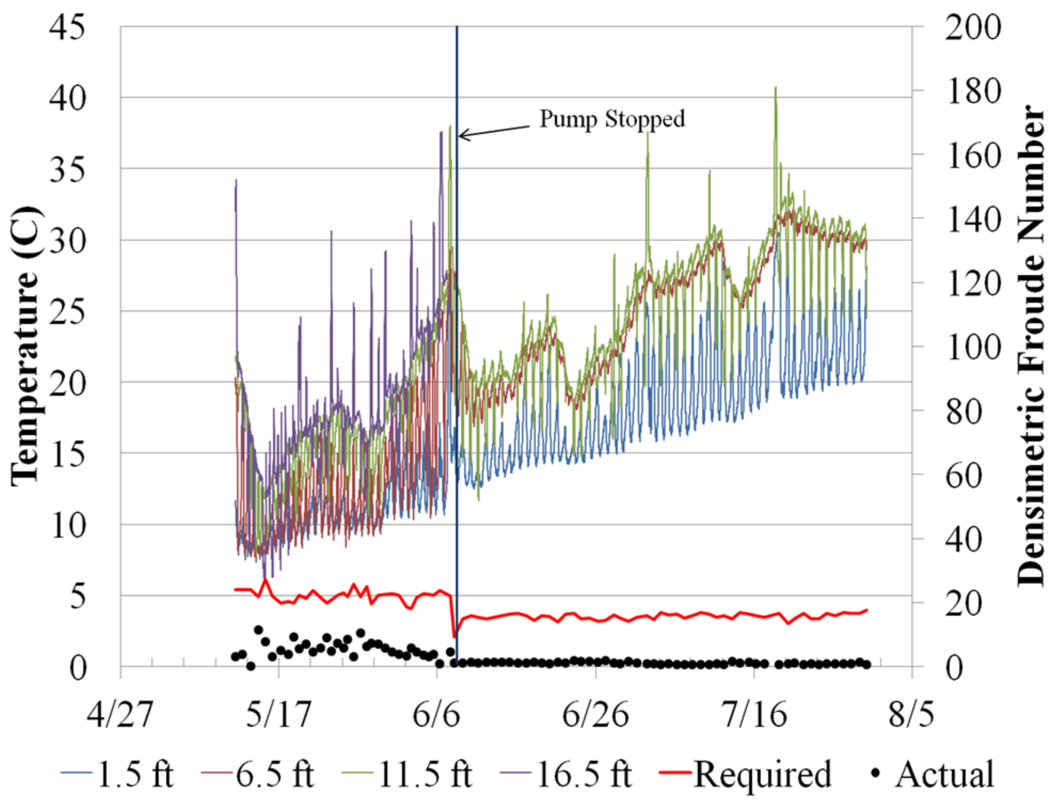

Figure 4.5: Long term tank C densimetric Froude number

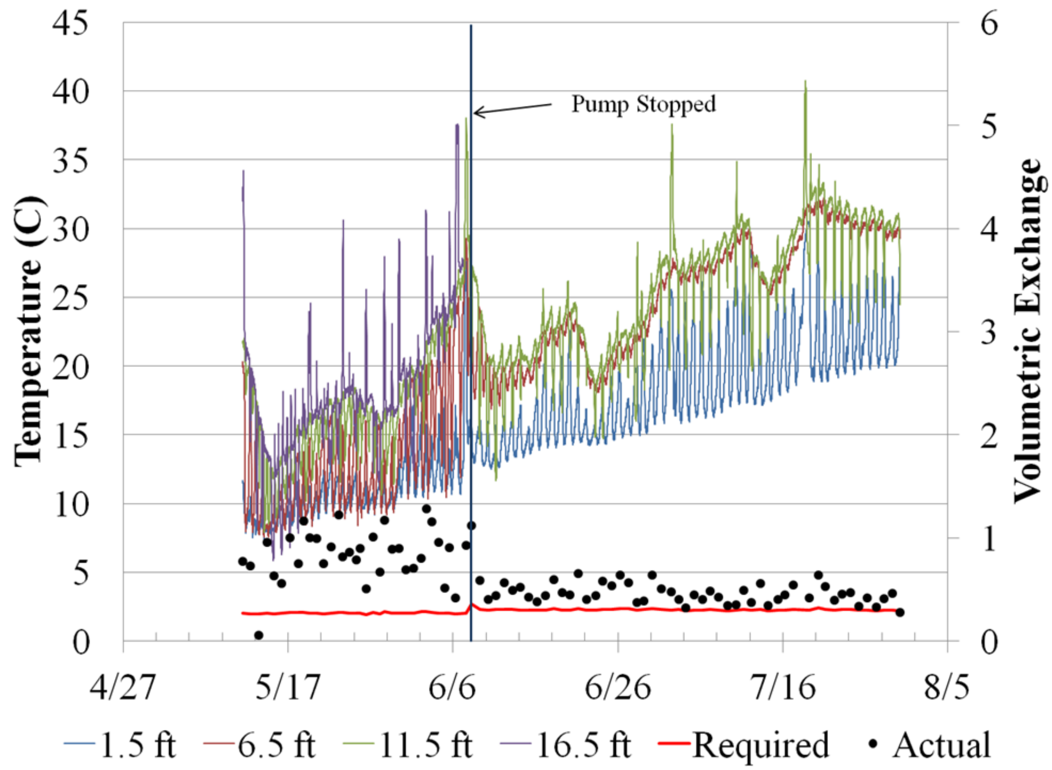

Figure 4.6: Long term tank C volumetric exchange

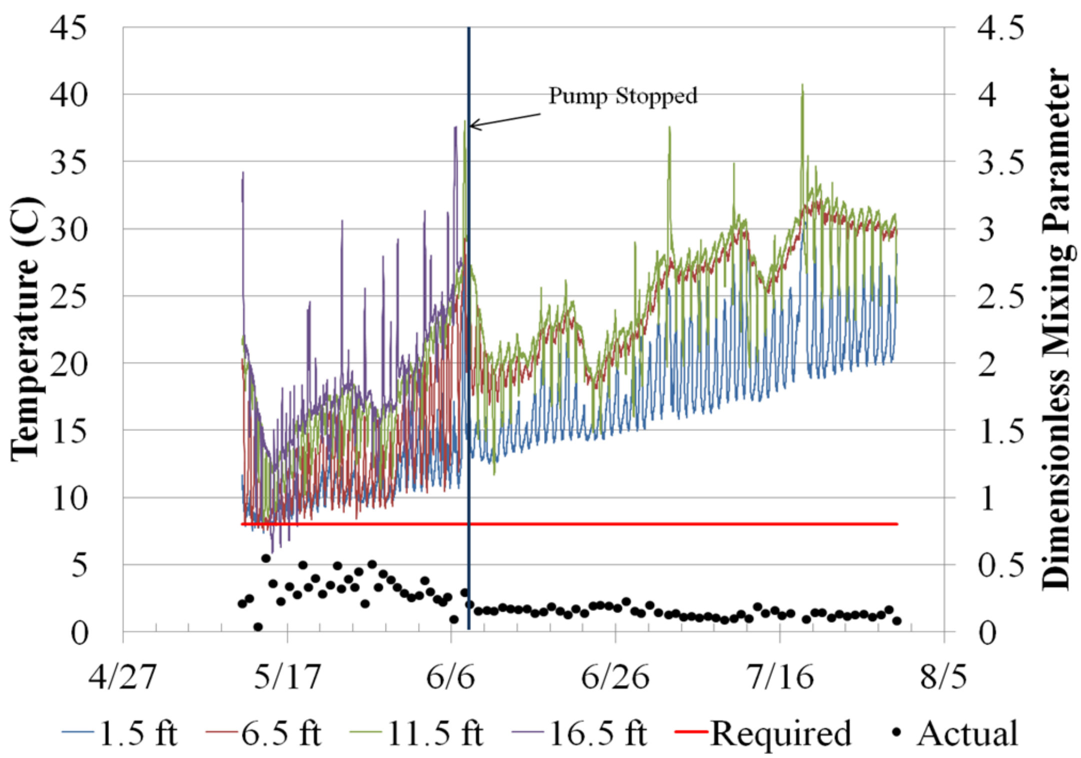

Figure 4.7: Long term tank C dimensionless mixing parameter

4.2.2 Long Term Tank D

Figure 4.8 shows the temperature profile of long term tank D throughout the study. Also, sampling events and the period the tank was drained are noted in Figure 4.8. Tank D was thermally stratified throughout the study. During the cooler temperatures at the beginning of monitoring, the stratification between the lower and upper zone were not as significant as the stratification that occurred between the zones when the temperature became warmer. At the warmest temperatures, the temperature difference between the upper and lower zone was approximately 10 degrees Celsius. The thermocline appeared to be between the depths of 1.5 feet and 8.5 feet. The impact of the thermal stratification on water quality was observed by analyzing water samples from the varying depths of the tank. An example of the water quality data is shown in Figure 4.9.

Figure 4.9 shows a substantial drop in total chlorine residual between 1.5 feet (1.75 mg/L) and 8.5 feet (0.57 mg/L) above the tank bottom. The total chlorine residual were usually low in the warmer upper zone of the tank. Tank D showed stratification in both temperature and water quality. The chlorine residuals that were measured on September 1 were low, which lead to concern from the water system. To restore the chlorine residual to the upper portion of the tank, the water system chose to drain the tank lower than during normal operation and then refill the tank.

Figure 4.10 shows the water quality parameters above the thermocline throughout the study. Draining the tank did achieve the goal of restoring the chlorine residual to an appropriate level. Before the tank was drained, the water system was concerned about nitrification arising as a result of low chlorine residual. Figure 4.10 shows no sign that nitrification had occurred in the upper zone before the water system drained the tank.

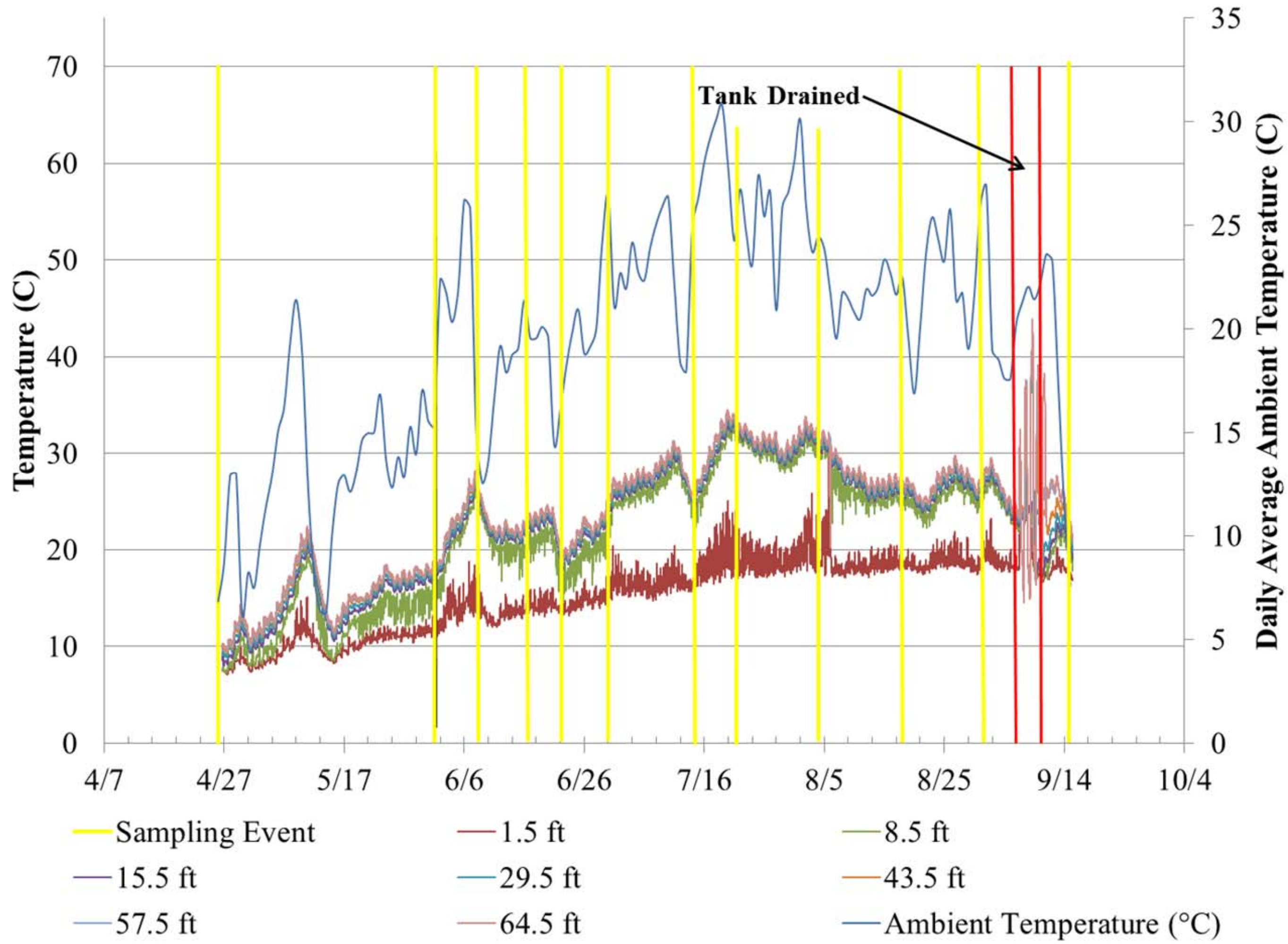

Figure 4.8: Long term tank D (H-D 2-4) temperature profile along with sampling dates and period when tank was drained.

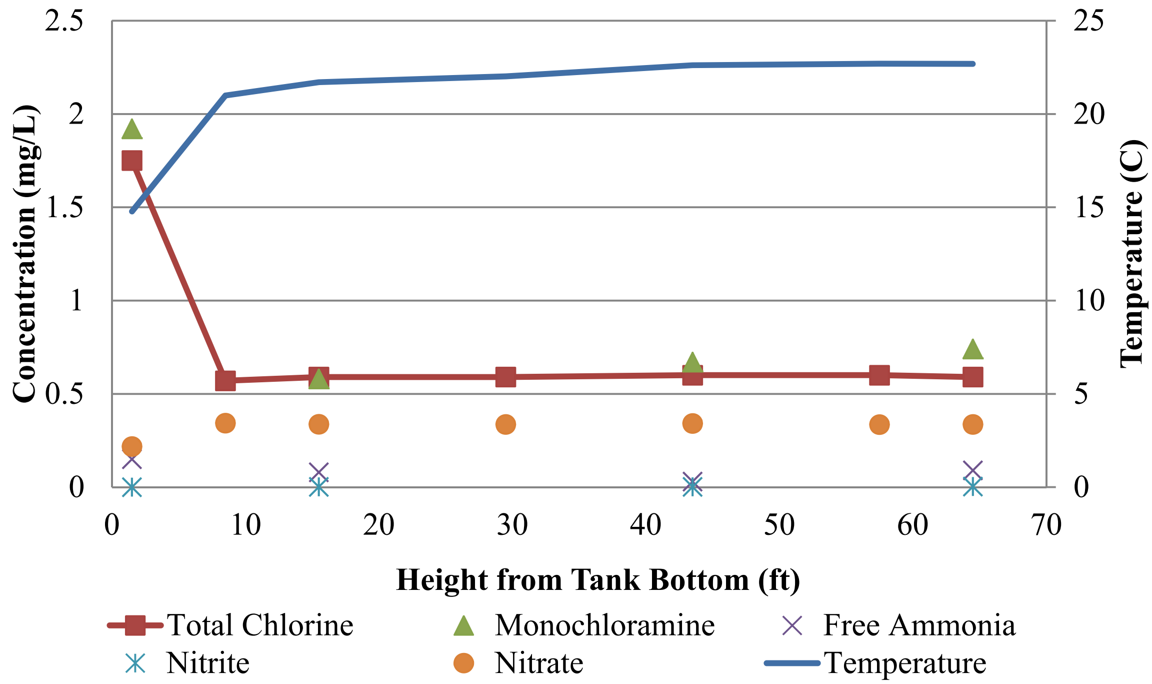

Figure 4.9: Long term tank D water quality data on June 16.

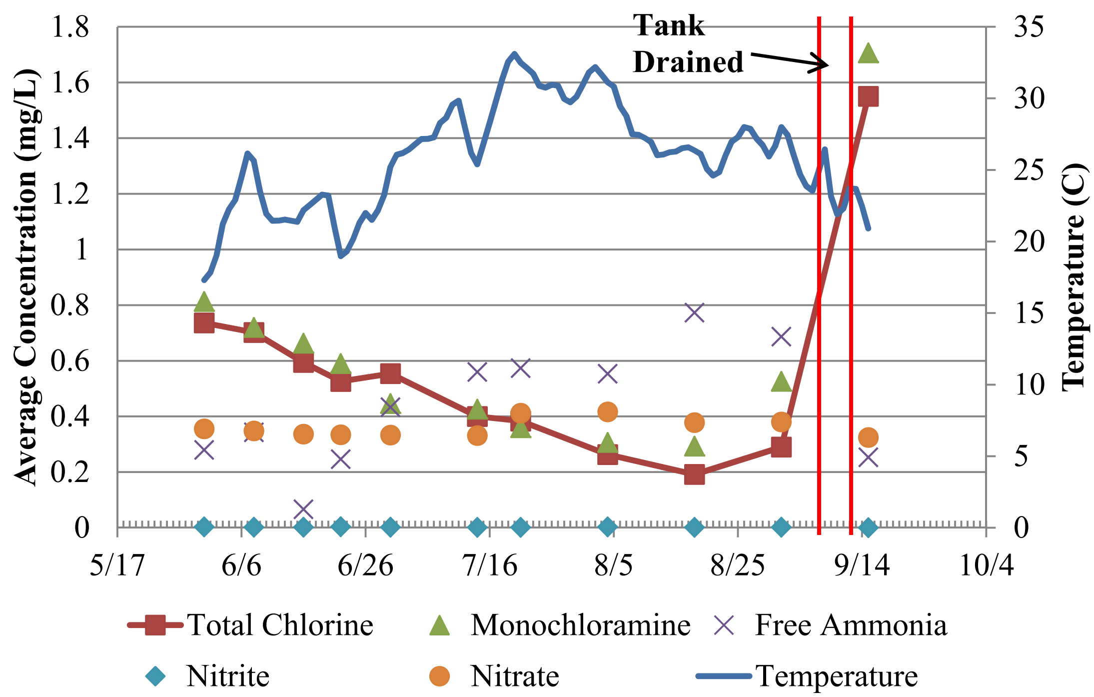

Figure 4.10: Long term tank D water quality parameters throughout study

Figure 4.11 portrays the water quality parameters on the first sampling event after the water system drained the tank. The chlorine residual returned to a proper level. However, the data indicated the tank was stratified. A drop in chlorine residual occurred between the 8.5 foot sampling point (1.92 mg/L) and the 15.5 foot sampling point (1.46 mg/L).

Figure 4.12 shows the temperature profile after the tank was drained. After draining, the temperatures were similar but the temperatures started to re-stratify as time passed with warmer ambient temperatures. However, the ambient temperature dropped and the temperatures started to unstratify.

Figure 4.13, Figure 4.14, and Figure 4.15 show the densimetric Froude number, volumetric exchange, and dimensionless mixing parameter calculated for tank D respectively. The densimetric Froude number, the volumetric exchange, and the dimensionless mixing parameter all show that the tank should not be mixed, which agrees with the temperature data and the water quality data. Hydraulic parameter calculations are presented in the Appendix A.

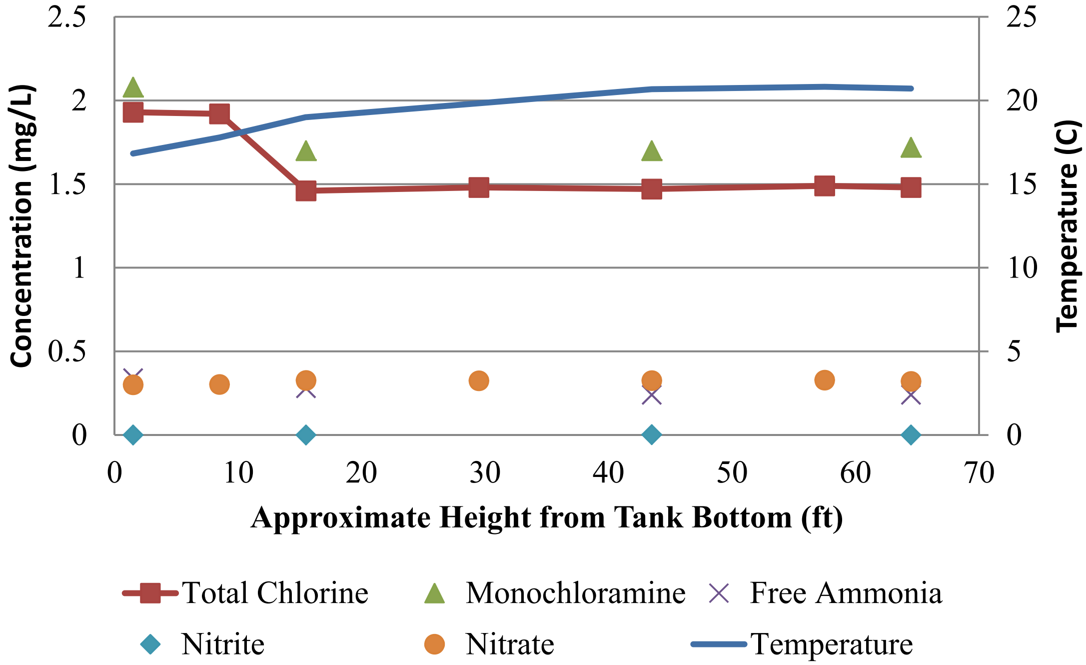

Figure 4.11:Long term tank D water quality sampling event after tank was drained

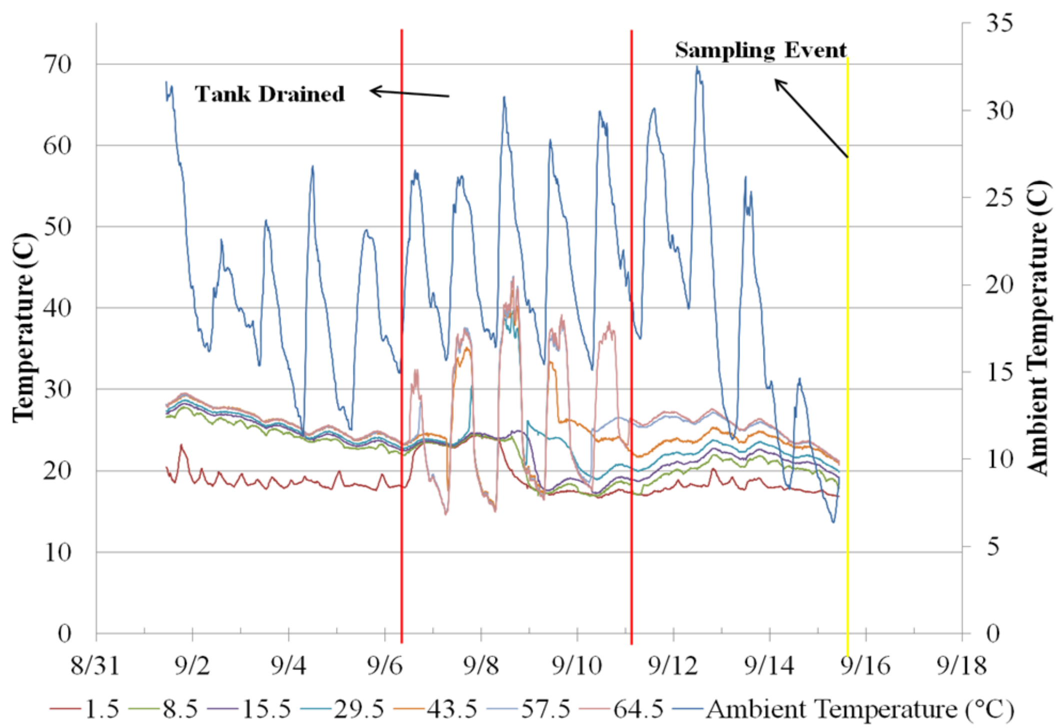

Figure 4.12: Long term tank D temperature profile after tank was drained.

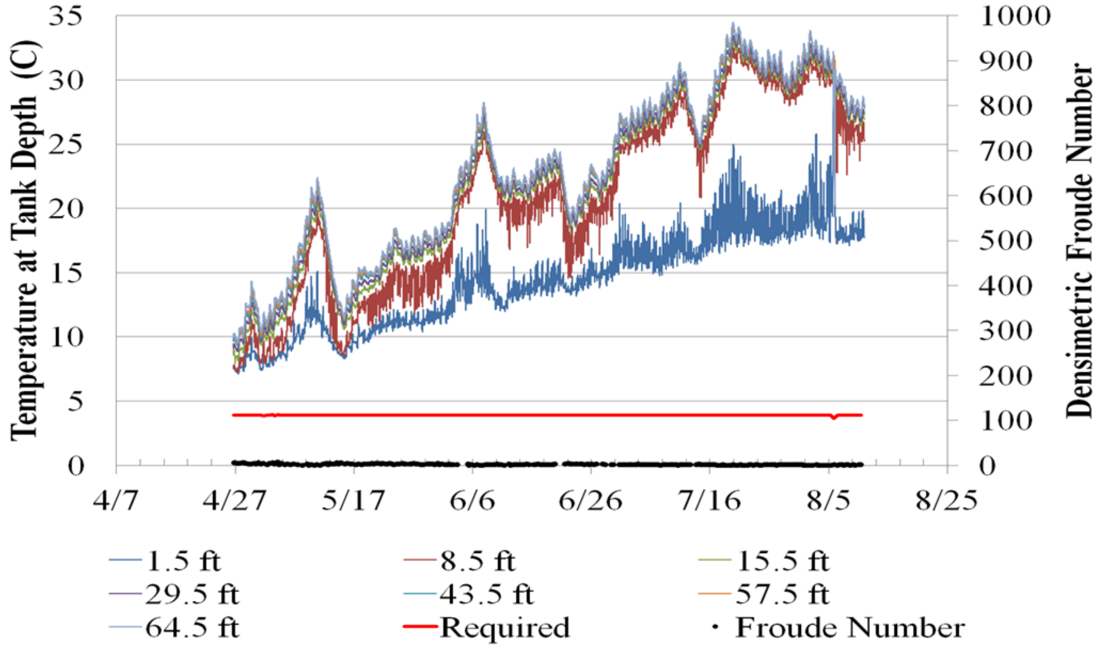

Figure 4.13: Long term tank D densimetric Froude number.

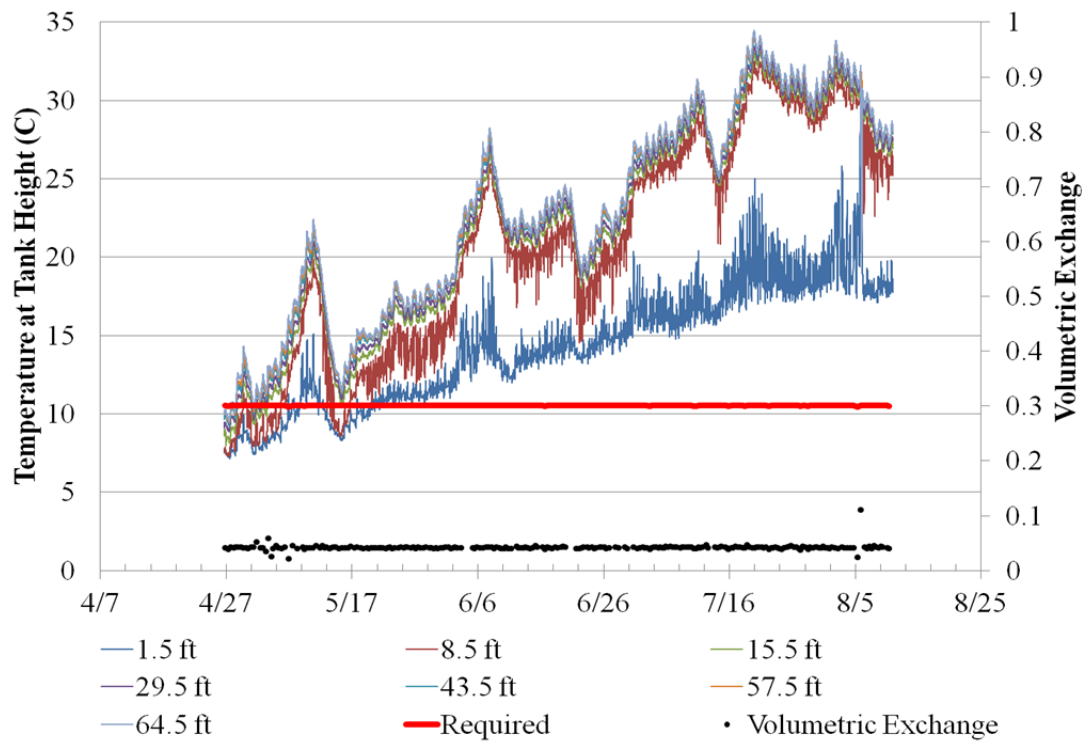

Figure 4.14: Long term tank D volumetric exchange.

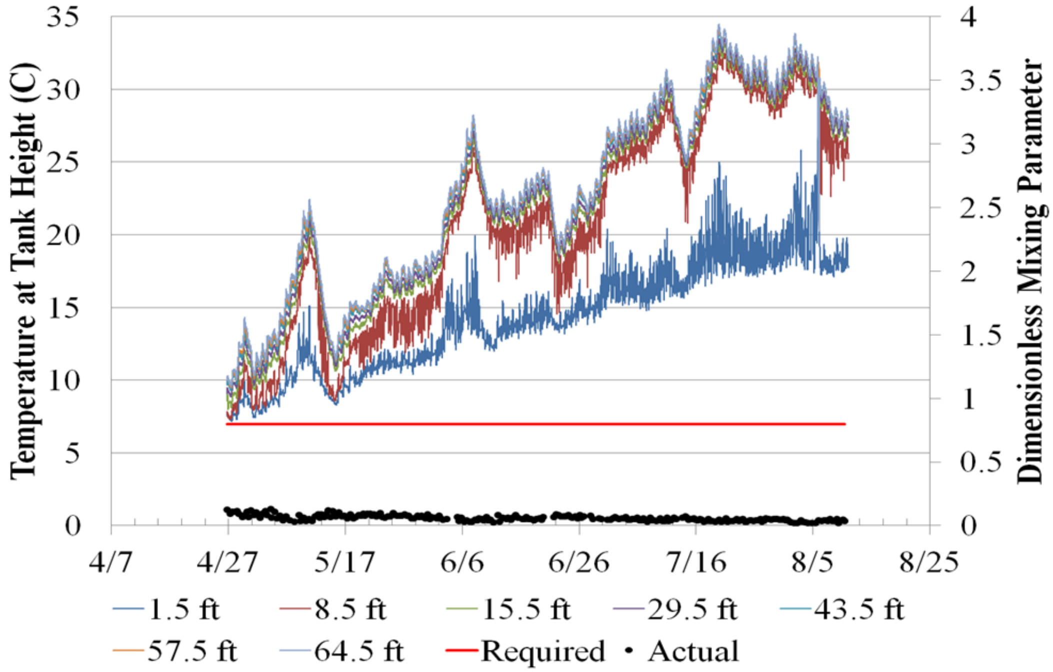

Figure 4.15: Long term tank D dimensionless mixing parameter.

