



Department of Natural Resources  
and Environmental Control

89 Kings Hwy  
Dover, DE 19901

dnrec.delaware.gov

Division of Water  
Commercial and Government Services Section

Phone: (302) 739-9946

Fax: (302) 739-2296

## **INSTRUCTIONS FOR COMPLETING THE PERMIT APPLICATION FOR THE CONSTRUCTION OF WASTEWATER COLLECTION AND CONVEYANCE SYSTEMS**

The following items must accompany the application. **Please note that incomplete application packages will be returned in their entirety and not reviewed until such time as all required information is received.**

- ☒ 1. A narrative summary of the intended purpose and design of the proposed facilities.
- ☒ 2. One (1) set of final construction plans and specifications (paper copy), if applicable, signed and sealed by a Delaware-registered Professional Engineer, or a Delaware-registered Professional Land Surveyor for gravity systems only.
- ☒ 3. One (1) electronic copy of final Plans.
- ☒ 4. The final plans must be drawn to scale showing slopes, inverts, pipe types and sizes, existing and proposed ground surfaces, tops of manholes, water lines, stormwater and stream crossings, encasements shown in plan and profile, and other information if pertinent or requested.
- ☒ 5. For pump/lift stations and force mains, include all calculations and pump/performance curves.
- ☒ 6. A check made payable to the State of Delaware for eight hundred twenty-five dollars (\$825.00), the non-refundable permit review fee. This fee covers the initial review and one follow-up review of any corrections or changes made to address the Division's comments. An additional eight hundred twenty-five dollars (\$825.00) non-refundable review fee must be submitted for resubmission of the plans if changes are made to the project which trigger a complete review of the permit application.
- ☒ 7. Your permit will have a public notice requirement if your system includes force mains or pump/lift stations. Include a check made payable to the State of Delaware for three hundred dollars (\$300.00) for the reimbursement of legal notices if the system has a force main connection or a pump/lift station.
- ☒ Please submit the completed application package, as outlined above, to DE DNREC, Division of Water, Commercial and Government Services Section, 89 Kings Highway, Dover, DE 19901. Please note, a new application, including the review fee, must be submitted if the Division's comments are not addressed or if requested supplemental information is not provided within one (1) year of the comment or request date.
- ☒ The following items must be submitted prior to permit issuance:
- ☒ 8. Verification from the appropriate county or municipal planning authority that the project has the proper zoning approval.
- ☒ 9. A letter from the owner/operator of the wastewater facilities to which the proposed collection and conveyance facilities connect. The letter must include confirmation that the owner/operator has approved the project, that the owner/operator will take responsibility for treating and disposing of the wastewater to be conveyed and that the downstream facilities have the capacity to manage the additional flows without causing or contributing to violations of Delaware's Environmental Protection Act (7 Del. C., Chapter 60) and the regulations promulgated thereafter. This includes, but is not limited to, unauthorized discharges such as overflows at manholes and violations of the treatment system's operating permit (for example, the National Pollutant Discharge Elimination System (NPDES) permit).

- Visit us on the web at: <https://dnrec.delaware.gov/water/commercial-government/>

