PUMP STATION DESIGN SUMMARY
FOR
LEE COUNTY SOLID WASTE TRANSFER STATION
EMPLOYEE BUILDING

June 2024

PREPARED FOR:

LEE COUNTY SOLID WASTE

PREPARED BY:

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1. PROJECT SUMMARY

1.1 Objective

The objective of this engineering report is to present and explain the design of a grinder pump station that will effectively service the estimated waste generated from the proposed project and its intended uses. Furthermore, the contents of this document have been crafted to provide adequate sewer design documentation for governmental agency permit reviews of the Florida Department of Environmental Protection (FDEP).

1.2 Project Identification and Location

Project Name	Lee County Solid Waste Transfer Station Employee Building
S/T/R	24/ 44S / 25 E
Street Address	10450-10550 Buckingham Road Fort Myers, Florida 33905
Strap No.	26-24-25-00-00001.0000

1.3 Project Description

The proposed project will feature the addition of a 3,372 SF modular employee building and associate parking located at the Lee County Waste Transfer Station site. Wastewater from the building will be collected by a 6" sewer service and directed to the proposed pump station. A proposed 2" force main will tie into an existing 12" gravity service main.

2. LIFT STATION CALCULATIONS

2.1. Design Flows

Design Flows								
# of employees	**Demand per Employee (gpd)***	**# shifts**	**Average Daily Demand (gpd)**	**Average Daily Demand (gpm)**	**Peak Hour Flow Factor****	**Design Peak Flow (gpd)**	**Design Peak Flow (gph)**	**Design Peak Flow (gpm)**
34	25	2	1,700	1	3.5	5,950	248	4.1

*demand per person = 15 gpd + 10 gpd for shower

** per Lee County Utilities Design Manual

2.2. System Head Calculations

Pressure Head

The force main will be discharging into an existing gravity main, therefore no pressure head was included in the calculation.

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Static Head

Elevation of Highest Point in Force Main	22.00	ft
Elevation Influent Invert at Pump Station	16.00	ft
Elevation of High Water Alarm Elevation	15.50	ft
Elevation of Lag Pump "On" Level	15.00	ft
Elevation of Lead Pump "On" Level	14.50	ft
Elevation of Pump "Off" Level	14.00	ft

Max Static Head = Elevation of High Point in FM - Pump Off	8.00	ft
Min Static Head = Elevation of High Point in FM - Pump On	7.50	ft

Pipe Friction Losses

D = Dia. in inches
Q = Flow in GPM
L = Length in Feet
C = C factor
V = Velocity in fps

H_L = Friction head loss in feet and psi

$$h = (10.44)(L)\frac{(gpm^{1.85})}{(C^{1.85})(d^{4.8655})}$$

Pipe Network

Force Main	2” CL200 DR14 PVC	438 LF
Pump Station pipe	1-1/4” CL200 DR14 PVC	10 LF
PVC C factor		110

Friction Losses at 2” Force Main

D (IN)	**Q** (GPM)	**L** (FT)	**C**	**H_L** (FT)	(PSI)	**V** (FPS)
2	2	438	110	0.09	0.04	0.20
2	4	438	110	0.34	0.15	0.41
2	6	438	110	0.72	0.31	0.61
2	8	438	110	1.23	0.53	0.82
2	10	438	110	1.86	0.80	1.02
2	15	438	110	3.93	1.70	1.53
2	20	438	110	6.70	2.90	2.04
2	24	438	110	9.38	4.06	2.45
2	25	438	110	10.12	4.38	2.55
2	30	438	110	14.18	6.14	3.06
2	35	438	110	18.86	8.16	3.57

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Friction Losses at 1-1/4" Pump Station

D (IN)	**Q** (GPM)	**L** (FT)	**C**	**H_L** (FT)	(PSI)	**V** (FPS)
1.25	2	12	110	0.03	0.01	0.52
1.25	4	12	110	0.09	0.04	1.05
1.25	6	12	110	0.19	0.08	1.57
1.25	8	12	110	0.33	0.14	2.09
1.25	10	12	110	0.50	0.22	2.61
1.25	15	12	110	1.06	0.46	3.92
1.25	20	12	110	1.81	0.78	5.23
1.25	24	12	110	2.53	1.10	6.27
1.25	25	12	110	2.73	1.18	6.54
1.25	30	12	110	3.82	1.66	7.84
1.25	35	12	110	5.09	2.20	9.15