4.2.3 Long Term Tank E

The temperature profile for tank E is shown in Figure 4.16. Sampling events and the period that the tank was overflowed are indicated in Figure 4.16. During the early part of the study the temperature cool and the tank showed little stratification. As the temperature increased stratification became more apparent. Between 8.5 feet and 22.5 feet above the tank bottom, a temperature difference of around 8 degrees Celsius was observed at times. The effect of stratification on water quality was observed by collecting samples from varying depths of the tank and analyzing the samples for water quality parameters. Figure 4.17 shows an example of the water quality parameters analyzed.

The chlorine residual dropped considerably between 8.5 feet and 22.5 feet above the tank bottom. At 8.5 feet, the chlorine residual was 1.58 mg/L, while the chlorine

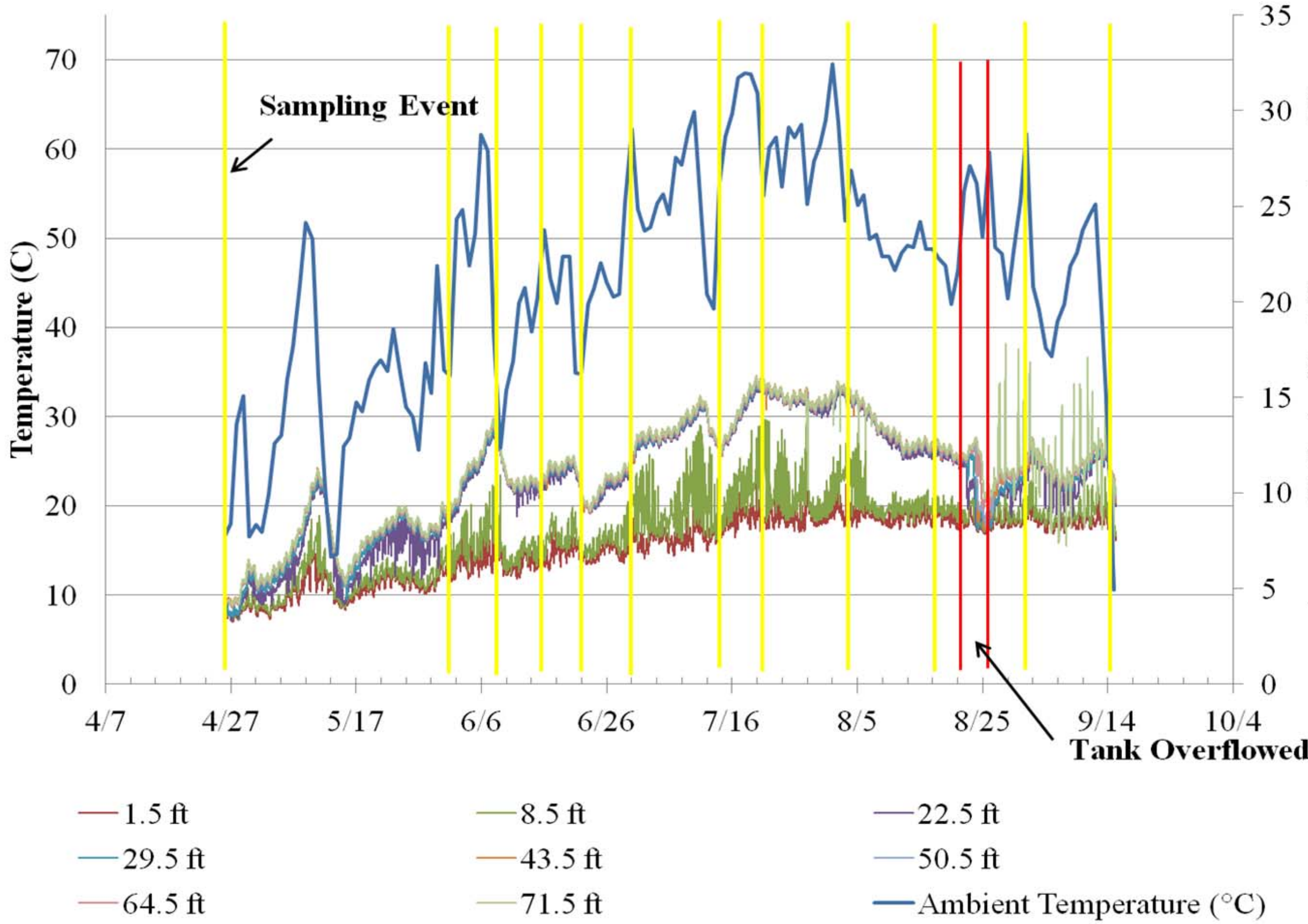

Figure 4.16: Long term tank E temperature profile with sampling events and period of tank overflow shown.

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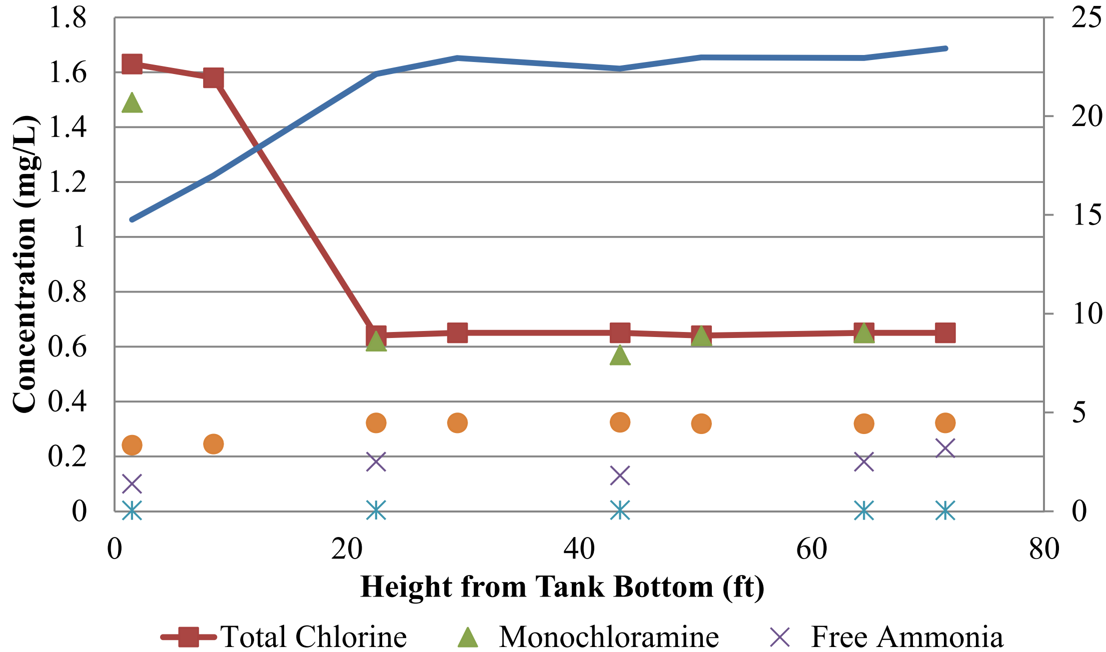

Figure 4.17: Long term tank E water quality parameters on June 16.

residual dropped to 0.64 mg/L at 22.5 feet. The temperature in the upper zone was about 6 degrees Celsius greater than the bottom zone. Stratification occurred in both temperature and water quality.

Figure 4.18 shows the water quality parameters throughout the study above the thermocline. On August 18, the low chlorine residuals measured in the upper portion of the tank caused the water system to overflow the tank in order to establish proper chlorine residuals.

Overflowing the tank restored a greater chlorine residual in the upper portion of the tank. The water system was worried about nitrification with the low chlorine residual before overflowing the tank. Figure 4.18 does show signs of nitrification in the tank before the tank was overflowed. The free ammonia was oxidized into nitrite between the sample events of August 4 and August 18. Nitrite increased from 0.009 mg/L as N to 0.38 mg/L as N. Oxidation to nitrate did not occur before the tank was overflowed and the chlorine residual was restored by the overflow event.

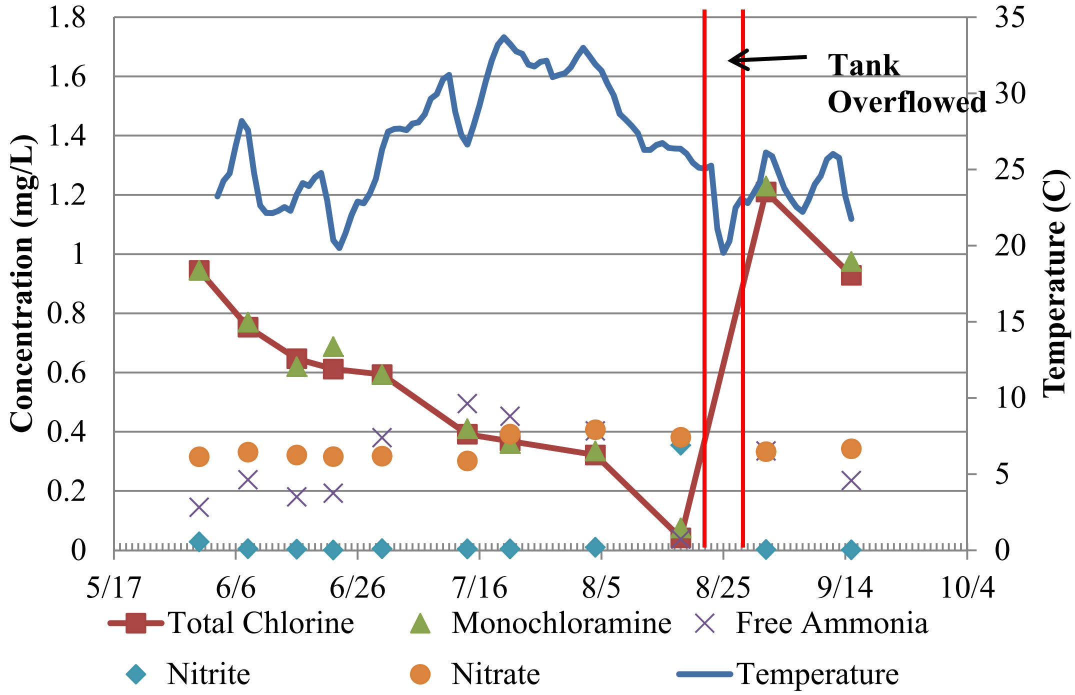

Figure 4.18: Long term tank E water quality parameters throughout study.

Figure 4.19 shows the water quality data on the first sampling event after the water system overflowed the tank. The chlorine residual was restored to a proper level; however, the tank indicated stratification. A difference in chlorine residual occurred between the 8.5 foot sampling point (1.72 mg/L) and the 15.5 foot sampling point (1.2 mg/L). The nitrite concentration went from an average of 0.38 mg/L as N before the tank was overflowed to an average of 0.002 mg/L as N.

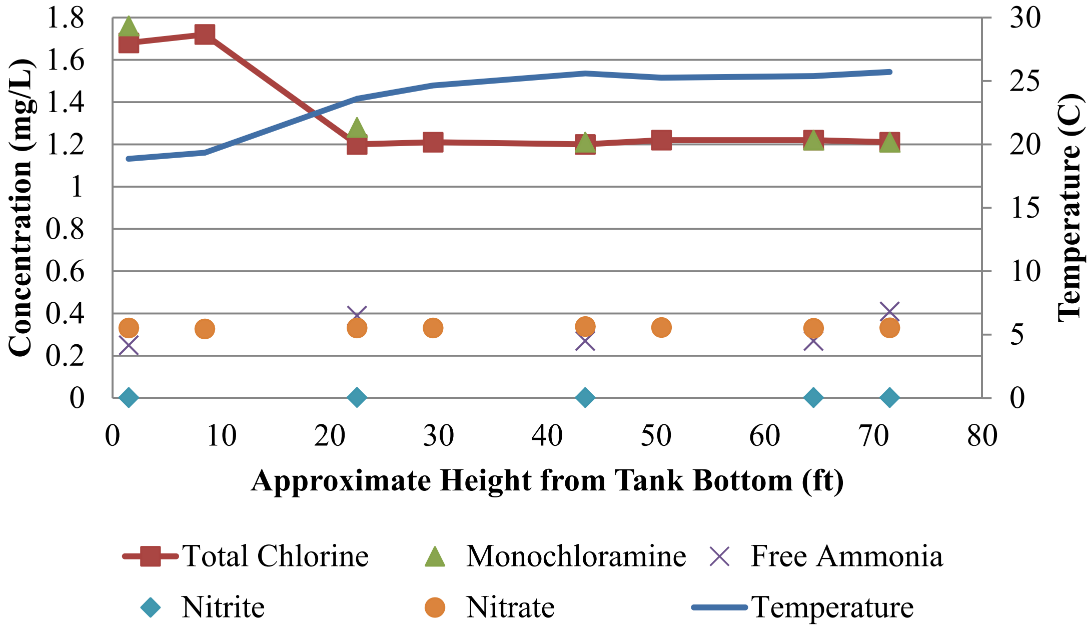

Figure 4.19: Long term tank E water quality data on sampling event after tank was overflowed.

The temperature profile after the tank was overflowed is shown in Figure 4.20. Overflowing the tank caused the warmer water in the upper portion to be released from the tank and replaced with the cooler water that was filling the tank. During the overflow, the temperatures were not stratified. However, after the overflow was done the temperatures started to stratify again.

Figure 4.21 shows the temperature profile along with the water depth in the tank. At the beginning of the temperature profile, the temperature at 22.5 feet showed that the fill and draw cycles influenced the temperature. As the temperature increased, the 22.5 foot temperature was less influenced; however, the temperature at 8.5 feet became more influenced by the fill and draw cycles. The temperature would increase during the draw cycle as warm water lowered in the tank and then the temperature would decrease during the fill cycle when the colder influent water entered the tank.

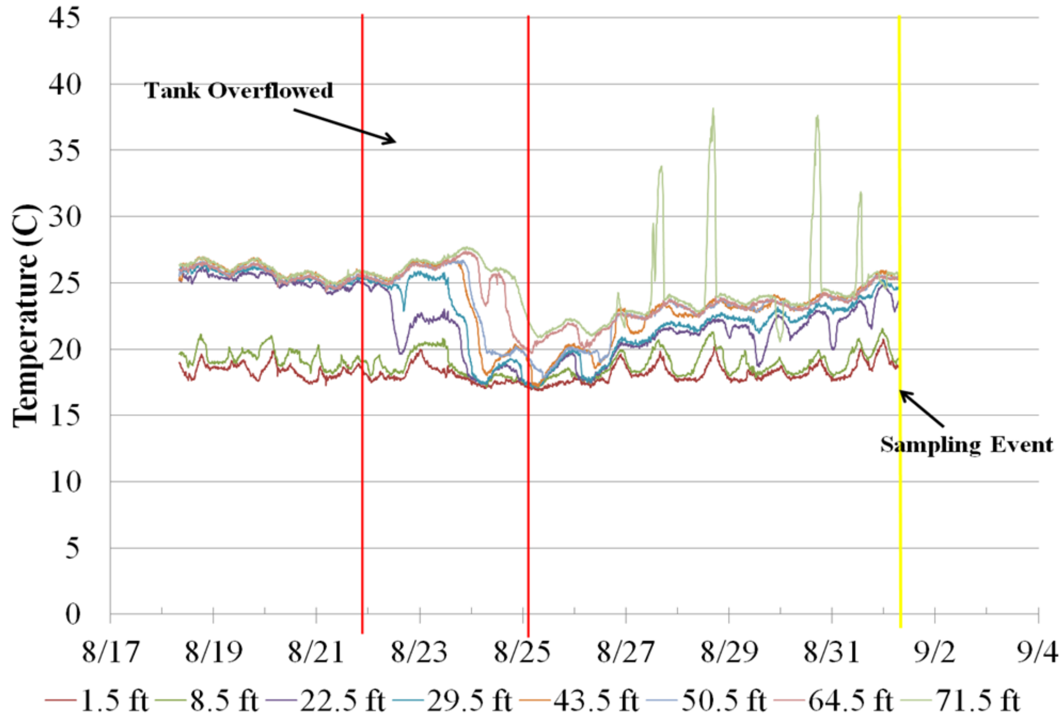

Figure 4.20: Long term tank E temperature profile after tank was overflowed.

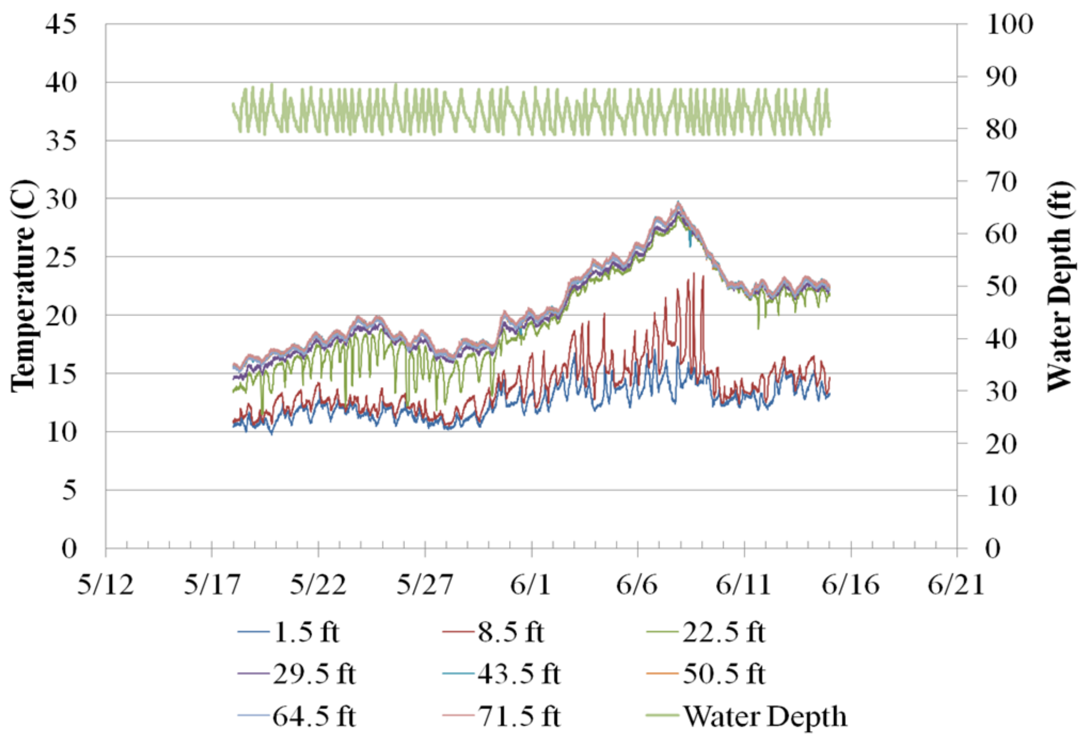

Figure 4.21: Long term tank E temperature profile with water depth.

The densimetric Froude number, volumetric exchange, and dimensionless mixing parameter were calculated and are shown in Figure 4.22, Figure 4.23, and Figure 4.24 respectively. Each of the three hydraulic parameters shows that the tank should not be mixed. Therefore, the hydraulic parameters agree with how the temperature and water quality behaved within the tank.

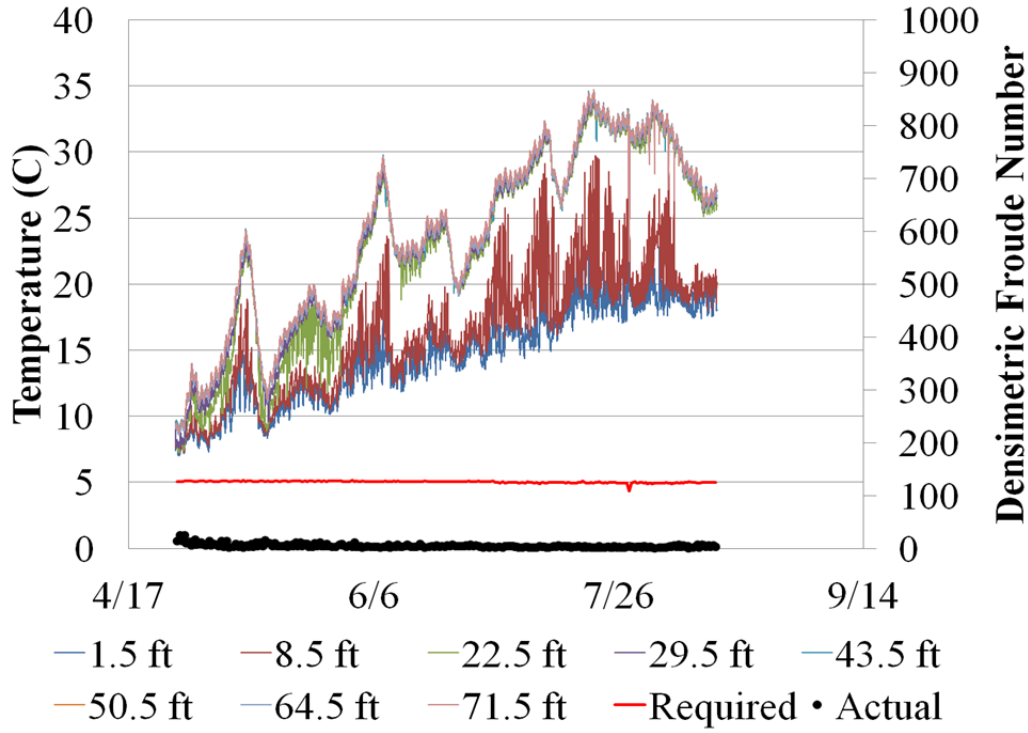

Figure 4.22: Long term tank E densimetric Froude number.

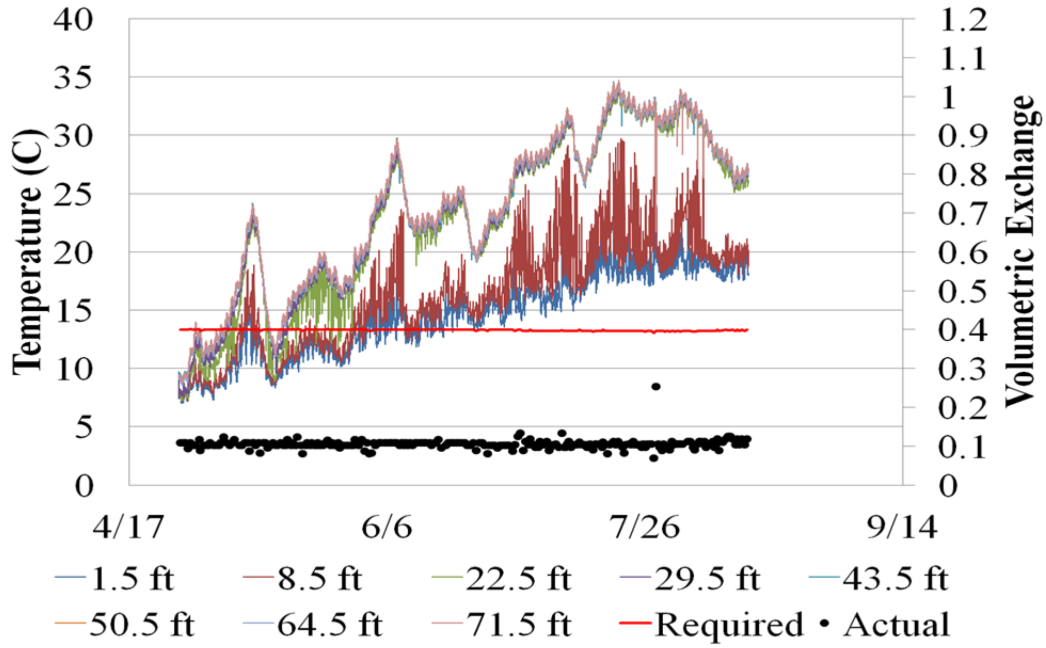

Figure 4.23: Long term tank E volumetric exchange.

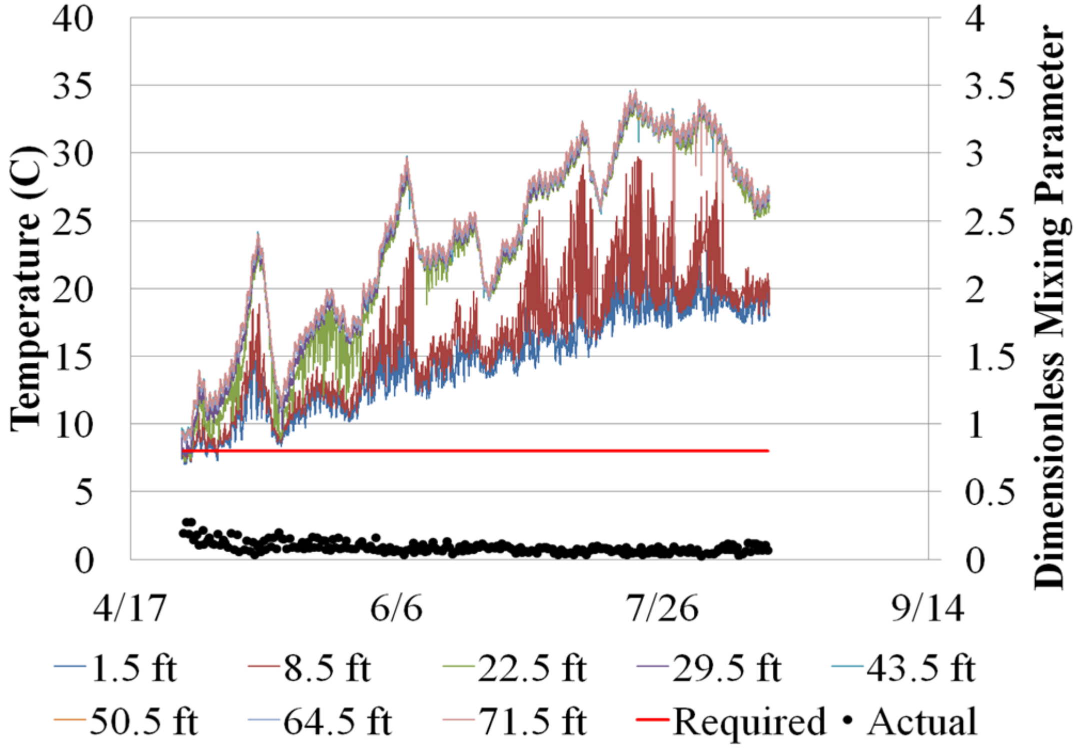

Figure 4.24: Long term tank E dimensionless mixing parameter.

4.2.4 Long Term Tank F

Figure 4.25 shows a temperature profile along with the sampling events of long term tank F. The temperature profile shows that the tank was stratified between 15.75 feet and 22.75 feet above the tank bottom. However, the temperature at 22.75 feet was influenced by the fill and draw cycles at times. Figure 4.26 shows the relationship between the temperature and the fill and draw cycle. Filling the tank caused the upper temperature to decrease in temperature, while the temperature increased during the draw cycle.

Stratification in the temperature had an effect on the water quality in the tank. An example of the water quality data is shown in Figure 4.27. A drop in the chlorine residual occurred between the lower zone of the tank and the upper zone of the tank. In the lower zone, the chlorine residual was around 1.8 mg/L, while the upper zone's chlorine residual was around 0.7 mg/L. The temperature difference was close to 10 degrees Celsius. Both the temperature and the water quality showed stratification during the tank visit.

At times during the study, the temperature at 22.75 feet was influenced by the fill and draw cycles. Figure 4.28 shows that the water quality was affected during the periods of influence. The chlorine residual was constant throughout the tank at around 1.9 mg/L, while the temperature also remained constant around 16 degrees Celsius. Figure 4.25 shows that the periods that the temperature at 22.75 ft. was influenced by the fill and draw cycles, coinciding with ambient temperatures around 20 degrees Celsius or lower.

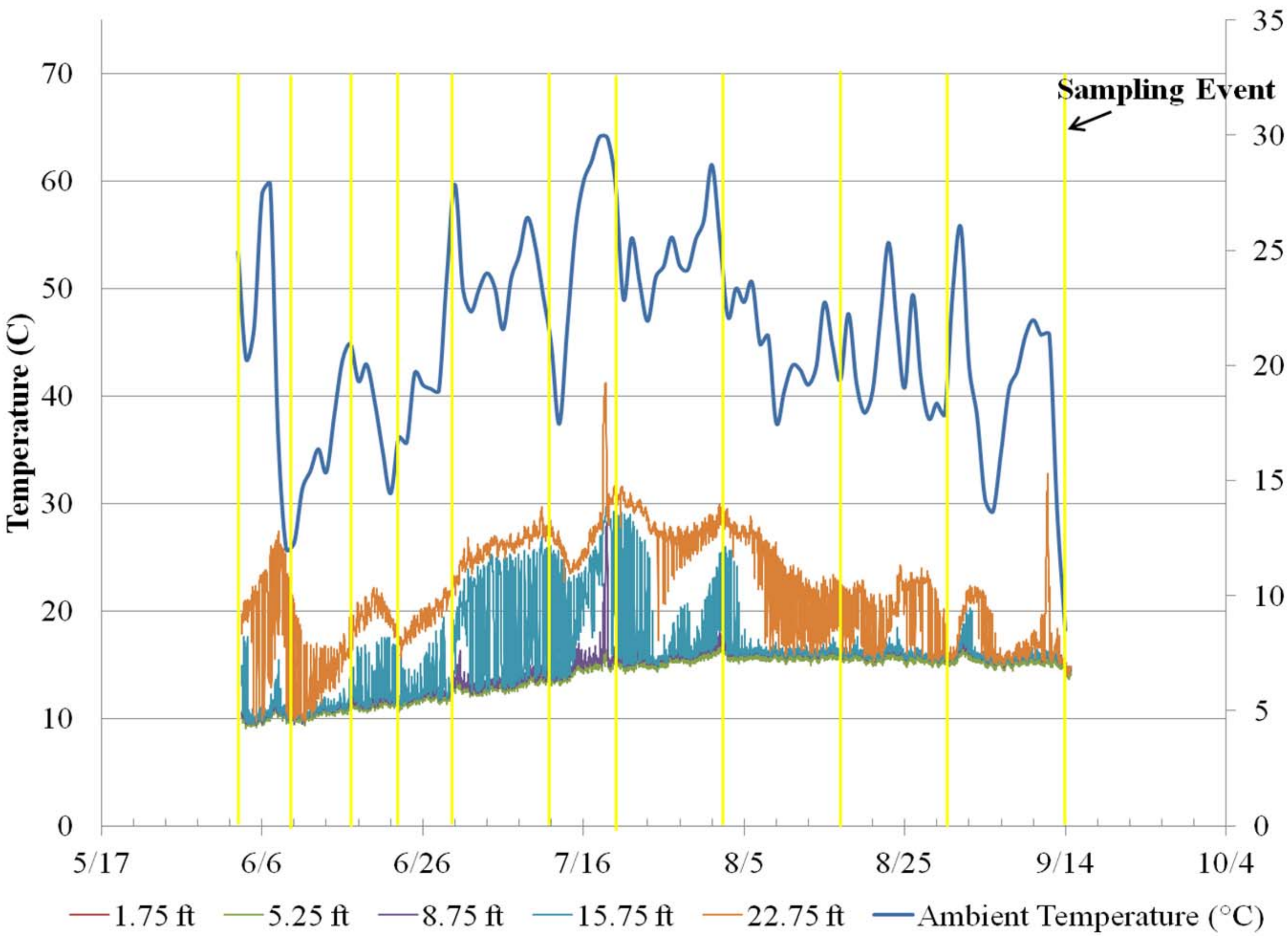

Figure 4.25: Long term tank F temperature profile.

