MIDDLETOWN MARYLAND
FOUNDED 1767

AGENDA FOR THE
WATER & SEWER COMMITTEE MEETING
January 23, 2019
7:00 p.m.

1. Review and Recommendations on Reservoir Final Report
    - **Technical Memorandum**
    - **Schedule**
    - **Tank Layout**

2. **Review of Sanitary Sewer Ordinance**

TECHNICAL MEMORANDUM

PROJECT: MIDDLETOWN RESERVOIR RAW WATER STORAGE IMPROVEMENTS

DETAIL: BASIS OF DESIGN RECOMMENDATIONS

DATE: 11/20/18

PURPOSE

On May 3rd, 2018, Gannett Fleming (GF) presented storage recommendations to the Middletown (Town) Burgess and Commissioners as part of an evaluation for improving the raw water storage at the Town's reservoir site. The recommendations, which included holding a minimum storage volume of 750,000 gallons within equally sized tanks (or independent cells of a single tank), were accepted by the Board subsequent to the May 3rd meeting. The Town has also expressed a preference of maintaining 1 million gallons of storage at the reservoir site provided it can be economically constructed. GF's recommendations and methodology are outlined in the previous technical memorandum, "Storage Capacity Recommendations", provided to the Town in April of 2018.

Following the Town's acceptance of the storage recommendations, tank manufacturers were invited to present storage tank alternatives for consideration to Town personnel.

The objective of this memorandum is to provide the basis of design recommendations for the various aspects of the design project, with the primary focus on tank material and configuration. The memorandum also provides an estimate of probable construction costs and evaluations of potential cost savings measures. Once accepted, the recommendations within this memorandum will be used to prepare preliminary design drawing and specifications to the 60 percent level of completion.

STORAGE TANK ALTERNATIVES EVALUATION

The Town currently maintains two, synthetic rubber lined embankment reservoirs, identified as the South Reservoir and North Reservoir. The general concept for improving the storage at the site is to construct the new ground storage tank(s) within the footprint of the North Reservoir once it has been drained and removed from service. Limiting the construction footprint to the east side of the common berm between reservoirs allows for the South Reservoir to remain active during construction until the new tank(s) can be placed into service. Additionally, constructing ground storage tank(s) at an elevation near the floor of the existing reservoirs allows for a reduction in the required earthwork, assuming partial backfill around the tank walls

Ground storage tanks for municipal water supply can be categorized as either concrete or steel, based on the primary material of construction. Within each category, various technologies have been developed to create different "styles" of tanks, each with unique characteristics intended to increase longevity and reduce maintenance. Most of these technologies have been standardized by the American Water Works Association (AWWA), which provides the minimum requirements that each tank style must meet. The following sections describe the various tank styles and the benefits/limitations to each. Tank descriptions are based on a combination of the appropriate AWWA standards and manufacturing/construction standards of tank companies who have the expertise and local experience to be in consideration for this project.

Welded Steel and Bolted Steel Tanks

Since the intention is to partially backfill around the tank walls after construction, steel tanks in general are not recommended for this application. Welded steel (AWWA D100) and bolted steel (AWWA D103) tanks require diligent inspection and maintenance programs for the tank's exterior coating system and often employ a cathodic protection system to mitigate corrosion. Backfilling around these structures not only puts a susceptible material into a potentially corrosive environment, but also hinders inspection by concealing the tank exterior. Moreover, placing backfill against steel tanks may adversely affect the manufacturer's warranty.

Glass Fused-to-Steel Bolted Steel Tanks[1]

Modern bolted steel tanks incorporate a glass fused-to-steel interior and exterior coating which requires markedly less maintenance than traditional epoxy-based coatings. The glass coating is applied to the steel panels as a mineral slurry and baked in a high-temperature kiln. The resulting molten glass chemically and mechanically bonds to the steel core. Since the glass coating could be damaged by the installation of the fasteners, stainless steel panel flanges are often provided. Even with the improved exterior coating, manufacturers do not recommend placing backfill around the tank wall as corrosion is still a concern around the flanges and fasteners. Maintenance issues are also a concern for the interior glass coating. Glass-fused tank manufacturers strongly recommend mechanisms to prevent ice formation within the tank, as ice caps can cause damage to the interior coating and sealants. Interior inspections are recommended at a minimum interval of five years.

Additionally, cathodic protection is also typically required for glass-fused tanks in order to comply with warranty requirements. Although usually low maintenance, corrosion control systems must be periodically checked to insure proper functionality and inspection logs should be retained for proof of warranty compliance.

While steel tanks typically have a lower initial cost, often times the higher maintenance costs of steel tanks outpace the comparative lifecycle cost of concrete tanks.

Conventionally Reinforced, Cast-In-Place Concrete Tank

Conventionally reinforced concrete (CRC) has often been used for below grade or partially buried water tanks due it's durability, availability, and resistance to corrosive soils. However, there are two major aspects associated with this style of tank that make conventionally reinforced concrete less desirable than the subsequently discussed prestressed tank options for this application.

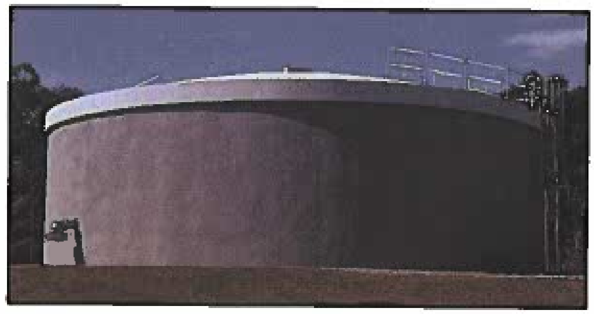
Quality control is the primary concern for this style of tank, as CRC tanks are typically constructed by a general contractor whose competency largely dictates the overall long-term performance of the structure. Seasonal tendencies can also cause issues for water-retaining CRC structures. The moisture and temperature differential between the interior and exterior of the tank can stress the concrete,

[1] Section based on AWWA D103 and Aquastore O&M manual

placing portions of the wall section in tension and increasing the potential for cracking. If the concrete has not been properly consolidated during construction, these cracks can lead to damage and leaks.

The second comparative disadvantage of a CRC tank, is the capital cost. Due to the required formwork for a cast-in-place structure, most CRC tanks are rectangular, which requires thicker walls and more reinforcing than a circular structure due to the transfer of applied forces.

Wire-Wound, Circular, Prestressed Concrete Tank[2]



400,000 Gallon D110 Type III Tank

Wire-wound tanks are manufacturer-designed and constructed considering site-specific parameters, such as dead loads (including backfill) and environmental loads. D110 tanks have been constructed in the United States for over 70 years, with modern designs remaining relatively unchanged since the 1970's. Most wire-wound tanks built within the last 40 years are still in service today. D110 tanks incorporate a cast-in-place floor, with either cast-in-place wall segments, or onsite precast wall panels which are lifted into place. Roof sections are cast in place and can be provided as either a free-span dome supported by the exterior walls and prestressing, or a flat slab style requiring interior column support. The dome roof generally requires less material, although this style typically adds 10-percent of the tank diameter to the overall height. As a result, a dome is typically more economic, making it the preferred roof option for applications without strict height limitations.

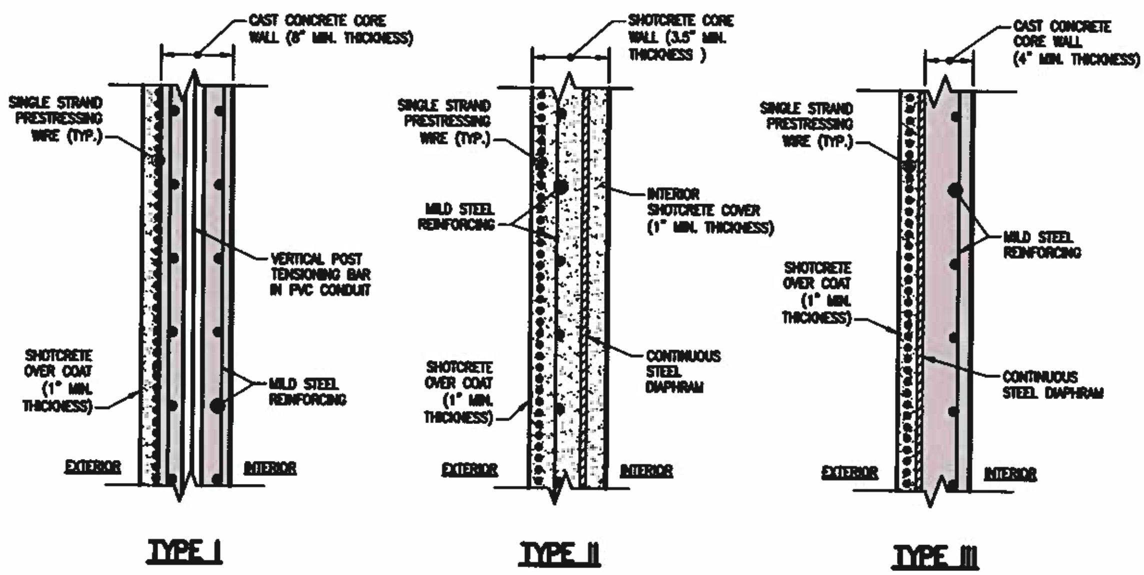
Wire-winding (prestressing) the tank ensures continuous circumferential compression of the tank walls. This constant state of compression reduces the amount of required wall reinforcing and consequently, the potential for cracking. Since there is considerably less reinforcing required in the walls of a D110 tank compared to a conventionally cast in place tank, the potential for rebar congestion and interruption of concrete flow is reduced during casting, increasing the overall concrete quality. D110 tanks are limited to circular layouts, as the prestressing wire is applied as a continuous process to the exterior of the structure and corners and angles would result in point loads and uneven compression of the structure.