# APPLICATION FOR THE CONSTRUCTION OF WASTEWATER COLLECTION AND CONVEYANCE SYSTEMS

Application must be complete, typewritten or clearly printed

Date Application Submitted 09/30/2025

| PROJECT INFORMATION   |   |                         |  |
|---|---|-------------------------|--|
| Project Name and Location/ Address<br><br>Joy Beach Sewer Collection System Phase II<br>Lewes, Sussex County, DE  |   |                         |  |
| Tax Parcel Number(s)<br>234-12.00-74.00, 234-12.00-64.00, 234-12.00-34.00, 234-12.00-31.00, 234-12.00-74.00   |   |                         |  |
| County<br><input type="checkbox"/> Kent <input type="checkbox"/> New Castle <input checked="" type="checkbox"/> Sussex  | Watershed ( <a href="http://www.dnrec.delaware.gov/swc/wa/Pages/WatershedAssessment.aspx">www.dnrec.delaware.gov/swc/wa/Pages/WatershedAssessment.aspx</a> )<br><input type="checkbox"/> Chesapeake Bay <input type="checkbox"/> DE Bay/Estuary <input checked="" type="checkbox"/> Inland Bays/Atl Ocean <input type="checkbox"/> Piedmont |                         |  |
| Sewer District or Interceptor<br><br>Interceptor  | Wastewater Treatment/Disposal Facility Name<br><br>Inland Bay WWTP  |                         |  |
| Anticipated Construction Start Date<br><br>Spring 2026  | Treatment/Disposal Facility Owner and Operating Permit Number<br>LTS 5004-90-12   DEN No. 359141-05   |                         |  |
| Please note, construction permits expire three (3) years from the date of permit issuance.  |   |                         |  |
| Are you requesting plan review and comment or <u>WPCC Construction Permit issuance</u> (circle one)   |   |                         |  |
| Design Flow (gallons/day)<br>Average   30,000 gpd   | Peak   158,400 gpd<br>(to meet scour velocity)  | Peak Factor<br><br>5.25 | Basis of Design<br>Sussex County Standards<br>and Specifications |
| Description<br>An 8" gravity sewer is proposed to be installed to serve the Cherry Creek Valley and Happy Go Lucky communities. The gravity sewer will flow to a proposed pump station. The proposed pump station will convey flow via a 4" force main and tie into the, existing 4" FM along Camp Arrowhead Road just north of the intersection with Waterview Road. |   |                         |  |
| OWNER/DEVELOPER   |   |                         |  |
| Company Name<br>Sussex County   |   |                         |  |
| Mailing Address<br>2 The Circle, PO Box 589   |   |                         |  |
| City<br>Georgetown  | State<br>DE   | Zip<br>19947            |  |
| Contact Name<br>Paul Mauser, PE, County Engineer  |   |                         |  |
| E-Mail Address<br>paul.mauser@sussexcountyde.gov  |   |                         |  |
| Telephone<br>(302)855-7370  | Cell<br>-   | Fax<br>(302)855-7799    |  |

| ENGINEER  |                          |   |  |                             |                               |
|---|--------------------------|---|--|-----------------------------|-------------------------------|
| Company Name<br>KCI Technologies, Inc.  |                          |   |  |                             |                               |
| Mailing Address<br>614 N Dupont Highway   |                          |   |  |                             |                               |
| City<br>Dover   |                          | State<br>DE   |  | Zip<br>19901                |                               |
| Contact Name<br>Daniel String, PE   |                          |   |  |                             |                               |
| E-Mail Address<br>Daniel.String@kci.com   |                          |   |  |                             |                               |
| Telephone<br>(302) 318-1124   |                          | Cell<br>(302) 747-5999  |  | Fax<br>None                 |                               |
| GRAVITY SEWER INFORMATION   |                          |   |  |                             |                               |
| Ownership<br><input checked="" type="checkbox"/> Public <input type="checkbox"/> Private  |                          | Type of Sewer System<br><input checked="" type="checkbox"/> Residential <input type="checkbox"/> Commercial <input type="checkbox"/> Industrial <input type="checkbox"/> Other? |  | If Other, list below        |                               |
| Type of Pipe<br>PVC   | Length (ft)<br>7,043     | Diameter (in)<br>8  | Joint Specification<br>MJ                                  | Min. Slope (ft/ft)<br>.0028 | Min. Velocity (ft/sec)<br>2.0 |
| PVC   | 7                        | 10  | MJ   | 0.004                       | 2.0                           |
|   |                          |   |  |                             |                               |
| Minimum Pipe Cover (ft)<br>3.5  | Number of Manholes<br>41 | Drop manholes provided?<br>Yes  | Maximum Distance Between Manholes (ft)<br>400              |                             |                               |
| Minimum ten foot (10') horizontal & eighteen inch (18") vertical separation from water lines maintained?<br><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No   |                          |   | If not, explain provisions to prevent cross-contamination: |                             |                               |
| Explain any special challenges (for example, stream, highway and/or railroad crossings, directional drilling, elevated sewers, etc.)<br><br>High water table anticipated in portions of the gravity sewer installation. |                          |   |  |                             |                               |
| Comments  |                          |   |  |                             |                               |