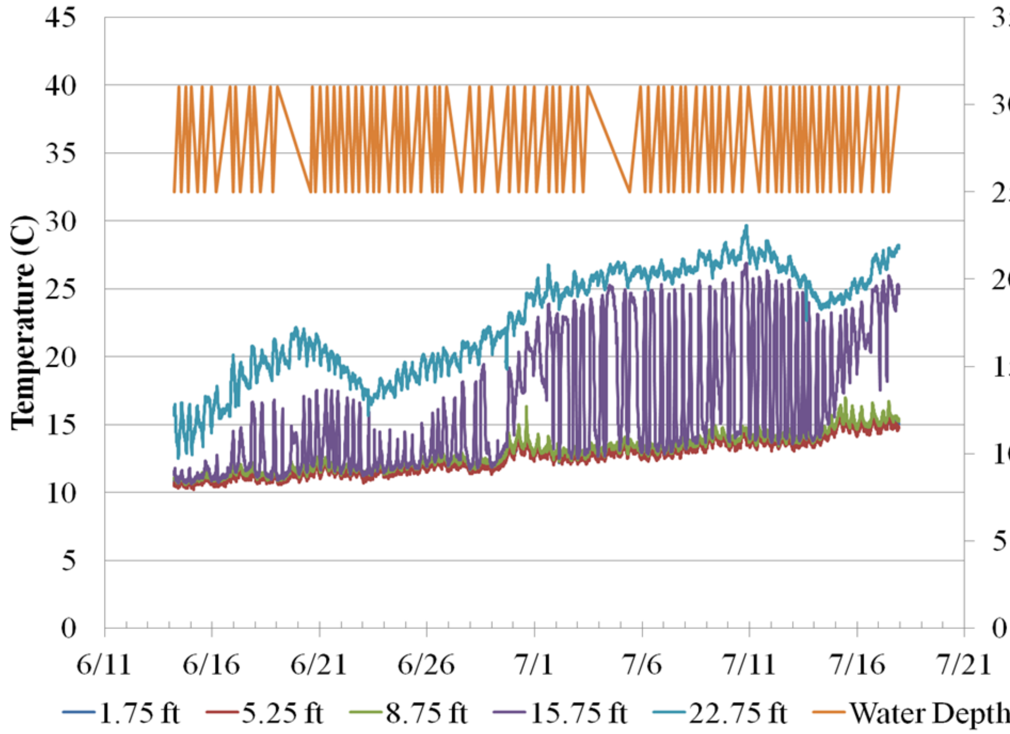

Figure 4.26: Long term tank F temperature profile and water depth.

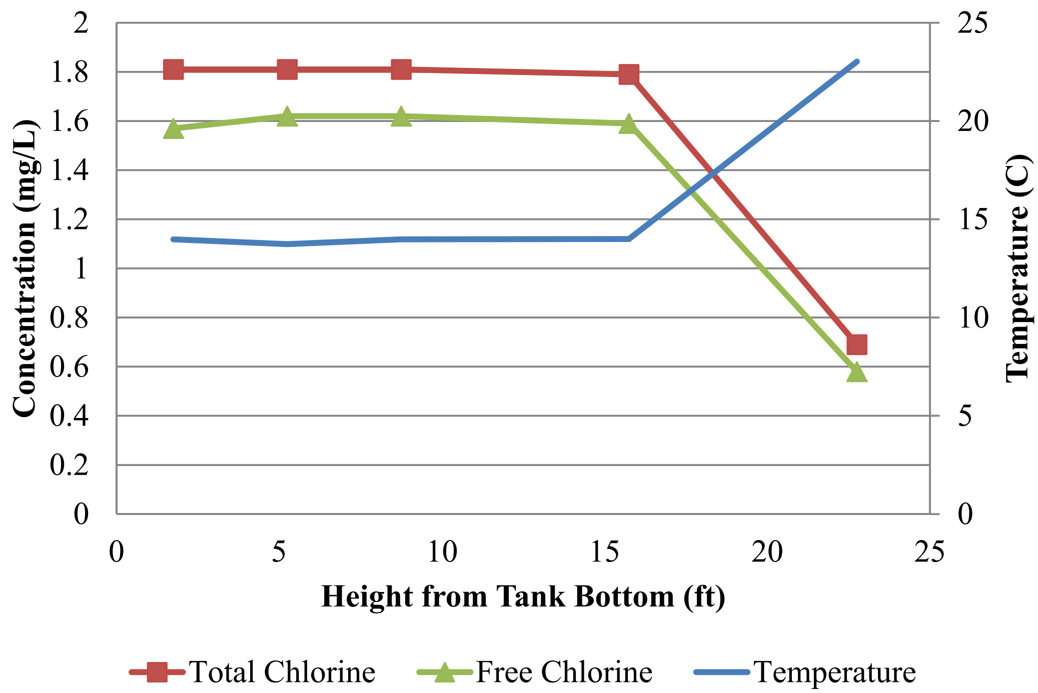

Figure 4.27: Long term tank F water quality data on July 13.

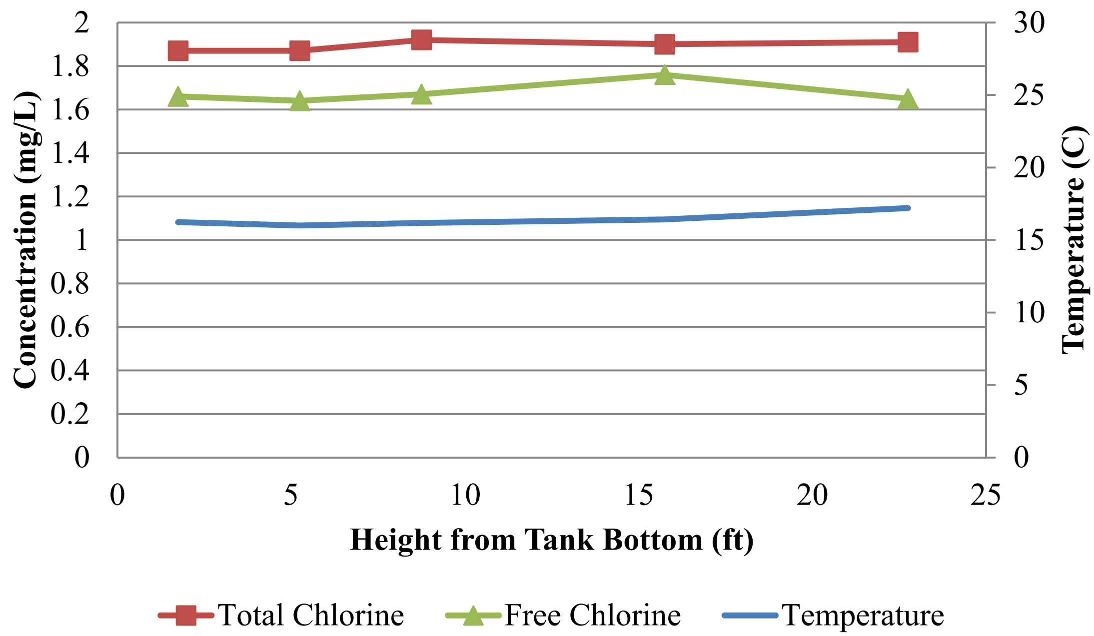

Figure 4.28: Long term tank F water quality data on August 31.

Three hydraulic parameters were calculated to show the tank's expected behavior. Figure 4.29, Figure 4.30, and Figure 4.31 show the densimetric Froude number, volumetric exchange, and dimensionless mixing parameter calculated respectively. The densimetric Froude number and the dimensionless mixing parameter show that the tank should not be mixed, which agrees with the temperature profile during the same period. The actual volumetric exchanges calculated in Figure 4.30 did not vary because the fill and draw cycles do not change. According to the volumetric exchange calculations, the tank should be mixed; however, the temperature profile does not agree during the period analyzed. The calculations used to calculate the hydraulic parameters are presented in Appendix A.

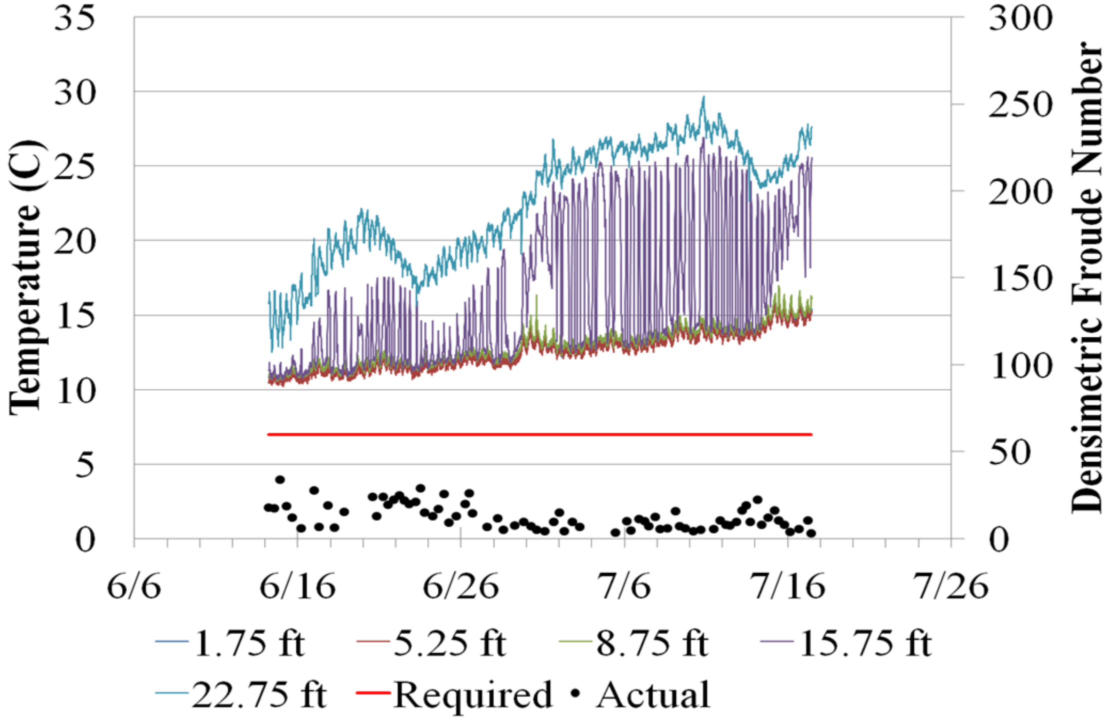

Figure 4.29: Long term tank F densimetric Froude number.

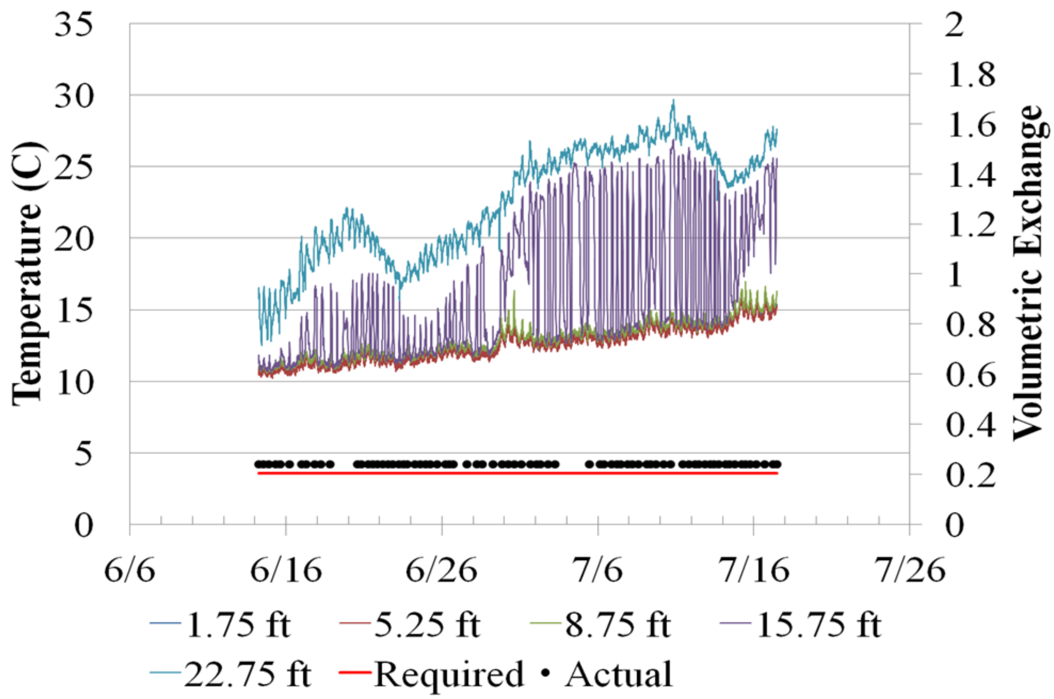

Figure 4.30: Long term tank F volumetric exchange.

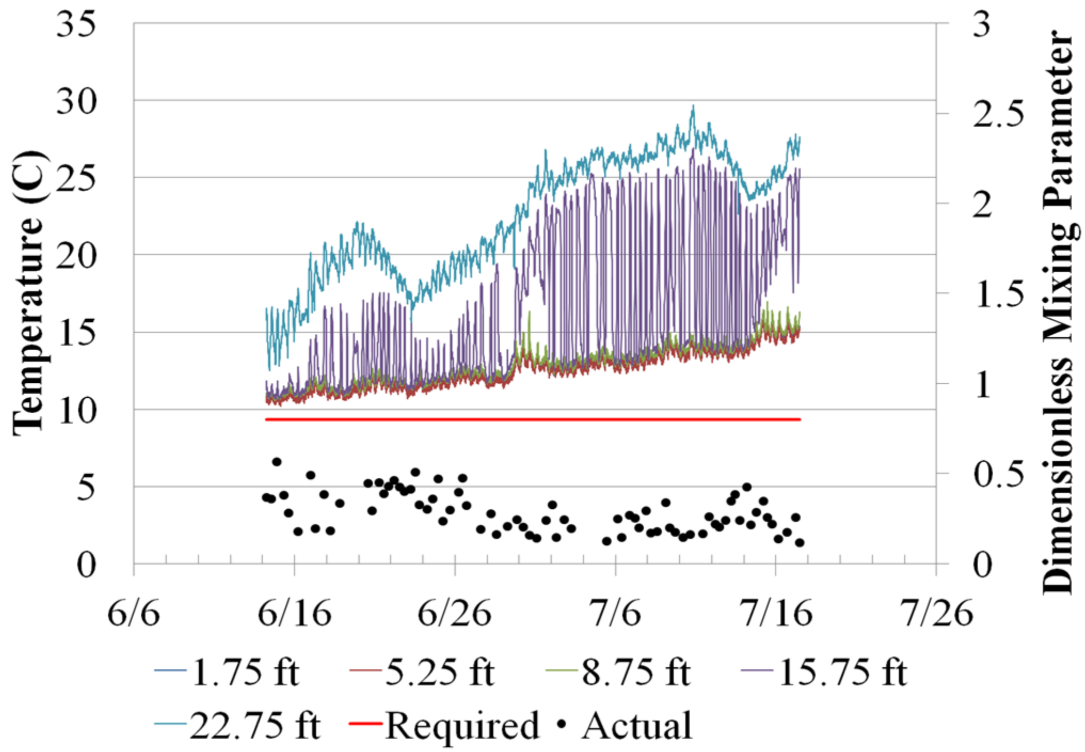

Figure 4.31: Long term tank F dimensionless mixing parameter.

4.2.5 Long Term Tank G

Figure 4.32 shows the temperature profile along with the time of the sampling events for long term Tank G. Throughout the study, tank G did not stratify in terms of temperature as shown in Figure 4.32. The temperatures throughout the tank remained steady around 15 degrees Celsius even with the changing ambient temperature, which shows that the temperature of the tank volume does not significantly depend on the ambient temperature outside of the tank.

Samples were collected and analyzed for total and free chlorine. Figure 4.33 shows an example of the data from the tests performed on July 14. Total chlorine residuals along with the free chlorine residuals were steady throughout the tank depth. At the bottom of the tank the total chlorine residual was 0.96 mg/L and the free chlorine residual was 0.86 mg/L. In the top of the tank, the total chlorine residual was 0.93 mg/L and the free chlorine residual was 0.90 mg/L. Both the temperature data and the water quality data show that tank G did not stratify.

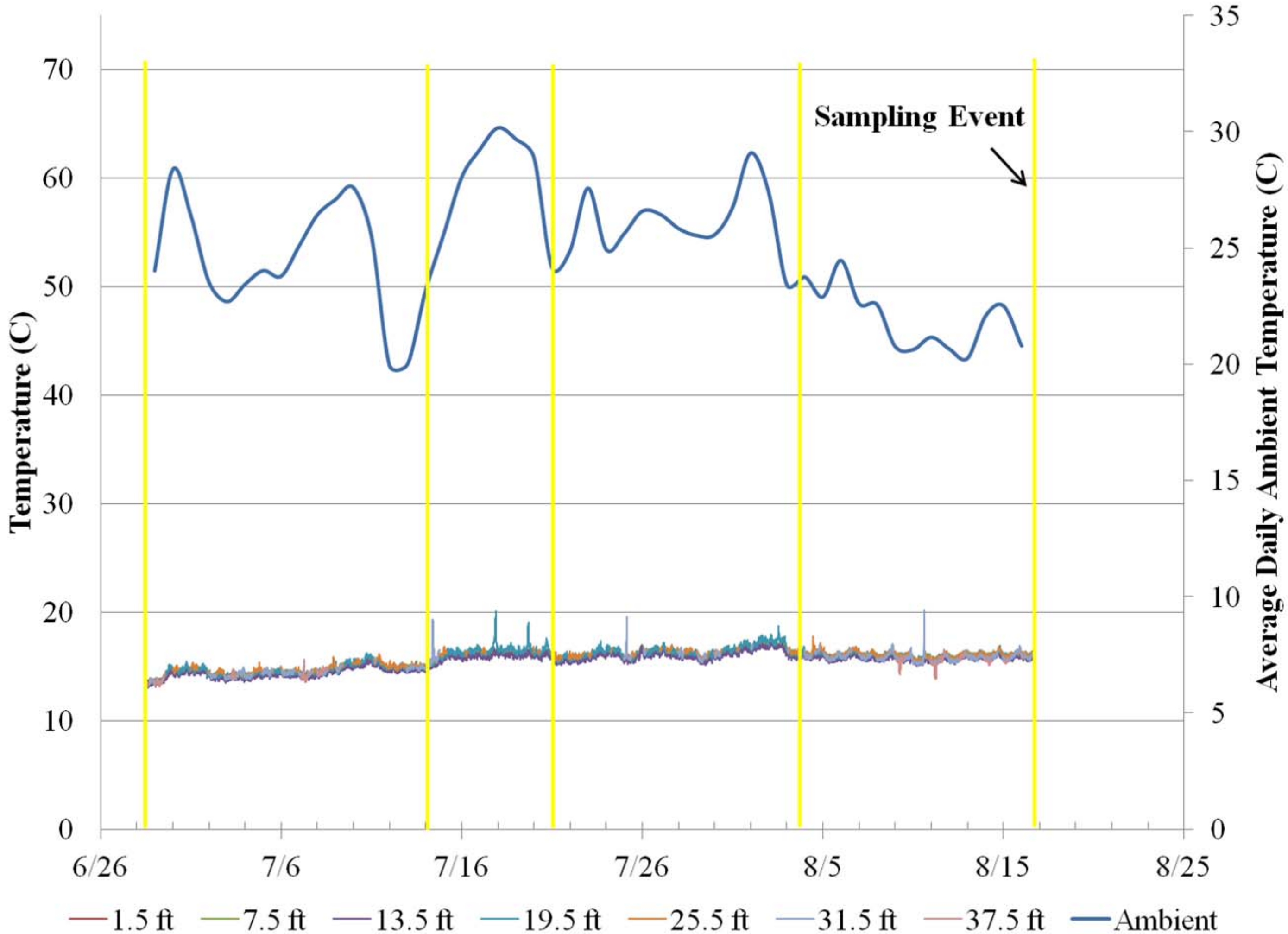

Figure 4.32: Long term tank G temperature profile and sampling events.

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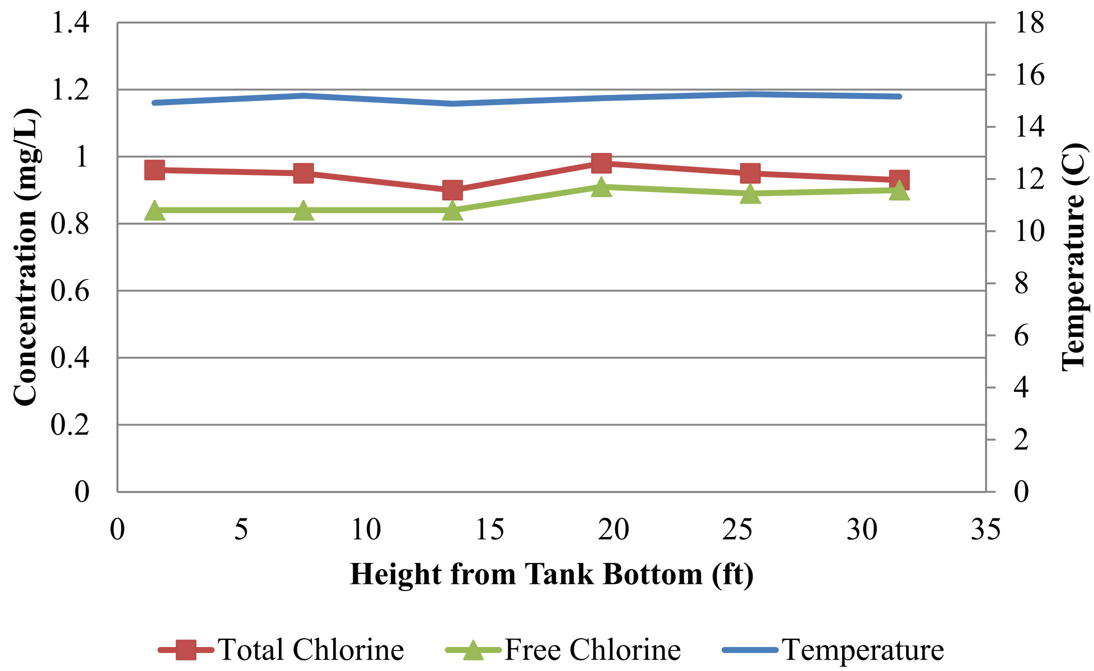

Figure 4.33: Long term tank G water quality parameters on July 14.

Hydraulic parameters were calculated to show the expected behavior of the tank. The densimetric Froude number, the volumetric exchange, and the dimensionless mixing parameter that were calculated are shown in Figure 4.34, Figure 4.35, and Figure 4.36 respectively. Both the densimetric Froude number and the dimensionless mixing parameter show that the tank operation did not meet the required values except in a few occasions, which does not agree with the temperature data and the water quality data. The volumetric exchanged shows mixed results as well; however, the volumetric exchange meets the required value more often than the other two parameters.

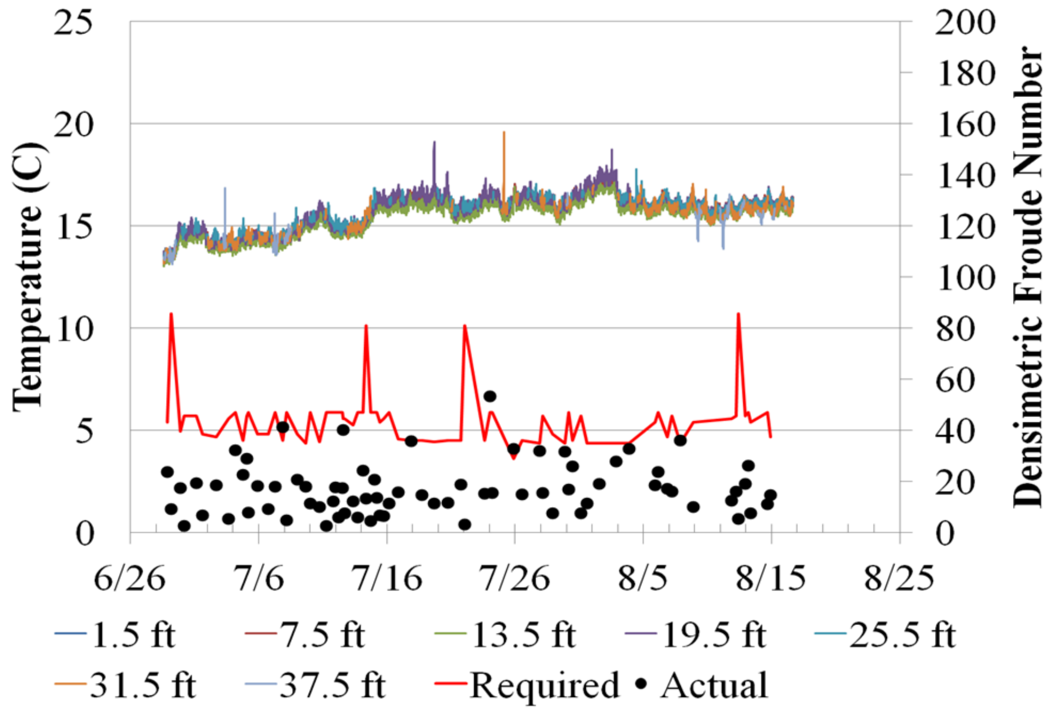

Figure 4.34: Long term tank G densimetric Froude number.

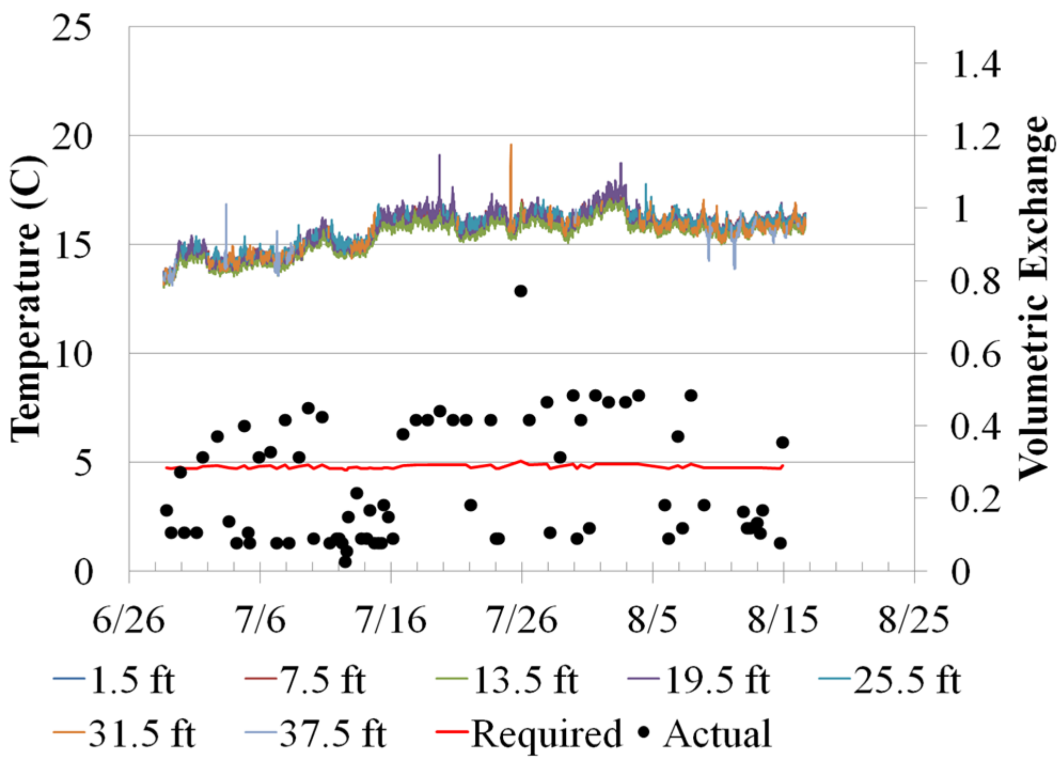

Figure 4.35: Long term tank G volumetric exchange.

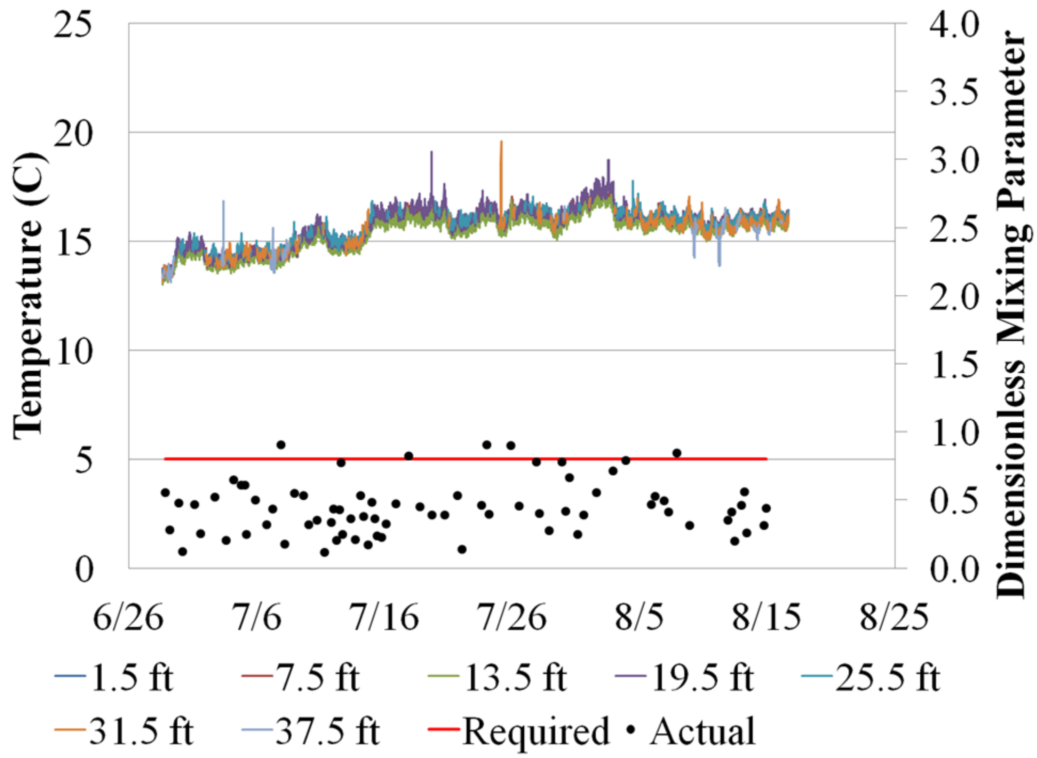

Figure 4.36: Long term tank G dimensionless mixing parameter.