There are four variations of wire-wound tanks under the D110 designation: Type I, Type II, Type III, and Type IV; however, the Type IV tank is excluded from consideration for this projected due to the lack of local construction experience. For the remaining three styles, the primary difference is evident in the wall section of each type as shown below in Figure 1. The advantage incorporated into the Type II and Type III tank is the continuous steel diaphragm which creates a waterproof barrier between the interior of the tank and the prestressing wire. Without the use a steel diaphragm, the Type I style incorporates vertical prestressing tendons along with the circumferential prestressing, creating bi-axial compression of the tank to counteract the moisture and temperature differential throughout the wall section. This bi-axial compression increases the water-tightness; however, it is not a true waterstop. Additionally, Type I walls are typically thicker than the other D110 styles, making it comparatively cost prohibitive for

[2] Section based on AWWA D110, Pleload LLC, and DN Tanks standards

volumes under 10 million gallons. The difference between the Type II and Type III tank is that the Type III style incorporates an interior cast concrete core wall as opposed to a shotcrete cover. Experience has shown that impact and abrasion from ice can potentially result in the delamination of the interior shotcrete cover of the Type II style, exposing the steel diaphragm and increasing the potential for corrosion. Therefore, Type II tanks are not typically constructed in regions that experience sustained freezing temperatures, such as the upper mid-Atlantic. Considering the inclusion of the steel diaphragm and a robust inner-core concrete wall, the Type III style is the preferred tank under the D110 designation for this application.

Figure 1: D110 Tank Wall Sections

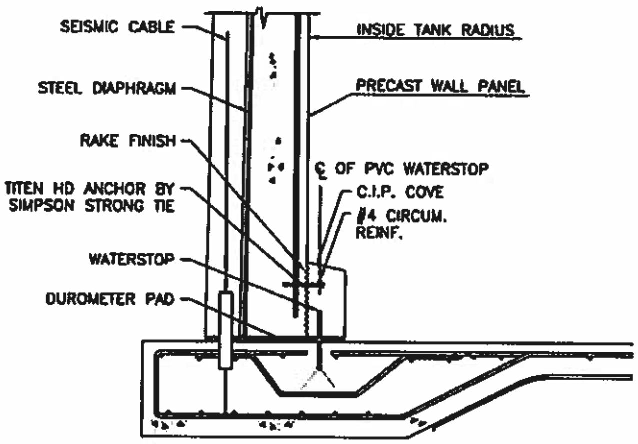


There are two critical components of the Type III tank that should be considered: the exterior shotcrete layer (cover coat) over the prestressing wire, and the continuous waterstop at the wall to floor interface, known as the curb or cove. Quality control is essential during the construction of these critical features to ensure the longevity of a Type III tank.

The shotcrete cover coat provides a critical barrier, protecting the prestressing wire from exposure to the elements and potential corrosion. Consequently, the cover layer is the only section of the D110 wall that is not in constant compression. Although shotcrete spalling and wire exposure is uncommon, these issues are easily identified and can often be repaired by the owner. Buried wall sections are not as easily inspected, but the surrounding soil provides insulation to the shotcrete cover, further reducing the concerns for cracking. Waterproof coatings and underdrain systems are also typically provided for buried wall sections to mitigate the amount of groundwater absorption into the shotcrete.

The tank curb provides the positive waterstop between the tank floor and walls. As the walls of a Type III tank are constructed by tilting up precast panels, an integral waterstop between the wall and floor is not possible. In order to achieve a positive seal, a continuous PVC waterstop is cast into the base slab inside of the exterior wall footprint. Once the walls have been erected, the concrete (or shotcrete) curb is cast, sealing the floor to the curb. After the curb has cured, the tank is prestressed, creating constant circumferential compression between the continuous curb ring and the tank wall. The circumferential forces increase the water-tightness between the wall and curb and also compress the curb itself. The completed product creates a watertight, yet flexible connection at the wall to floor interface. As shown n Figure 2, the philosophy for a Type III (and all D110) tanks is to have an 'anchored flexible base' which allows for slight radial movement of the walls, and for structural members to act independently. Load transfer, which would be required during a seismic event, is provided through the seismic base cables preventing transverse movement. The seismic tendons are cast into the floor and incorporated into the wall during prestressing and shotcreting.

Figure 2: D110 Type III Base Connection Detail



Tendon-Prestressed Concrete Tank[3]

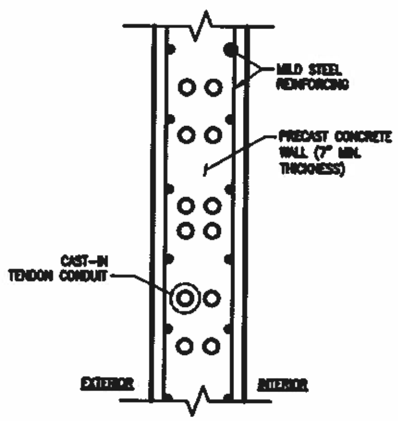
Similar to wire-wound tanks, tendon-prestressed tanks are manufacturer designed and constructed considering site specific parameters. Modern tendon-prestressed tanks have been constructed under the D115 designation for the past 20 years, and although relatively new, the number of D115 style tanks has rapidly increased in recent years. Other than the tank floor, which is cast in place, all other concrete components of the D115 tank (walls, roof, columns) are precast in the manufacturers facility. Geodesic aluminum domes are also an available roof option for D115 tanks. The geodesic dome typically has a lower initial cost than the precast concrete panels, however, this style requires sealants and isolation from the concrete walls to prevent corrosion. Concrete roofs require minimal maintenance and incorporate internal prestressing to increase quality and longevity. In addition to the

D115 Tank with Partial and Differential Backfill

[3] Section based on AWWA D115 and Dutchland Tanks standards

increased level of quality control, factory casting concrete members allows for various aesthetic tank options and smooth, form-finished walls. The precast components are shipped to the site and erected on the cast-in-place floor slab.

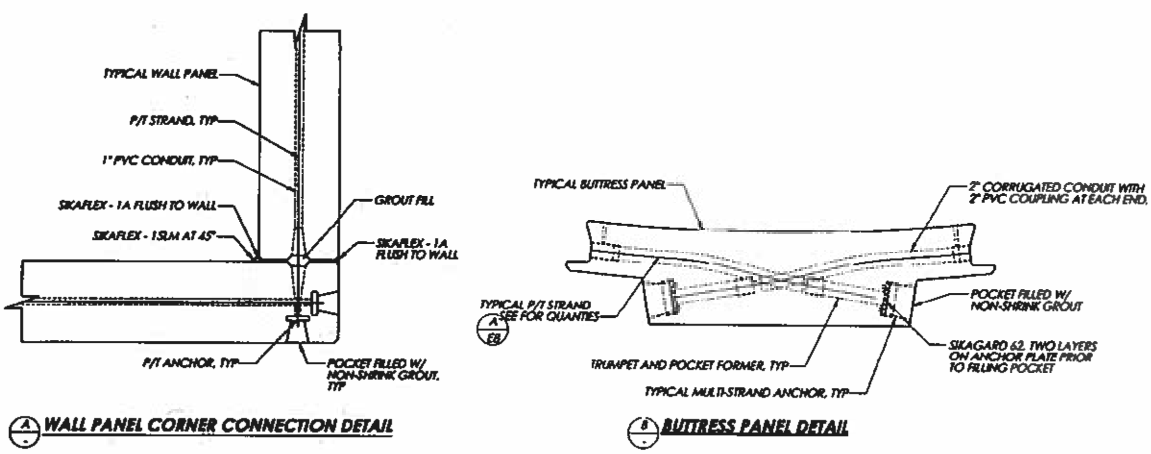
Figure 3: D115 Wall Section



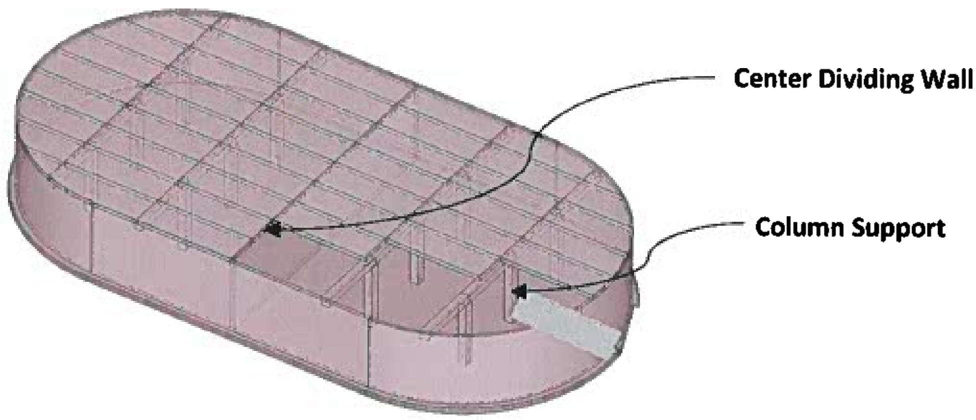
Prestressing of a D115 tank is accomplished by stressing tendons using a hydraulic jack. In precast wall panels, post-tensioning tendons are threaded through horizontal ducts (Figure 3) that have been cast into the panels. Conduits are coupled at the wall joints to allow for the prestressing of multiple wall sections and intermediate joints by a continuous tendon. Once the tendons have been stressed and anchored, the ducts are grouted for corrosion protection.