| PUMP/LIFT STATION INFORMATION   |   |   |  |   |
|---|---|---|--|---|
| Ownership<br><input checked="" type="checkbox"/> Public <input type="checkbox"/> Private  |   | Type of Wastewater<br><input checked="" type="checkbox"/> Residential <input type="checkbox"/> Commercial <input type="checkbox"/> Industrial <input type="checkbox"/> Other? |  | If Other, list below<br>None  |
| Pump Station Flows (gallons/day)<br>Design<br>158,400 gpd   |   | Average<br>30,000 gpd   | Peak<br>158,400 gpd  | Peak Factor<br>5.25   |
| Basis of Design<br>Sussex County Standard and Specifications  |   |   | Pump Type<br>Submersible Pump  |   |
| Will peak flows be accommodated if largest unit fails?<br><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No   |   | Pump calc's and pump curves attached?<br><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  |  | Cycle Time (minutes)<br>6   |
|   |   |   |  | Wet Well Detention Time (minutes)<br>15   |
| Check valves provided on discharge line?<br><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No   |   |   | Gate valves provided on discharge line?<br><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |   |
| If not, explain alternate procedure:  |   |   |  |   |
| Ventilation provided in wet well?<br><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  |   | Dry Well?<br><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  |  | Is an alarm system included?<br><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
|   |   |   |  | Alternate source of power?<br><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No   |
| What other provisions for emergency operations?<br>Emergency Bypass connection provided   |   |   |  |   |
| Height of Influent Above Pump (suction head) (ft)<br>-4.73  |   | Height of Effluent Above Pump (discharge head) (ft)<br>-2.8   |  | Friction Loss (ft)<br>23  |
| Pump Design Point<br>110 GPM @ 66' TDH  | Pump Operating Point<br>112 GPM @ 67' TDH   | Static Head (ft)<br>43  | Total Head (ft)<br>66  | Required Motor Horsepower (hp)<br>4.0   |
| FORCE MAIN INFORMATION  |   |   |  |   |
| Type of Pipe<br>PVC DR-18 & HDPE DR-11  |   | Length (ft)<br>1920   |  | Diameter (in)<br>4"   |
| Hazen-Williams "C" Design Factor<br>140   | Type of Joints<br>PVC - Bell & Spigot<br>HDPE - Butt fusion                                 |   | Velocity Under Design Conditions (ft/sec)<br>2.99  | Minimum Pipe Cover (ft)<br>3.5  |
| Air relief valves specified?<br><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No   | Clean-outs provided?<br><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |   | Maximum distance between clean-outs (ft)<br>1,000  |   |
| Minimum ten foot (10') horizontal & eighteen inch (18") vertical separation from water lines maintained?<br><input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |   | If not, explain provisions to prevent cross-contamination:<br>N/A   |  |   |
| Comments  |   |   |  |   |

# **JOY BEACH PHASE 2**

## **PUMPING STATION & FORCE MAIN CALCULATION SHEET**

### **A. Calculate Peak Design Flow:**

|     |            |
|-----|------------|
| 120 | # of EDU's |
| 250 | GPD/EDU    |

\*Number of homes, RVs & trailers in area to be served

|        |     |
|--------|-----|
| Qavg = |     |
| 30,000 | gpd |
| 20.83  | gpm |

|             |      |            |
|-------------|------|------------|
| Peak Factor | 2.42 | Calculated |
| Peak Factor | 5.25 | Used*      |

$$PF = (20 + 2[EDU/10]^{0.5}) / (5 + 2[EDU/1]^{0.45})$$

|         |        |     |
|---------|--------|-----|
| Qpeak = | 72,656 | gpd |
|         | 50.46  | gpm |

Minimum FM Size Per Sussex County Guidelines

$$D = 0.175 \sqrt{(Q_p \times 0.1334 \times C / 2.5)}$$

Min FM Dia. 3.40 inches

|        |                 |
|--------|-----------------|
| 110.00 | Flow Rate (gpm) |
| 0.25   | Flow Rate (cfs) |