4.2.6 Total Coliform

Samples were collected throughout the study on the long term tanks to perform the test for total coliform. Drinking water is regulated by the Total Coliform Rule, which states that 95% of the samples should contain 0 cfu/ml. Throughout the study, the results of the total coliform test were that there were no coliforms present. Therefore, the tanks followed the total coliform rule.

4.2.7 Heterotrophic Plate Count (HPC)

The samples that were collected for the total coliform test were also analyzed for heterotrophic plate count. Table 4.1 and Table 4.2 show the results of the HPC tests during the study. Results from long term tank C, D, and E are shown in Table 4.1. Tank D and E both have a HPC test that resulted in values significantly greater than the other tests. Both tests were conducted on June 16, which could have been caused by contamination of the medium used during the test. Tanks F and G also have a similar error as shown in Table 4.2. The tests were performed on consecutive days and used the same media, so contamination could explain the higher results. The rest of the samples showed low HPC results, which indicates low heterotrophic microbial growth.

Table 4.1: Heterotrophic plate count results for long term tanks C, D, and E.

Heterotrophic Plate Count (MPN/ml) for Tanks F and G																
	6/3	6/9	6/17	6/23	6/28	6/29	7/13	7/14	7/20	7/21	8/3	8/4	8/16	8/17	8/31	9/14
Long Term Tank F	2	2.8	4.2	0	--	272	22.2	--	0.4	--	0	--	--	0	0.7	1.3
Long Term Tank G	--	--	--	--	276	--	--	15	--	1.7	--	0	1	--	--	--

Table 4.2: Heterotrophic plate count results for long term tanks F and G.

Heterotrophic Plate Count (MPN/ml) for Tanks C , D, and E											
	5/31	6/8	6/16	6/22	6/30	7/14	7/21	8/4	8/18	9/1	9/15
Long Term Tank C:	1.3	0	1.3	0	12.5	13.5	3.3	0	0	0	0
Long Term Tank D: Below Thermocline	0	0	161	4	6	10	0	0	2	0	0
Long Term Tank D: Above Thermocline	1.2	0.4	91	0	2	15.8	4	1.6	2.4	1.6	0.8
Long Term Tank E: Below Thermocline	1	2	124	0	6	0	0	0	0	0	0
Long Term Tank E: Above Thermocline	2	1.6	92.4	0	2	3.6	4	1.2	2.4	0	0.4

Long term tank E indicated the occurrence of nitrification; therefore, the water in the tank contained nitrifying organisms.

4.3 Short Term Tank Study

Short term tanks were analyzed for temperatures at varying depths throughout the tank. Temperature data was collected for a shorter period of time compared to the long term tanks, and the temperature data was gathered using separate temperature sensors at each depth of the tank. A pressure sensor was used to calculate the water depth in the tank during the study, which was used to calculate the hydraulic parameters. Both short term tanks had a passive mixing system installed.

4.3.1 Short Term Tank 4

Figure 4.37 shows the temperature profile of short term tank 4. Stratification did not occur throughout the study period. Temperatures throughout the tank remained relatively constant. The effect of the ambient temperature on the temperature of the water in the tank is also shown in Figure 4.37. Change in the ambient temperature correlates with the change in the temperature of the water in the tank. Occasionally, the upper two temperature sensors would show little separation from the other temperature sensors. Figure 4.38 shows the temperature profile compared with the water elevation in the tank. The fill and draw cycles do not affect the temperatures in the tank. The change in temperature observed on Figure 4.38 is due to daily cycle of ambient temperature. The temperature increases during the day and then decreases during the night.

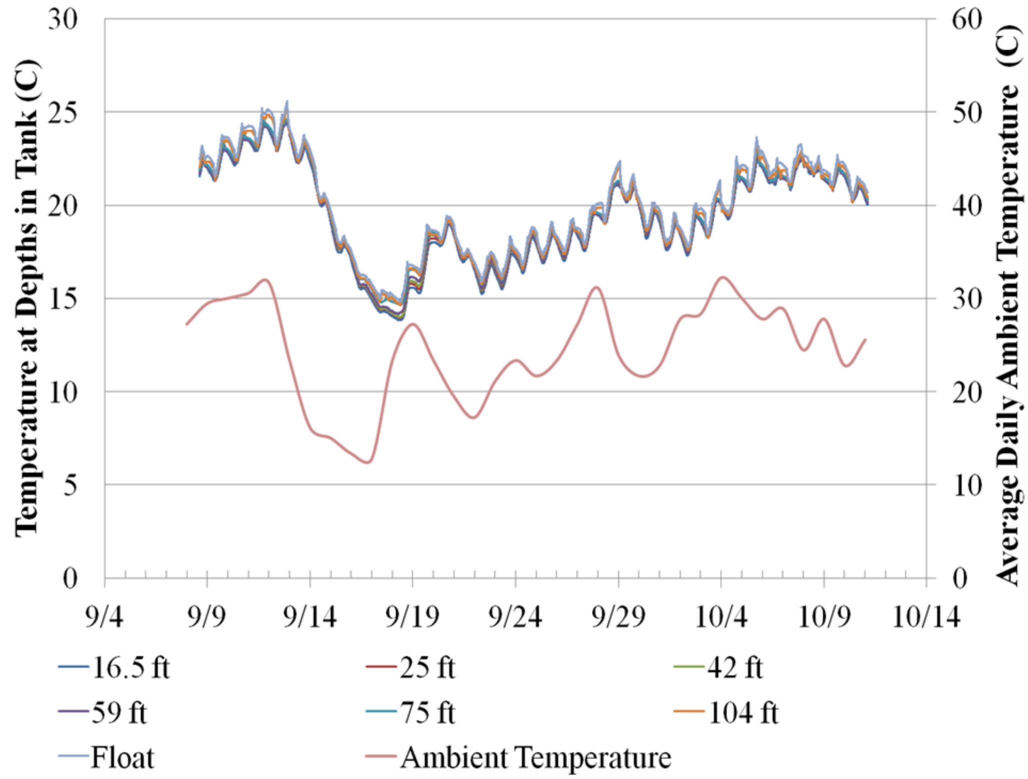

Figure 4.37: Short term tank 4 temperature profile.

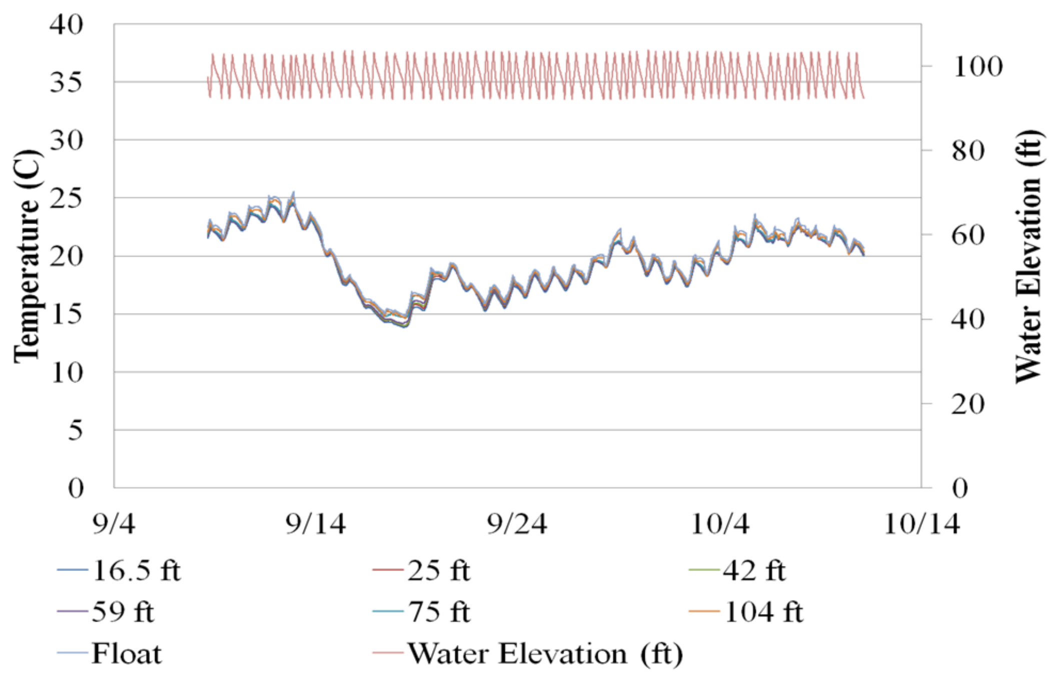

Figure 4.38: Short term tank 4 temperature profile and water elevations.

Short term tank 4 was also studied in a previous study in which the passive mixing system was not installed (Olson, 2011). Comparing the data from the two studies can illustrate the impact of the passive mixing system. Figure 4.39 shows the temperature profile from the study performed by Olson. Figure 4.40 shows a portion of the temperature profile from the current study that shows similar temperatures in the tank (15-20 degrees Celsius). Stratification occurred when there was not a passive mixing system with a temperature difference up to around 8 degrees Celsius, while there was no stratification when the passive mixing system was installed. A passive mixing system helped in preventing stratification throughout the tank.

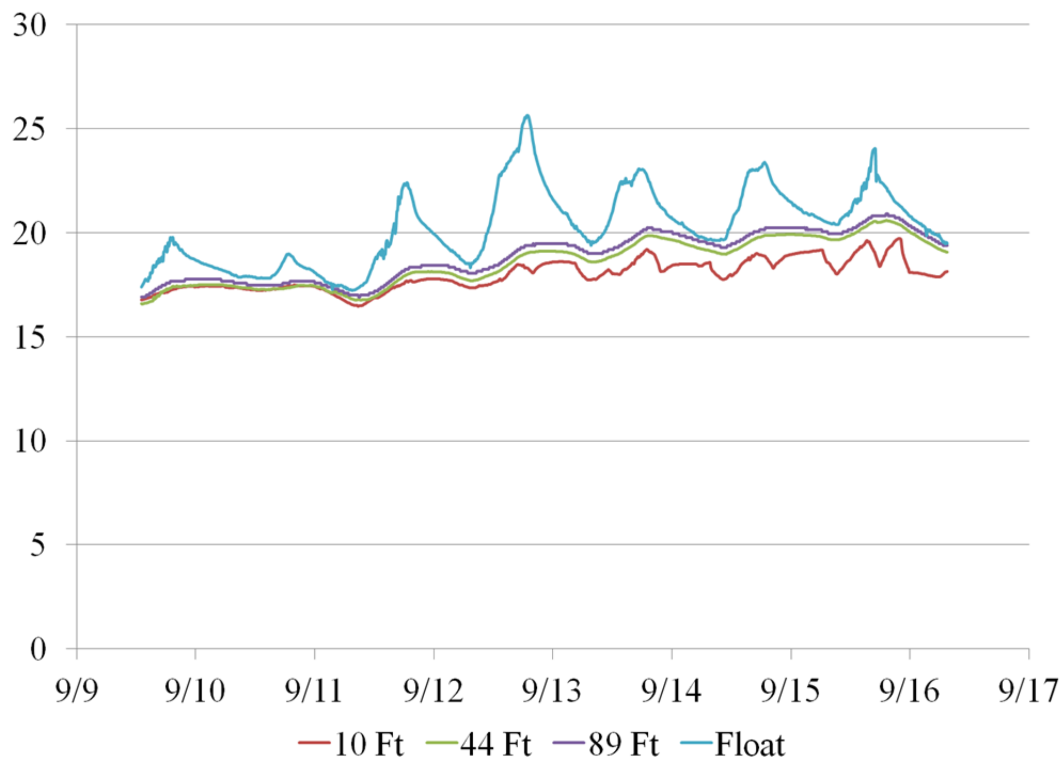

Figure 4.39: Short term tank 4 temperature profile without passive mixing system.

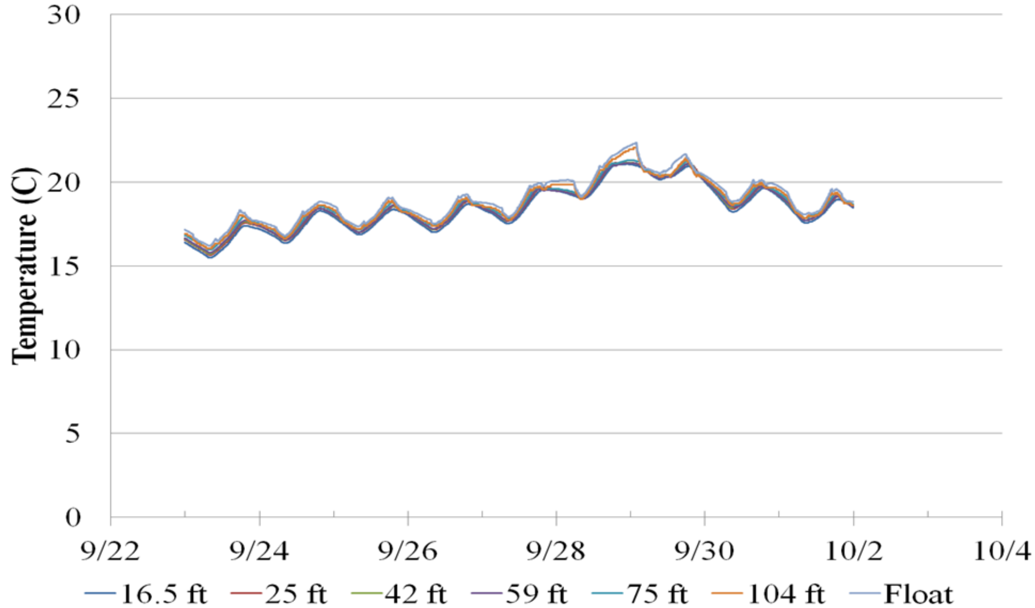

Figure 4.40: Short term tank 4 temperature profile with passive mixing system installed.

Hydraulic parameters were calculated using the height of the tank as the distance from the top of the inlet pipe to the top of the water elevation (38 ft.) since that is the height of water that required mixing (based on hydraulic considerations). The densimetric Froude number, the volumetric exchange, and the dimensionless mixing parameter calculated are shown in Figure 4.41, Figure 4.42, and Figure 4.43 respectivly. Both the densimetric Froude number and the dimensionless mixing parameter comparisons indicate the actual values obtained do not always meet the required value to promote mixing. The volumetric exchange shows that the required value usually doubles the required value, which may explain why the tank is not stratified during the times that the other hydraulic parameters show that the tank should be improperly mixed.

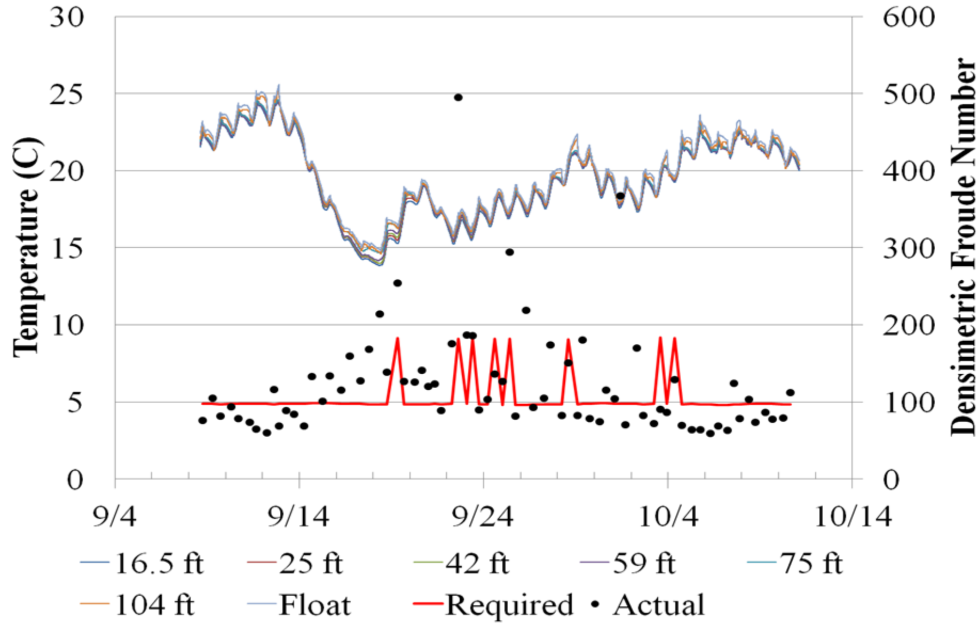

Figure 4.41: Short term tank 4 densimetric Froude number.

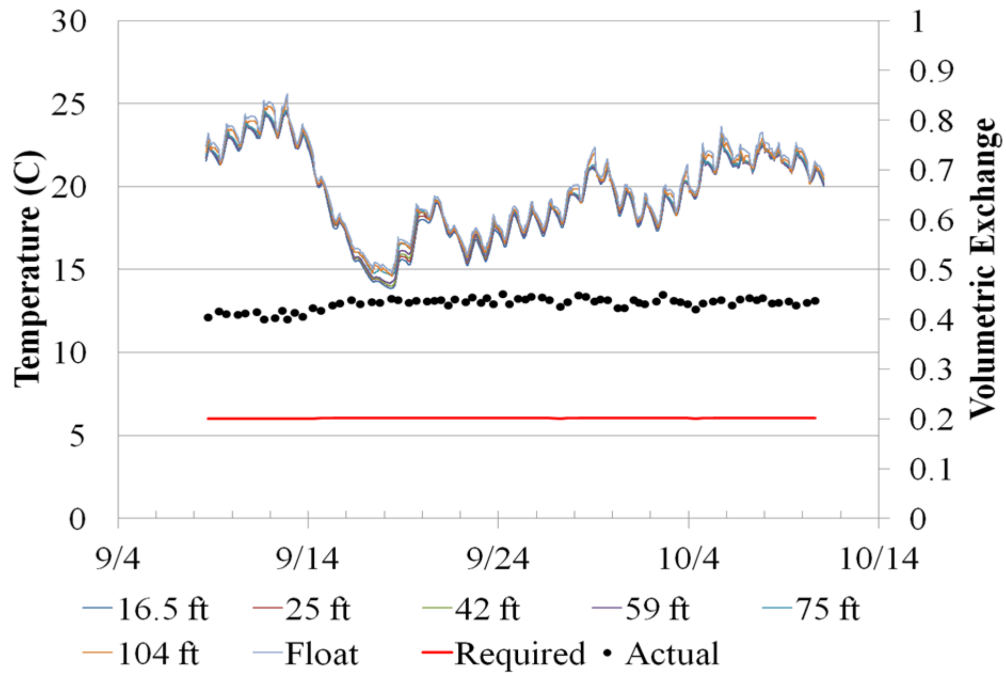

Figure 4.42: Short term tank 4 volumetric exchange.

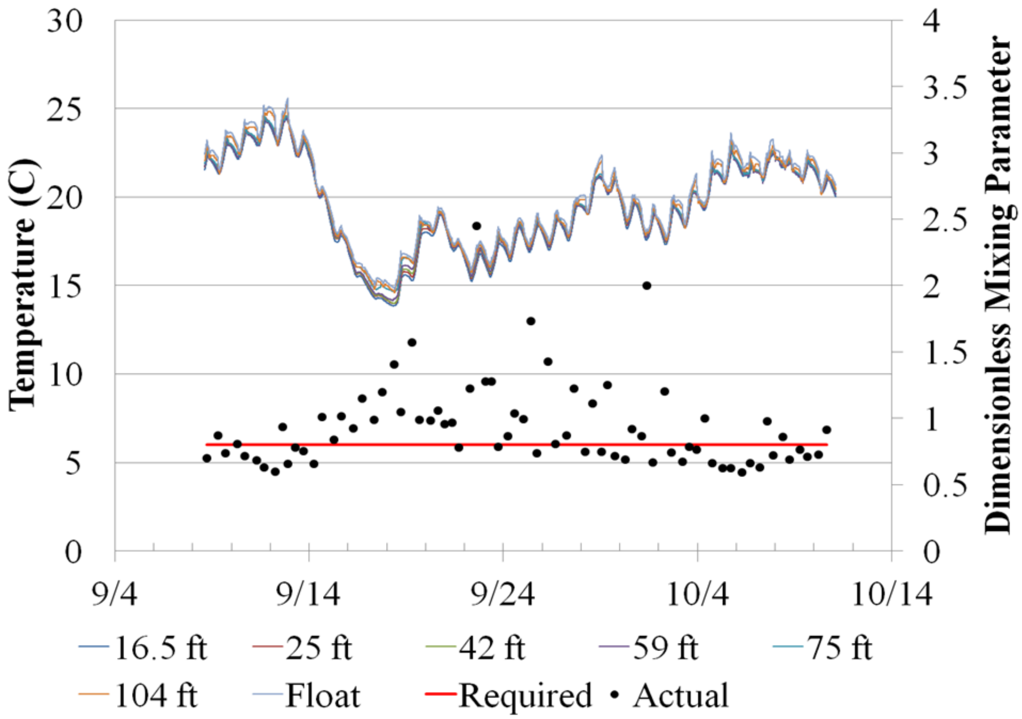

Figure 4.43: Short term tank 4 dimensionless mixing parameter.

4.3.2 Short Term Tank 9

Figure 4.44 shows the temperature profile for short term tank 9 during the study. In the first part of the study, stratification occurred; however, as the ambient temperature decreased, stratification no longer occurred throughout the tank. Figure 4.45 shows how the fill and draw cycle affected the temperature in the tank. During the period of stratification, the upper portion of the tank's temperature was affected by the fill and draw cycle. The temperature increased during the draw cycle as the warmer water lowered through the tank and then decreased during the fill cycle due to the cooler temperature of the influent water.

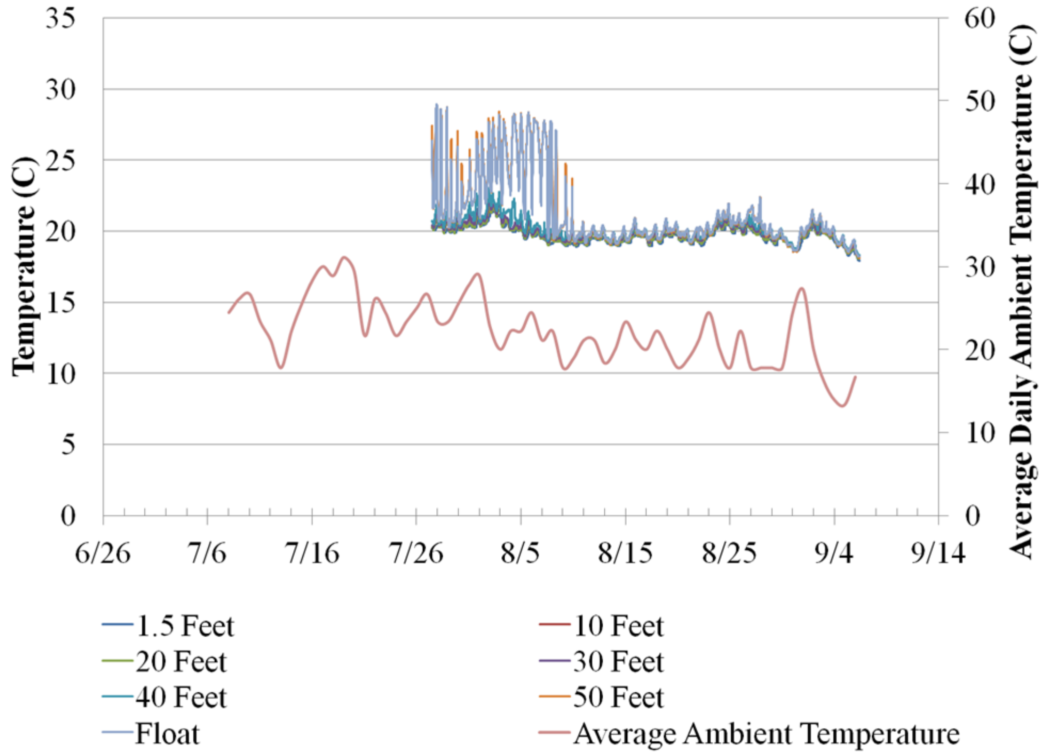

Figure 4.44: Short term tank 9 temperature profile.

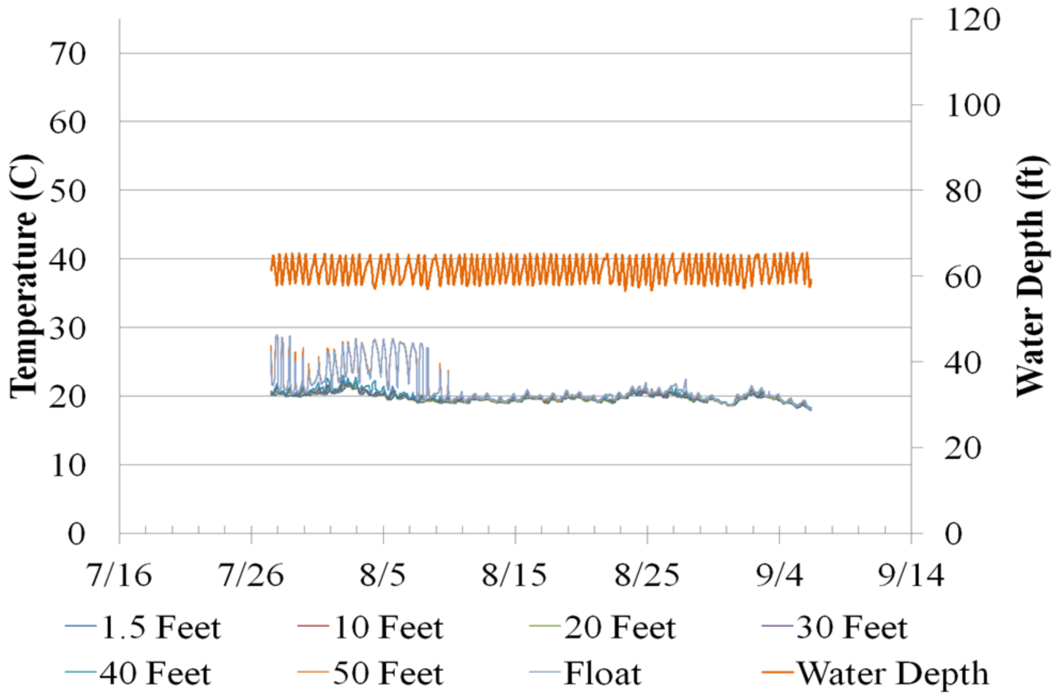

Figure 4.45: Short term tank 9 temperature profile and water elevation data.

The densimetric Froude number, volumetric exchange, and dimensionless mixing parameter were calculated for tank 9. Figure 4.46, Figure 4.47, and Figure 4.48 show the three hydraulic parameters respectively. Both the actual densimetric Froude number and the actual dimensionless mixing parameter surpassed the required value in only a few instances, while the actual volumetric exchange surpassed the required value consistently throughout the study. The volumetric exchange was a factor in influencing the temperatures during stratification and preventing stratification when the tank was not stratified.

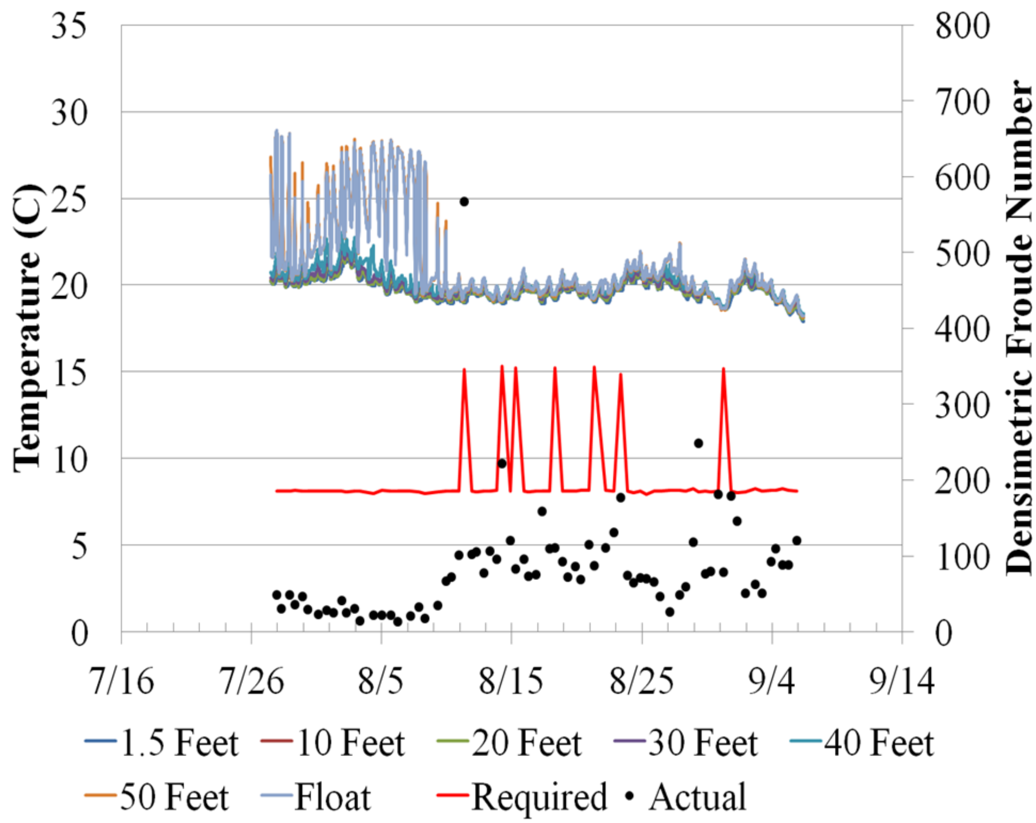

Figure 4.46: Short term tank 9 densimetric Froude number.

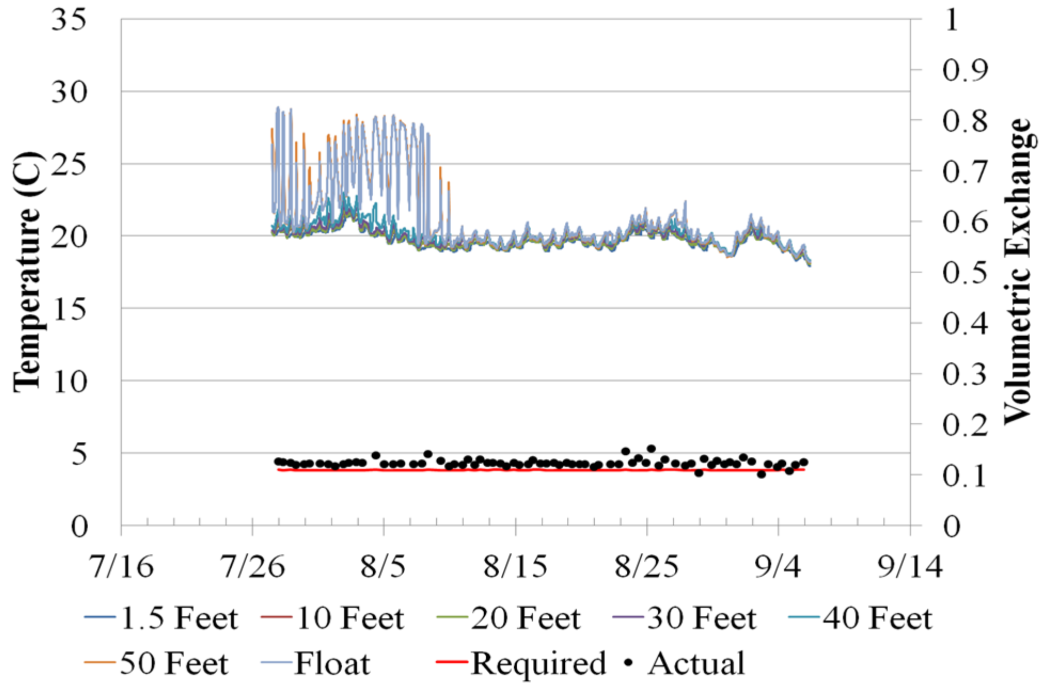

Figure 4.47: Short term tank 9 volumetric exchange.