For circular tanks, the post-tensioning tendons are anchored at one, or two opposing buttress panels (Figure 4), placing the inner half of the tank walls in a state of constant circumferential compression. Although comparatively, the D110 style provides circumferential compression to the entire wall section, one of the advantages to the internal tendons over the external wire-wrapping is that D115 tanks are not limited to circular footprints. With internal tendons, wall sections can be prestressed to abutting walls (as shown in Figure 4), allowing for rectangular and stadium (rectangle with semicircular ends) tank options. These non-circular options can also be built to AWWA D115 standards.

Figure 4: D115 Tendon Anchoring Details



For this project, constructing two circular tanks would be more cost effective than constructing two rectangular tanks of equivalent volume due to the efficiency of perimeter-to-area of a circle. However, one viable alternative would be to construct a singular rectangular (or stadium) tank with a structural dividing wall, creating two equal volume, independent storage cells of the same tank. Divided tanks are generally used in locations with a limited footprint that require separate or redundant storage. Additionally, non-circular D115 tanks are an option for sites that may require future storage. Additional walls can be prestressed to the existing linear walls of a D115 tank, provided provisions are made during the initial construction. Otherwise, multiple circular tanks are generally preferred due to their total independence as opposed to a common wall. Although linear-walled tanks generally require thicker walls and more prestressing than circular tanks, a single divided tank may be a more cost-effective option than multiple circular tanks depending on the location and tank configuration.



Isometric Example of a Stadium Style D115 Tank with Dividing Wall

The critical components of a D115 tank are similar to those of the D110 Type III tank: protection of the areas where the prestressing can be exposed, and the water-tightness floor to wall joint. As with any tank, quality control during the construction of the critical components helps ensure the longevity of the structure.

Since the prestressing tendons of a D115 tank are routed through conduit embedded within the wall section, the critical procedure for corrosion protection is the grouting and joining of the tendon ducts. As shown in Figure 5, the conduit runs are glued and coupled with a section of vinyl tubing. Since the prestressing conduits are required to be grouted after tensioning, the risk of tendon corrosion is minimal; however, the potential exists for air pockets to form within the conduit, as complete grouting of the duct cannot be visually confirmed. If not joined properly, water may leak into the conduit joints and potentially corrode the prestressing in areas where air pockets may have formed.

Figure 5: D115 Wall Joint Detail

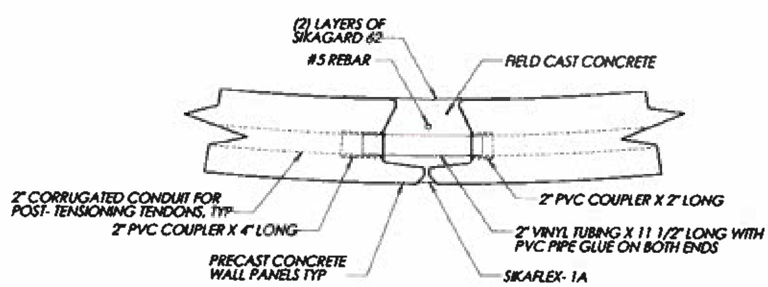
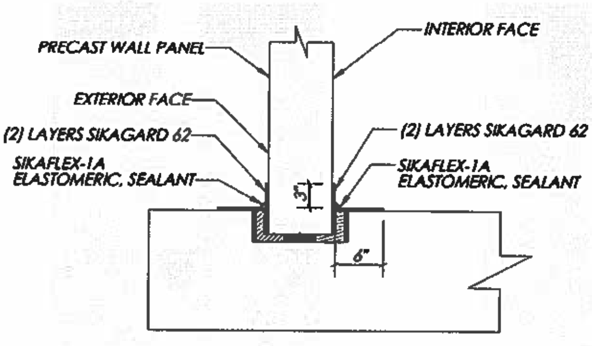


Figure 6: D115 Base Connection Detail



Like the D110 Type III tank, wall panels for a D115 tank are cast prior to erection, meaning an integrally cast waterstop between the floor and wall is not possible. Unlike a D110 tank, the philosophy behind a D115 tank is to prevent any wall movement (radial or otherwise) by imparting a higher degree of tensioning to the prestressing of the walls. Consequently, the walls and floor are joined by a fixed connection, as shown in Figure 6. Once the walls have been prestressed, the interior and exterior pockets of the floor keyway are grouted. The joints are then coated with a high-build epoxy and caulked. The water-tightness at the base connection relies heavily on the grout application and the preparation and application of the two-part epoxy coating.

Summary

Although equivalent sized steel tanks may have a considerably lower initial cost, they are not recommended for this installation due to the need for partial tank burial. Prestressed tanks, however, can be backfilled and require minimal maintenance with a lower lifecycle cost compared to steel tanks.

Prestressed concrete tanks are designed and constructed to provide durable, long-lasting service with minimal maintenance. Compared to conventionally reinforced concrete tanks, prestressed concrete structures reduce the amount of conventional reinforcing and concrete required by placing the walls in a constant state of compression via external wire-winding, or internal post-tensioning tendons. The constant compressive state also reduces the potential for cracking, increasing the longevity of the tank. The improved quality control and cost effectiveness of prestressed tanks make them a preferable option over conventionally reinforced concrete for this application. Additionally, prestressed tank manufacturers are the sole warranty source for their product. As prestressed tanks are manufacturer designed and constructed, they are not as susceptible to warranty and responsibility conflicts as traditionally cast-in-place structures may be.

Of the preferred alternatives, the wire-wound and tendon tanks share a similar design approach: using prestressed reinforcement to place the walls in a constant state of compression, reducing the potential for cracking and the amount of concrete and conventional reinforcement throughout the wall section. The difference between the D110 and the D115 is how that objective is achieved. D110 tanks use external wire wrapping with shotcrete cover and incorporate a flexible base connection, while D115 tanks utilize internal tendons in fully cast wall panels and feature a fixed base connection. Both tank styles are currently constructed in the mid-Atlantic region by experienced manufacturers.

If there is a certain advantage to the D110 style over the D115, it would be experience. Manufacturers have been constructing wire-wound tanks and refining design and construction details over the past 70 years, and these manufacturers can identify tanks that are still in service after 50 years as proof of quality. Most D115 tanks in the region have been constructed in the past 15 years. Extended service will be the ultimate factor in determining the performance of characteristic features of the D115 tank, like the rigid base connection.

Conversely, the comparative advantage to the D115 tank stems from the factory precasting of both interior and exterior faces. The factory setting allows for the economic incorporation of architectural finishes like pilasters or block patterns in addition to a smooth form-finish. Tendon tanks consequently are not only highly aesthetic but are also more resistant to algae growth over time on the tank exterior than the comparatively rough shotcrete finish on wire-wound tanks. Performing most of the concrete work offsite, also results in less construction site activity, fewer concrete trucks, and generally less community disturbance.

Table 1 below displays budgetary pricing provided by prestressed concrete tank manufacturers for the 750,000-gallon and 1-million gallon storage options. The pricing shown for each option includes two equally sized, structures (or cells of one structure) and does not include piping, vaults or other site work.

Table 1: Preliminary Tank Pricing

Total Volume	AWWA D110 (Type 3) Circular		AWWA D115-Circular		AWWA D115-Divided Tank	
	Total Price (2 Tanks)	Price per Gallon	Total Price (2 Tanks)	Price per Gallon	Total Price (2 Cells)	Price per Gallon
0.75 MG	$875,000	$1.17	$862,000	$1.15	-	-
1.0 MG	$1,025,000	$1.03	$1,032,000	$1.03	$980,000	$0.98

Constructing two storage structures is recommended for redundancy and reliability, allowing one structure to be out of service for maintenance or emergency operations without losing the full operational function of the storage facility. This can be achieved either with two independent structures or with a divided D115 style tank since the common wall of the D115 tank would be structurally designed to allow either half of the tank to remain in service while the adjacent half is drained. The primary advantage that two separate circular storage tanks provides is complete structural independence so that a structural repair or modification could be made without needing to take the storage facility fully offline. In consideration of the low probability of needing to affect this level of repair on the D115 style tank and the lower construction cost, the divided D115 style tank presents as a preferred option for this installation.