Fitting Losses at Force Main

Fitting	Quantity	K	Total K
Bend - 90°	0	0.8	0
Bend - 45°	0	0.2	0
Bend - 22.5°	0	0.15	0
Bend - 11.25°	0	0.1	0
Plug Valve	0	0.77	0
Cross	0	0.5	0
Expansion Fitting	0	0.57	0
Wye (Side Outlet)	1	0.5	0.5
Reducer	0	0.25	0
Tee (Straight Run)	0	0.35	0
outlet loss	0	1	0.00

Q (GPM)	Q CFS	A SF	V ft/s	K_{TOT}	Minor head loss
2	0.004	0.022	0.20	0.50	0.000
4	0.009	0.022	0.41	0.50	0.001
6	0.013	0.022	0.61	0.50	0.003
8	0.018	0.022	0.82	0.50	0.005
10	0.022	0.022	1.02	0.50	0.008
15	0.033	0.022	1.53	0.50	0.018
20	0.045	0.022	2.04	0.50	0.032
24	0.053	0.022	2.45	0.50	0.047
25	0.056	0.022	2.55	0.50	0.051
30	0.067	0.022	3.06	0.50	0.073
35	0.078	0.022	3.57	0.50	0.099

Total K for all Fittings (K_{TOT}) 0.50

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Fitting Losses at Pump Station

Fitting	Quantity	K	Total K
Bend - 90°	2	0.8	1.6
Bend - 45°	0	0.2	0
Check Valve	1	2.5	2.5
Gate Valve	1	0.19	0.19
Plug Valve	0	0.77	0
Cross	0	0.5	0
Expansion Fitting	0	0.57	0
Wye (Side Outlet)	0	0.5	0
Reducer	0	0.25	0
Tee(Straight Run)	0	0.35	0
Tee(Branch Run)	1	0.5	0.5

Q (GPM)	Q CFS	A SF	V ft/s	K_{TOT}	Minor head loss
2	0.004	0.009	0.52	4.79	0.020
4	0.009	0.009	1.05	4.79	0.081
6	0.013	0.009	1.57	4.79	0.183
8	0.018	0.009	2.09	4.79	0.325
10	0.022	0.009	2.61	4.79	0.508
15	0.033	0.009	3.92	4.79	1.144
20	0.045	0.009	5.23	4.79	2.033
24	0.053	0.009	6.27	4.79	2.928
25	0.056	0.009	6.54	4.79	3.177
30	0.067	0.009	7.84	4.79	4.575
35	0.078	0.009	9.15	4.79	6.228