**\*Peak Flow is** 50.46 but increased to 110.0  
to reach min scour velocity of 2.5 ft/s IN 4" PIPE

|     |           |
|-----|-----------|
| 140 | C -factor |
| 100 | C-factor  |

\*PVC pipe for FM and gravity

\*Ductile iron for PS

### **Analyze Pipe Diameters:**

HDPE DR-11 Pipe (DIPS) & PVC Pipe

| Pipe Diameter (in) | Actual Inside Pipe Diameter (in) | X - Sectional Area (sqft) | Flow Rate (cfs) | Velocity (fps) | hL (ft/100ft) |
|--------------------|----------------------------------|---------------------------|-----------------|----------------|---------------|
| 2.00               | 1.91                             | 0.02                      | 0.25            | 12.28          | 28.461        |
| 3.00               | 2.86                             | 0.04                      | 0.25            | 5.48           | 3.995         |
| <b>4.00</b>        | <b>3.88</b>                      | <b>0.08</b>               | <b>0.25</b>     | <b>2.99</b>    | <b>0.917</b>  |
| <b>4.00</b>        | <b>4.23</b>                      | <b>0.10</b>               | <b>0.25</b>     | <b>2.51</b>    | <b>0.599</b>  |
| 6.00               | 5.57                             | 0.17                      | 0.25            | 1.45           | 0.157         |
| 8.00               | 7.31                             | 0.29                      | 0.25            | 0.84           | 0.042         |
| 10.00              | 8.96                             | 0.44                      | 0.25            | 0.56           | 0.016         |
| 12.00              | 10.66                            | 0.62                      | 0.25            | 0.40           | 0.007         |
| 14.00              | 12.35                            | 0.83                      | 0.25            | 0.29           | 0.003         |
| 16.00              | 14.05                            | 1.08                      | 0.25            | 0.23           | 0.002         |

**Design Flow (gpm)** **110.00**

Choose Pipe Diameter (in)

**3.88**

for a

Velocity (fps) = **2.99**

\*Velocity should be between 2.5 and 5.0 feet per second

### **C. Pump Station Friction Losses**

|              |  |
|--------------|--|
| <b>4.100</b> | Actual Diameter of Piping within Pump Station (inches) |
| <b>2.67</b>  | Velocity   |

| <u>Fittings</u> | <u>Size (inch)</u> | <u>Leq (ft)</u> | <u>Qty.</u> | <u>Leq (ft)</u> |
|-----------------|--------------------|-----------------|-------------|-----------------|
| Reducer 3/4     | 4.1                | 5               | 1           | 5               |
| Plug Valve      | 4.1                | 1.75            | 2           | 3.5             |
| Entrance Losses | 4.100              | 4.5             | 1           | 4.5             |
| 90 deg. Elbow   | 4.1                | 8               | 2           | 16              |
| 22.5 deg Elbox  | 4.10               | 2.5             | 0           | 0               |
| Check valve     | 4.1                | 19              | 1           | 19              |
| 45 deg bends    | 4.1                | 5.5             | 0           | 0               |
| T (flow thru)   | 4.1                | 6               | 2           | 12              |
| Pipe Length     | 4.1                | 1               | 30          | 30              |
| Total Leq (ft)  |                    |                 |             | <b>90</b>       |

### **Force Main Friction Losses (DR11 HDPE)**

PS to Camp Arrowhead

|              |  |
|--------------|--|
| <b>3.876</b> | Diameter of Force Main Piping (inches) |
|--------------|--|

| <u>Fittings</u> | <u>Size (inch)</u> | <u>Leq (ft)</u> | <u>Qty.</u> | <u>Leq (ft)</u> |
|-----------------|--------------------|-----------------|-------------|-----------------|
| Reducer 2/3     | 3.876              | 5               |             | 0               |
| Plug Valve      | 3.876              | 2.3             | 1           | 2.3             |
| Entrance Losses | 3.876              | 4.5             |             | 0               |
| 90 deg. Elbow   | 3.876              | 11              |             | 0               |
| Check valve     | 3.876              | 19              |             | 0               |
| Gate Valve      | 3.876              |                 |             | 0               |
| 45 deg bends    | 3.876              | 5               | 2           | 10              |
| 22.5 deg bends  | 3.876              | 2.5             | 2           | 5               |
| Wye (flow thru) | 3.876              | 6               |             | 0               |
| Pipe Length     | 3.876              | 1               | 675         | 675             |
| Total Leq (ft)  |                    |                 |             | <b>692.3</b>    |