Given the Town's preference for maintaining 1 million gallons of storage at the reservoir site, the divided stadium tank becomes the most economical of the acceptable alternatives at this size. The divided tank option also provides additional opportunities for cost savings. The linear side walls of the tank may allow for some of the valve and metering vaults to be incorporated into the prestressed structure. For instance, a vault that can be constructed against a tank wall effectively requires only three walls to construct, as one wall is shared with the storage tank. A singular tank also provides a cost savings with the consolidation of yard piping compared to the required piping for multiple structures. Finally, a stadium-style tank also fits the existing site well while providing more area per vertical foot of storage than the circular tank alternatives[4]. This lower profile reduces the amount of required earthwork, as more of the tank can fill the void of the existing North Reservoir.

EARTHWORK, PIPING, AND SITE IMPROVEMENTS

One of the primary objectives of the site design and layout of the proposed improvements for this project is to balance the required earthwork while sequencing the construction to ensure uninterrupted water service is maintained to the Town. To accomplish this intention, the construction can be considered in three phases.

Phase 1

The first phase, as shown in Figure 7 is to isolate the North Reservoir from the distribution system for decommissioning. The well supply lines have valved feeds to each reservoir which should result in simple isolation. The 6-inch supply from the springs, however, is currently only fed to the North Reservoir. For the spring supply, a temporary pipe or hose can be connected to the existing pipe stub at the upper vertical bend in the North Reservoir and run over-ground to the South Reservoir. Connecting a temporary line at this location (within the basin) maintains metering capabilities for the spring flows.

The only outlet from the North Reservoir is an equalization pipe that connects the basins between the dividing embankment. This pipe can be isolated; however, it is located roughly four feet above the basin floor elevation of the North Reservoir, meaning roughly 0.5 million gallons will need to be pumped out to completely drain the reservoir. By pausing production from some of the larger well sources and allowing the reservoirs to be drawn down, the volume of water to be pumped from the North Reservoir can be minimized.

Phase 2

Once the North Reservoir has been drained, subgrade preparation can begin for tank construction. As shown in Figure 8, the tank footprint is expected to be within the extent of the existing basin floor. Some intermediate excavation and grading will be required for construction access, but the berm between reservoirs must remain intact during construction. All of the new vault and pipe work (up to the five connections to the existing system) can also be completed during this phase. After the new influent piping has been tested and disinfected, connections to the existing supply mains can be sequentially made. Once the new supply connections are made, the South Reservoir will be isolated from the supply. A bypass connection can be provided on the supply header within the Influent Vault (Figure 9) which would allow supply flow to be temporarily piped to the South Reservoir through the new piping and metering manifold. This small addition allows for greater flexibility in the construction sequencing and requires fewer temporary facilities (piping, metering, valving).

The Influent Vault is proposed to provide the same metering configuration as the existing system but consolidated in a single structure. The spring flows would be metered individually, with combined metering of well fields 'A' and 'B', and combined metering of the remaining wells. By incorporating an influent header and the valving shown in Figure 9, each meter can be bypassed for maintenance without removing a supply from metered service. A fabricated stainless steel header is also a cost-effective

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[4] Manufacturers were consulted to develop the most cost-effective tank dimensions for each style.