Total K for all Fittings (K_{TOT}) 4.79

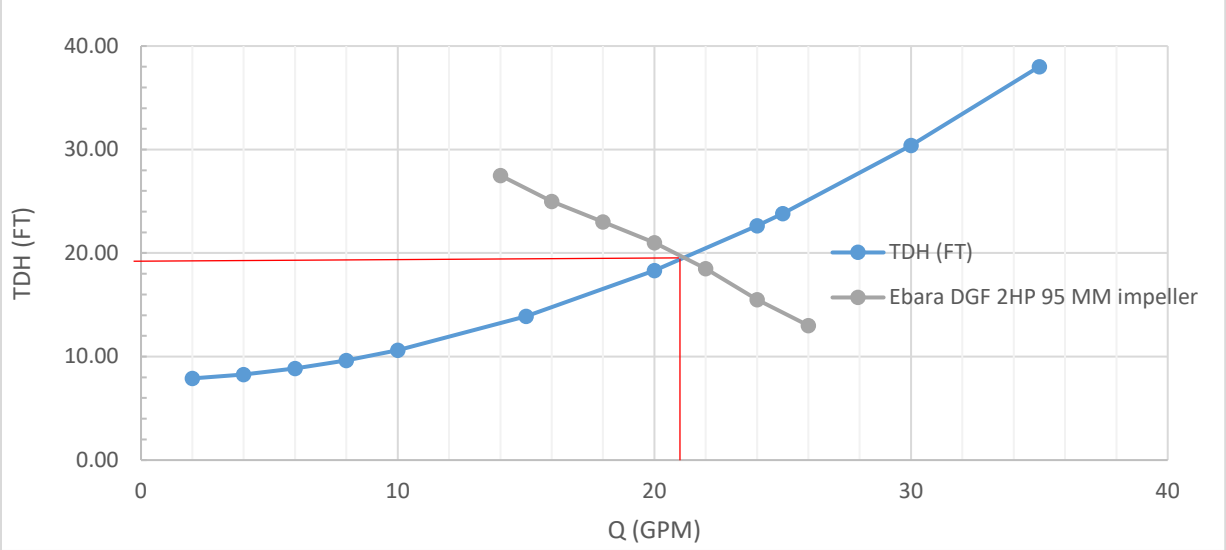
Total Discharge Head

Q (GPM)	Pressure Head (FT)	Avg. Static Head (FT)	Minor Head loss @ Pump Station (FT)	Minor Head Loss @ FM (FT)	Friction Head 2" PVC (FT)	Friction Head 1.25" PVC (FT)	TDH (FT)
2	0	7.75	0.02	0.00	0.09	0.03	7.89
4	0	7.75	0.08	0.00	0.34	0.09	8.27
6	0	7.75	0.18	0.00	0.72	0.19	8.85
8	0	7.75	0.33	0.01	1.23	0.33	9.64
10	0	7.75	0.51	0.01	1.86	0.50	10.62
15	0	7.75	1.14	0.02	3.93	1.06	13.91
20	0	7.75	2.03	0.03	6.70	1.81	18.32
24	0	7.75	2.93	0.05	9.38	2.53	22.64
25	0	7.75	3.18	0.05	10.12	2.73	23.83
30	0	7.75	4.58	0.07	14.18	3.82	30.40
35	0	7.75	6.23	0.10	18.86	5.09	38.02

2.3. Pump Selections

Due to the low flow, a pump that provides the minimum pump run time design criteria of 2 minutes was selected:

Ebara DGF with 95 mm impeller
2 HP, 3 phase, 230 volts.
Q_D = Design Pumping Rate = 21 gpm at 19.5'



2.4. Pump Run Time and Cycle Time

A. Design Parameters:
Q_A = Average Flow = 1.2 gpm
Q_P = Peak Flow = 4.1 gpm
Q_D= Design Pumping Rate = 22 gpm
Minimum Pump Run Time = 2 minutes
Maximum Cycle Time for Average Flow = 30 minutes per cycle (2 cycles per hour)
Minimum Cycle Time for Peak Flow = 6 minutes per cycle (10 cycles per hour)

B. 4' diameter wet well storage volume = 94 gal/ft
V_{WW} = Wet Well Storage Volume from Lead Pump "On" Level to Pump "Off" Level (gal)
V_{WW} = 47 gal

C. Minimum Pump Run Time:

$$T = \frac{V_w}{Q_d}$$

where:
T = minimum run time in minutes
V_w = Storage volume of wet well in gallons
Q_D = Design Pumping Rate in gpm

$$T = \frac{47\ gal}{22\ gpm} = 2.2\ min$$ > 2.0 min minimum run time

D. Pump Cycle Time at Average Flow:

$T_{avg} = \frac{V_w}{Q_D - Q_A} + \frac{V_w}{Q_A}$

where:

T_{avg} = cycle time in minutes
V_w = Storage volume of wet well in gallons
Q_D = Design Pumping Rate in gpm
Q_A = Average Flow in gpm

$T_{avg} = \frac{47 \text{ gal}}{22 \text{ gpm} - 1.2 \text{ gpm}} + \frac{47 \text{ gal}}{1.2 \text{ gpm}} = 42 \text{ minutes/cycle}$ or 1.4 cycles/hr

E. Pump Cycle Time at Peak Flow:

$T_{peak} = \frac{V_w}{Q_D} + \frac{V_w}{Q_{peak}}$

$where$:

T_{peak} = cycle time in minutes
V_w = Storage volume of wet well in gallons
Q_D = Design Pumping Rate in gpm
Q_{peak} = Peak Flow in gpm

$T_{peak} = \frac{V_w}{Q_D} + \frac{V_w}{Q_{peak}}$

$T_{peak} = \frac{47}{22\ gpm} + \frac{47}{4.1\ gpm} = 14\ minutes/cycle$ or 4.4 cycles/hr

F. Force Main Size Check:

Q = VA
V = Q/A

Q_D = 21 gpm = 0.047 cfs

Force Main (2”): V = 0.047 cfs /π x (2 in/12 ft/in)^2
V = 2.14 ft/s

At Lift Station (1.25”): V = 0.047 cfs / π x (1.25 in/12 ft/in)^2
V = 5.49 ft/s

Velocities are between the recommended range 2.0 ft/s to 6.0 ft/s therefore okay.