### **Force Main Friction Losses (4" DR18 PVC Pipe)**

Camp Arrowhead to Waterview & Joy Beach 1 FM

|              |  |
|--------------|--|
| <b>4.230</b> | Diameter of Force Main Piping (inches) |
|--------------|--|

| <u>Fittings</u> | <u>Size (inch)</u> | <u>Leq (ft)</u> | <u>Qty.</u> | <u>Leq (ft)</u> |
|-----------------|--------------------|-----------------|-------------|-----------------|
| Reducer 2/3     | 4.230              | 5               |             | 0               |
| Plug Valve      | 4.230              | 2.3             | 1           | 2.3             |
| Entrance Losses | 4.230              | 4.5             |             | 0               |
| 90 deg. Elbow   | 4.230              | 11              |             | 0               |
| Check valve     | 4.230              | 19              |             | 0               |
| Gate Valve      | 4.230              |                 |             | 0               |
| 45 deg bends    | 4.230              | 5               | 9           | 45              |
| 22.5 deg bends  | 4.230              | 2.5             | 2           | 5               |
| Wye (flow thru) | 4.230              | 6               | 1           | 6               |
| Pipe Length     | 4.230              | 1               | 2562        | 2562            |
| Total Leq (ft)  |                    |                 |             | <b>2620.3</b>   |

**Static Head Loss:**

|       |                           |
|-------|---------------------------|
| 23.50 | High Point in System (ft) |
| -9.23 | "Pump Off" Elevation (ft) |

|              |                  |
|--------------|------------------|
| 10           | Joy Beach 1 Pump |
| <b>32.73</b> | Static Head      |

**Calculate Total Dynamic Head:**

\* Summation of PS Friction Losses, Force Main Friction Losses, and Static Head

|              |   |
|--------------|---|
| <b>1.17</b>  | Pump Station Friction Losses (ft)       |
| <b>6.35</b>  | 4" PVC Force Main Friction Losses (ft)  |
| <b>15.70</b> | 4" HDPE Force Main Friction Losses (ft) |

**Design Point:**

|               |                               |
|---------------|-------------------------------|
| <b>65.94</b>  | <b>TDH (ft)</b>               |
| <b>110.00</b> | <b>Design Flow Rate (gpm)</b> |

**SYSTEM CURVE:**

| GPM | Static Loss | Loss in PS Pipe (ft) | Loss in FM Pipe (ft) | Total |
|-----|-------------|----------------------|----------------------|-------|
| 0   | 42.73       | 0.00                 | 0.00                 | 42.73 |
| 10  | 42.73       | 0.01                 | 0.08                 | 42.82 |
| 20  | 42.73       | 0.05                 | 0.27                 | 43.05 |
| 30  | 42.73       | 0.11                 | 0.57                 | 43.41 |
| 40  | 42.73       | 0.18                 | 0.98                 | 43.89 |
| 50  | 42.73       | 0.27                 | 1.48                 | 44.48 |
| 60  | 42.73       | 0.38                 | 2.07                 | 45.18 |
| 70  | 42.73       | 0.51                 | 2.75                 | 45.99 |
| 80  | 42.73       | 0.65                 | 3.52                 | 46.90 |
| 90  | 42.73       | 0.81                 | 4.38                 | 47.91 |
| 100 | 42.73       | 0.98                 | 5.32                 | 49.03 |
| 110 | 42.73       | 1.17                 | 6.35                 | 50.24 |
| 120 | 42.73       | 1.37                 | 7.45                 | 51.56 |
| 130 | 42.73       | 1.59                 | 8.64                 | 52.97 |
| 140 | 42.73       | 1.83                 | 9.91                 | 54.47 |
| 160 | 42.73       | 2.34                 | 12.69                | 57.76 |
| 180 | 42.73       | 2.91                 | 15.78                | 61.42 |
| 200 | 42.73       | 3.53                 | 19.18                | 65.44 |
| 220 | 42.73       | 4.22                 | 22.87                | 69.82 |
| 240 | 42.73       | 4.95                 | 26.87                | 74.55 |
| 260 | 42.73       | 5.74                 | 31.16                | 79.63 |