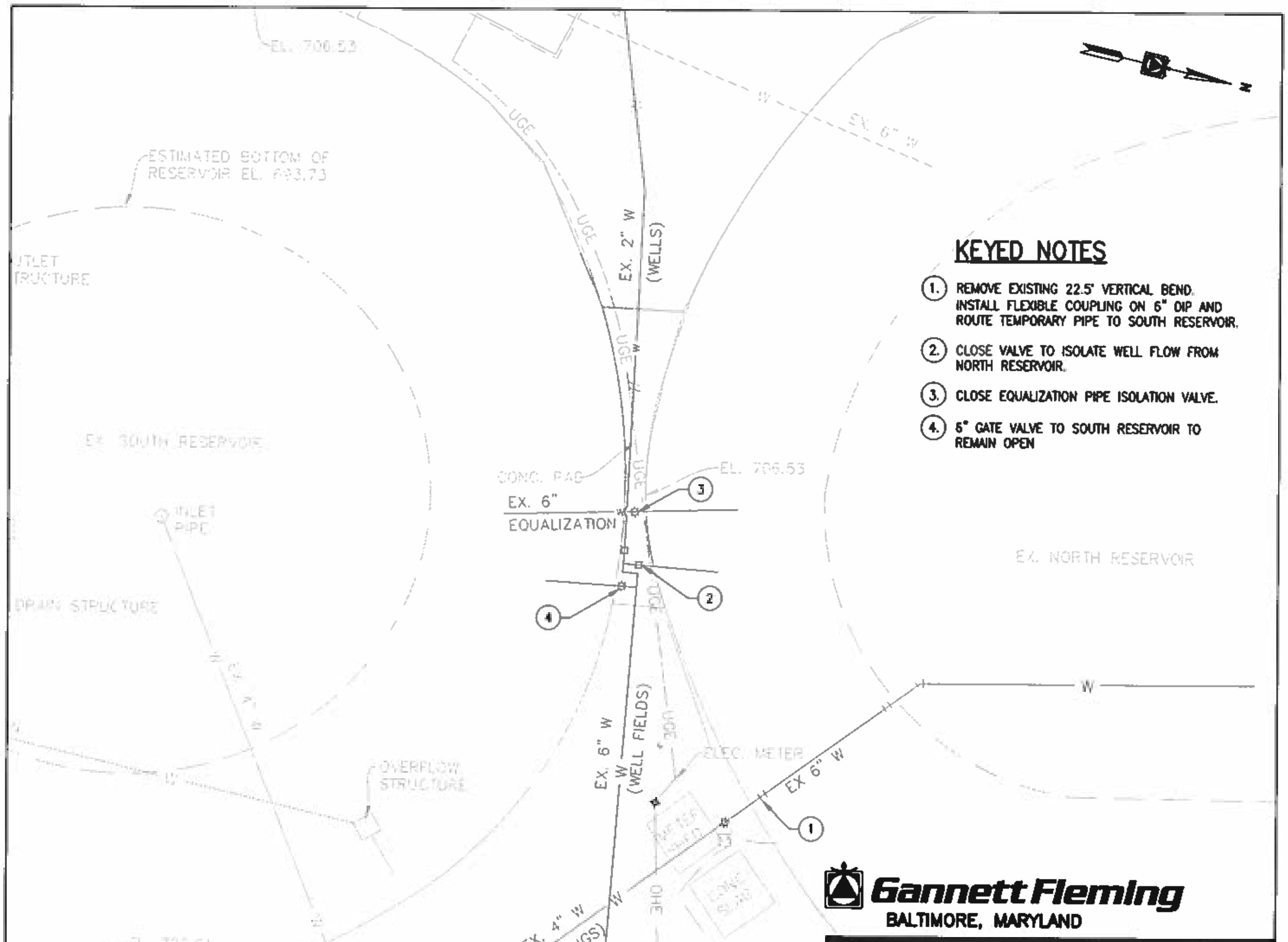


Figure 7: North Reservoir Isolation Plan

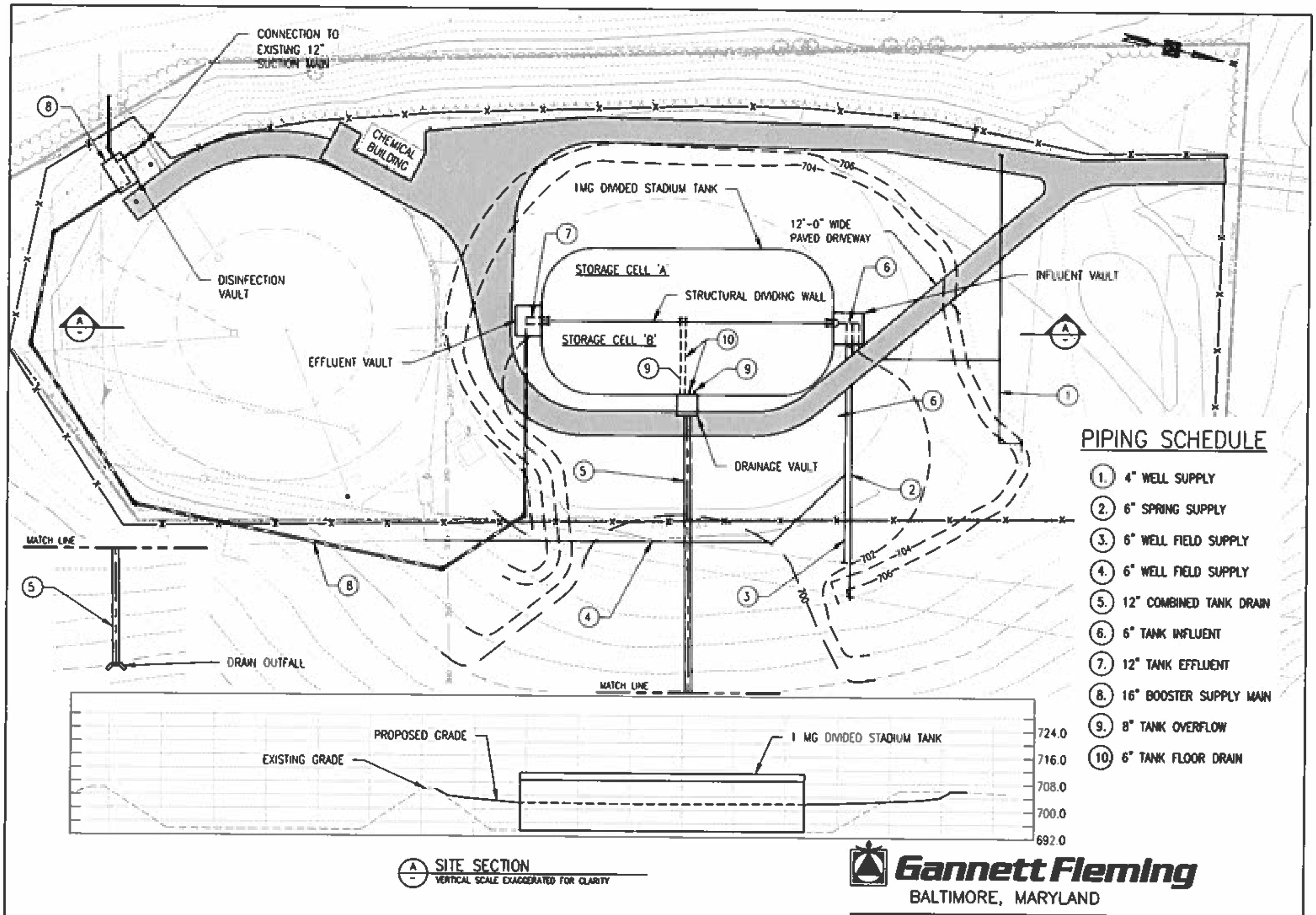
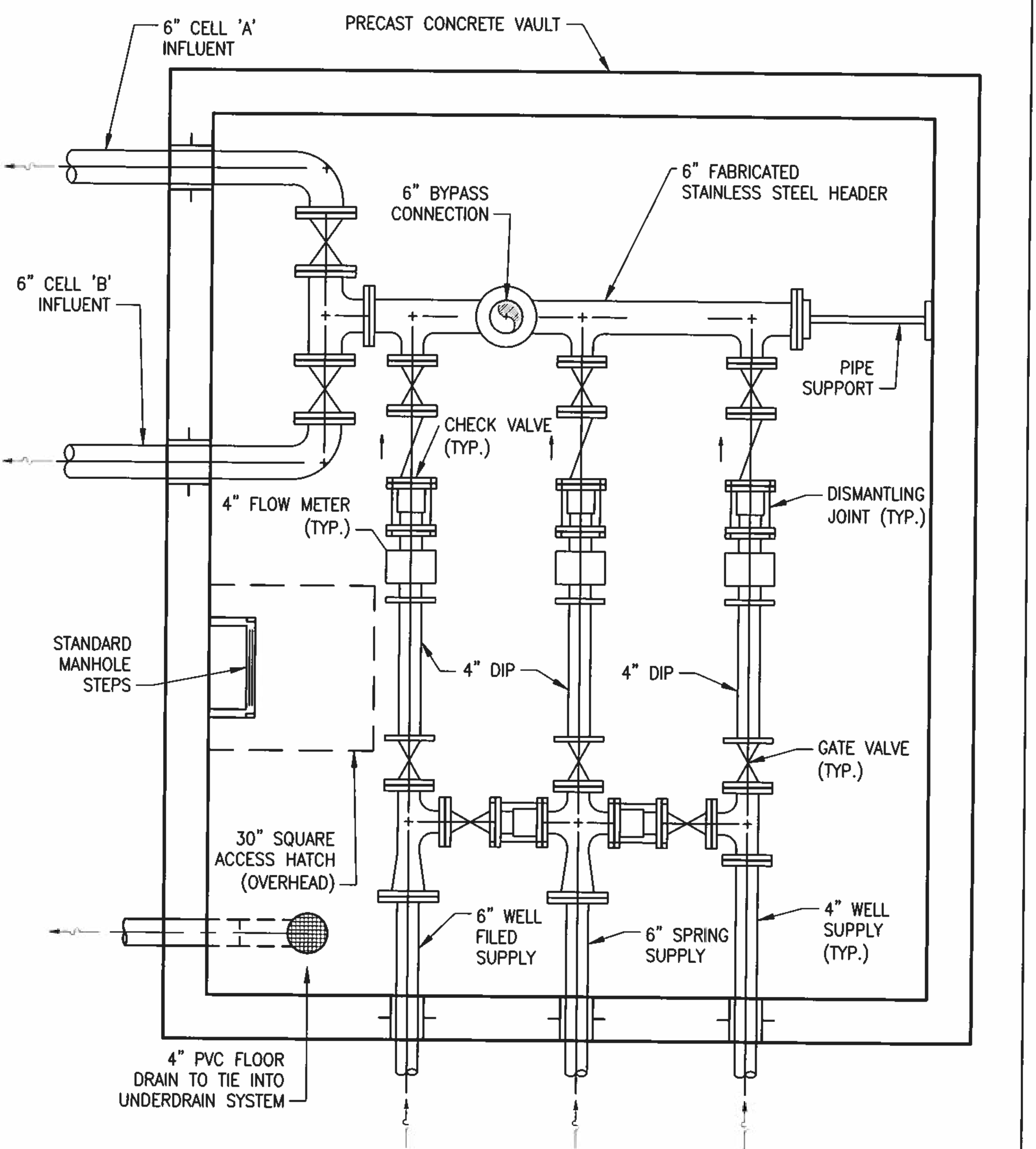


Figure 8: Proposed Site Plan



Gannett Fleming
BALTIMORE, MARYLAND

Figure 9: Influent Vault

alternative to numerous fittings, flange kits, and couplings. Fabricated steel specialties can be manufactured to meet AWWA standards.

The Effluent Vault will simply combine flows from the proposed tanks and allow isolation using 12-inch gate valves. As effluent flow is currently metered at the Booster Station, effluent metering at the reservoir site is not currently proposed. If requested, metering can be provided in the Effluent Vault, or provisions can be made to allow for future metering (similar to the existing Effluent Vault configuration).

There are a few options for making the tie-in on the effluent side of the tanks, depending on when a parallel suction main is built. If built concurrent with the project, the existing main can be taken out of service and the connection made after the new system is online. Without the new suction line in place, the connection could be made during a low demand period and with a short interruption of service from the reservoirs. If interruption is not allowable the existing suction main can also be tapped while in service.

Each tank cell is recommended to be provided with an overflow drain and a floor drain. The tanks can also incorporate a common underdrain. These five total drains are proposed to combine in one vault with a common outfall. As shown in Figure 10, the overflow drains will be provided with rubber check valves to prevent small animals from entering the tank and prevent the potential siphoning of drain or storm water. The tank floors will be sloped to a centrally located floor drain, permitting complete drainage of the tanks. Each floor drain will be isolated with a gate valve housed in the Drainage Vault. Water level in each cell can also be monitored in the Drainage Vault using a pressure transducer connected to the tank floor drain. Level readings can be remotely output to a digital or analog display in the Chemical Building. Lastly, the underdrain will serve as leak detection since the tank is proposed to be partially backfilled. The system will be composed of a perforated PVC pipe ring drain with a radial outlet to the Drainage Vault. The ring drain will be encased in a layer of drainage stone and wrapped in geofabric. The fabric layer prevents the migration of the surrounding soils into the drainage stone.

Phase 3

The initial site grading concept was developed with the intent of removing the existing South Reservoir once the new storage structure was operational, using the voided space of the South Reservoir to create a gradual slope across the site without the need for hauled fill. The proposed grading would provide a mostly level area suited for any future use by the Town. One caveat to this concept is that the electric pole onsite would likely need to be reset by the electric company, which would be an additional expense and require coordination. An alternative site grading plan was prepared that would leave the South Reservoir intact to evaluate the possible cost savings of the reduced earthwork.

As shown in Figure 8, the site can be graded and balanced without the excavation of the common berm between the reservoirs, while providing adequate accessibility and drainage. This grading plan requires approximately 17 percent less earthwork than the initial concept and does not include any demolition of the South Reservoir or site piping and infrastructure. This demolition work is not necessary to be completed simultaneously and can be performed later at the Town's discretion. Due to the limited footprint, the electric pole would also not require resetting under this plan. Considering the earthwork, demolition, and overhead utility savings, there is a potential for a \$100,000 to \$150,000 cost savings by limiting the site work scope.