APPENDIX

Exhibit A

64E-6.008 System Size Determinations.

(1) Minimum design flows for systems serving any structure, building or group of buildings shall be based on the estimated daily sewage flow as determined from Table I or the following:

(a) The DOH county health department shall accept, for other than residences and food operations, metered water use data in lieu of the estimated sewage flows set forth in Table I. For metered flow consideration, the applicant shall provide authenticated monthly water use data documenting water consumption for the most recent 12 month period for at least six similar establishments. Similar establishments are those like size operations engaged in the same type of business or service, which are located in the same type of geographic environment, and which have approximately the same operating hours. Metered flow values will not be considered to be a reliable indicator of typical water use where one or more of the establishments utilized in the sample has exceeded the monthly flow average for all six establishments by more than 25 percent or where the different establishments demonstrate wide variations in monthly flow totals. When metered flow data is accepted in lieu of estimated flows found in Table I, the highest flow which occurred in any month for any of the six similar establishments shall be used for system sizing purposes. Except for food operations which exceed domestic sewage waste quality parameters as defined in subsection 64E-6.002(15), F.A.C., where an existing establishment which has been in continuous operation for the previous 24 months seeks to utilize its own metered flows, the applicant shall provide authenticated monthly water use data documenting water consumption for the most recent 24 month period. The highest monthly metered flow value for an existing establishment shall be used for system sizing purposes.

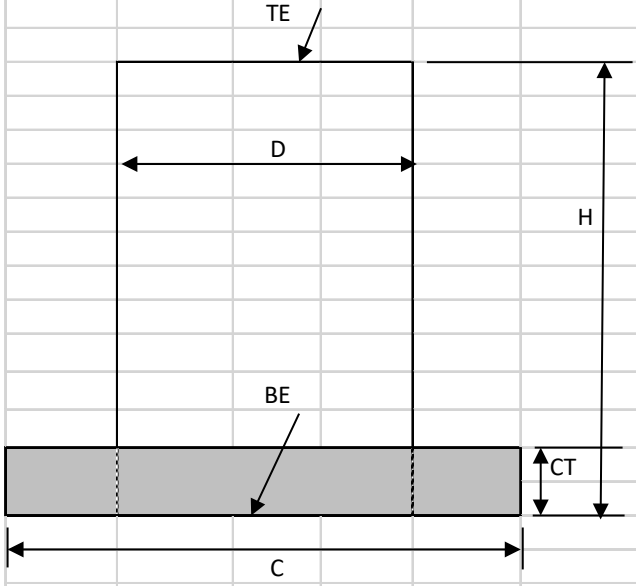
(b) When onsite systems use multiple strategies to reduce the total estimated sewage flow or the drainfield size, only one reduction method shall be credited.

TABLE I
For System Design
ESTIMATED SEWAGE FLOWS

TYPE OF ESTABLISHMENT	GALLONS PER DAY
COMMERCIAL:	
Factories, exclusive of industrial wastes	
gallons per employee per 8 hour shift	
(a) No showers provided	15
(b) Showers provided	25
Office building	15
per employee per 8 hour shift or	
per 100 square feet of floor space,	15
whichever is greater	
Transient Recreational Vehicle Park	
(a) Recreational vehicle space for overnight stay, without water and sewer hookup per vehicle space	50
(b) Recreational vehicle space for overnight stay, with water and sewer hookup per vehicle space	75
Service stations per water closet	
(a) Open 16 hours per day or less	250
(b) Open more than 16 hours per day	325
Shopping centers without food or laundry	0.1
per square foot of floor space	
Stadiums, race tracks, ball parks per seat4	
Stores per bathroom	100
Swimming and bathing facilities, public	10
per person	
Theatres and Auditoriums, per seat	4

Exhibit B

Buoyancy Calculations



D =	**4.00**	FT =	Wetwell Diameter
C =	**7.75**	FT =	Collar Diameter
CT =	**2.00**	FT =	Collar Thickness
H =	**12.00**	FT =	Height of Wetwell
TE =	**23.00**	FT =	Top Elevation
BE =	**13.00**	FT =	Bottom Elevation

Assumptions:

Concrete	= 150	LBS/FT ^{3}
Saturated Soil	= 100	LBS/FT
Water	= 62.4	LBS/FT ^{3}
No water in Wet Well		
Neglect Soil Friction		
Neglect Equipment Weight		
Neglect Wet Well Weight		