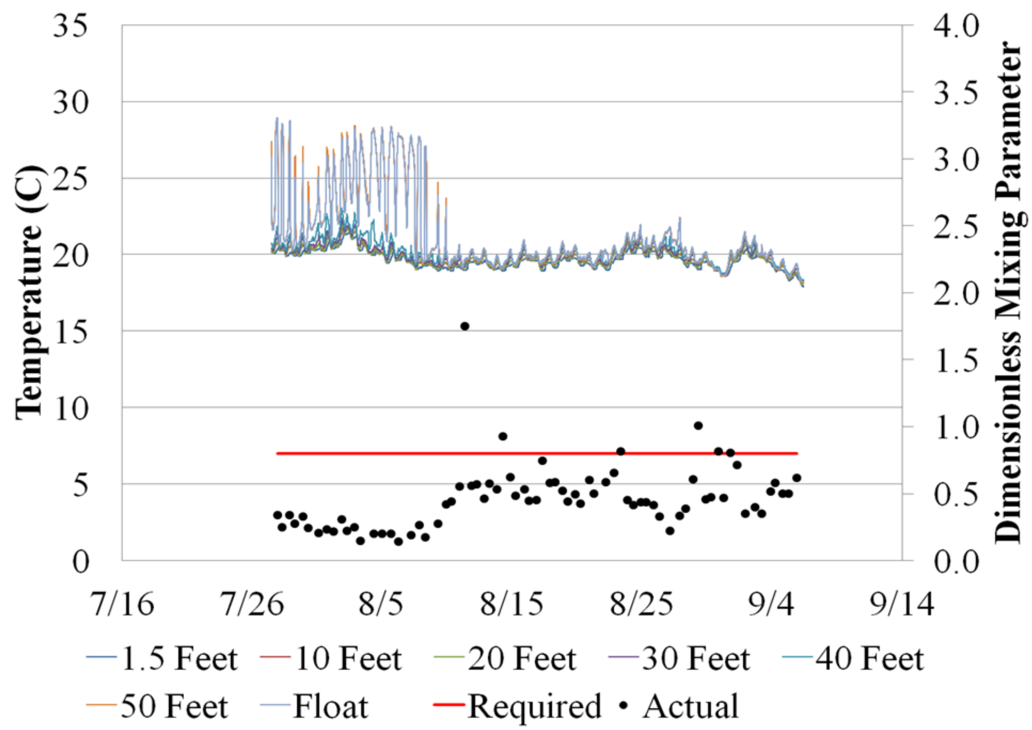

Figure 4.48: Short term tank 9 dimensionless mixing parameter.

4.4 Disenfectant Decay Modeling for Long Term Tanks D and E

A disinfectant decay model was created using the computer program CompTank. Parameters used were initial chlorine concentration, flow in and out of the tank, and the disinfectant decay coefficient. The model created was compared to data obtained from the sampling events in order to show whether the model represented the field conditions.

4.4.1 Disinfectant Decay Coefficient

A disinfectant decay coefficient was calculated between each sampling event using a simple first order equation. The calculated values were corrected to 20 degrees Celsius for comparison of values. An average decay coefficient was found and corrected for the average temperature of the dead zone in the tank during the study to use in the CompTank program. The data used for these calculations are in Appendix C.

4.4.2 Long Term Tank D

Long term tank D was modeled using a stratified 3-compartment model. The model was created for the time period of 4/26 to 8/10. Table 4.3 shows the inputs used for the CompTank program. The initial total chlorine concentrations are from the data obtained on the first site visit (4/26), while the inflow chlorine concentration was an average of the total chlorine concentrations at the bottom of the tank during the period. Inflow and outflow rates were calculated using the water elevation data from the water system. The volumes used for each zone were calculated based on the temperature profiles. The inlet zone was the volume below the 8.5 foot sampling point and the main zone was the volume between the 8.5 foot and 15.5 foot sampling point. The dead zone was the remaining volume in the tank.

Table 4.3: Inputs for the stratified long term tank D model.

Model Input	**Inlet Zone**	**Main Zone**	**Dead Zone**
Volume	0.02 Mgal	0.02 Mgal	0.12 Mgal
Initial total chlorine concentration	1.67 mg/L	1.44 mg/L	1.44 mg/L
Decay coefficient	0.018 d^{-1}	0.018 d^{-1}	0.018 d^{-1}
Average inflow rate	28.3 gpm		
Average outflow rate	27.6 gpm		
Inflow concentration	1.65 mg/L		
Flow rate between main and dead zone	0 gpm		
Flow rate between inlet and main zone	0 gpm		

The modeling results are shown in Figure 4.49 along with actual data measured throughout the time period. The modeled concentration in the dead zone declined throughout the time period. The actual data shows a decline as well. At certain points, the actual concentrations are greater than the predicted value. The largest difference was about 0.1 mg/L. Mixing between the inlet zone and the dead zone could explain this difference. The temperature profile of long term tank D (Figure 4.8) shows that the temperatures of the upper zone and inlet zone neared each other around June 30. Also, if the zones mixed the inlet concentration would decrease as the dead zone concentration increases, which is supported by the data obtained on June 30.

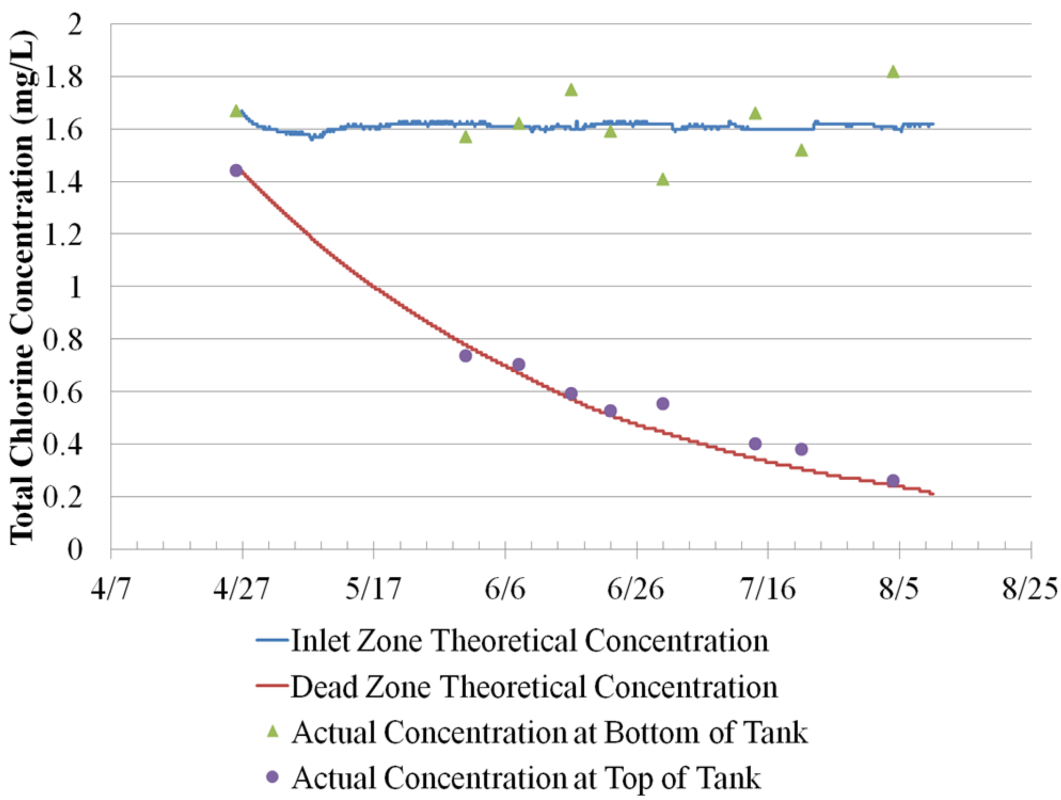

Figure 4.49: Long term tank D modeling results with actual concentration data.

The theoretical concentration in the inlet zone remained constant around 1.65 mg/L, which was the concentration of the influent water. Differences between the theoretical concentration and the actual concentrations occurred. The concentration of the influent water does not remain constant during operation, which explains some of the differences between the actual total chlorine concentration and the theoretical concentration. Mixing between the zones can also lead to differences as illustrated by the June 30 data.

4.4.3 Long Term Tank E

Long term tank E was modeled using the stratified 3-compartment model from 4/26 to 8/15. Table 4.4 shows the input data used for the CompTank model. The initial concentrations are from the data obtained on the first site visit (4/26). Inflow concentration was an average of influent concentrations obtained from the water system. Inflow and outflow rates were calculated using the water elevation data obtained from the water system. The volumes used for each zone were calculated based on the temperature profiles. The inlet zone was the volume below the 8.5 foot sampling point and the main zone was the volume between the 8.5 foot and 22.5 foot sampling point. The dead zone was the remaining volume in the tank.

Table 4.4 Inputs for the stratified long term tank E model.

Model Input	**Inlet Zone**	**Main Zone**	**Dead Zone**
Volume	0.01 Mgal	0.02 Mgal	0.11 Mgal
Initial total chlorine concentration	1.75 mg/L	1.53 mg/L	1.53 mg/L
Decay coefficient	0.011 d^{-1}	0.011 d^{-1}	0.011 d^{-1}
Average inflow rate	59.0 gpm		
Average outflow rate	50.7 gpm		
Inflow concentration	1.66 mg/L		
Flow rate between main and dead zone	0 gpm		
Flow rate between inlet and main zone	0 gpm		

The modeling results are shown in Figure 4.50 along with actual total chlorine concentrations obtained during the time period. A steady decline is shown in the modeled total chlorine concentration in the dead zone. The actual total chlorine concentration shows a similar trend in decline; however, the concentrations are lower than the predicted values from the model. At certain points, the difference between the theoretical total chlorine concentration and the actual total chlorine concentration was 0.2 mg/L. A couple of factors could lead to the higher predicted values. First, the decay coefficent use was for the average temperature (23.6 degrees Celsius), while temperatures were higher at certain times. The decay coefficient is greater in warmer temperatures.

The theoretical total chlorine concentration in the inlet zone remained around 1.66 mg/L, which was the concentration used for the influent water. Differences in the theoretical concentration and the actual concentration occurred. During operation, the influent concentration does not remain constant, which could lead to the differences. Mixing in the tank could also cause the concentrations to differ.

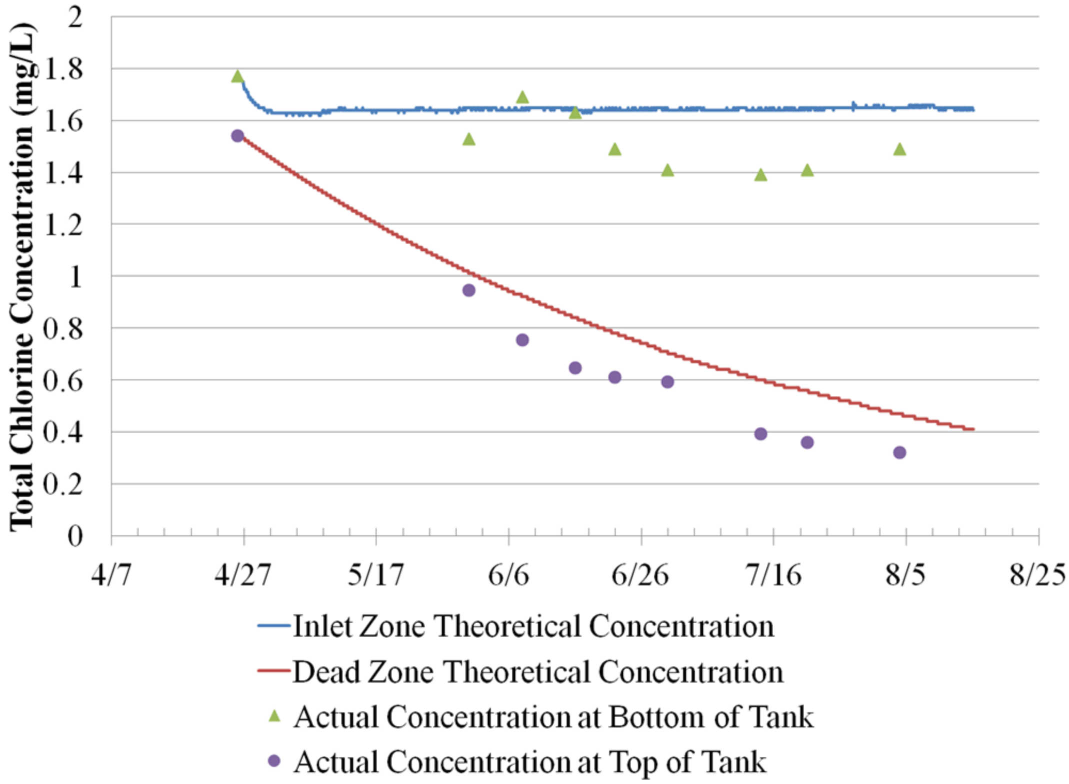

Figure 4.50: Long term tank E modeling results with actual concentration data.

4.5 Hydraulic Parameters Excel Program

An Excel sheet was created to allow water systems to optimize their design or operation to reach the required hydraulic parameters. The affect of a riser pipe in a tank can also be calculated. The inputs for the program are the tank's diameter, the inlet diameter, the low and high water level, the height of a riser pipe, flow into the tank, and the temperature of the water in the tank and the filling water. Using the inputs, the Excel program calculates the required value and actual value for volmetric exchange, densimetric Froude number, and the dimensionless mixing parameter. A water system can change the inputs to optimize their operation. Also, the water system could use the program to guide decisions for new designs. Table 4.5 shows the Excel spreadsheet created.

In the hydraulic parameter Excel program, the black values represent inputs that may be changed by the user, while the red values are calculated values. For the volumetric exchange, the tank's diameter, the water levels, the inlet's diameter, and the height of a riser pipe may be varied. The program will calculate the required and the actual volumetric exchange along with the percent of the required volumetric exchange achieved.

The densimetric Froude number calculator uses inputs from the volumetric exchange calculator and new inputs (flow into the tank and the temperature of the filling water and the water in the tank). The required densimetric Froude number, the actual densimetric Froude number, and the percent of the required densimteric Froude number can be calculated from these inputs. With the inputs from the volumetric exchange and the densimetric Froude number calulator; the required dimensionless mixing parameter, the actual dimensionless mixing parameter, and the percent achieved of the required dimensionless mixing parameter can be calculated.

Table 4.5: Hydraulic parameter Excel program (continued to following page)

Volumetric Exchange		
Tank Diameter	20	ft
Inlet Diameter	3	in
Low Water Level	75	ft
High Water Level	80	ft
Riser Pipe Height	60	ft
Corrected Low Water Level	15	ft
Corrected High Water Level	20	ft
Operational Zone	5	ft
Aspect Ratio	0.875	
Dimensionless Mixing Time	10.00	
Required Volumetric Exchange	13%	
Actual Volumetric Exchange	33%	
% Required Exchange Achieved	252%	
Densimetric Froude Number		
Inlet Orientation (Vertical/Horizontal)	Vertical	
Flow of Filling Water	60000	gpd
Flow of Filling Water	0.093	ft^3/s
Velocity of Filling Water	1.89	ft/s
Temperature of Filling Water	5.3	˚C
Temperature of Water in Tank	8.9	˚C
Density of Filling Water	1.940	$slug/ft^3$
Density of Water in Tank	1.940	$slug/ft^3$

g'	0.0076	ft/s^2
Bouyancy	Negative	
C	0.8	
Required Densimetric Froude Number	48	
Actual Densimetric Froude Number	43.25	
% Required Froude Number	90.10%	
Dimensionless Mixing Parameter		
Inlet Momentum	0.1756	ft^4/s^2
Bouyant Force	0.0007	ft^4/s^3
Required Dimensionless Mixing Parameter	0.8	
Actual Dimensionless Mixing Parameter	0.7722	
% Required Dimensionless Mixing Parameter	96.5%	

Figure 4.51 illustrates the effect of installing a riser pipe on the volumetric turnover in a standpipe. The standpipe used was assumed to be 20 ft. in diameter, with an 80 ft. high water level, and 75 ft. low water level. As the height of the riser pipe increased, the percentage of the volumetric turnover achieved increased. In this example with a 6 in diameter inlet, the volumetric turnover required was achieved when the riser pipe was about 55 ft. tall.

Figure 4.52 illustrates the effect of changing the low water level, increasing the operational zone, on the volumetric exchange. The same standpipe was used as the previous example except the inlet diameter is 6 inches. Increasing the operational zone leads to an increase in the percentage of the volumetric exchange achieved. At about 18 ft. operational zone, the tank's volumetric turnover achieved was the same as the volumetric turnover requried.

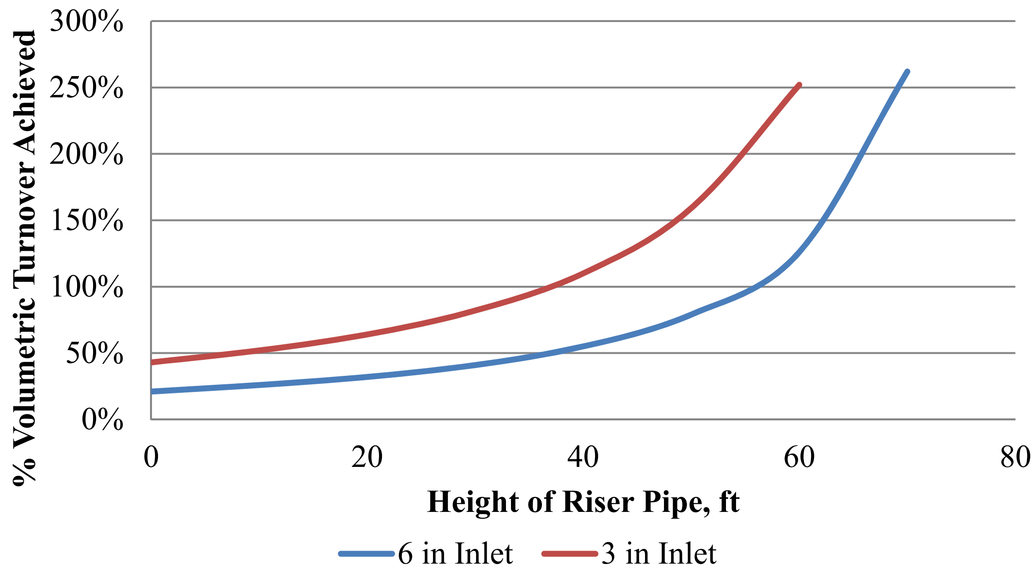

Figure 4.51: The effect of riser pipes on the volumetric exchange

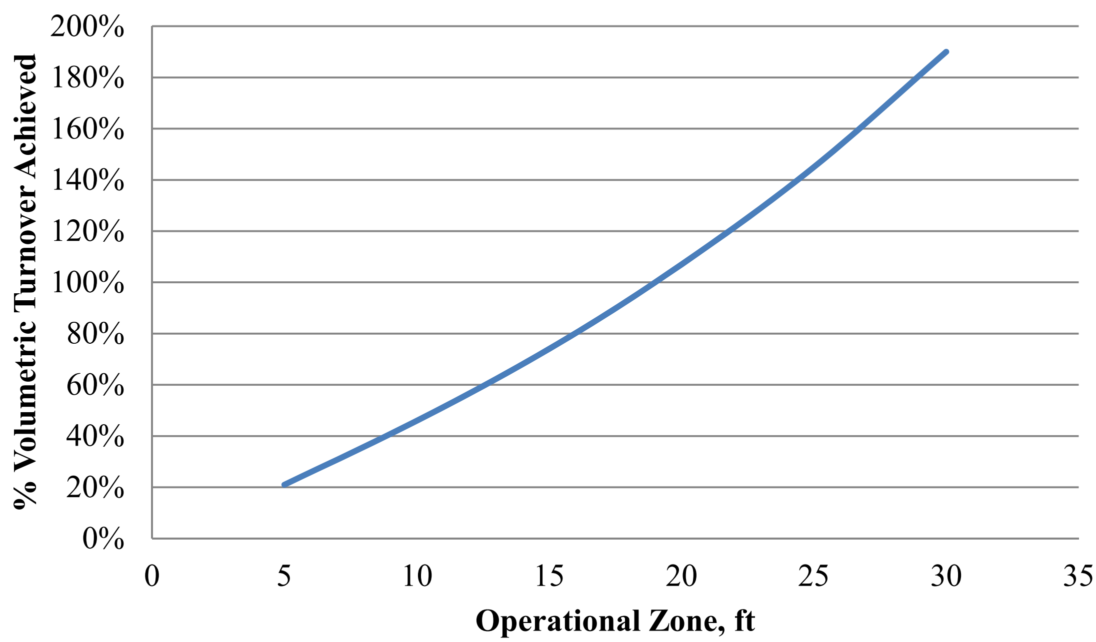

Figure 4.52: The effect of operational zone on volumetric exchange

CHAPTER 5: SUMMARY AND CONCLUSION

5.1 Summary of Work

Storage facilities were evaluated to observe the impacts of storage tank mixing characteristics on water quality. Tanks were chosen for long term tank study using the water system survey and data from the previous study (Olson, 2011). Two short term tanks were also chosen because each tank included a passive mixing system. For the long term tank study, an apparatus was constructed to measure temperature and collect samples for water quality analysis from varying depths in the tank. For the short term tanks, an apparatus was constructed to measure temperature. Elevation data was obtained from the water systems for long term tanks and by a pressure sensor for short term tanks. Temperature profiles and water parameter profiles were created for the tanks.

Several parameters were calculated to provide information on the tank's mixing ability. The parameters include the densimetric Froude number, the volumetric exchange, and the dimensionless mixing parameter (Roberts et al, 2006). A disinfectant decay model was created for stratified tanks using CompTank to estimate the chlorine residual. The model was compared to actual values obtained during the study.

5.2 Conclusions

After evaluating the results from the study, the following conclusions could be made.

1. Affects of tank geometry on mixing

Long term tank C obtained an average operational H:D of 0.98 at the beginning of the study. After the filling pump failed, the average operational H:D was 0.60. Throughout the study, thermal stratification occurred in the tank with a maximum difference in temperature between the top and bottom of the tank being around 10 ^{o}C. Although the tank was thermally stratified, the chlorine concentrations did not stratify in the tank due to the tank operation maintaining sufficient volumetric exchange. The total chlorine concentration ranged from 1.77 mg/L to 2.62 mg/L. Therefore, a tank can show thermal stratification and still maintain an adequate chlorine concentration.

Long term tank D and E both have an average operational H:D above 3.5. Both of the tanks showed stratification in temperature and water quality. Tank D showed a temperature difference of around 10 ^{o}C between the top and the bottom of the tank, while tank E showed a difference of 15 ^{o}C. Before the water system drained tank D, the chlorine concentration in the upper zone was 0.30 mg/L compared to 1.66 mg/L in the lower zone. In tank E, the concentration in the upper zone was 0.05 mg/L compared to

1.25 mg/L in the lower zone before the water system overflowed the tank. The stratification, both thermal and in water quality, of tanks D and E indicate that storage tanks with a H:D greater than 3.5 are at risk of poor mixing and water quality.

Long term tanks F and G both fall in the H:D range of 1-2 with H:D of 1.65 and 1.60 respectively. Tank F showed thermal stratification with a maximum difference between the upper and lower zones of the tank of around 12 ^{o}C. The total chlorine concentrations at times showed stratification. On June 23, the upper zone's concentration was 0.99 mg/L while the lower zone had a concentration of 1.70 mg/L. Although the upper zone concentration was lower, the amount of chlorine was adequate. At other times, the chlorine concentration did not show stratification. The operation of the tank surpassed the required volumetric exchange, which allowed for the tank to maintain adequate chlorine concentrations when thermal stratification occurred. Tank G showed no stratification in temperature or water quality throughout the tank. The chlorine concentration in the tank ranged from 0.92 mg/L to 1.34 mg/L. Tanks F and G indicate that tanks in the 1-2 H:D category may have thermal stratification, but if operated correctly the tanks can maintain adequate mixing to prevent poor water quality.

The temperature and data profiles created in the study show that shorter and wider tanks promote good mixing. Although the tank geometry is important, the operation of the tank needs to be optimized to prevent stratification and poor water quality.

2. Impact of ambient temperature on water quality in tall standpipes

In taller standpipes (H:D >3.5) ambient temperature affects the temperature in the tank and therefore the water quality. The tanks tended to start stratifying when the ambient temperature rose above 15 ^{o}C. As the ambient temperature increased, the temperatures in the upper zone of the tank increased. Increased temperature cause an increase in chlorine decay, which can lead to poor water quality.

3. Total coliform and heterotrophic plate count

Throughout the study, the total coliform tests showed zero coliforms in the storage tanks. The heterotrophic plate counts were also low throughout the study ranging from 0 MPN/ml to 22.5 MPN/ml. Long term tanks C, F, and G maintained proper chlorine concentrations due to proper mixing. Long term tanks D and E showed low chlorine concentrations above the thermocline; however, the water systems either drained or overflowed their tank to replenish the chlorine concentration in the upper zone before microbiological activity could thrive. Water systems need to maintain a proper chlorine concentration in their storage facilities to prevent microbiological growth from occurring.

4. Impact of passive mixing systems

Two short term tanks were studied with passive mixing systems. The temperature profile (Figure 4.37) of short term tank 4 showed the tank did not stratify. Tank 4 was studied by Olson (2011) and stratification occurred in the tank when no passive mixing system was installed. The temperature profile for short term tank 9 (Figure 4.44) showed stratification at the beginning of the study with the upper zone being highly influenced by the influent water. As the temperature cooled, the tank became unstratified. Both tanks show signs of proper mixing as the volumetric exchange for both tanks met the required value. Therefore, passive mixing systems could be used to obtain proper mixing in a storage tank.

5. Volumetric exchange affects mixing

The tanks that met the required value for volumetric exchange showed signs of proper mixing. Long term tank C achieved an average of 213% of the required volumetric exchange. Although tank C showed thermal stratification, the chlorine concentration did not stratify. Long term tank F achieved an average of 118% of the required volumetric exchange. Tank F maintained a proper chlorine concentration even though thermal stratification occurred. Both of the short term tanks met the required volumetric exchange and both showed proper mixing.

Tanks that did not meet the required volumetric exchange consistently showed stratification. Both long term tank D and E did not meet the required volumetric exchange and both tanks were stratified. Meeting the required volumetric exchange in the taller standpipes can be difficult. The water level would need to be drawn down to a lower level, which could cause pressure issues and insufficient storage for the demand in the system.

6. Densimetric Froude number

Long term tank G and short term tank 4 did not always meet the required densimetric Froude number; however, both tanks did not show signs of stratification. All of the other tanks did not meet the required densimetric Froude number and each showed some sign of stratification. Operating the tanks to meet the required densimetric Froude number should promote mixing in the tank.

7. Dimensionless mixing parameter

The dimensionless mixing parameter ($M^{1/2}/(B^{1/3}H^{2/3})$) presented in Roberts et al. (2006) was only consistently met in short term tank 4, which did not show stratification. Short term tank 4 required a dimensionless mixing parameter of 0.8 and achieved an average dimensionless mixing parameter of 0.93. All of the other tanks did not meet the required value and each tank showed signs of stratification except for long term tank G. A tank that is designed and operated to maintain the required dimensionless mixing parameter should cause the tank to be well mixed.

Water systems can optimize tank design and operation to increase the dimensionless mixing parameter. One method would be to increase the inlet momentum, which can be done by increasing flow rates, increasing velocity, or both. Velocity can be increased by decreasing the size of the inlet. Another method would be to decrease the initial water level before the fill cycle.

8. Disinfectant decay modeling

CompTank software was used to create a model of chlorine decay in long term tanks D and E, which both showed stratification. The actual chlorine concentrations measured throughout the study followed the predicted chlorine concentrations in the dead zone. Long term tank D showed a 0.1 mg/L maximum difference. The predicted chlorine concentrations were lower than the actual concentrations. Long term tank E showed a maximum difference of 0.2 mg/L. The predicted chlorine concentration was higher than the actual concentration. Overall, the model demonstrated the chlorine decay trend with some error due to occasional mixing between the inlet and dead zones and the decay coefficient changing due to temperature. Both models show that if the input parameters are accurate, then chlorine concentration decay can be modeled.

9. Hydraulic parameter Excel program

The hydraulic parameter Excel program created can be used for design of a storage tank or the operation of a storage tank. Designers can use the program to find the appropriate design for a tank to promote mixing based on the hydraulic parameters. Water systems can use the program to optimize a tank by tank design and operation characteristics to obtain the required hydraulic parameters for the tank. The effects of a riser pipe on mixing in a tank can also be calculated.

CHAPTER 6: RECOMMENDATIONS

6.1 Recommendations

The following recommendations are based on the analyses of the data collected throughout the study.

6.1.1 Recommendations for design and operation of storage tanks

1. Higher H:D ratio standpipes (taller tanks) are more likely to exhibit mixing problems, which leads to stratification in the tank. In designing a new tank, taller standpipes should be avoided.

2. If a tank experiences water quality issues due to stratification, the water systems could drain the water in the tank into the distribution system before the chlorine concentration drops below the acceptable level. The tank would then be filled with water with a higher chlorine concentration to replenish the chlorine concentration in the tank.

3. Hydraulic parameters such as the volumetric exchange, densimetric Froude number, and the dimensionless mixing parameter from Roberts et al (2006) could be used by the water systems and tank designers to optimize their storage tanks' mixing characteristics.

4. Water systems need to sample from the upper levels in the tank for chlorine residual to understand the water quality in the tank. Water samples collected from the bottom of the storage tank are not always representative of the whole tank.

5. Adding a riser pipe (passive mixing system) to a storage tank is an effective way of promoting mixing in the tank.

6. Mechanical mixing equipment is available for installation into storage tanks. This study did not focus on the mechanical mixing options.

6.1.2 Recommendations for further study

1. The effectiveness of mechanical mixers should be studied to see if they mix standpipes effectively.

2. This study focused on vertical mixing. Mixing in the horizontal direction should be studied since stagnant water in the horizontal direction could occur, which could lead to poor water quality.

3. Chlorine decay modeling could be improved by collecting samples from the inflow pipes to obtain an average inflow chlorine concentration to be used in the modeling program.

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APPENDIX A

CALCULATIONS

Table A.1 contains data used for some upcoming calculations.

Table A.1: Data points used in sample calculations for mixing parameters.

