PART 1: GENERAL

1.1 DESCRIPTION AND CLASSIFICATION OF STATIONS

Lift stations shall be provided at any point in a proposed sewage collection system where the upstream gravity collection system cannot be physically connected to the existing collection system in a manner to permit gravity flow. System extensions shall be designed to avoid lift stations as far as possible.

A. In general, stations may lift flows to a higher elevation, transport flow horizontally or combine lifting and horizontal transport.

B. Stations may be classified by rated flows as follows:

1. Very Small  10-100 gpm
2. Small       100-250 gpm
3. Medium      250-950 gpm
4. Large       950-2,000 gpm
5. Regional    2,000+ gpm

C. In general, lift stations shall utilize submersible pumps placed in a below-ground wet well. Other configurations may be considered where appropriate.

1.2 Lift station location and design capacity shall be compatible with the ECUA Master Plan for Wastewater. Lift stations shall be designed to operate effectively at initial flows as well as at ultimate design flows. To that end, each lift station design must address several interrelated elements including, but not limited to:

A. Wet well size (diameter and depth)

B. Force main size and station piping

C. Pump and control selection

D. Flow quality and station appurtenances

1.3 Lift station design calculations submitted to ECUA for approval shall include all design considerations and assumptions. (See Lift Station Design Worksheet, pages 575.6 and 575.7)

PART 2: REFERENCE STANDARDS - See Section 570, Part 2
PART 3: DESIGN FLOWS

3.1 Flow Requirements

Lift station design flow requirements shall be developed in accordance with Section 570, Part 3 of ECUA’s Engineering Manual. In addition, flows shall be estimated for each of the following conditions:

A. Peak flow for initial, intermediate, and ultimate periods
B. Average flow for initial, intermediate, and ultimate periods
C. Minimum flow for initial, intermediate, and ultimate periods

PART 4: DESIGN PARAMETERS AND FUNCTIONAL CRITERIA

4.1 Lift Station Site

Lift stations shall be located so as to permit gravity sewer connection(s) from the largest feasible drainage area, or to permit continuing downstream gravity sewer system development where possible.

A. Station top elevation shall be above the 100 year flood level as designated by FEMA Flood Maps. In no case should the lift station be placed in an area subject to prolonged periods of flooding.

B. Station shall be readily accessible by truck at all times.
   1. Not adjacent to right-of-way, access easement will be required.
      a. 10-foot paved driveway preferred, but shell driveway on solid base with good drainage may be accepted.
      b. Drainage ditches and streams must be crossed using properly sized culverts.
      c. A truck turn-around shall be provided at all lift stations.
   2. Minimum size of parcel to be 20' X 20'; larger if appurtenances may be required.
      a. Title to the lift station site shall be conveyed to ECUA in accordance with ECUA Policy.
b. The lift station shall be fenced in accordance with ECUA requirements unless specifically exempted.

C. Station shall be located with consideration for availability of:

1. Three-phase electrical service
2. Potable water

### 4.2 Functional Criteria

A. Lift stations shall contain a minimum of 2 pumps with each pump capable of pumping at peak hourly flow. Peak hour flow shall be determined using the curve or formula in Appendix E-2 (page 575.9).

B. Wet well volume shall be calculated based on the projected ultimate peak flows with consideration for initial peak flows.

1. Minimum liquid level in the wet well shall be 2 feet above the bottom of the wet well or in accordance with the manufacturer's requirements for the pump specified, whichever is greater.

2. Cycle time, to pump down and refill, shall be not less than 10 minutes nor more than 15 minutes at 1/2 peak flow.

3. The spacing between 'lead pump on' and 'lag pump on' shall be a minimum of 1 foot.

4. The high level alarm shall be set not less than 1 foot above 'lag pump on', and at sufficient depth to provide a minimum of 30 minutes storage, calculated at average flow, below the lowest influent line.

C. 1. The force main velocity at the initial pumping rate shall be not less than 2.5 fps. The velocity in the force main at the design pumping rate shall be not more than 6 fps.

2. Downstream capacities shall be checked.

3. When the force main will manifold into an existing force main the impact on that line and all existing pump stations that utilize that line must be evaluated.