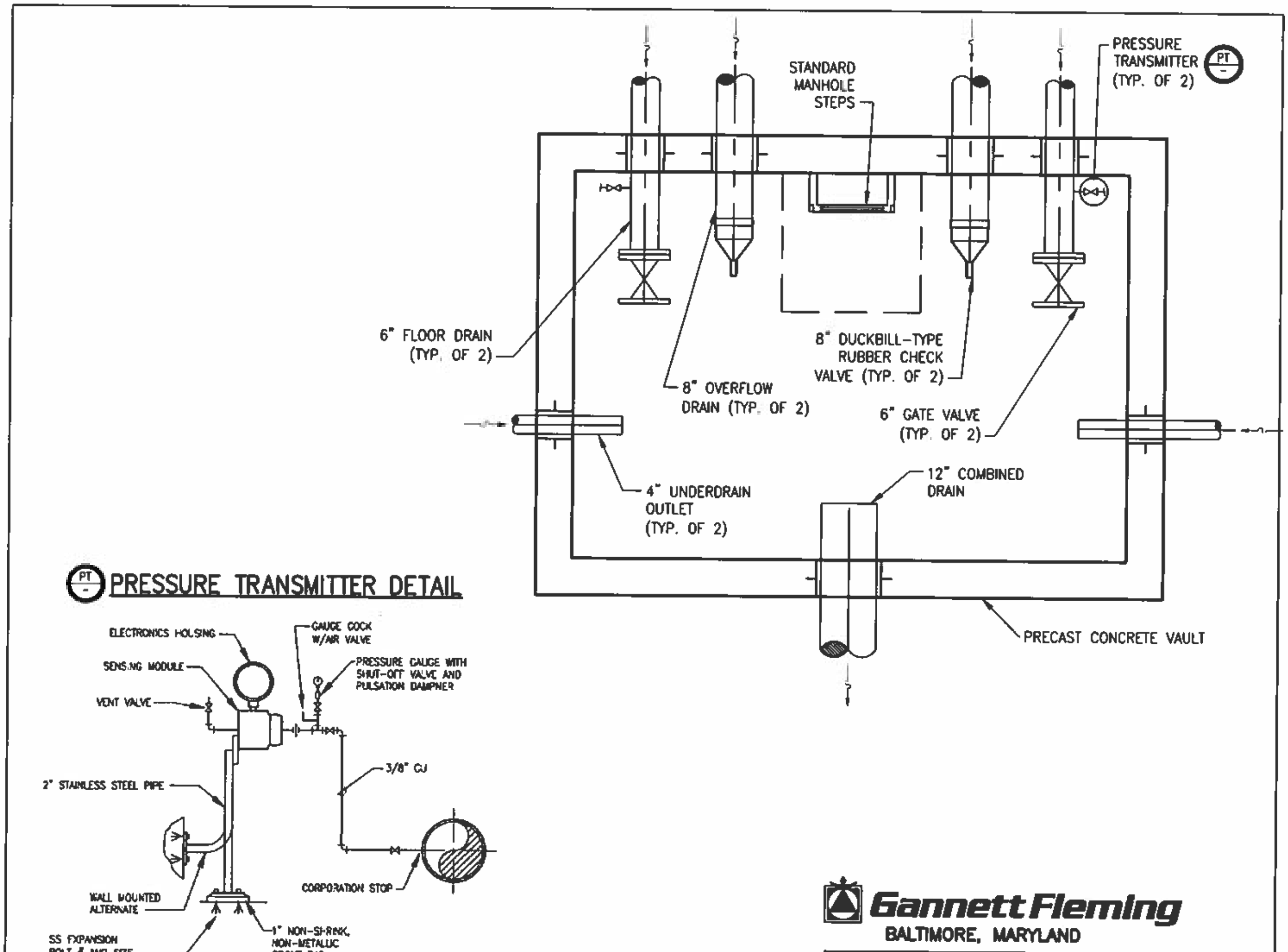


Figure 10: Drainage Vault

Additionally, the sitework scope will incorporate access improvements, including new site fencing, gates, and a paved access road.

ESTIMATED CONSTRUCTION COSTS

Considering the project description and conceptual basis of design discussed herein, the total probable construction costs associated with this project is $2,760,761. The estimate is based on a 15-month construction period beginning in late 2019.

The total cost includes an estimate for the construction of a parallel booster suction main as recommended in the previous "Storage Capacity Recommendations" memorandum provided by Gannett Fleming. The estimate for the suction main assumes a 3,500 linear-foot main that parallels the existing suction main alignment. The new main is assumed to be a nominal 16-inch diameter, Class 53 ductile iron pipe, with a standard asphaltic exterior coating and cement mortar lining. The estimated cost does not include potential costs for easement acquisition.

Table 2: Estimate of Probable Total Construction Costs

Item No.	Description	Cost (1MG Divided Storage Tank Option)
1	Mobilization	$33,635
2	Erosion and Sediment Control	$14,848
3	Yard Piping	$95,468
4	Booster Suction Main	$486,666
5	Mass Earthwork	$79,259
6	Demolition	$11,794
7	Site Improvements	$73,363
8	Vaults and Mechanical Piping	$236,517
9	Tanks	$980,000
10	Electrical	$24,923
	Subtotal	**$2,036,041**
11	Profit, Bonds, Escalation, Tax and Overhead	$724,720
	Total Estimated Construction Cost[1]	**$2,760,761**

1: Includes 10% Design Contingency

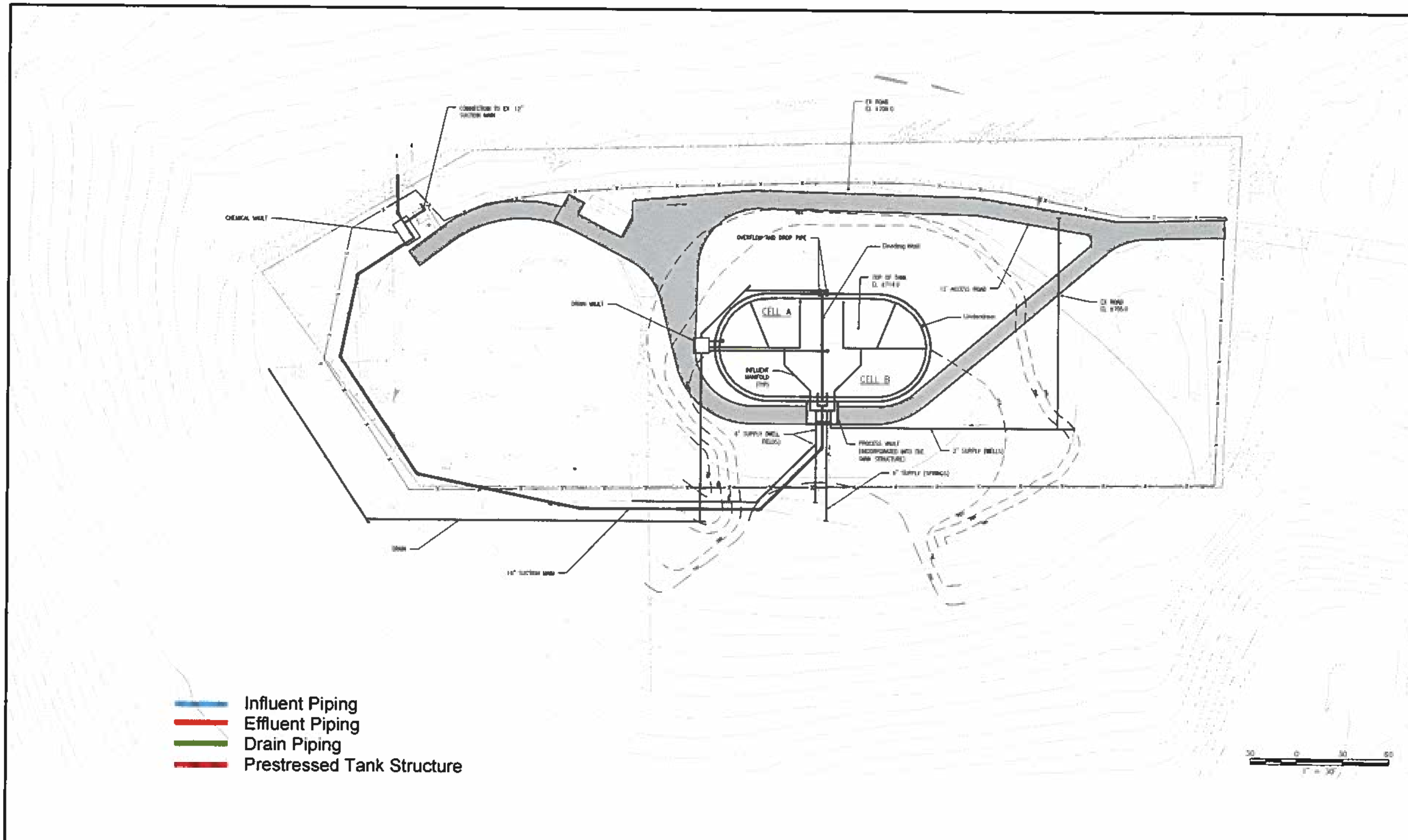
Town of Middletown

Raw Water Storage Tank Project

Design Schedule Update: 11/20/18

Gannett Fleming

Task Name	Start	Finish	Duration (weeks)
Phase I: Evaluation Services	**11/21/2017**	**11/20/2018**	**52**
Phase II: Design and Specifications	**10/15/2018**	**5/19/2019**	**31**
Preliminary Design	***10/15/2018***	***2/12/2019***	***17***
Geotechnical Investigations and Report	12/3/2018	1/2/2019	4
Permit Applications	1/7/2019	2/21/2019	6
Preliminary Design Submittal	10/15/2018	1/28/2019	15
Preliminary Design Review	1/28/2019	2/12/2019	2
Final Design	***2/12/2019***	***4/28/2019***	***11***
Permit Revisions	3/6/2019	4/5/2019	4
Final Design Submittal	2/13/2019	4/14/2019	9
Final Design Review	4/14/2019	4/28/2019	2
Bid Ready Documents	***4/28/2019***	***5/19/2019***	***3***
Bid Phase Services	**5/19/2019**	**7/18/2019**	**9**