**B. Wet Well Volume**

**General Guideline Equation:  $V_{min} = (T_{min} \times Q_p) / 4$ ; Use  $T_{min} = 10$  minutes**  
**Use Manufacturer's recommendations for on/off cycle times to confirm sizing**

|           |     |
|-----------|-----|
| $T_{min}$ | 10  |
| $Q_p$     | 110 |

|             |        |         |
|-------------|--------|---------|
| $V_{min} =$ | 275.00 | gallons |
|             | 36.76  | cuft    |

**Alternate Wet Well Volume Calcs:**

|      |        |
|------|--------|
| Tmin | 10     |
| Qin  | 55.00  |
| Qout | 110.00 |

|        |        |         |
|--------|--------|---------|
| Vmin = | 275.00 | gallons |
|        | 36.76  | cuft    |

\* change to size wetwell for minimum pump run time ->  
when Qi = 1/2 Qo

\* Qin is Qout (Qpeak) divided by 2, simulating best

\* Qout is Qpeak because Qpeak is output of

|      |                                   |   |
|------|-----------------------------------|---|
| 6    | Choose Wet Well Diameter, in feet | 4 foot works, for duplex pump spacing assume 6 foot     |
| 1.30 | Required Operating Depth          | normal 2 ft or smaller<br>Round up to nearest 0.25 feet |
| 1.50 | Selected Operating Depth          |   |

**C. Ventilation** \* Ventilation fans must be positive pressure feeds per MD, Smyrna & NCC Standards

Fan Type (Intermittent(0)/Constant(1))

Volume of wet well =

|        |
|--------|
| 1.00   |
| 515.44 |

Cu. Ft

**Ten States/Sussex County** flow rates =

**NCC** flow rate changes/hr variable =

**Intermittent Flow**

|        |     |
|--------|-----|
| 257.72 | CFM |
| 51.54  | CFM |
| 103.09 | CFM |

Costant

Intermittent

C Factor

Pipe Dia:

|        |
|--------|
| 140.00 |
| 4.00   |

**Net Positive Suction Head (NPSH) & Cavitation:**

\*\*Barometric Pressure of water column =

\*\*Vapor Pressure of Liquid =

\*\*Entrance Losses =

Transport Friction Losses =

Static Head=

|       |    |
|-------|----|
| 33.90 | ft |
| 0.21  | ft |
| 1.00  | ft |
| 0.00  | ft |
| 1.00  | ft |

\*\* Change for high elevations

Design NPSHr =

Actual NPSHa =

|       |    |
|-------|----|
| 17.36 | ft |
| 33.69 | ft |

\* Manufacturer's NPSH

\* 20% > than NPSH Req'd

(See safety factor below.)

\* Actual NPSH should be no lower than

20.83 ft

**Buoyancy Calculations**

Density Table:

|          |      |       |
|----------|------|-------|
| Water    | 62.4 | LB/CF |
| Dry Soil | 110  | LB/CF |
| Wet Soil | 70   | LB/CF |
| Concrete | 150  | LB/CF |

Wetwell Dimension Table:

|               | Concrete | Wet Soil | Dry Soil |    |
|---------------|----------|----------|----------|----|
| Height        | 19.7     | 18.2     | 18.2     | FT |
| Width         | 0.58     | 1        | 1        | FT |
| Avg Perimeter | 22.49    | 25.13    | 25.13    | FT |

|                      |   |   |   |    |
|----------------------|---|---|---|----|
| <b>Base Height</b>   | 1 | 0 | 0 | FT |
| <b>Base Diameter</b> | 9 | 0 | 0 | FT |

|                            |        |      |     |
|----------------------------|--------|------|-----|
| Wetwell Volume(inc. lip) = | 718    | CF   |     |
| Total Buoyant Force =      | 44,823 | LBS. | (1) |
| Weight of Pump Station =   | 5000   | LBS. | (2) |