4. When the force main could either discharge to an existing lift station or manifold into that station's force main, an analysis shall be made to determine which alternative is in the best long-term interest of ECUA.
D. Calculate system head: static, friction and velocity. Select pumps. (See Worksheet, pages 575.6 and 575.7). Pump curves shall show range and efficiencies, and shall include the system curve(s).

4.3 Wet Well Design

The wet well shall be sized by determining the combination of diameter and depth most suitable to handle the intended maximum design capacity with adequate provision for emergency storage.

A. Based on location constraints, functional criteria, and the approximate wet well size, the following design elements shall be established:

1. Ground elevation at wet well.
2. Lowest influent elevation of gravity system.
3. "High level alarm" elevation.
4. "Lag pump on" elevation.
5. "Lead pump on" elevation.
6. "All pumps off" elevation.
7. Wet well bottom elevation.
8. Base thickness shall be calculated to assure that the wet well will not float when empty. See page 575.7 for method of calculation.

B. When the wet well and force main are oversized for future requirements, the station piping, electrical service, and controls shall be sized accordingly. When it is anticipated that a third pump is to be installed in the future, the station shall be designed to accommodate through-wall piping in the wet well, a manifold into the discharge force main, and appropriate equipment in the control panel.
C. Compute design elements for larger and/or smaller diameter wet wells, then select optimum size to meet initial and future demands. Wet well sizing, force main sizing and pump selection may require several iterations to arrive at optimum design for sound economic selection over the proposed design period.

**PART 5: DETAIL SPECIFICATIONS FOR WET WELL, PUMPS AND CONTROLS**
(See Section 2575)

**PART 6: APPURTENANCES**

6.1 The lift station site shall be fenced in accordance with ECUA specifications unless specifically waived by ECUA's Engineer.

A. The fence shall enclose an area sufficient to protect the lift station and all appurtenances.

B. The electric supply meter shall be outside the fence or located so as to be read without entering the fence.

C. See Section 2830 for specifications.

6.2 Emergency bypass piping with gate valve and quick-connect coupling shall be the same size (up to 8" ∅) as the station piping, and shall be located within the valve box as shown on ECUA's Standard Lift Station Detail Sheet.

6.3 Standby emergency power will be required as follows:

A. Regional stations shall require an on-site emergency generator suitably located and wired for automatic transfer. Generator will be of sufficient size to run all of the station equipment.

B. All other lift stations, if not provided with on-site generating capabilities, shall be equipped with a manual transfer switch for connecting a portable generator.

C. Lift stations serving individual single-family homes are exempt from requirements for standby emergency power.

6.4 Chemical feed equipment may be required at lift stations or elsewhere in the collection system if detention times are such that septic conditions may develop causing generation of hydrogen sulfide and other gases.
LIFT STATION DESIGN - WORKSHEET

Project Name: ____________________________  Date: ____________________________
Project Location: _________________________  By: ____________________________

REQUIRED CALCULATIONS FOR WET WELL DESIGN:

1. Estimate average daily flow (ADF):
   
   Initial (first year) \( (\__ \text{ERC} + \__ \text{Acre} \times \frac{\text{ERC}}{\text{AC}}) \times \frac{300}{1440} = \__ \text{gpm} \)
   
   Intermediate (this project) \( (\__ \text{ERC} + \__ \text{Acre} \times \frac{\text{ERC}}{\text{AC}}) \times \frac{300}{1440} = \__ \text{gpm} \)
   
   Ultimate (build-out of lift station coverage area) \( (\__ \text{ERC} + \__ \text{Acre} \times \frac{\text{ERC}}{\text{AC}}) \times \frac{300}{1440} = \__ \text{gpm} \)

2. Select appropriate peaking factor (see Appendix E-1, page 575.8) and determine Design Peak Flow:
   
   Initial  \( \text{Avg.} \times \__ \text{Peak} = \__ \text{gpm} \)
   Intermediate  \( \text{Avg.} \times \__ \text{Peak} = \__ \text{gpm} \)
   Ultimate  \( \text{Avg.} \times \__ \text{Peak} = \__ \text{gpm} \)

3. Primary Operating Volume in gallons for a minimum cycle time of 12 minutes will be 3 X the pumping rate in gallons per minute.