Downward Force:

Collar Weight =	$[(C)^2 - (D)^2](\pi/4)(CT)(150)$	=	**10382**	LBS Down
Soil Weight =	$[(C)^2 - (D)^2](\pi/4)(H-CT)(100-62.4)$	=	**13012**	LBS Down
	Total Weight	=	**23394**	LBS Down

Upward Force (Weight of Water Displaced):

$[(D)^2(\pi/4)(H)(62.4)] + [(C)^2 - (D)^2](\pi/4)(CT)(62.4)]$ = **13729** LBS Up

Safety Factor:

(Downward Force / Upward Force) = **1.70** Safety Factor

Collar Weight =	10382	LBS	The amount of concrete called out in the lift station
=	69.2	CF	detail provided by Technical Sale Corp of 2.54 CY for a
	2.56	CY	4x12 wetwell is adequate.

Exhibit C

Pump Curve Ebara DGF 2HP – 95mm impeller

Ebara Submersible Pumps

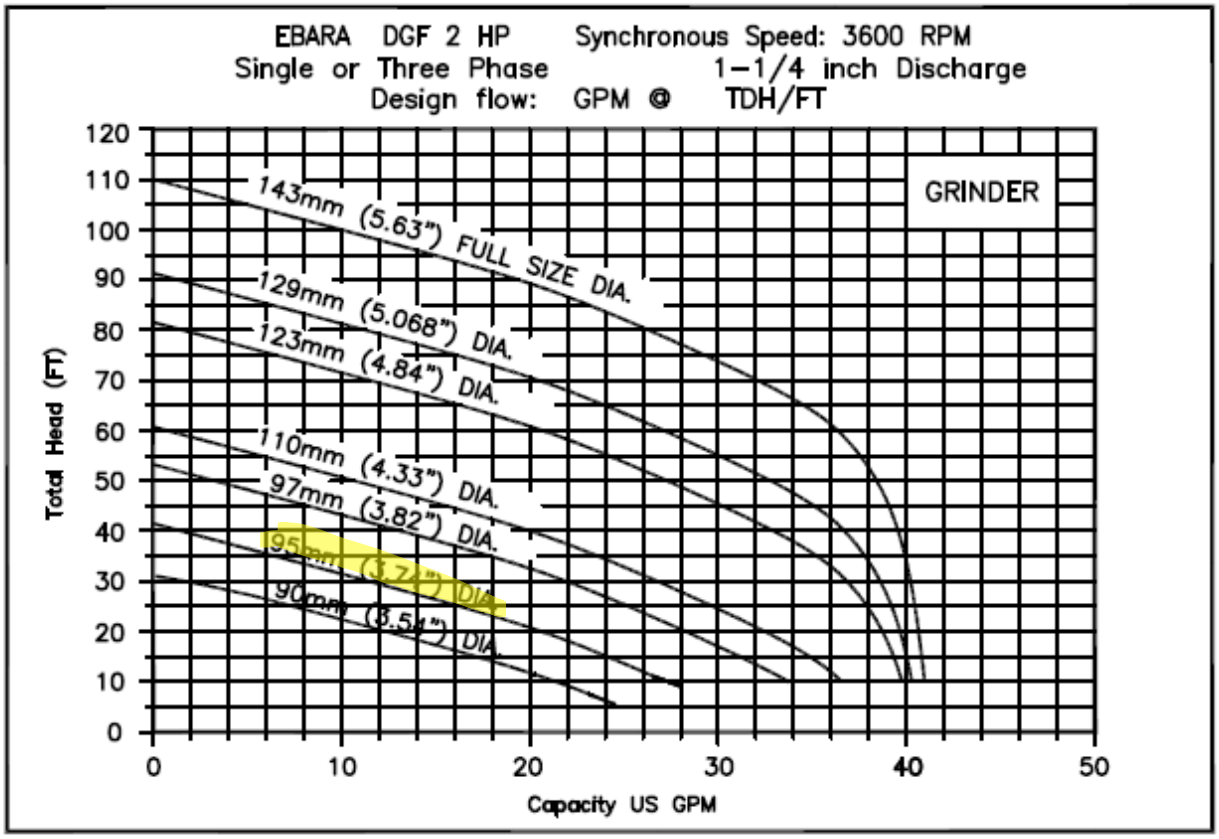


Exhibit D

Lift Station Details