	Time	**Water Level**
Start of fill	T_{SF} = 5/11/11 12:25	L_{SF} = 15 ft.
End of fill	T_{EF} = 5/11/2011 21:40	L_{EF} = 26.6 ft.
End of draw	T_{ED} = 5/12/2011 10:20	L_{ED} = 15 ft.

Temperature at top of tank: 21^{O} C

Temperature at bottom of tank: 8.15^{O} C

Tank diameter = 20 ft.

Inlet diameter = 6 inches

Aspect ratio

$$Aspect\ ratio = \frac{(L_{SF} + 0.5(L_{EF} - L_{SF})}{(D_T)}$$

$$Aspect\ ratio = \frac{(15\ ft + 0.5(26.6\ ft - 15\ ft)}{(20\ ft)}$$

$$Aspect\ ratio = 1.04$$

Flow Rate

$$Q_{fill} = \frac{(L_{EF} - L_{SF}) * \frac{\pi D_T^2}{4}}{(T_{EF} - T_{SF}) * 86{,}400}$$

$$Q_{fill} = \frac{(26.6\,ft - 15\,ft) * \frac{\pi 20^2}{4}}{(5/11/2011\ 21{:}40 - 5/11/11\ 12{:}25) * 86{,}400}$$

$$Q_{fill} = 0.109\,cfs$$

Inflow Velocity

$$v = \frac{Q_{fill}}{\left(\frac{\pi d_i^2}{4}\right)}$$

$$v = \frac{0.109\,cfs}{\frac{\pi \left(\frac{6\,in}{12}\right)^2}{4}}$$

$$v = 0.56 ft/s$$

Volumetric Exchange Required to Achieve a 90% Mixed Tank

For a tank to be mixed the actual volumetric exchange must be greater than the required volumetric exchange as shown in the following equation.

$$\frac{\Delta V}{V} > \frac{(\pi)^{1/2} \tau_m d_i}{2V^{1/3}}$$

Since H:D > 1:

$$\tau_m = 10.0 + 3.5\left(\frac{H}{D} - 1\right)$$

$$\tau_m = 10.0 + 3.5(1.04 - 1)$$

$$\tau_m = 10.14$$

$$\frac{\Delta V}{V} > \frac{(\pi)^{1/2}(10.14)0.5\ ft}{2\left(15 * \frac{\pi}{4} * 20^2\right)^{1/3}}$$

$$\frac{\Delta V}{V} > 0.27$$

Compared to the actual volumetric exchange ratio:

$$\frac{\Delta V}{V} = \frac{(26.6\ ft - 15\ ft)\frac{\pi 20^2}{4}}{(15\ ft)\frac{\pi 20^2}{4}} = 0.77$$

Densimetric Froude number

$$F_d = \frac{v}{\sqrt{g'd}}$$

$$g' = g\frac{\rho_f - \rho_a}{\rho_a}$$

$$\rho = \frac{1}{515.379}(1000 - 0.0178(T-4)^{1.7})$$

$$\rho_f = \frac{1}{515.379}(1000 - 0.0178(8.15-4)^{1.7}) = 1.940\frac{slug}{CF}$$

$$\rho_a = \frac{1}{515.379}(1000 - 0.0178(21-4)^{1.7}) = 1.936\ \frac{slug}{CF}$$

$$g' = 32.2\frac{ft}{s^2}\left(\frac{1.940 - 1.936}{1.936}\right) = 0.067\frac{ft}{s^2}$$

The densimetric Froude number becomes:

$$F_d = \frac{0.56\frac{ft}{s}}{\sqrt{\left(0.067\frac{ft}{s^2}\right)(0.5\ ft)}} = 3.06$$

The required densimetric Froude number is:

$$F_d > C\frac{H}{D}$$

Because the inlet is vertical and under negatively buoyant conditions, C = 0.8

$$F_d > C\frac{H}{D}$$

$$F_d > 0.8\left(\frac{15\ ft}{0.5\ ft}\right)$$

$$F_d > 24$$

Dimensionless Mixing Parameter from Roberts et al (2006)

The criterion for a tank to be mixed under vertically oriented, negatively buoyant jets is:

$$\frac{\sqrt{Msin\theta}}{(B)^{1/3}H^{2/3}} > 0.85 - 0.05n$$

$$M = 0.0113\frac{ft^4}{s^2}$$

$$\theta = 90^0$$

$$B = g'Q = \left(0.067\frac{ft}{s^2}\right)(0.109\ cfs) = 0.0073\frac{ft^4}{s^3}$$

$$H = 15\ ft$$

$$\frac{\sqrt{\left(0.0113\frac{ft^4}{s^2}\right)\sin(90^0)}}{\left(0.0073\frac{ft^4}{s^3}\right)^{1/3}(15\ ft)^{2/3}} = 0.212$$

To mix the tank:

$$\frac{\sqrt{Msin\theta}}{(B)^{1/3}H^{2/3}} > 0.8$$

Disinfectant Decay Coefficient

A first order equation was used:

$$C = C_0e^{-kt}$$

Solving for k:

$$k = -\frac{\ln(\frac{C}{C_0})}{t}$$

k was found between sampling trips in the upper zone of stratified tanks. Values used in sample calculation:

$$Initial\ Concentration = C_0 = 0.55\ mg/L$$

$$Final\ Concentration = C = 0.4\ mg/L$$

$$Time\ Between\ Sampling = t = 14\ days$$

$$k = -\frac{\ln(\frac{0.4\ mg/L}{0.55\ mg/L})}{14\ d}$$

$$k_1 = \frac{0.023}{d}$$

Correcting for temperature:

$$k_2 = k_1 * \theta^{T_2 - T_1}$$

$$\theta = 1.03$$

$$T_1 = 27.58$$

$$T_2 = 20$$

$$k_2 = \frac{0.023}{d} * 1.03^{20-27.58}$$

$$k_2 = \frac{0.018}{d}$$

APPENDIX B

Water Quality, Total Coliform, and Heterotrophic Plate Count (HPC) Data

Table B.1: Water quality data for long term tank C

Date	Height	Temperature	Total Chlorine	Monochloramine	Free Amonia	Nitrite	Nitrate
	ft.	°C	mg/L as Cl	mg/L as Cl	mg/L as N	mg/L as N	mg/L as N
5/9/2011	1.5		2.54				
5/9/2011	6.5		2.62				
5/9/2011	11.5		2.28				
5/9/2011	16.5	AWL					
5/9/2011	21.5	AWL					
5/9/2011	26.5	AWL					
5/31/2011	1.5	14.5	2.48	3.05	0.06	0.009	0.303
5/31/2011	6.5	17.44	2.38	2.86	0.25	0.012	0.314
5/31/2011	11.5	18.85	2.52	2.46	0.33	0.012	0.319
5/31/2011	16.5	AWL					
5/31/2011	21.5	AWL					
5/31/2011	26.5	AWL					
6/8/2011	1.5	16.04	2.38	2.68	0.22	0.004	0.383
6/8/2011	6.5	27.1	2.26	2.46	0.15	0.006	0.341
6/8/2011	11.5	AWL					
6/8/2011	16.5	AWL					
6/8/2011	21.5	AWL					
6/8/2011	26.5	AWL					
6/16/2011	1.5	14.63	2.24	2.51	0.08	0.005	0.281
6/16/2011	6.5	20.52	2.16	2.43	0.07	0.007	0.338
6/16/2011	11.5	21.27	2.16	2.42	0.02	0.006	0.332
6/16/2011	16.5	AWL					
6/16/2011	21.5	AWL					
6/16/2011	26.5	AWL					

Table B.1: (Continued) Water quality data for long term tank C

Date	Height	Temperature	Total Chlorine	Monochloramine	Free Amonia	Nitrite	Nitrate
	ft.	°C	mg/L as Cl	mg/L as Cl	mg/L as N	mg/L as N	mg/L as N
6/22/2011	1.5	15.35	2.18	2.58	0.24	0.002	0.264
6/22/2011	6.5	20.27	2.02	2.41	0.16	0.004	0.31
6/22/2011	11.5	20.68	2	2.36	0.12	0.003	0.306
6/22/2011	16.5	AWL					
6/22/2011	21.5	AWL					
6/22/2011	26.5	AWL					
6/30/2011	1.5	20.95	2.12	2.13	0.36	0	0.284
6/30/2011	6.5	24.31	1.96	2.12	0.62	0.004	0.288
6/30/2011	11.5	AWL					
6/30/2011	16.5	AWL					
6/30/2011	21.5	AWL					
6/30/2011	26.5	AWL					
7/14/2011	1.5	20.99	1.96	2.08	0.52	0.007	0.256
7/14/2011	6.5	25.25	2	2	0.52	0.007	0.261
7/14/2011	11.5	AWL					
7/14/2011	16.5	AWL					
7/14/2011	21.5	AWL					
7/14/2011	26.5	AWL					
7/21/2011	1.5	19.25	2.32	2.49	0.46	0.006	0.359
7/21/2011	6.5	31.2	2.02	1.89	0.46	0.006	0.353
7/21/2011	11.5	31.46	2	1.9	0.49	0.006	0.355
7/21/2011	16.5	AWL					
7/21/2011	21.5	AWL					
7/21/2011	26.5	AWL					
8/4/2011	1.5	28.91	1.77	1.86	0.54	0.007	0.36
8/4/2011	6.5	29.75	1.78	1.86	0.44	0.008	0.359
8/4/2011	11.5	AWL					
8/4/2011	16.5	AWL					
8/4/2011	21.5	AWL					

Table B.1: (Continued) Water quality data for long term tank C

Date	Height	Temperature	Total Chlorine	Monochloramine	Free Amonia	Nitrite	Nitrate
	ft.	°C	mg/L as Cl	mg/L as Cl	mg/L as N	mg/L as N	mg/L as N
8/4/2011	26.5	AWL					
8/18/2011	1.5	24.12	1.96	2.34	0.43	0.007	0.293
8/18/2011	6.5	25.08	2.02	2.24	0.38	0.005	0.281
8/18/2011	11.5	AWL					
8/18/2011	16.5	AWL					
8/18/2011	21.5	AWL					
8/18/2011	26.5	AWL					
9/1/2011	1.5	22.93	1.93	2.07	0.52	0.006	0.307
9/1/2011	6.5	24.51	2.04	2.12	0.53	0.002	0.309
9/1/2011	11.5	AWL					
9/1/2011	16.5	AWL					
9/1/2011	21.5	AWL					
9/1/2011	26.5	AWL					
9/15/2011	1.5	20.14	2.15	1.97	0.44	0.004	0.294
9/15/2011	6.5	20.54	2.04	1.91	0.4	0.004	0.300
9/15/2011	11.5	AWL					
9/15/2011	16.5	AWL					
9/15/2011	21.5	AWL					
9/15/2011	26.5	AWL					

Table B.2: Total Coliform and heterotrophic plate count (HPC) data for long term tank C

Date	Height	Total Coliform	HPC
	ft.	CFU/100 ml	MPN/ml
5/31/2011	1.5	0	2
5/31/2011	6.5	0	0
5/31/2011	11.5	0	2
Average		0	1.33
6/16/2011	1.5	0	2
6/16/2011	6.5	0	0

Date	Height	Total Coliform	HPC
	ft.	CFU/100 ml	MPN/ml
6/8/2011	1.5	0	0
6/8/2011	6.5	0	0
6/8/2011	11.5	AWL	AWL
Average		0	0
6/22/2011	1.5	0	0
6/22/2011	6.5	0	0

Table B.2: (Continued) Total Coliform and heterotrophic plate count (HPC) data for long term tank C

Date	Height	Total Coliform	HPC		Date	Height	Total Coliform	HPC
	ft.	CFU/100 ml	MPN/ml			ft.	CFU/100 ml	MPN/ml
6/16/2011	11.5	0	2		6/22/2011	11.5	0	0
Average		0	1.33		Average		0	0
6/30/2011	1.5	0	6		7/14/2011	1.5	0	21
6/30/2011	6.5	0	19		7/14/2011	6.5	0	6
6/30/2011	11.5	AWL	AWL		7/14/2011	11.5	AWL	AWL
Average		0	12.5		Average		0	13.5
7/21/2011	1.5	0	6		8/4/2011	1.5	0	0
7/21/2011	6.5	0	2		8/4/2011	6.5	0	0
7/21/2011	11.5	0	2		8/4/2011	11.5	AWL	AWL
Average		0	3.33		Average		0	0
8/18/2011	1.5	0	0		9/1/2011	1.5	0	0
8/18/2011	6.5	0	0		9/1/2011	6.5	0	0
8/18/2011	11.5	AWL	AWL		9/1/2011	11.5	AWL	AWL
Average		0	0		Average		0	0
9/15/2011	1.5	0	0					
9/15/2011	6.5	0	0					
9/15/2011	11.5	AWL	AWL					
Average		0	0					

Table B.3: Water quality data for long term tank D

Date	Height	Temperature	Total Chlorine	Monochloramine	Free Amonia	Nitrite	Nitrate
	ft.	°C	mg/L as Cl	mg/L as Cl	mg/L as N	mg/L as N	mg/L as N
4/26/2011	1.5	7.58	1.67				
4/26/2011	8.5	7.72	1.58				
4/26/2011	15.5	8.61	1.46				
4/26/2011	29.5	9.09	1.43				
4/26/2011	43.5	9.67	1.44				
4/26/2011	57.5	10.06	1.46				

Table B.3: (Continued) Water quality data for long term tank D

Date	Height	Temperature	Total Chlorine	Monochloramine	Free Amonia	Nitrite	Nitrate
	ft.	°C	mg/L as Cl	mg/L as Cl	mg/L as N	mg/L as N	mg/L as N
4/26/2011	64.5	10.07	1.42				
4/26/2011	71.5	AWL					
Average in Dead Zone			1.442				
5/31/2011	1.5	11.25	1.57	1.6	0.21	0.002	0.281
5/31/2011	8.5	14.48	0.84				0.366
5/31/2011	15.5	16.56	0.73	0.79	0.28	0.001	0.362
5/31/2011	29.5	17.12	0.74				0.36
5/31/2011	43.5	17.73	0.72	0.83	0.25	0.003	0.355
5/31/2011	57.5	17.63	0.74				0.353
5/31/2011	64.5	17.53	0.75	0.82	0.31	0.006	0.349
5/31/2011	71.5	AWL					
Average in Dead Zone		16.842	0.736	0.813	0.280	0.003	0.356
6/8/2011	1.5	16.47	1.62	1.64	0.31	0.001	0.282
6/8/2011	8.5	24.34	0.68				0.346
6/8/2011	15.5	24.61	0.72	0.68	0.36	0.002	0.347
6/8/2011	29.5	25.08	0.7				0.347
6/8/2011	43.5	25.46	0.69	0.74	0.35	0.001	0.347
6/8/2011	57.5	25.65	0.69				0.348
6/8/2011	64.5	25.5	0.71	0.74	0.32	0.003	0.352
6/8/2011	71.5	AWL					
Average in Dead Zone		25.107	0.702	0.720	0.343	0.002	0.348
6/16/2011	1.5	14.78	1.75	1.92	0.15	0	0.218
6/16/2011	8.5	20.99	0.57				0.343
6/16/2011	15.5	21.7	0.59	0.58	0.08	0.002	0.337
6/16/2011	29.5	22.01	0.59				0.336
6/16/2011	43.5	22.61	0.6	0.67	0.03	0.002	0.341
6/16/2011	57.5	22.69	0.6				0.335
6/16/2011	64.5	22.68	0.59	0.74	0.09	0.003	0.336
6/16/2011	71.5	AWL					
Average in Dead Zone		22.113	0.594	0.663	0.067	0.002	0.337
6/22/2011	1.5	13.84	1.59	1.86	0.23	0.001	0.203

Table B.3: (Continued) Water quality data for long term tank D

Date	Height	Temperature	Total Chlorine	Monochloramine	Free Amonia	Nitrite	Nitrate
	ft.	°C	mg/L as Cl	mg/L as Cl	mg/L as N	mg/L as N	mg/L as N
6/22/2011	8.5	16.46	1.38				0.237
6/22/2011	15.5	18.31	0.51	0.58	0.23	0.002	0.336
6/22/2011	29.5	18.57	0.53				0.334
6/22/2011	43.5	19.06	0.54	0.59	0.24	0.005	0.336
6/22/2011	57.5	18.82	0.52				0.334
6/22/2011	64.5	18.8	0.53	0.6	0.27	0.004	0.332
6/22/2011	71.5	AWL					
Average in Dead Zone		18.337	0.526	0.590	0.247	0.004	0.334
6/30/2011	1.5	15.59	1.41	1.19	0.32	0.003	0.254
6/30/2011	8.5	23.05	0.51				0.335
6/30/2011	15.5	23.99	0.53	0.44	0.4	0.003	0.335
6/30/2011	29.5	24.6	0.54				0.333
6/30/2011	43.5	25.17	0.54	0.44	0.48	0.002	0.333
6/30/2011	57.5	25.34	0.57				0.334
6/30/2011	64.5	25.32	0.59	0.46	0.42	0.002	0.33
6/30/2011	71.5	AWL					
Average in Dead Zone		24.578	0.554	0.447	0.433	0.002	0.333
7/14/2011	1.5	16.38	1.66	1.49	0.41	0.002	0.233
7/14/2011	8.5	23.28	0.4				0.33
7/14/2011	15.5	24.62	0.4	0.42	0.56	0	0.331
7/14/2011	29.5	25.04	0.4				0.331
7/14/2011	43.5	25.61	0.41	0.42	0.56	0.003	0.335
7/14/2011	57.5	25.55	0.4				0.333
7/14/2011	64.5	25.42	0.39	0.44	0.56	0.001	0.329
7/14/2011	71.5	AWL					
Average in Dead Zone		24.920	0.400	0.427	0.560	0.001	0.332
7/21/2011	1.5	18.11	1.52	1.41	0.43	0.002	0.344
7/21/2011	8.5	31.19	0.38				0.411
7/21/2011	15.5	31.52	0.38	0.34	0.56	0.001	0.412
7/21/2011	29.5	32	0.38				0.411
7/21/2011	43.5	32.35	0.38	0.38	0.6	0.001	0.413

Table B.3: (Continued) Water quality data for long term tank D

Date	Height	Temperature	Total Chlorine	Monochloramine	Free Amonia	Nitrite	Nitrate
	ft.	°C	mg/L as Cl	mg/L as Cl	mg/L as N	mg/L as N	mg/L as N
7/21/2011	57.5	32.41	0.39				0.413
7/21/2011	64.5	32.14	0.39	0.36	0.56	0.002	0.412
7/21/2011	71.5	AWL					
Average in Dead Zone		31.935	0.383	0.360	0.573	0.001	0.412
8/4/2011	1.5	18.83	1.82	1.48	0.48	0.002	0.327
8/4/2011	8.5	29.54	0.26				0.416
8/4/2011	15.5	29.94	0.27	0.3	0.54	0.004	0.413
8/4/2011	29.5	30.51	0.25				0.417
8/4/2011	43.5	30.96	0.27	0.34	0.56	0.002	0.416
8/4/2011	57.5	31.1	0.27				0.417
8/4/2011	64.5	30.89	0.26	0.28	0.56	0.004	0.421
8/4/2011	71.5	AWL					
Average in Dead Zone		30.490	0.263	0.307	0.553	0.003	0.417
8/18/2011	1.5	18.12	1.97	2.19	0.6	0.004	0.297
8/18/2011	8.5	24.47	0.19				0.378
8/18/2011	15.5	25.38	0.2	0.34	0.8	0.001	0.376
8/18/2011	29.5	25.78	0.17				0.38
8/18/2011	43.5	26.22	0.19	0.28	0.76	0.002	0.381
8/18/2011	57.5	26.11	0.2				0.373
8/18/2011	64.5	25.97	0.2	0.26	0.76	0.001	0.38
8/18/2011	71.5	AWL					
Average in Dead Zone		25.655	0.192	0.293	0.773	0.001	0.378
9/1/2011	1.5	20.35	1.66	1.9	0.52	0.002	0.306
9/1/2011	8.5	26.57	0.26				0.382
9/1/2011	15.5	26.98	0.29	0.54	0.7	0.001	0.381
9/1/2011	29.5	27.29	0.29				0.379
9/1/2011	43.5	27.81	0.31	0.52	0.66	0.002	0.383
9/1/2011	57.5	27.97	0.31				0.381
9/1/2011	64.5	27.85	0.29	0.52	0.7	0.004	0.377
9/1/2011	71.5	AWL					
Average in Dead Zone		27.412	0.292	0.527	0.687	0.002	0.380

Table B.3: (Continued) Water quality data for long term tank D

Date	Height	Temperature	Total Chlorine	Monochloramine	Free Amonia	Nitrite	Nitrate
	ft.	°C	mg/L as Cl	mg/L as Cl	mg/L as N	mg/L as N	mg/L as N
9/15/2011	1.5	16.83	1.93	2.08	0.34	0	0.301
9/15/2011	8.5	17.78	1.92				0.302
9/15/2011	15.5	19	1.46	1.7	0.28	0	0.326
9/15/2011	29.5	19.83	1.48				0.324
9/15/2011	43.5	20.67	1.47	1.7	0.24	0.002	0.326
9/15/2011	57.5	20.82	1.49				0.329
9/15/2011	64.5	20.71	1.48	1.72	0.24	0	0.320
9/15/2011	71.5	AWL					
Average in Dead Zone		19.802	1.48	1.707	0.253	0.001	0.325

Table B.4: Total Coliform and heterotrophic plate count (HPC) data for long term tank D

Date	Height	Total Coliform	HPC
	ft.	CFU/100 ml	MPN/ml
5/31/2011	1.5	0	0
5/31/2011	15.5	0	0
5/31/2011	29.5	0	0
5/31/2011	43.5	0	6
5/31/2011	57.5	0	0
5/31/2011	64.5	0	0
Average		0	1
6/16/2011	1.5	0	161
6/16/2011	15.5	0	100
6/16/2011	29.5	0	166
6/16/2011	43.5	0	108
6/16/2011	57.5	0	71
6/16/2011	64.5	0	8
Average		0	102.3
6/30/2011	1.5	0	6
6/30/2011	15.5	0	4
6/30/2011	29.5	0	4

Date	Height	Total Coliform	HPC
	ft.	CFU/100 ml	MPN/ml
6/8/2011	1.5	0	0
6/8/2011	15.5	0	0
6/8/2011	29.5	0	0
6/8/2011	43.5	0	2
6/8/2011	57.5	0	0
6/8/2011	64.5	0	0
Average		0	0.33
6/22/2011	1.5	0	4
6/22/2011	15.5	0	0
6/22/2011	29.5	0	0
6/22/2011	43.5	0	0
6/22/2011	57.5	0	0
6/22/2011	64.5	0	0
Average		0	0.67
7/14/2011	1.5	0	10
7/14/2011	15.5	0	10
7/14/2011	29.5	0	12

Table B.4: (Continued) Total Coliform and heterotrophic plate count (HPC) data for long term tank D

Date	Height	Total Coliform	HPC	Date	Height	Total Coliform	HPC
	ft.	CFU/100 ml	MPN/ml		ft.	CFU/100 ml	MPN/ml
6/30/2011	43.5	0	0	7/14/2011	43.5	0	30
6/30/2011	57.5	0	0	7/14/2011	57.5	0	15
6/30/2011	64.5	0	2	7/14/2011	64.5	0	12
Average		0	2.67	Average		0	14.8
7/21/2011	1.5	0	0	8/4/2011	1.5	0	0
7/21/2011	15.5	0	4	8/4/2011	15.5	0	2
7/21/2011	29.5	0	8	8/4/2011	29.5	0	0
7/21/2011	43.5	0	2	8/4/2011	43.5	0	2
7/21/2011	57.5	0	2	8/4/2011	57.5	0	0
7/21/2011	64.5	0	4	8/4/2011	64.5	0	4
Average		0	3.33	Average		0	1.33
8/18/2011	1.5	0	2	9/1/2011	1.5	0	0
8/18/2011	15.5	0	2	9/1/2011	15.5	0	2
8/18/2011	29.5	0	4	9/1/2011	29.5	0	2
8/18/2011	43.5	0	2	9/1/2011	43.5	0	0
8/18/2011	57.5	0	0	9/1/2011	57.5	0	0
8/18/2011	64.5	0	4	9/1/2011	64.5	0	4
Average		0	2.33	Average		0	1.33
9/15/2011	1.5	0	0				
9/15/2011	15.5	0	0				
9/15/2011	29.5	0	0				
9/15/2011	43.5	0	2				
9/15/2011	57.5	0	2				
9/15/2011	64.5	0	0				
Average		0	0.67				

Table B.5: Water quality data for long term tank E

Date	Height	Temperature	Total Chlorine	Monochloramine	Free Amonia	Nitrite	Nitrate
	ft.	°C	mg/L as Cl	mg/L as Cl	mg/L as N	mg/L as N	mg/L as N
4/26/2011	1.5	7.53	1.77				

Table B.5: (Continued) Water quality data for long term tank E

Date	Height	Temperature	Total Chlorine	Monochloramine	Free Amonia	Nitrite	Nitrate
	ft.	°C	mg/L as Cl	mg/L as Cl	mg/L as N	mg/L as N	mg/L as N
4/26/2011	8.5	7.69	1.71				
4/26/2011	22.5	8.39	1.59				
4/26/2011	29.5	9.39	1.53				
4/26/2011	43.5	9.37	1.51				
4/26/2011	50.5	9.18	1.5				
4/26/2011	64.5	9.09	1.55				
4/26/2011	71.5	9.31	1.54				
Average in Dead Zone			1.526				
5/31/2011	1.5	13.74	1.53	1.49	0.17	0.03	0.384
5/31/2011	8.5	14.89	1.56	1.38	0.2	0.031	0.383
5/31/2011	22.5	18	0.92	0.91	0.16	0.031	0.315
5/31/2011	29.5	18.89	0.97	0.98	0.13	0.025	0.316
5/31/2011	43.5	AWL					
5/31/2011	50.5	AWL					
5/31/2011	64.5	AWL					
5/31/2011	71.5	AWL					
Average in Dead Zone		18.445	0.945	0.945	0.145	0.028	0.316
6/8/2011	1.5	15.31	1.69	1.52	0.33	0.004	0.296
6/8/2011	8.5	21.75	1.38				0.319
6/8/2011	22.5	27.15	0.76	0.75	0.28	0.005	0.33
6/8/2011	29.5	27.49	0.76				0.331
6/8/2011	43.5	26.82	0.72	0.74	0.33	0.007	0.331
6/8/2011	50.5	27.5	0.77				0.331
6/8/2011	64.5	27.76	0.74	0.77	0.16	0.004	0.332
6/8/2011	71.5	28.12	0.77	0.82	0.18	0.004	0.333
Average in Dead Zone		27.473	0.753	0.770	0.238	0.005	0.331
6/16/2011	1.5	14.76	1.63	1.49	0.1	0.003	0.241
6/16/2011	8.5	16.99	1.58				0.245
6/16/2011	22.5	22.13	0.64	0.62	0.18	0.004	0.322
6/16/2011	29.5	22.94	0.65				0.322
6/16/2011	43.5	22.41	0.65	0.57	0.13	0.004	0.324

Table B.5: (Continued) Water quality data for long term tank E

Date	Height	Temperature	Total Chlorine	Monochloramine	Free Amonia	Nitrite	Nitrate
	ft.	°C	mg/L as Cl	mg/L as Cl	mg/L as N	mg/L as N	mg/L as N
6/16/2011	50.5	22.97	0.64				0.319
6/16/2011	64.5	22.94	0.65	0.64	0.18	0.003	0.319
6/16/2011	71.5	23.43	0.65	0.65	0.23	0.003	0.322
Average in Dead Zone		22.803	0.647	0.620	0.180	0.004	0.321
6/22/2011	1.5	14.35	1.49	1.61	0.15	0.007	0.235
6/22/2011	8.5	14.75	1.4				0.235
6/22/2011	22.5	19.49	0.61	0.69	0.26	0	0.316
6/22/2011	29.5	20.17	0.61				0.316
6/22/2011	43.5	19.46	0.62	0.67	0.11	0	0.329
6/22/2011	50.5	20.04	0.61				0.307
6/22/2011	64.5	20.33	0.61	0.7	0.13	0.003	0.314
6/22/2011	71.5	20.66	0.61	0.69	0.27	0	0.315
Average in Dead Zone		20.025	0.612	0.688	0.193	0.001	0.316
6/30/2011	1.5	18.18	1.41	1.33	0.39	0.01	0.202
6/30/2011	8.5	21.6	1.2				0.228
6/30/2011	22.5	24.88	0.57	0.57	0.32	0.007	0.332
6/30/2011	29.5	25.33	0.6				0.313
6/30/2011	43.5	24.96	0.6	0.6	0.37	0.003	0.313
6/30/2011	50.5	25.62	0.59				0.314
6/30/2011	64.5	25.45	0.6	0.63	0.35	0.005	0.317
6/30/2011	71.5	26.02	0.6	0.57	0.48	0.004	0.316
Average in Dead Zone		25.377	0.593	0.593	0.380	0.005	0.318
7/14/2011	1.5	17.63	1.39	1.35	0.22	0.002	0.288
7/14/2011	8.5	18.73	1.4				0.291
7/14/2011	22.5	25.84	0.38	0.37	0.51	0.005	0.3
7/14/2011	29.5	26.31	0.4				0.302
7/14/2011	43.5	25.8	0.39	0.42	0.49	0.004	0.302
7/14/2011	50.5	26.14	0.4				0.301
7/14/2011	64.5	26.14	0.39	0.43	0.49	0.005	0.297
7/14/2011	71.5	26.49	0.39	0.42	0.49	0.003	0.306

Table B.5: (Continued) Water quality data for long term tank E

Date	Height	Temperature	Total Chlorine	Monochloramine	Free Amonia	Nitrite	Nitrate
	ft.	°C	mg/L as Cl	mg/L as Cl	mg/L as N	mg/L as N	mg/L as N
Average in Dead Zone		26.120	0.392	0.410	0.495	0.004	0.301
7/21/2011	1.5	18.32	1.41	1.36	0.21	0.003	0.343
7/21/2011	8.5	19.13	1.39				0.347
7/21/2011	22.5	32.26	0.39	0.34	0.46	0.005	0.389
7/21/2011	29.5	32.85	0.37				0.393
7/21/2011	43.5	32.43	0.36	0.37	0.41	0.004	0.393
7/21/2011	50.5	32.84	0.35				0.391
7/21/2011	64.5	32.96	0.38	0.37	0.46	0.005	0.392
7/21/2011	71.5	33.3	0.36	0.36	0.48	0.003	0.395
Average in Dead Zone		32.773	0.368	0.360	0.453	0.004	0.392
8/4/2011	1.5	18.72	1.49	1.38	0.24	0.005	0.365
8/4/2011	8.5	22.55	1.22				0.376
8/4/2011	22.5	31.31	0.31	0.34	0.42	0.008	0.405
8/4/2011	29.5	31.54	0.32				0.404
8/4/2011	43.5	31.85	0.32	0.34	0.42	0.009	0.404
8/4/2011	50.5	31.51	0.32				0.409
8/4/2011	64.5	31.59	0.35	0.32	0.37	0.012	0.406
8/4/2011	71.5	31.79	0.31	0.34	0.4	0.009	0.412
Average in Dead Zone		31.598	0.322	0.335	0.403	0.010	0.407
8/18/2011	1.5	19.09	1.26	1.56	0.34	0.006	0.322
8/18/2011	8.5	19.61	1.24				0.325
8/18/2011	22.5	25.59	0.04	0.05	0.01	0.352	0.379
8/18/2011	29.5	26.04	0.05				0.387
8/18/2011	43.5	26.41	0.05	0.05	0.1	0.36	0.378
8/18/2011	50.5	26.16	0.03				0.384
8/18/2011	64.5	26.13	0.04	0.06	0.04	0.352	0.381
8/18/2011	71.5	26.45	0.04	0.14	0	0.354	0.380
Average in Dead Zone		26.130	0.042	0.075	0.038	0.355	0.382
9/1/2011	1.5	18.86	1.68	1.76	0.25	0.002	0.331
9/1/2011	8.5	19.34	1.72				0.327
9/1/2011	22.5	23.6	1.2	1.28	0.39	0.003	0.332