Gannett Fleming
BALTIMORE, MARYLAND

TOWN OF MIDDLETOWN
MIDDLETOWN, MARYLAND

MIDDLETOWN RAW WATER
STORAGE TANKS

PRELIMINARY SITE LAYOUT

JOB NO.
63501

DATE
11/20/18

Chapter 13.08 - SEWER SERVICE SYSTEM

Sections:

13.08.010 - Definitions.

As used in this chapter:

"Biochemical oxygen demand (BOD)" means the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedure in five days at twenty (20) degrees centigrade, expressed in milligrams per liter.

"Building drain" means that portion of the lowest horizontal piping of a drainage system which receives discharge from drainage pipes inside the walls of the building and conveys it to the building sewer, beginning five feet (1.5 meters) outside the inner face of the building wall.

"Building sewer" means the extension from the building drain to the public sewer or other place of disposal, also called house connection.

"Easement" means an acquired legal right for the specific use of land owned by others.

"Floatable oil" means oil, fat or grease in a physical state such that it will separate by gravity from wastewater by treatment in an approved pretreatment facility. A wastewater shall be considered free of floatable fat if it is properly pretreated and the wastewater does not interfere with the collection system.

Commented [DB1]: This could be amended based on the final version of the grease ordinance.

"Garbage" means the animal and vegetable waste resulting from the handling, preparation, cooking and serving of foods.

"Industrial wastes" means the wastewater from industrial processes, trade, or business as distinct from domestic or sanitary wastes.

"Natural outlet" means any outlet, including storm sewers and combined sewer overflows, into a watercourse, pond, ditch, or other body of surface or ground water.

"pH" means the logarithm of the reciprocal of the hydrogen concentration. The concentration is the weight of hydrogen ions, in grams, per liter of solution. Neutral water, for example, has a pH value of 7 and hydrogen-ion concentration of 10-7.

"Properly shredded garbage" means the wastes from the preparation, cooking and dispensing of food that have been shredded to such a degree that all particles will be carried freely under the flow conditions normally prevailing in public sewers, with no particle greater than one-half inch (1.27 centimeters) in any dimension.

"Public sewer" means a common sewer controlled by a governmental agency or public utility.

"Sanitary sewer" means a sewer that carries liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with minor quantities of ground, storm and surface waters that are not admitted intentionally.

"Sewage" means the spent water of a community. The preferred term is "wastewater."

"Sewer" means a pipe or conduit that carries wastewater or drainage water.

"Slug" means any discharge of water or wastewater which, in concentration of any given constituent or in quantity of flow, exceeds for any period of duration longer than fifteen (15) minutes more than five times the average twenty-four (24) hour concentration or flows during normal operation and shall adversely affect the collection system and/or performance of the wastewater treatment works.

"Storm drain" (sometimes termed "storm sewer") means a drain or sewer for conveying water, groundwater, subsurface water, or unpolluted water from any source.

"Suspended solids" means total suspended matter that either floats on the surface of, or is in suspension in, water, wastewater, or other liquids, and that is removable by laboratory filtering as prescribed in "Standard Methods for the Examination of Water and Wastewater" and referred to as nonfilterable residue.

"Unpolluted water" means water of quality equal to or better than the effluent criteria in effect or water that could not cause violation of receiving water quality standards and would not be benefited by discharge to the sanitary sewers and wastewater treatment facilities provided.

"Wastewater" means the spent water of a community. From the standpoint of source, it may be a combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water and storm water that may be present.

"Wastewater facilities" means the structures, equipment and processes required to collect, carry away, and treat domestic and industrial wastes and dispose of the effluent.

"Wastewater treatment works" means an arrangement of devices and structures for treating wastewater, industrial water, and sludge, sometimes used as synonymous with "waste treatment plant" or "wastewater treatment plant" or "water pollution control plant."

"Watercourse" means a natural or artificial channel for the passage of water, either continuously or intermittently.

(Ord. 99-09-04 § 2, 1999; prior code § 4-2101)

Deleted: "Superintendent" means the town administrator or such duly authorized or designated person as the burgess and commissioners may deem appropriate. ¶

13.08.020 - Disposal of wastes.

It is unlawful for any person to place, deposit, or permit to be deposited in any unsanitary manner on public or private property within the town, in any area under the jurisdiction of the town, any human or animal excrement, garbage, or objectionable waste.
(Prior code § 4-2201)

13.08.030 - Discharge of wastewater.

It shall be unlawful to discharge to any natural outlet within the town, or in any area under the town's jurisdiction, any wastewater or other polluted waters, except where suitable treatment has been provided in accordance with the provisions of this chapter.
(Prior code § 4-2202)

13.08.040 - Drainwater.

No person(s) shall make connection of roof downspouts, foundation drains, areaway drains, or other sources of surface runoff or groundwater to a building sewer or building drain which in turn is connected directly or indirectly to a public sanitary sewer unless such connection is approved by the director of public works or such other person designated by the commissioners for purposes of disposal of polluted surface drainage.

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(Prior code § 4-2204)

13.08.050 - Unpolluted water.

No person(s) shall discharge or cause to be discharged any unpolluted waters such as storm water, groundwater, roof runoff, subsurface drainage, or cooling water to any sanitary sewer.

(Prior code § 4-2205)

13.08.060 - Toxic waste.

No person(s) shall discharge or cause to be discharged any of the following described waters or wastes to any public sewers:

A. Any gasoline, benzene, naphtha, fuel oil, or other flammable liquid or explosive liquid, solid or gas;

B. Any waters containing toxic or poisonous solids, liquids or gases in sufficient quantity, either singly or by interaction with other wastes, to injure or interfere with any waste treatment process, constitute a hazard to humans or animals, create a public nuisance, or create any hazard in the receiving waters of the wastewater treatment plant;

C. Any waters or wastes having a pH lower than 5.5, or having any other corrosive property capable of causing damage or hazard to structures, equipment and personnel of the wastewater works;

D. Solid or viscous substances in quantities or of such size capable of causing obstruction to the flow in sewers, or other interference with the proper operation of the wastewater facilities such as, but not limited to, ashes, bones, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, paunch manure, hair and fleshings, entrails and paper dishes, cups, milk containers, etc., either whole or ground by garbage grinders.

(Prior code § 4-2206)

13.08.070 - Discharge limitations.

The following described substances, materials, waters or waste shall be limited in discharges to municipal systems to concentrations or quantities which will not harm either the sewers, wastewater treatment process or equipment, will not have an adverse effect on the receiving stream, or will not otherwise endanger lives, limb, public property, or constitute a nuisance. The director of public works may set limitations lower than the limitations established in the regulations below if in his or her opinion such more severe limitations are necessary to meet the above objectives. In forming his or her opinion as to their acceptability, the director of public works will give consideration to such factors as the quantity of subject waste in relation to flows and velocities in the sewers, materials of construction of the sewers, the wastewater treatment process employed, capacity of the wastewater treatment plant, degree of treatability of the waste in the wastewater treatment plant, and other pertinent factors. The limitations or restrictions on materials or characteristics of waste or wastewaters discharged to the sanitary sewer which shall not be violated without approval of the director of public works are as follows:

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A. Wastewater having a temperature higher then one hundred fifty (150) degrees Fahrenheit (sixty-five (65) degrees Celsius);

B. Wastewater containing more than twenty-five (25) milligrams per liter of petroleum oil, nonbiodegradable cutting oils, or products of mineral oil origin;

C. Wastewater from industrial plants containing floatable oils, fat or grease;

D. Any garbage that has not been properly shredded. Garbage grinders may be connected to sanitary sewers from homes, hotels, institutions, restaurants, hospitals, catering establishments, or similar places where garbage originates from the preparation of food in kitchens for the purpose of consumption on the premises or when served by caterers;

E. Any waters or wastes containing iron, chromium, copper, zinc and similar objectionable or toxic substances to such degree that any such material received in the composite wastewater at the wastewater treatment works exceeds the limits which may be established by the superintendent for such materials;

F. Any waters or wastes containing odor-producing substances exceeding limits which may be established by the superintendent;

G. Any radioactive wastes or isotopes of such half-life or concentration as may exceed limits established by the superintendent in compliance with applicable state or federal regulations;

H. Quantities of flow, concentrations, or both which constitute a "slug" as defined herein;

I. Waters or wastes containing substances which are not amenable to treatment or reduction by the wastewater treatment processed employed, or are amenable to treatment only to such degree that the wastewater treatment plant effluent cannot meet the requirements of other agencies having jurisdiction over discharge to the receiving waters;

J. Any water or wastes which, by interaction with other water or wastes in the public sewer system, release obnoxious gases, form suspended solids which interfere with the collection system, or create a condition deleterious to structures and treatment processes;

K. Any water or wastes having suspended solids or BOD in excess of three hundred (300) mg/p.

(Prior code § 4-2207)

Commented [DB2]: Instead of listing our limits, which are based on our NPDES Permit, I think would should just reference in accordance with our NPDES Permit(s). Remember when this was written, we only had one (1) WWTP. Now we have two (2) with different limits.