|                                 |        |      |     |
|---------------------------------|--------|------|-----|
| Vol. (Concrete Barrel) =        | 259    |      |     |
| Wt of Wetwell Concrete Barrel = | 38,833 | LBS. | (3) |

|                        |       |      |     |
|------------------------|-------|------|-----|
| Vol. (Concrete Base) = | 63.62 | CF   |     |
| Wt of Concrete Base =  | 9,543 | LBS. | (4) |

|                   |        |      |     |
|-------------------|--------|------|-----|
| Vol. (Wet Soil) = | 458    | CF   |     |
| Wt of Wet Soil =  | 32,072 | LBS. | (5) |

|                   |        |      |     |
|-------------------|--------|------|-----|
| Vol. (Dry Soil) = | 458    | CF   |     |
| Wt of Dry Soil =  | 50,399 | LBS. | (6) |
| Wt of Wet Soil =  | 32,072 | LBS. |     |

|                  |        |     |  |
|------------------|--------|-----|--|
| Resisting Force= | 80,447 | LBS |  |
|------------------|--------|-----|--|

|                        |        |  |  |
|------------------------|--------|--|--|
| Force Balance =        | 40,624 |  |  |
| <b>(2)+(4)+(7)-(1)</b> |        |  |  |

Safety Factor = **1.8** **SF of > 1.2 is Required**

### Water Hammer

|                             |           |                                     |  |
|-----------------------------|-----------|-------------------------------------|--|
| K, For Water =              | 45792000  | psf                                 |  |
| K, For Water =              | 318000.00 | psi                                 |  |
| Density of Water =          | 1.936     | slug/cu ft AKA (ft lbs s-1) / cu ft |  |
| Initial Acoustic Velocity = | 4863.42   | fps                                 |  |
| Gravity =                   | 32.17     | ft/s2                               |  |
| Pipe Internal Diameter =    | 3.88      | in                                  |  |
| Pipe Wall Thickness =       | 0.69      | in                                  |  |
| Young's Modulus (E) =       | 700000    | psi                                 |  |
| Acoustic Velocity =         | 2580.55   | fps                                 |  |

|  |               |             |
|--|---------------|-------------|
| <b>Change in Pressure due to Waterhammer</b> | <b>73.52</b>  | psi         |
|  | <b>169.10</b> | ft of water |

**PVC Approved to 185 psi**

### D. Electrical Load Calculations

#### Horsepower sizing

|              |             |                 |
|--------------|-------------|-----------------|
| Qpeak =      | 110.00      | gpm             |
| TDH =        | 65.94       | ft              |
| Specific g = | 1.00        | (dimensionless) |
| Horsepower   | <b>1.83</b> | <b>HP</b>       |

| <b>EQUIPMENT</b>          | <b>WATTS</b> | <b>VOLTS</b> | <b>AMPS.</b>  |
|---------------------------|--------------|--------------|---------------|
| Odor Control (Heat Trace) | 1800         | 120          | 15            |
| Odor Control (Ctrl panel) | 1800         | 120          | 15            |
| 4 Floor Lights            | 640          | 120          | 5.33          |
| Ext. Light                | 200          | 120          | 1.67          |
| Wet Well Light            | 200          | 120          | 1.67          |
| Hoist                     | 748          | 120          | 6.23          |
| Heater #1                 | 3600         | 240          | 15.00         |
| Heater #2                 | 3600         | 240          | 15.00         |
| Battery Charger           | 500          | 120          | 4.17          |
| Generator Wat. J. Heater  | 1500         | 120          | 12.50         |
| Supply Fan & Mtr. Dmpr.   | 230          | 120          | 1.92          |
| Exhaust Fan               | 190          | 120          | 1.58          |
| 2 Louver Motors           | 200          | 120          | 1.67          |
| Telemetry                 | 100          | 120          | 0.83          |
| Receptacle                | 1500         | 120          | 12.50         |
| 2 - 25HP Motor            | 37285        | 240          | 155.35        |
| <b>TOTAL</b>              |              |              | <b>265.42</b> |

# Pump Curve and System Curve