Table B.5: (Continued) Water quality data for long term tank E

Date	Height	Temperature	Total Chlorine	Monochloramine	Free Amonia	Nitrite	Nitrate
	ft.	°C	mg/L as Cl	mg/L as Cl	mg/L as N	mg/L as N	mg/L as N
9/1/2011	29.5	24.65	1.21				0.331
9/1/2011	43.5	25.59	1.2	1.21	0.27	0.002	0.338
9/1/2011	50.5	25.25	1.22				0.334
9/1/2011	64.5	25.38	1.22	1.22	0.27	0.002	0.330
9/1/2011	71.5	25.71	1.21	1.21	0.41	0.002	0.333
Average in Dead Zone		25.030	1.210	1.230	0.335	0.002	0.333
9/15/2011	1.5	16.27	1.42	1.14	0.27	0.002	0.322
9/15/2011	8.5	16.71	1.4				0.322
9/15/2011	22.5	19.97	0.94	1.03	0.25	0	0.348
9/15/2011	29.5	21.02	0.88				0.341
9/15/2011	43.5	20.38	0.93	0.97	0.27	0.002	0.340
9/15/2011	50.5	20.79	0.91				0.338
9/15/2011	64.5	20.91	0.95	1.01	0.24	0.002	0.347
9/15/2011	71.5	21.3	0.96	0.89	0.18	0	0.343
Average in Dead Zone		20.728	0.928	0.975	0.235	0.001	0.343

Table B.6: Total Coliform and heterotrophic plate count (HPC) data for long term tank E

Date	Height	Total Coliform	HPC	Date	Height	Total Coliform	HPC
	ft.	CFU/100 ml	MPN/ml		ft.	CFU/100 ml	MPN/ml
5/31/2011	1.5	0	2	6/8/2011	1.5	0	2
5/31/2011	8.5	0	0	6/8/2011	22.5	0	6
5/31/2011	22.5	0	0	6/8/2011	43.5	0	0
5/31/2011	29.5	0	4	6/8/2011	50.5	0	2
5/31/2011	AWL			6/8/2011	64.5	0	0
5/31/2011	AWL			6/8/2011	71.5	0	0
Average		0	1.5	Average		0	1.67
6/16/2011	1.5	0	124	6/22/2011	1.5	0	0
6/16/2011	22.5	0	80	6/22/2011	22.5	0	0
6/16/2011	43.5	0	56	6/22/2011	43.5	0	0
6/16/2011	50.5	0	83	6/22/2011	50.5	0	0

Table B.6: (Continued) Total Coliform and heterotrophic plate count (HPC) data for long term tank E

Date	Height	Total Coliform	HPC	Date	Height	Total Coliform	HPC
	ft.	CFU/100 ml	MPN/ml		ft.	CFU/100 ml	MPN/ml
6/16/2011	64.5	0	146	6/22/2011	64.5	0	0
6/16/2011	71.5	0	97	6/22/2011	71.5	0	0
Average		0	97.67	Average		0	0
6/30/2011	1.5	0	6	7/14/2011	1.5	0	0
6/30/2011	22.5	0	4	7/14/2011	22.5	0	2
6/30/2011	43.5	0	4	7/14/2011	43.5	0	6
6/30/2011	50.5	0	0	7/14/2011	50.5	0	6
6/30/2011	64.5	0	0	7/14/2011	64.5	0	2
Date	Height	Total Coliform	HPC	Date	Height	Total Coliform	HPC
	ft.	CFU/100 ml	MPN/ml		ft.	CFU/100 ml	MPN/ml
6/30/2011	71.5	0	2	7/14/2011	71.5	0	2
Average		0	2.67	Average		0	3
7/21/2011	1.5	0	0	8/4/2011	1.5	0	0
7/21/2011	22.5	0	4	8/4/2011	22.5	0	0
7/21/2011	43.5	0	4	8/4/2011	43.5	0	4
7/21/2011	50.5	0	2	8/4/2011	50.5	0	0
7/21/2011	64.5	0	6	8/4/2011	64.5	0	0
7/21/2011	71.5	0	4	8/4/2011	71.5	0	2
Average		0	3.33	Average		0	1
8/18/2011	1.5	0	0	9/1/2011	1.5	0	0
8/18/2011	22.5	0	0	9/1/2011	22.5	0	0
8/18/2011	43.5	0	2	9/1/2011	43.5	0	0
8/18/2011	50.5	0	4	9/1/2011	50.5	0	0
8/18/2011	64.5	0	2	9/1/2011	64.5	0	0
8/18/2011	71.5	0	4	9/1/2011	71.5	0	0
Average		0	2	Average		0	0
9/15/2011	1.5	0	0				
9/15/2011	22.5	0	0				
9/15/2011	43.5	0	0				
9/15/2011	50.5	0	2				
9/15/2011	64.5	0	0				

Table B.6: (Continued) Total Coliform and heterotrophic plate count (HPC) data for long term tank E

Date	Height	Total Coliform	HPC	Date	Height	Total Coliform	HPC
	ft.	CFU/100 ml	MPN/ml		ft.	CFU/100 ml	MPN/ml
9/15/2011	71.5	0	0				
Average		0	0				

Table B.7: Water quality, total coliform, and heterotrophic plate count data for long term tank G

Date	Height	Temperature	Total Chlorine	Free Chlorine	Total Coliforms	HPC
	ft.	°C	mg/L as Cl	mg/L as Cl	CFU/100 ml	MPN/ml
6/28/2011	1.5	13.47	1.34	1.21	0	216
6/28/2011	7.5	13.69	1.22	1.19	0	
6/28/2011	13.5	13.37	1.23	1.23	0	248
6/28/2011	19.5	13.62	1.24	1.22	0	287
6/28/2011	25.5	13.38	1.35	1.21	0	311
6/28/2011	31.5	13.39	1.23	1.2	0	339
6/28/2011	37.5	13.41	1.35	1.25	0	257
6/28/2011	43.5	AWL				
Average					0	276
7/14/2011	1.5	14.92	0.96	0.84	0	12
7/14/2011	7.5	15.19	0.95	0.84	0	17
7/14/2011	13.5	14.88	0.9	0.84	0	4
7/14/2011	19.5	15.1	0.98	0.91	0	21
7/14/2011	25.5	15.25	0.95	0.89	0	17
7/14/2011	31.5	15.16	0.93	0.9	0	19
7/14/2011	37.5	AWL				
7/14/2011	43.5	AWL				
Average					0	15
7/21/2011	1.5	15.5	0.92	0.88	0	2
7/21/2011	7.5	15.49	0.96	0.83	0	0
7/21/2011	13.5	15.22	0.94	0.85	0	2
7/21/2011	19.5	15.57	0.91	0.86	0	0
7/21/2011	25.5	15.67	0.95	0.84	0	4
7/21/2011	31.5	23.83	0.92	0.87	0	2
7/21/2011	37.5	AWL				

Table B.7: (Continued) Water quality, total coliform, and heterotrophic plate count data for long term tank G

Date	Height	Temperature	Total Chlorine	Free Chlorine	Total Coliforms	HPC
	ft.	°C	mg/L as Cl	mg/L as Cl	CFU/100 ml	MPN/ml
7/21/2011	43.5	AWL				
Average					0	1.67
8/4/2011	1.5	15.98	1.12	1.07	0	0
8/4/2011	7.5	16.12	1.02	1.08		
8/4/2011	13.5	15.59	1.02	1.07	0	0
8/4/2011	19.5	16.09	1.1	1.04	0	0
8/4/2011	25.5	16.05	1.14	1.07	0	0
8/4/2011	31.5	15.82	1.17	1.13	0	0
8/4/2011	37.5	24.02	1.1	1.08	0	0
8/4/2011	43.5	AWL				
Average					0	0
8/16/2011	1.5	16.22	1.11	1.06	0	2
8/16/2011	7.5	16.4	1.11	1.05	0	0
8/16/2011	13.5	16.02	1.08	1.05	0	0
8/16/2011	19.5	16.27	1.11	1.05	0	0
8/16/2011	25.5	16.31	1.09	1.05	0	0
8/16/2011	31.5	16.14	1.1	1.03	0	4
8/16/2011	37.5	AWL				
8/16/2011	43.5	AWL				
Average					0	1

Table B.8: Water quality, total coliform, and heterotrophic plate count data for long term tank F

Date	Height	Temperature	Total Chlorine	Free Chlorine	Total Coliforms	HPC
	ft.	°C	mg/L as Cl	mg/L as Cl	CFU/100 ml	MPN/ml
6/3/2011	1.75	10.32	1.59	1.21	0	2
6/3/2011	5.25	10.19	1.74	1.47	0	0
6/3/2011	8.75	10.51	1.71	1.48	0	2
6/3/2011	15.75	13.95	1.49	1.28	0	4
6/3/2011	22.75	17.84	1.33	1.16	0	2
6/3/2011	29.75	AWL				
Average					0	2

Table B.8: (Continued) Water quality, total coliform, and heterotrophic plate count data for long term tank F

Date	Height	Temperature	Total Chlorine	Free Chlorine	Total Coliforms	HPC
	ft.	°C	mg/L as Cl	mg/L as Cl	CFU/100 ml	MPN/ml
6/9/2011	1.75	9.85	0.8	0.54	0	4
6/9/2011	5.25	9.72	0.81	0.57	0	6
6/9/2011	8.75	10.32	0.88	0.44	0	0
6/9/2011	15.75	10.34	0.83	0.59	0	2
6/9/2011	22.75	19.47	1.04	0.86	0	2
6/9/2011	29.75	AWL				
Average					0	2.8
6/17/2011	1.75	11.29	1.56	1.32	0	2
6/17/2011	5.25	11.04	1.6	1.29	5	2
6/17/2011	8.75	11.72	1.57	1.35	6	15
6/17/2011	15.75	12.21	1.58	1.34	0	0
6/17/2011	22.75	16.46	1.15	0.96	0	2
6/17/2011	29.75	AWL				
Average					2.2	4.2
6/23/2011	1.75	11.34	1.77	1.47	0	0
6/23/2011	5.25	11.23	1.71	1.45	0	0
6/23/2011	8.75	11.35	1.7	1.41	0	0
6/23/2011	15.75	11.61	1.25	1.02	0	0
6/23/2011	22.75	15.79	0.99	0.6	0	0
6/23/2011	29.75	AWL				
Average					0	0
6/29/2011	1.75	12.78	1.58	1.38	0	311
6/29/2011	5.25	12.33	1.6	1.42	0	324
6/29/2011	8.75	12.89	1.63	1.42	0	177
6/29/2011	15.75	13.41	1.61	1.42	0	299
6/29/2011	22.75	19.59	1.04	0.85	0	248
6/29/2011	29.75	AWL				
Average					0	271.8
7/13/2011	1.75	13.98	1.81	1.57	0	21
7/13/2011	5.25	13.74	1.81	1.62	0	15
7/13/2011	8.75	13.98	1.81	1.62	0	26
7/13/2011	15.75	14	1.79	1.59	0	26

Table B.8: (Continued) Water quality, total coliform, and heterotrophic plate count data for long term tank F

Date	Height	Temperature	Total Chlorine	Free Chlorine	Total Coliforms	HPC
	ft.	°C	mg/L as Cl	mg/L as Cl	CFU/100 ml	MPN/ml
7/13/2011	22.75	23.03	0.69	0.58	0	23
7/13/2011	29.75	AWL				
Average					0	22.2
7/20/2011	1.75	15.09	1.89	1.59	0	0
7/20/2011	5.25	14.72	1.93	1.63	0	0
7/20/2011	8.75	15.27	1.89	1.68	0	0
7/20/2011	15.75	16.31	0.76	0.64	0	2
7/20/2011	22.75	28.16	0.83	0.66	0	0
7/20/2011	29.75	AWL				
Average					0	0.4
8/3/2011	1.75	15.87	0.4	0.29	0	0
8/3/2011	5.25	15.47	0.4	0.28	0	0
8/3/2011	8.75	15.93	0.43	0.29	0	0
8/3/2011	15.75	16	0.42	0.31	0	0
8/3/2011	22.75	26.3	0.7	0.58	0	0
8/3/2011	29.75	AWL				
Average					0	0
8/17/2011	1.75	15.98	1.93	1.67	0	0
8/17/2011	5.25	15.52	1.98	1.71	0	0
8/17/2011	8.75	16.09	1.97	1.7	0	0
8/17/2011	15.75	16.09	1.98	1.71	0	0
8/17/2011	22.75	16.91	1.94	1.66	0	0
8/17/2011	29.75	AWL				
Average					0	0
8/31/2011	1.75	16.23	1.87	1.66	0	0
8/31/2011	5.25	16	1.87	1.64	0	2
8/31/2011	8.75	16.17	1.92	1.67	0	0
8/31/2011	15.75	16.41	1.9	1.76	0	0
8/31/2011	22.75	17.2	1.91	1.65	0	2
8/31/2011	29.75	AWL				
Average					0	0.8
9/14/2011	1.75	14.38	1.79	1.56	0	0

Table B.8: (Continued) Water quality, total coliform, and heterotrophic plate count data for long term tank F

Date	Height	Temperature	Total Chlorine	Free Chlorine	Total Coliforms	HPC
	ft.	°C	mg/L as Cl	mg/L as Cl	CFU/100 ml	MPN/ml
9/14/2011	5.25	14.11	1.72	1.53	0	2
9/14/2011	8.75	14.71	1.74	1.5	0	2
9/14/2011	15.75	14.53	1.75	1.52	0	0
9/14/2011	22.75	14.83	1.75	1.55	0	4
9/14/2011	29.75	AWL				
Average					0	1.6

APPENDIX C

Chlorine Decay Coefficient Data

Table C.1: Chlorine decay coefficient data for long term tank D

Initial Cl Concentration	Final Cl Concentration	Time	Average Temperature	k (1/d)	k (1/d)
mg/L	mg/L	days	˚C	at average temperature	at 20 ˚C
0.702	0.594	8.06	22.25	0.0207	0.0194
0.594	0.526	5.88	22.62	0.0201	0.0186
0.554	0.4	14.06	27.58	0.0231	0.0185
0.4	0.383	6.97	30.24	0.0155	0.0115
0.383	0.263	13.99	31.09	0.0269	0.0194
0.263	0.192	13.92	27.19	0.0226	0.018
				Average	0.0176

Table C.2: Chlorine decay coefficient used in CompTank for long term tank D

Average k at 20 ˚C	Average Temperature	Final k
(1/day)	˚C	(1/day)
0.0176	21.59	0.0184

Table C.3: Chlorine decay coefficient data for long term tank E

Initial Cl Concentration	Final Cl Concentration	Time	Average Temperature	k (1/d)	k (1/d)
mg/L	mg/L	days	˚C	at average temp	at 20 ˚C
0.753	0.647	8.05	23.01	0.0188	0.0172
0.647	0.612	5.9	23.83	0.0094	0.0084
0.612	0.593	7.99	22.28	0.0039	0.0036
0.593	0.392	14.08	28.51	0.0294	0.0229
0.392	0.368	6.98	30.95	0.0091	0.0066
0.368	0.322	13.99	32.06	0.0096	0.0067
				Average	0.0109

Table C.4: Chlorine decay coefficient used in CompTank for long term tank E

Average k at 20 ˚C	Average Temperature	Final k
(1/day)	˚C	(1/day)
0.0109	22.76	0.0118

NTEC

Nelson Tank Engineering & Consulting, Inc.

CITY OF SAULT STE. MARIE
MAINTENANCE INSPECTION
200,000-GALLON
ELEVATED TANK

DATE: DECEMBER 30, 2021

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SUMMARY

Chicago Bridge & Iron constructed the tank in 1992. The tank is a spheroid design constructed with a height to low-water line of 65 feet. It is supported by a single pedestal of welded construction. The internal water-containing structure is equipped with a cathodic protection system. Maintenance was performed in 2012 when the interior and exterior were repainted.

The elevated water storage tank and appurtenances are in good condition. The tank has not been significantly damaged by internal or external corrosion. The tank's foundation is in good condition with little evidence of deterioration. The wet interior coating is an epoxy system that is in good condition 99.999 percent intact. The dry interior coating is an epoxy system that is in fair to good condition, 99.999 percent intact. The exterior coating is a polyurethane system that is in good condition, 99.999 percent intact.

The following maintenance is recommended. Associated probable costs for construction are provided for preparing a budget. These estimates do not include normal engineering costs:

Maintenance costs (2021):

Item	Recommended Repair	Estimated Cost
1	Modify access tube vent by replacing the screen with a rubber gasket per the Ten State Standards.	$2,000
2	Install wet interior roof hatch gasket per the Ten State Standards.	$ 300
3	Replace burned out aviation light bulb	In-house

Future maintenance costs (2026):

Item	Recommended Repair	Estimated Cost
1	Re-inspect tank	$4,500

INTRODUCTION

Nelson Tank Engineering & Consulting, Inc. (NTEC) conducted a maintenance inspection on the 200,000-gallon elevated storage tank owned by the City of Sault Ste. Marie. The inspection consisted of an evaluation of the condition of the tank and appurtenances, a review of the coatings' condition and an evaluation of potential environmental, health and safety concerns. The inspection was conducted by NTEC technicians Matt Otberg and Steve Kwart with the report reviewed by Keith Nelson, PE. Kirk Tews, Water Director, scheduled the inspection. The City provided personnel for assistance to expedite the inspection.

The interior surfaces were inspected using a remote operated vehicle (ROV). NTEC uses a Chasing Innovation Gladius Mini Underwater ROV submarine. The ROV is powered from a DC source that is tethered to the control unit. Live video images are sent to the operator's video monitor where they are recorded.

The submarine and tether are chlorinated to 200 ppm prior to placing into the tank. The tank's water is evaluated for chlorine residual prior to and post inspection. The testing indicated no drop in chlorine residual.

The inspection consists primarily of a visual observation of the condition of the tank, appurtenances, coatings and exposed foundations. The inspection was conducted in accordance with a combination of AWWA D101 methods and procedures developed by NTEC. Coatings are reviewed for percent intact based upon Steel Structures Painting Council (SSPC) visual standards. Coatings are reviewed for signs of failure that include but are not limited to lifting, delaminating, cracking and blistering. Defects, such as overspray, runs and sags, are discussed when they are determined remarkable.

The tank and appurtenances are reviewed for visual signs of corrosion or structural damage. Corrosion damage is evaluated by visual observations or by using depth gauges or calipers wherever possible. Ultrasonic testing is only used in instances where the original plate thickness cannot be established. Estimates of internal pitting are prepared for each of the individual locations (i.e., roof, sidewall, bowl and riser) by selecting a representative area within each location. The estimate for total pitting within each location is then extrapolated from the representative area.

Environmental testing is performed on coatings only when uncertainty exists. Testing, therefore, is not performed on epoxy or polyurethane coating systems. Samples are analyzed to determine the presence of metals (lead, chromium and cadmium) in the coating system. Samples are collected by removing coating from the steel substrate. The reliability of the results is highly dependent upon sampling techniques. Variations in accuracy may be caused by difficulties in removing all the primer, multiple coating systems and variations in dry film thickness.

Estimates of probable costs are provided within the recommendations and summary of this report for the construction year reported. Probable costs are based upon the competitive bidding prices for construction costs only and do not include engineering costs. Construction costs are evaluated for prices received in the past year for similar work plus inflation.

Estimates consider the method of surface preparation, applied coatings, surface area, complexity and location of the structure and environmental compliance requirements. Estimates do not consider variations imposed by market factors, revisions in the scope of work, work performed with restricted schedules or projects scheduled in low temperature seasons.

EVALUATION

WET INTERIOR

The tank is lined with an epoxy system applied in 2012. It is in good condition with no significant areas of deterioration. It has good adhesion with no signs of lifting, delamination or blistering. The coating has been stained from the mineral and iron content of the water. A few minor defects were observed in varying locations. The following is a description of the classifications of the remaining intact coating along with notable defects or the presence of corrosion.

The epoxy coating remains 99.999 percent intact along the roof and access tube. Coating deterioration is occurring on the couplings through the roof shell. Rust staining was noted at the top of the access tube.

The epoxy coating remains 100 percent intact along the bowl and equator. It is lightly stained at the water fluctuation line at the upper equator. There is also, light sediment buildup, less than a quarter inch, along the lower bowl plates.

The tank's interior steel plating is in good condition except for one equator plate where the steel is in poor condition. Corrosion has resulted where the coating system deteriorated. Damage to the interior tank has been minimal. Existing corrosion has been more aggressive above the water line along the top of the access tube and at the roof couplings.

Scale corrosion has developed along the exposed surface above the water line. The scale corrosion has manifested itself along roof couplings and top of the access tube. The scale is relatively minor and has had no significant impact.

Pitting has occurred in concentrated patterns below the water line along one equator plate. It was damaged by heavy pitting prior to the last maintenance painting. Currently, the coating appears to be protecting this area from further damage. Approximately 1,000 pits have exceeded one half the steel plate thickness (normally repaired) along the equator. For individual pit estimates refer to the field inspection report form.

The tank is equipped with a cathodic protection system. The cathodic protection system is, apparently, functioning properly as there is no evidence of active galvanic cell corrosion. The system is a horizontal design consisting of a titanium oxide anode connected to the access tube. The anode remains in its original design position with no obvious damage.

A ladder is connected to the access tube and descends to the bowl. It is in good condition with no significant corrosion damage observed. The rungs and rails remain intact with no obvious damage due to icing. The ladders have a rail-type fall prevention system which remains in good condition.

DRY INTERIOR

The tank is lined with an epoxy system applied in 2012. It is in good condition with intermittent signs of deterioration. The coating appears to have good adhesion with no significant areas of cracking, lifting or delamination. Several minor defects were observed in varying locations. The following is a description of the classifications of the remaining intact coating along with notable defects or the presence of corrosion.

The epoxy coating remains 99.999 percent intact along the basebell, pedestal and access tube. Minor deterioration of the coating was observed along the basebell threshold, pedestal platforms and stiffeners and along the lower portion of the access tube. The coating is lifting in these locations with surface corrosion forming. The epoxy coating remains 100 percent intact along the diaphragm plate with no apparent failures.

The appurtenances include piping, valves, ladders and balconies. Ladders are located in the basebell, pedestal and access tube. The ladders are in good condition with no significant corrosion damage observed. The ladders have a rail-type fall prevention system. The fall prevention system is in good condition. The rail appears in proper alignment with the hardware secured in place.

The tank includes the following piping: fill pipe, overflow pipe and condensate drain. All piping and support bracing are in good condition. There was no evidence of significant external corrosion.

The fill pipe is covered with a urethane insulation and aluminum frost jacket. The insulation is secured to the pipe in sections with taped seams. The frost jacket covers only the bottom section of the pipe within the basebell. The insulation covering is damaged on the section just below the upper platform. It appears that it was damaged during sandblasting of the interior during the last maintenance painting. A repair with loose insulation and tape has been made to this area. The remaining insulation and frost jacket are in good condition and all sections remain intact.

The condensate drain is a 2.5-inch pipe that is connected to the overflow pipe with a check valve. The pipe is in good condition with no significant external corrosion.

Two 3-inch mud valves are located in the lower diaphragm plate. They are designed for removal of sediments during routine cleaning. The valves were not opened during the inspection.

The valve vault is located below grade within the basebell. The vault contains the inlet/outlet piping and gate valve. The coating is in good condition on the piping.

The expansion joint is located in the basebell just above the valve vault. It is covered with insulation and shows no evidence of leaking.

EXTERIOR

The tank's exterior is coated with a polyurethane system applied in 2012. It is in good condition with no significant areas of deterioration. It has good adhesion with only a few signs of lifting and delamination. There are no significant misses or skips apparent in the finish coat. Several minor defects were observed in varying locations. The following is a description of the classifications of the remaining intact coating along with notable defects or the presence of corrosion.

The polyurethane coating remains over 99.999 percent intact along the basebell. A few coating breaks were noted along the lower portion of the basebell. The coating is beginning to fade and chalk.

The polyurethane coating remains over 100 percent intact along the pedestal, bowl and equator. The coating is faded and is beginning to chalk. Mildew was present on all sections; however, it is concentrated on the bowl.

The polyurethane coating remains over 99.9 percent intact along the roof. Several small coating breaks were noted mostly around the access tube. Rust staining was observed originating from the access tube vent.

The coating's adhesion was tested using a crosshatch adhesion method. This is a modified version of the ASTM D3359 and as a result does not replicate the same results as the ASTM. This modified test method is used by NTEC to determine the coating's overall adhesion and cohesion. NTEC uses this method for evaluation of coating systems for repair. When results indicate good adhesion, coatings may be top coated with compatible coating systems. Similarly, results indicating poor adhesion should not be top coated. The test, although important, is only one of the variables used to assess the coating's ability to be top coated. Other variables include, but are not limited to, the generic type of coating, the age of the coating, number of coats, percent intact, presence of defects or failure and dry film thickness.

The method consists of cutting a lattice pattern in the painted surface using a guide. Pressure sensitive tape is applied to the scribed area and then removed. The remaining pattern is evaluated by comparison with descriptions and illustrations. The illustrations are classified ranging from 0B to 5B. 0B represents greater than 65% removal of the coating and 5B represents fully intact coating.

Tests were performed on the roof and basebell. The following represents the classifications observed:

1. Roof 4B, 4B, 4B
2. Basebell 5B, 5B

The appurtenances include overflow pipe, vents, balcony and hatches. The overflow pipe and support bracing are located within the dry interior. The base of the pipe extends through the basebell. There was no evidence of significant external corrosion. The base of the overflow pipe has a screen to prevent contamination. The screen remains intact and in good condition. The screen does meet the requirements for the Ten State Standards for mesh size.

The splash pad is located below the overflow pipe drain opening and is in good condition. It is constructed out of concrete and the dimensions are 3 feet by 3 foot 4 inches.

The tank contains two vents: a frost free located near the center of the roof and an access tube design located at the center of the roof. The frost-free vent is in good condition. There was no evidence of significant internal or external corrosion. The screen remains intact and in good condition. The vent meets the requirements for the Ten State Standards.

The access tube vent is in poor condition. The interior coating has pinholes where surface corrosion has formed. The screen is in good condition; however, the band holding the screen on has light scale corrosion. This vent does not meet the requirements for the Ten State Standards.

The roof balcony is in good condition. No coating defects were noted. The roof, also, contains a painter's rail just outside the handrail. The painter's rail is, also, in good condition.

The tank contains three hatches: one at the top of the pedestal and two on the roof. The hatches are in good condition; however, the roof hatch does not contain a gasket per the Ten State Standards.

The exposed concrete foundation was visually inspected for deterioration, undermining and root encroachment. The foundation is in good condition with no signs of deterioration.

RECOMMENDATIONS

General

NTEC recommends reinspecting the tank in five (5) years to reevaluate the tanks condition and determine the rate of coating deterioration. The inspection will evaluate the coating's condition and the future repainting schedule. The inspection will, also, review the condition of the appurtenances for health and safety compliance.

Ten State Standards Modification

NTEC recommends modification of the existing access tube vent. The existing screen would be removed and a gasket would be secured to the opening using the existing bands. The bands will need to be sandblasted and painted prior to the installation of the gasket. All venting will occur at the frost-free vent. The access tube would be allowed to move per Chicago Bridge & Iron's original design. The estimated cost to modify the vent is $2,000.

We recommend installation of a gasket to the roof hatch. A gasket is required by the Ten State Standards. The estimated cost to furnish and install the gasket is $300.

FIELD REPORT FORM

I. GENERAL

OWNER:	City of Sault Ste. Marie	DATE:	November 16, 2021
ADDRESS:	W Allan Ln	HEIGHT:	65' HLW
TANK SIZE:	200,000-gallon	CONSTRUCTION:	Welded
TANK DESIGN:	Spheroid	LETTERING:	None
MANUFACTURE:	CBI	LOGO:	None
ERECTION DATE:	1992	COLOR:	Light blue
LEAD INSP:	Matthew Otberg	ASST INSP:	Steve Kwart

II. CONTROLS

CONTROL LOCATION:	Basebell	BRAND:	Aquatrol Digital Systems
TELEMETERED:	No	RADIO TRANS:	Yes
HEATED:	No	INSULATED:	No
CATHODIC PROTECTION:	Yes	MANUFACTURER:	Corrpro
RECTIFIER (MAN, AUTO):	Auto	OPERATIONAL:	Yes
ANODE MATERIAL:	Titanium oxide	CONFIGURATION:	Horizontal
ANY DAMAGE:	No	DESCRIBE:	N/A

III. VALVE VAULT

VAULT CONDITION:	Good	HEATED:	No
INSULATED:	No	WATER SEEPAGE:	No
PIPING CONDITION:	Good	COATING INTACT:	99.999%
EXPANSION JOINT TYPE:	N/A	CONDITION	N/A
ALTITUDE VALVE:	No	CONDITION:	N/A

IV. FOUNDATION

CONDITION OF CONCRETE:	Good
ANY APPARENT SETTLEMENT:	No
SOIL EROSION OR LACK OF COVER:	No
CRACKS:	No
DELAMINATION:	No
SPALLING:	No
AGGREGATE EXPOSED:	No
CONDITION OF GROUT:	Good
CONDITION OF BASE PLATES:	Good
CONDITION OF ANCHOR BOLTS:	Good

SHRUBS ENCROACHING:	No

V. EXISTING COATING HISTORY

SURFACE	DATE	PAINT SYSTEM	MANUFACTURER	CONTRACTOR
WET INTERIOR:	2012	Epoxy	Unknown	Unknown
DRY INTERIOR:	2012	Epoxy	Unknown	Unknown
EXTERIOR:	2012	Polyurethane	Unknown	Unknown

VI. EXTERIOR CONDITIONS

A. PEDESTAL

NUMBER OF SECTIONS:	1 Bell, 7 pedestal +1 transition
GENERAL CONDITION OF COATING:	Good
PERCENT TOPCOAT INTACT:	99.999
PERCENT INTERMEDIATE/ PRIMER INTACT:	99.999
ADHESION TEST:	5B, 5B basebell
CONDITION OF INSULATION/FROST JACKET:	N/A
RISER TIE BANDS:	N/A
COMMENTS:	A few minor spots of corrosion on basebell. Coating is beginning to fade and chalk. Weld seams on pedestal show minor mildew buildup.

B. BOWL

DESIGN:	Hemisphere
NUMBER OF SECTIONS:	2
GENERAL CONDITION OF COATING:	Good
PERCENT TOPCOAT INTACT:	100
PERCENT INTERMEDIATE/PRIMER INTACT:	100
COMMENTS:	Covered in heavy mildew buildup.