   Compute for Initial and Ultimate conditions.


5. Calculate Emergency Storage Time (see paragraph 4.02, B.4, page 575.3).

6. Calculate Emergency Storage Volume = Emergency Storage Time \( \times Q_{AV} \times \frac{1}{2} \) Peaking Factor. Calculate for Initial and Ultimate Flow conditions.

7. Calculate Alarm Time Range = Alarm Volume divided by volume per vertical foot.

8. Identify the lowest discharge (or spill) point assuming all pumps off.

9. Establish critical pump control elevations.
10. Check Flotation: Total weight - buoyancy force must be positive.

Total Weight = Vol of (Walls thickness + top slab + bottom slab + taper fill) X 150 lbs./cu. ft.

Buoyancy Force = Exterior Vol (below max. high water) X 62.4 lbs./cu. ft.

If negative or close, increase bottom slab thickness and/or increase bottom diameter then calculate volume of earth (backfill) cone pressing on ring X 52.4 lbs./cu.ft.

REQUIRED CALCULATION FOR FORCE MAIN DESIGN:

Compute System Curve

TDH shall be evaluated separately for discharge elevation and elevation of high points of the force main, and for initial and aged "C" factors.

| Static Head | High Point _____ or Discharge _____ - Pump Off _____ = _____ ft. |

Pump Selection:

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>PUMP</th>
<th>MOTOR</th>
<th>PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MAKE</td>
<td>MODEL</td>
<td>IMPELLER</td>
</tr>
<tr>
<td>Start</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Future</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ultimate</td>
<td></td>
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APPENDIX E-1

LIFT STATION DESIGN
REFERENCE DATA

Peaking Factor Selection Guide

<table>
<thead>
<tr>
<th>STATION SIZE</th>
<th>TOP Q PUMP gpm</th>
<th>TOP Q PUMP MGD</th>
<th>AVG. PK FACTOR</th>
<th>AVG. Q MGD</th>
<th>AVG. ERC's</th>
<th>AVG. POP.</th>
<th>PEAKING FACTOR*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Small</td>
<td>100</td>
<td>.144</td>
<td>4.0</td>
<td>.036</td>
<td>144</td>
<td>432</td>
<td>4.01</td>
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<tr>
<td>Small</td>
<td>250</td>
<td>.360</td>
<td>4.0</td>
<td>.090</td>
<td>360</td>
<td>1080</td>
<td>3.78</td>
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<tr>
<td>Medium</td>
<td>950</td>
<td>1.368</td>
<td>3.5</td>
<td>.39</td>
<td>1560</td>
<td>4680</td>
<td>3.27</td>
</tr>
<tr>
<td>Large</td>
<td>2000</td>
<td>2.88</td>
<td>3.0</td>
<td>.96</td>
<td>3840</td>
<td>11520</td>
<td>2.89</td>
</tr>
<tr>
<td>Regional</td>
<td>5000+</td>
<td>7.20</td>
<td>2.5</td>
<td>2.86</td>
<td>11520</td>
<td>34560</td>
<td>2.42</td>
</tr>
</tbody>
</table>

ERC = 300 gpd for Wastewater and 3 Persons Per Unit
*for Peaking Factor see Appendix E-2, page 575.9

Capacity of Force Mains at Given Velocity Q = AV gpm

<table>
<thead>
<tr>
<th>VELOCITY</th>
<th>FORCE MAINS - NOMINAL SIZE - INCHES DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>fps</td>
<td>2&quot;</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>2.5</td>
<td>25</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
</tr>
<tr>
<td>8</td>
<td>80</td>
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</tbody>
</table>

(for friction losses and full chart see Appendix E-3, page 575.10)

Manhole or Wet Well Volume per Vertical Foot in Gallons

<table>
<thead>
<tr>
<th>DIAMETER (FT)</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOL. (GAL)</td>
<td>94.0</td>
<td>147.0</td>
<td>211.5</td>
<td>376.0</td>
<td>587.5</td>
<td>846.0</td>
<td>1151.5</td>
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(adjust for reduced diameters for sidewall taper at bottom)