13.08.080 - Municipal infractions.

Any violation of the provisions of Sections 13.08.020—13.08.070 shall be a general municipal infraction.

(Prior code § 4-2208)

13.08.090 - Cost of installation.

A. No unauthorized person(s) shall uncover, make any connections with or opening into, use, alter, or disturb any public sewer or appurtenance thereof without first obtaining a written permit from the director or public works.

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B. All costs and expenses incidental to the installation and connection of the building sewer shall be borne by the owner(s). The owner(s) shall indemnify the town from any loss or damage that may directly or indirectly be occasioned by the installation of the building sewer.

(Prior code § 4-2301)

13.08.100 - Separate sewers required.

A. A separate and independent building sewer shall be provided for every building, except where one building stands at the rear of another on an interior lot, and no private sewer is available or can be constructed to the rear building through an adjoining alley, court, yard or driveway, the front building sewer may be extended to the rear building and the whole considered as one building sewer with the appropriate number of sewer taps, if approved by the planning commission. But the town does not and will not assume any obligation or responsibility for damage caused by or resulting from any such single connection aforementioned.

B. Old building sewers may be used in connection with new buildings only when they are found, on examination and test by the director of public works, to meet all requirements of this chapter.

Commented [DB3]: I believe this is a bad idea to leave this in the code. We have run across a few of these in Town years later and they are a nightmare to resolve.

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(Prior code § 4-2302)

13.08.110 - Specifications.

A. The size, slope, alignment, materials of construction of a building sewer, and the methods to be used in excavating, placing of the pipe, jointing, testing and backfilling the trench, shall all conform to the requirements of the building and plumbing code or other applicable rules and regulations adopted by the town.

B. Whenever possible, the building sewer shall be brought to the building at an elevation below the basement floor. In all buildings in which any building drain is too low to permit gravity flow to the public sewer, sanitary sewage carried by such building drain shall be lifted by an approved means and discharged to the building sewer.

(Prior code § 4-2303)

13.08.120 - Connections.

The connection of the building sewer into the public sewer shall conform to the requirements of the building and plumbing code or other applicable rules and regulations adopted by the town. All such connections shall be made gastight and watertight and verified by proper testing. Any deviation from the prescribed materials and procedures must be approved by the director of public works before installation.

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(Prior code § 4-2304)

13.08.130 - Inspection.

The applicant for the building sewer permit shall notify the director of public works when the building sewer is ready for inspection, and connection and testing shall be made under the supervision of the director of public works or his or her representative.

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(Prior code § 4-2305)

13.08.140 - Excavation.

All excavations for building sewer installation shall be adequately guarded with barricades and lights so as to protect the public from hazard. Streets, sidewalks, parkways, and other public property disturbed in the course of the work shall be restored in a manner satisfactory to the town.

(Prior code § 4-2306)

13.08.150 - Required connections.

At such time as a public sewer becomes available to a property served by a private wastewater disposal system, a direct connection shall be made to the public sewer within sixty (60) days in compliance with an order to connect; and any septic tanks, cesspools, and similar private wastewater disposal facilities shall be cleaned of sludge and filled with suitable material.

(Prior code § 4-2307)

13.08.160 - Interceptors.

Grease, oil and sand interceptors shall be provided when, in the opinion of the director of public works, they are necessary for the proper handling of liquid wastes containing floatable grease in excessive amounts or any flammable wastes, sand, or other harmful ingredients, except that such interceptors shall not be required for private living quarters or dwelling units. All interceptors shall be of a type and capacity approved by the director of public works, and shall be located as to be readily and easily accessible for cleaning and inspection, in the maintaining of these interceptors the owner (s) shall be responsible for the proper removal and disposal by appropriate means of the captured material and shall maintain records of the dates, and means of disposal which are subject to review by the director of public works. Any removal and hauling of the collected materials not performed by the owner(s)' personnel must be performed by currently licensed waste disposal firms.

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Commented [DB4]: This entire section will likely be replaced by the Grease Ordinance once approved.

(Prior code § 4-2308)

13.08.170 - Equalizing tanks.

Where pretreatment or flow equalizing facilities are provided or required for any waters or wastes, they shall be maintained continuously in satisfactory and effective operation by the owner(s) at his or her expense.

(Prior code § 4-2309)

13.08.180 - Administrative discretion.

A. If any waters or wastes are discharged or are proposed to be discharged to the public sewers, which waters contain the substances or possess the characteristics enumerated in Section 13.08.070, and which in the judgment of the director of public works may have a deleterious effect upon the wastewater facilities, processes, equipment, or receiving waters, or which otherwise create a hazard to life or constitute a public nuisance, the director of public works may:

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1. Reject the wastes;

2. Require pretreatment to an acceptable condition for discharge to the public sewers;

3. Require control over the quantities and rates of discharge, and/or

4. Require payment to cover added cost of handling and treating the wastes not covered by existing taxes or sewer changes.

B. If the director of public works permits the pretreatment or equalization of waste flow, the design and installation of the plants and equipment shall be subject to the review and approval of the director of public works.

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(Prior code § 4-2401)

13.08.190 - Observation, sampling and measurement.

When required by the superintendent, the owner of any property serviced by a building sewer carrying industrial wastes shall install a suitable structure together with such necessary meters and other appurtenances in the building sewer to facilitate observation, sampling and measurement of the wastes. Such structure, when required, shall be accessibly and safely located and shall be constructed in accordance with plans approved by the director of public works. The structure shall be installed by the owner at his or her expense and shall be maintained by the owner so as to be safe and accessible at all times.

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(Prior code § 4-2402)

13.08.200 - Reporting requirements.

The director of public works may require a user of sewer services to provide information needed to determine compliance with this chapter. These requirements may include:

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A. Wastewater discharge at a peak rate and volume over a specified time period;

B. Chemical analyses of wastewaters;

C. Quantity and disposition of specific liquid, sludge, oil, solvent, or other materials important to sewer use control;

D. Information on raw materials, processes, and products affecting wastewater volume and quality;

E. A plot plan of sewers of the user's property showing sewer and pretreatment facility location;

F. Details of wastewater pretreatment facilities;

G. Details of systems to prevent and control the losses of materials through spills to the municipal sewer.

(Prior code § 4-2403)

13.08.210 - Standard criteria.

All measurements, tests and analyses of the characteristics of waters and wastes to which reference is made in this chapter shall be determined in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, or with such other reference as shall be maintained in the office of the town administrator. Sampling methods, location, times, durations and frequencies are to be determined on an individual basis subject to approval and periodic review or revision by the director of public works.

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(Prior code § 4-2404)

13.08.220 - Special agreements.

No statement contained in this chapter shall be construed as preventing any special agreement or arrangement between the town and any industrial concern whereby an industrial waste of unusual strength or character may be accepted by the town for treatment.

(Prior code § 4-2405)

13.08.230 - Entry of premises.

The director of public works and other duly authorized employees of the town bearing proper credentials and identification shall be permitted to enter all properties for the purposes of inspection, observation, measurement, sampling and testing pertinent to discharge to the community system.

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(Prior code § 4-2501)

13.08.240 - Technical information.

The director of public works or other duly authorized employees are authorized to obtain information concerning industrial processes which have a direct bearing on the kind and source of discharge to the wastewater collection system. In order to refuse to provide such information, a company must establish that the revelation to the public of the information in question might result in an advantage to the competitors.

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(Prior code § 4-2502)

13.08.250 - Safety rules.

While performing the necessary work on the premises of private companies, the director of public works or duly authorized employees of the town shall observe all safety rules established by the company, and the company shall be held harmless for injury or death to the town employees, and the town shall indemnify the company against loss or damage to its property by town employees and against liability claims and demands for personal injury or property damage asserted against the company and growing out of the gauging and sampling operation, except as such may be caused by negligence or failure of the company to maintain safe conditions.

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(Prior code § 4-2503)