C. EQUATOR

NUMBER OF SHELL SECTIONS:	1
GENERAL CONDITION OF COATING:	Good
PERCENT TOPCOAT INTACT:	100
PERCENT INTERMEDIATE/PRIMER INTACT:	100
ADHESION TEST:	N/A

COMMENTS:	Light mildew buildup.

D. ROOF

DESIGN:	Hemisphere
GENERAL CONDITION OF COATING:	Fair
PERCENT TOPCOAT INTACT:	99.9
PERCENT INTERMEDIATE/PRIMER INTACT:	99.9
ADHESION TEST:	4B, 4B, 4B
COMMENTS:	Some lifting of the coating around access tube. Roof covered in ice.

E. ACCESSORIES

LADDER CONDITION:	--	FALL PREVENTION:	--
CAGED:	--	IF YES, WHERE:	--
SHELL LADDER FIXED:	--	ROOF LADDER FIXED:	--
OVERFLOW PIPE SIZE:	8”	CONDITION:	Good
SCREEN SIZE:	24 mesh	CONDITION:	Good
STUB:	No	GROUND LEVEL:	Yes
FLAP GATE:	Yes	SPLASH PAD MEASUREMENT:	3’ x 3’4”
RIP RAP:	No	SLOPED FROM TANK:	Yes
SHELL MANWAY SIZE	--	GASKET CONDITION:	--
RISER MANWAY SIZE:	--	GASKET CONDITION:	--
MUD VALVE:	No	SIZE:	--
CONDITION OF ROOF VENT:	Good	DESIGN:	Frost free
VACUUM RELIEF:	Yes	DISTANCE FROM SCREEN TO ROOF:	21”
SCREEN SIZE:	24 mesh	SCREEN CONDITION:	Good
CONDITION OF ACCESS TUBE VENT:	Poor	SCREEN POSITION:	Horizontal
SCREEN SIZE:	>24 mesh	SCREEN CONDITION:	Good
BANDS:	Yes	BAND CONDITION:	Good/fair
DISTANCE FROM SCREEN TO ROOF:	8”	-BLANK-	--
CATHODIC CAPS:	No	MISSING OR SLIPPED:	--
ROOF HATCH #1 SIZE:	30”	CONDITION:	Good
GASKET:	No	HASP LOCKED:	No lock
ROOF HATCH #2 SIZE:	--	CONDITION:	--
GASKET:	--	HASP LOCKED:	--

AVIATION LIGHTS:	Yes	CONDITION:	1 bulb burned out
OBSTRUCTIONS:	No	ANTENNAE:	No
BALCONY OR HANDHOLD:	Handhold	LOCATION:	Center roof
CONDITION:	Good	-BLANK-	--

VII. INTERIOR CONDITIONS

A. DRY INTERIOR

1. BASEBELL

GENERAL CONDITION OF COATING:	Good
PERCENT TOPCOAT INTACT:	99.999
PERCENT INTERMEDIATE/PRIMER INTACT:	99.999
COMMENTS:	Corrosion at entrance, as well as lifting on condensate platform support beam.
FILL PIPE DIAMETER:	12"
INSULATION TYPE:	Polyurethane
CONDITION:	Good
FROST JACKET:	Yes
EXPANSION JOINT:	Yes
DESIGN AND CONDITION:	Covered by insulation
LADDER CONDITION:	Good
CAGED:	No
FALL PREVENTION DEVICE:	None
CONDENSATE DRAIN CONDITION:	Good
PIPE SUPPORTS CONDITION:	Good
LIGHTING CONDITION:	Working

2. PEDESTAL

GENERAL CONDITION OF COATING:	Good
PERCENT TOPCOAT INTACT:	99.999
PERCENT INTERMEDIATE/PRIMER INTACT:	99.999
COMMENTS:	Pinhole corrosion on condensate platform and pedestal plate sections. Lifting on stiffener ring.
FILL PIPE INSULATION CONDITION:	Fair
FROST JACKET:	No

EXPANSION JOINT:	No
DESIGN AND CONDITION:	N/A
LADDER CONDITION:	Good
CAGED:	No
FALL PREVENTION DEVICE:	Rail
PIPE SUPPORTS CONDITION:	Good
LIGHTING CONDITION:	Working

3. DIAPHRAGM

GENERAL CONDITION OF COATING:	Good
PERCENT TOPCOAT INTACT:	100
PERCENT INTERMEDIATE/PRIMER INTACT:	100
COMMENTS:	No apparent failures.
MUD VALVE:	Yes (X2)
SIZE:	Both @ 3"
COMPRESSION MANWAY:	No
SIZE:	N/A
GASKET CONDITION:	N/A

4. ACCESS TUBE

GENERAL CONDITION OF COATING:	Good
PERCENT TOPCOAT INTACT:	99.999
PERCENT INTERMEDIATE/PRIMER INTACT:	99.999
COMMENTS:	Minor pinhole corrosion on bottom section.
LADDER CONDITION:	Good
FALL PREVENTION DEVICE:	Rail
PIPE SUPPORTS CONDITION:	Good
COMPRESSION MANWAY SIZE:	18X24
GASKET CONDITION:	Unknown - hatch not removed
LIGHTING CONDITION:	Working

B. WET INTERIOR

1. BOWL

GENERAL CONDITION OF COATING:	Good
PERCENT TOPCOAT INTACT:	100
PERCENT INTERMEDIATE/PRIMER INTACT:	100

ACTIVE CORROSION:	No	TYPE:	N/A
CONCENTRATION:	N/A	INACTIVE CORROSION:	No
DEEPEST PIT:	N/A	AVG PIT DEPTH:	--
PIT ESTIMATE:	0	WELDING ESTIMATE:	0
PRIOR PIT WELDS:	No	# TO GRIND:	--
STRAY WELDS:	No	LINEAL ESTIMATE:	--
FILL PIPE DIAMETER:	12"	DRAIN DIAMETER:	--
ADDTNL PIPING:	No	CONDITION:	--
MIXING SYSTEM:	No	CONDITION:	--
COMMENTS:	The upper bowl has light sediment buildup on the weld seams. Sediment buildup is more heavily concentrated on the lower bowl.		

2. EQUATOR

GENERAL CONDITION OF COATING:		Good	
PERCENT TOPCOAT INTACT:		100	
PERCENT INTERMEDIATE/PRIMER INTACT:		100	
ACTIVE CORROSION:	No	TYPE:	--
CONCENTRATION:	N/A	INACTIVE CORROSION:	Yes
DEEPEST PIT:	≈1/8"	AVG PIT DEPTH:	≈1/16"
PIT ESTIMATE:	10,000	WELDING ESTIMATE:	1,000
PRIOR PIT WELDS:	No	# TO GRIND:	0
STRAY WELDS:	No	LINEAL ESTIMATE:	--
PAINTER'S RAIL:	No	STIFFENER:	No
ANY LADDER:	No	CONDITION:	--
FALL PREVENTION:	N/A	CONDITION:	--
COMMENTS:	The equator is lightly stained in some areas. One plate section is heavily pitted; however, the existing coating is protecting the area.		

3. ACCESS TUBE

GENERAL CONDITION OF COATING:		Good	
PERCENT TOPCOAT INTACT:		99.999	
PERCENT INTERMEDIATE/PRIMER INTACT:		99.999	
ACTIVE CORROSION:	Yes	TYPE:	Surface
CONCENTRATION:	Connection to roof	INACTIVE CORROSION:	No
DEEPEST PIT:	N/A	AVG PIT DEPTH:	--
PIT ESTIMATE:	0	WELDING ESTIMATE:	0
PRIOR PIT WELDS:	No	# TO GRIND:	0
STRAY WELDS:	No	LINEAL ESTIMATE:	0

PAINTER'S RAIL:	No	STIFFENER:	Yes
ANY LADDER:	Yes	CONDITION:	Good
FALL PREVENTION:	Rail	CONDITION:	Good
WEIR DESIGN:	Anti-vortex plate	CONDITION:	Good
COMMENTS:	Minor staining at the water fluctuation line. A few minor drips and runs noted.		

4. ROOF

GENERAL CONDITION OF COATING:		Good	
PERCENT TOPCOAT INTACT:		99.999	
PERCENT INTERMEDIATE/PRIMER INTACT:		99.999	
ACTIVE CORROSION:	Yes	TYPE:	Surface
CONCENTRATION:	Roof couplings	INACTIVE CORROSION:	No
DEEPEST PIT:	N/A	AVG PIT DEPTH:	--
PIT ESTIMATE:	0	WELDING ESTIMATE:	0
ROOF BEAMS:	N/A	DESIGN:	--
NUMBER:	N/A	CONDITION:	--
CORROSION TYPE:	N/A	EST. PERCENT LOSS:	--
BOLTS:	N/A	CONDITION:	--
COMMENTS:	A light frost was on portions of the coating.		

Note: Percentage of intact coating is based upon visual observation of actual paint remaining in comparison to SSPC-Guide Visual Standard No. 2, Figure 1. It does not indicate the coating has good adhesion, is free from defects or is failing. Any surface preparation estimates should consider these variables.

VIII. RECOMMENDATIONS

REPAIRS:	Install wet interior roof hatch gasket per the Ten State Standards. Modify access tube vent by replacing the screen with a rubber gasket per the Ten State Standards. Budget to pit weld 1,000 pits the during the next wet interior rehabilitation.

PAINTING:	N/A

MISC:	Replace burned out aviation light bulb.

CROSS HATCH TEST FIGURE

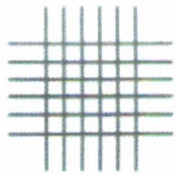
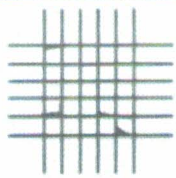
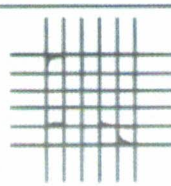
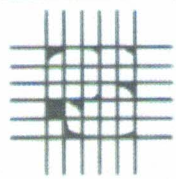
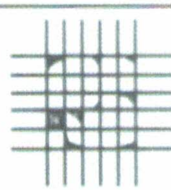
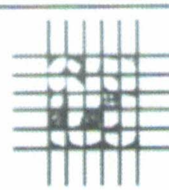
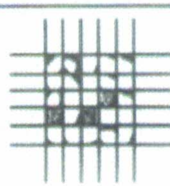
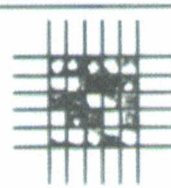
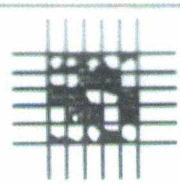
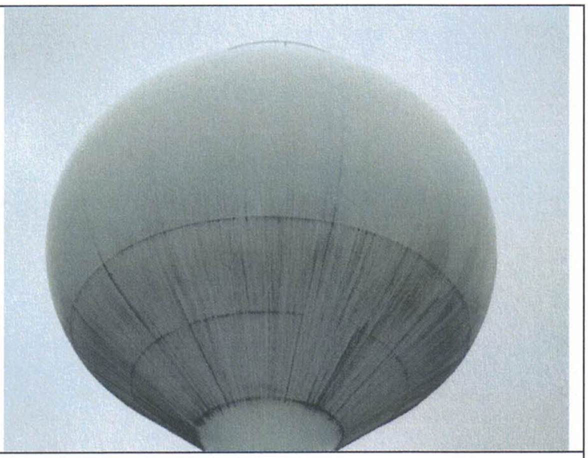
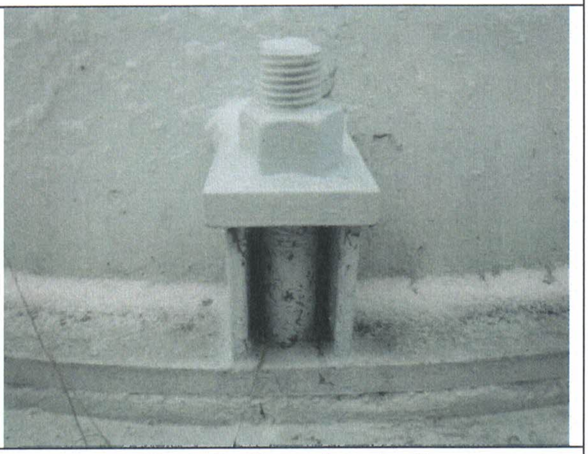
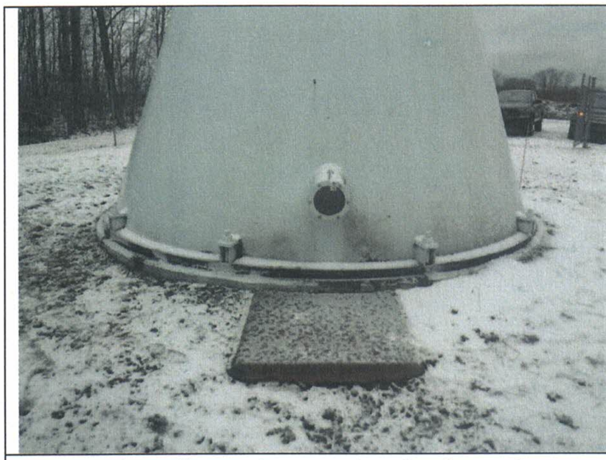
CLASSIFICATION OF ADHESION TEST RESULTS		
CLASSIFICATION	PERCENT AREA REMOVED	SURFACE OF CROSS-CUT AREA FROM WHICH FLAKING HAS OCCURRED FOR SIX PARALLEL CUTS AND ADHESION RANGE BY PERCENT
5B	0% None	
4B	Less than 5%	
3B	5 - 15%	 
2B	15 - 35%	 
1B	35 - 65%	 
0B	Greater than 65%	

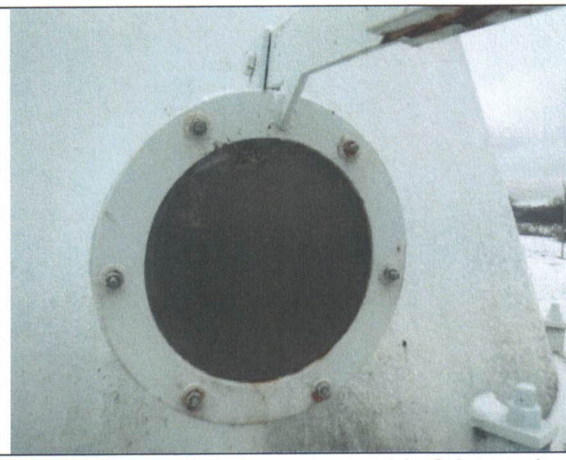
FIG. 1 Classification of Adhesion Test Results

PHOTOGRAPHS

	
200,000-gallon tank owned by the City of Sault Ste. Marie	Exterior equator and bowl
	
Exterior pedestal	Exterior basebell
	
Typical view of foundation and grout	Basebell anchor bolt

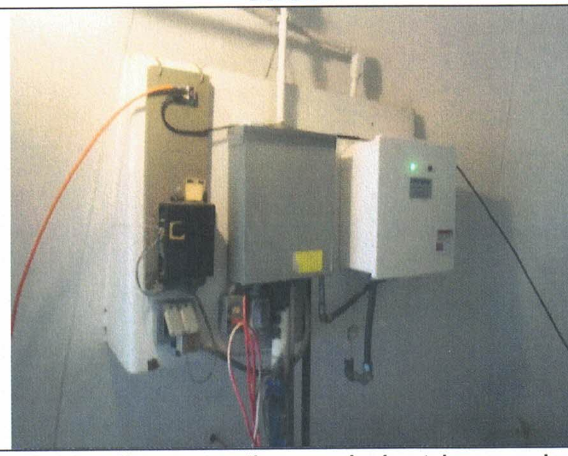


Overflow pipe and splash pad

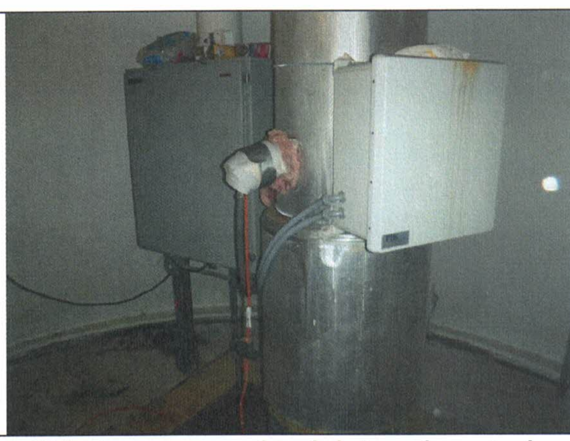


Overflow pipe flap gate with 24-mesh screen

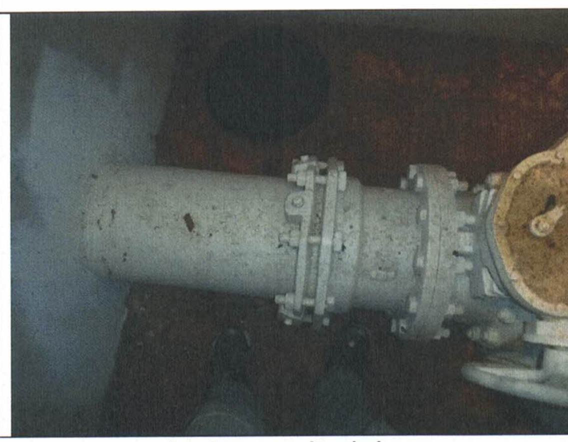
Minor coating breaks at basebell entrance



Cathodic protection and electric panels

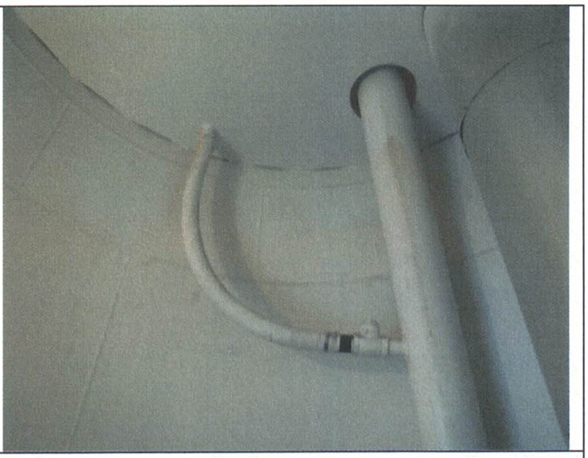


Fill pipe, expansion joint and controls



Valve vault piping

Corrosion at condensate platform support beam



Condensate drain hose connection to overflow pipe

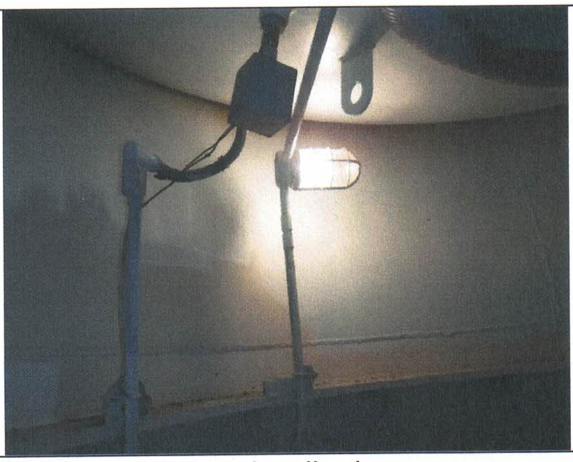
Corrosion on condensate platform

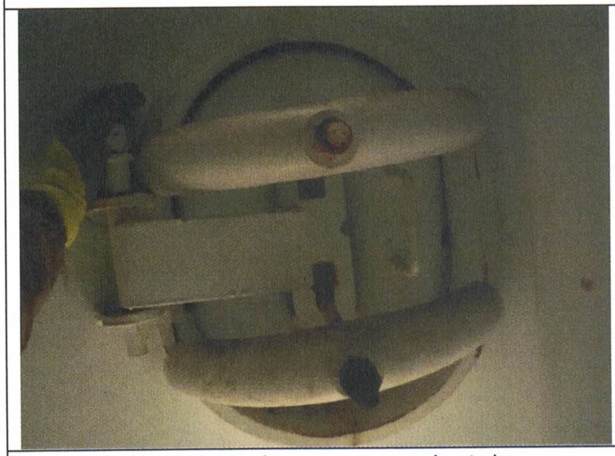
Dry interior pedestal

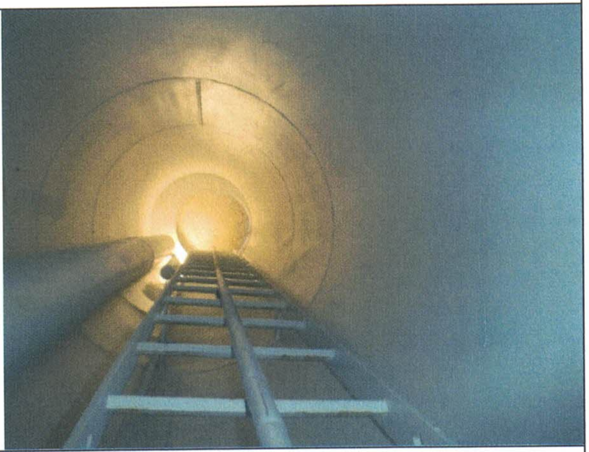
Lifting at pedestal stiffener ring

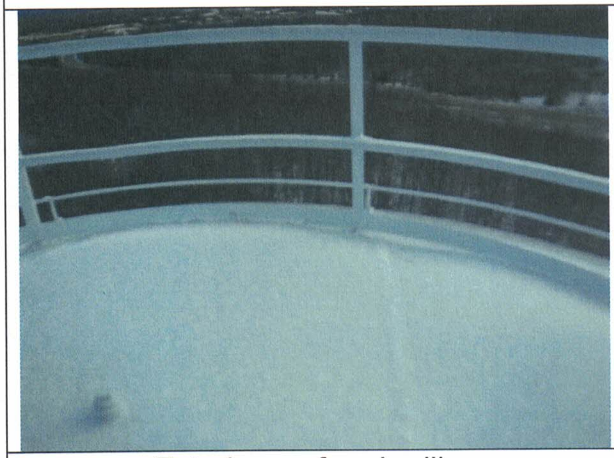
Damage to fill pipe insulation at upper pedestal


Upper platform

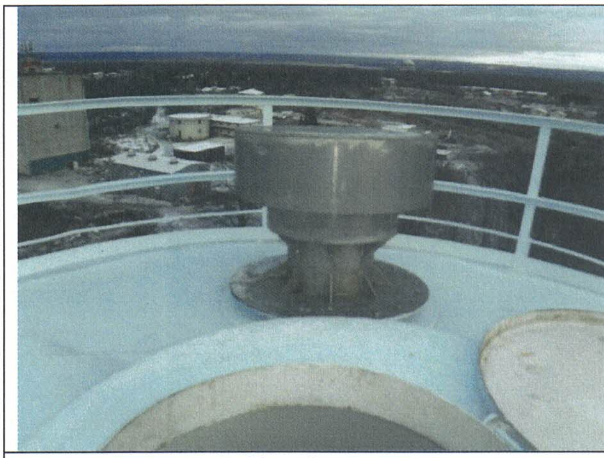

Dry interior diaphragm


Access tube manway hatch

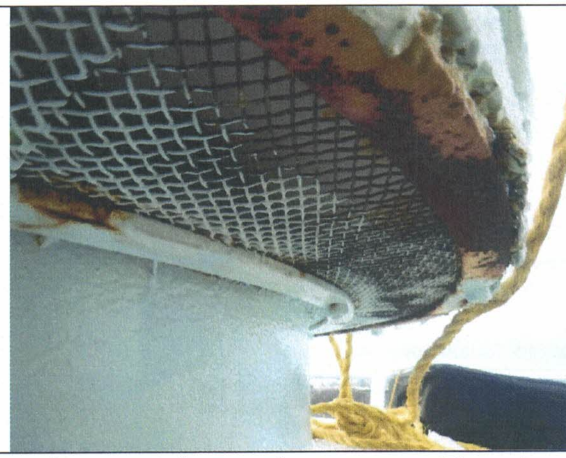

Dry interior access tube


Exterior roof and railing

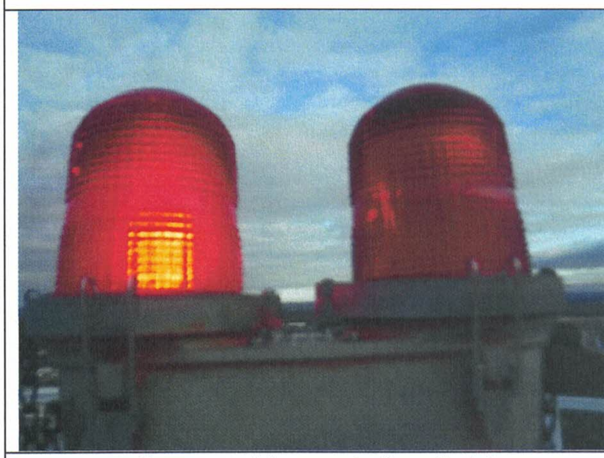

Exterior roof and railing



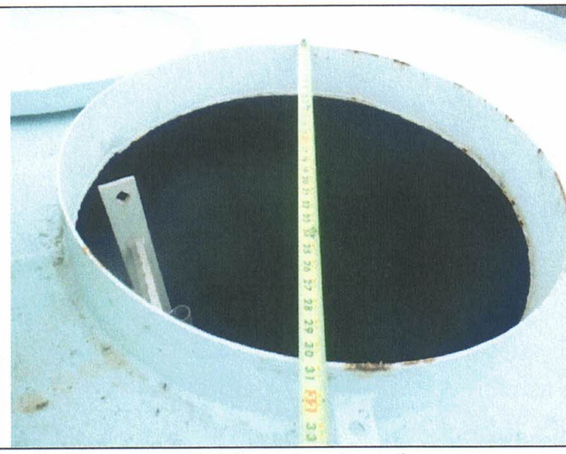
Roof vent



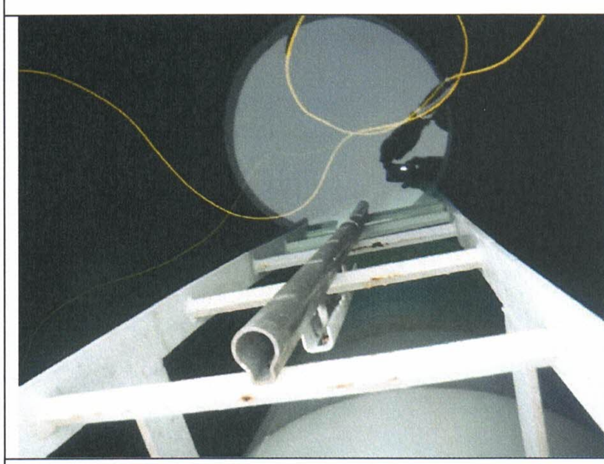
Access tube vent screen and bands



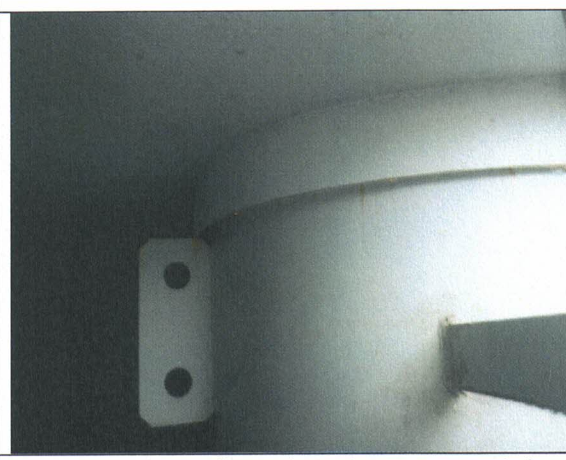
One working aviation light



Wet interior hatch



Wet interior ladder



Top section of wet interior access tube meeting with roof

	
Wet interior roof	Wet interior roof

SIOUX	SF11-DTTM

Steam-Flo

Steam-Flo Features Include:
• Redundant safety controls: auto reset pressure switch, manual reset pressure switch, ASME pressure relief valve, pressure gauge, water feeder with level switch, manual reset level switch, check valve, and inlet water screens
• Full steam production within 5-10 minutes of start-up
• Continuous supply of steam
• NEMA 4 electrical enclosure
• Safety Standards: UL-508A/CSA C22.2#14; ASME Section IV, CRN

Electrical & Mechanical Information			
Voltage	Phase	Hertz	Operating Current Amps
115	1	60	16

Performance				
Boiler HP	Heat Input BTU/Hr	Steam Output Lbs/Hr	Max Steam Pressure PSIG	Max Steam Temperature °F
11	427,000	380	15	250

Connections			
Water Inlet	Steam Outlet	Fuel Inlet	Flue Size
3/4” Garden Hose	4” NPT	3/8” Hose Barb	6”

Water Supply		
Total Boiler Volume	Operating Boiler Volume	Heat Transfer Surface
57 Gallons	47 Gallons	65 sq ft

Fuel Supply	
Fuel Type	Fuel Usage
Diesel	3 GPH

Weight & Dimensions					
Length		Width		Height	
in	mm	in	mm	in	mm
202	5,137	83	2,103	75	1,904
Weight			3,100 (lbs), 1,450 (kgs)		

For More Info Visit sioux.com

SIOUX	SF-20D-ENC

Steam-Flo

Steam-Flo Features Include:
- Redundant safety controls: auto reset pressure switch, manual reset pressure switch, ASME pressure relief valve, pressure gauge, water feeder with level switch, manual reset level switch, check valve, and inlet water screens
- Full steam production within 5-10 minutes of start-up
- Continuous supply of steam
- NEMA 4 electrical enclosure
- Safety Standards: UL-508A/CSA C22.2#14; ASME Section IV, CRN

Electrical & Mechanical Information			
Voltage	Phase	Hertz	Operating Current Amps
115	1	60	3

Performance				
Boiler HP	Heat Input BTU/Hr	Steam Output Lbs/Hr	Max Steam Pressure PSIG	Max Steam Temperature °F
20	791,000	690	15	250

Connections			
Water Inlet	Steam Outlet	Fuel Inlet	Flue Size
3/4” Garden Hose	4” NPT	3/8” Hose Barb	10”

Water Supply		
Total Boiler Volume	Operating Boiler Volume	Heat Transfer Surface
143 Gallons	100 Gallons	118 sq ft

Fuel Supply	
Fuel Type	Fuel Usage
Diesel	6 GPH

Weight & Dimensions					
Length		Width		Height	
in	mm	in	mm	in	mm
278	7,068	102	2,591	117	2,959
Weight			7,100 (lbs), 3,250 (kgs)		

For More Info Visit sioux.com

Hi Kirk,

Thank you for your interest in Sioux equipment!

Per our conversation I've included spec sheets for the two models I feel would best suit your needs. See pricing and availability below:

SF11-DTTM: $37,388.00 (unit only)
Lead Time: 13-15 weeks

SF-20D-ENC: $84,084.00 (unit only)
Lead Time: 2 new in stock, 13-15 weeks to build new one later.

*Quote does not include freight
**Credit card payments are subject to a 2% surcharge.

Please give me a call if you would like a formal quote.

Regards,

Brian S Johnson
Industry Sales Specialist

Ph: 605.763.4028
brian@sioux.com

SIOUX

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