Milford Township
Engineering Design Standards

These Engineering Design Standards are intended to provide a reasonable basis for design of public and private improvements in Milford Township. They are not intended as a substitute for sound engineering judgment. The Standards may not apply to all conditions, and alternate solutions shall be permitted as approved by the Township's Engineer.

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Milford Township
Engineering Design Standards

1. GENERAL

1.1 Complete improvement plans bearing the seal of a licensed Professional Engineer, Surveyor or Architect licensed to practice in the State of Michigan shall be submitted prior to review and approval of any portion thereof.

1.2 A certified boundary survey of the site, prepared and sealed by a licensed Professional Engineer, Surveyor licensed to practice in the State of Michigan, or a copy of the completed plat shall be submitted with the engineering drawings.

1.3 Plans submitted shall be on 24" x 36" white prints having blue or black lines, and shall be neatly and accurately prepared. Judgment should be exercised in the design, layout, and the presentation of proposed improvements.

1.4 For projects or subdivisions having more than one sheet of plans, a general plan having a scale of 1" = 100' shall be provided showing the overall project and indicating the size and general location of all improvements shown in the detailed plans.

1.5 Street names, street and easement widths, lot lines, lot dimensions, lot numbers and ownership shall be shown on all plans.

1.6 Elevations shall be on U.S.G.S. Datum. Two (2) permanent bench marks for the work shall be indicated on the plans.

1.7 Any areas that are considered to be "wetlands" as defined by the Michigan Department of Environmental Quality (MDEQ) shall be indicated on the plans. No improvements will be allowed in wetlands unless the MDEQ or Township issues a permit, or a letter of "No Authority", for such improvements.

1.8 Finished grade shall be indicated for all structures.

1.9 The developer or their engineer shall be responsible for forwarding plans for approval to any private utility company (gas, electric, phone, cable, etc.) and any Federal, State or County (Drain Commission, Road Commission, etc.) agency whose facilities or rights-of-way may be affected by the proposed construction.

1.10 It shall be the owner's engineer and contractor's responsibility to verify the existence and location of all underground utilities.

1.11 All engineering construction plans shall contain the latest version of the applicable Milford Township Standard Detail Sheets and the developers/owners name(s), address, phone number and fax number.

1.12 An Engineer’s Opinion of Construction Cost must be supplied with the Construction Plan submittal. This estimate will be used by the Township to establish review and inspection fees for the improvements in accordance with the Township Ordinance.

1.13 All sewer trenches under the 45 degree zone of influence line of existing or proposed pavements, bike paths, sidewalks or drive approaches shall be backfilled with sand compacted to at least 95% of maximum unit weight.

1.14 Utility crossings of paved roadways will be required to be bored. Open cutting of paved roadways will not be permitted.

1.15 An itemized quantity list will be required for all proposed utility improvements (water main, sanitary sewer, storm sewer, paving).

1.16 The developer shall submit to the Township five (5) sets of complete construction plans for review. After the plans receive approval, they will be distributed as follows; one (1) set to the Township, one (1) set to the developer/owner and three (3) sets to the Township Engineer.

2. WATER MAIN

2.1 *General*

2.1.1 If the proposed improvements include the construction of public water main, the developer shall submit nine (9) sets of water main only plans with a completed MDEQ permit application. This information will be forwarded by the Township's Engineer to the MDEQ for permitting.

2.1.2 All water system improvements shall be design in accordance with the current edition of "Recommended Standards for Water Works" (a/k/a Ten State Standards).

2.1.3 Water mains in new developments shall be installed from boundary to boundary in abutting roads and interior streets, and at other locations as may be deemed necessary by the Township for future extensions.

2.2 *Design Requirements*

2.2.1 Eight inch (8") minimum diameter mains will be installed in single family residential areas.

2.2.2 Twelve (12) inch mains are considered to be the minimum size in commercial, office, industrial, and multiple family residential areas except in a looped system of 1,500 feet or less where eight (8) inch mains may be permitted.

2.2.3 Water mains are to be looped whenever possible. Interconnection to existing public water supply systems is encouraged.

2.2.4 Hydrant leads longer than 75 feet must be eight (8) inches.

2.2.5 No service leads are allowed to extend from a 6" hydrant lead.

2.2.6 Profile view is required for 16" and larger water mains, and for other smaller sizes when determined necessary.

2.2.7 Water mains shall be kept on one side of the street for the entire length of the street. Water mains shall not be located under pavement or under cul-de-sacs.

2.2.8 Gate valves shall be spaced at a maximum of 800 feet intervals on distribution lines. They shall be spaced such that not more than four valves need to be turned off to isolate any section of the water main.

2.2.9 Sufficient valves shall be placed such that not more than 30 single family homes, 30 multiple family units or two (2) hydrants shall be out of service within a section of isolated water main.

2.2.10 Dead-end mains must be end with a hydrant and a gate valve and well.

2.2.11 Gate valves should not be located under roadway pavement, bike paths, sidewalks or driveway approaches when possible.

2.2.12 Eight (8)" and larger valves are required to be installed in a gate well, except for 6" hydrant shut off valves.

2.2.13 In single family residential areas, hydrants shall be spaced along the water main a maximum of 600 feet. In no case shall a house be more than 350' from a hydrant. Commercial, industrial and multiple family spacing shall be a maximum of 400 feet.

2.2.14 Along major roadways and in areas other than single family residential, hydrant spacing shall be a maximum of 350 feet.

2.2.15 In commercial and industrial areas, the exterior of buildings shall be no further than 250 feet from a hydrant, measured along shortest feasible exterior route for laying hose. Hydrants shall be no closer than 2 times the height of the tallest part of the structure. There shall be a fire hydrant located within 150 feet of any building fire department connection.

2.2.16 Where possible, hydrants shall be located at the lot corners, but no closer than eight (8) feet from any driveway or driveway approach.

2.2.17 Hydrants located in parking areas shall be protected with a six (6) inches (minimum) concrete curb or standard guard posts.

2.2.18 When connecting to an existing water main, a tapping sleeve, gate valve and well will be required unless connection to the existing main can be made without interrupting service on the main.

2.2.19 The plans shall indicate the finish grades of all hydrants and gate well rims.

2.2.20 Water mains shall be located so as to provide a minimum of ten (10) feet horizontal clearance between the nearest edge of the water main and the nearest edge of any sanitary or storm sewer.

2.2.21 A minimum vertical clearance of 18 inches shall be maintained between the top or bottom of any water main and the top or bottom of any sewer or utility. Vertical clearance of less than 18 inches will require concrete encasement of the sewer or utility.

2.2.22 Restrained joints shall be used at all bends, tees, hydrant shoes, plugs and caps where necessary to prevent lateral movement of the water main. Thrust blocks will not be allowed.

2.3 *Materials*

2.3.1 All water main 20" diameter and smaller shall be Ductile Iron pipe, Class 54. Two (2) brass wedges shall be used per joint.

2.3.2 Milford Township standard valve is East Jordan Iron Works, FlowMaster, left hand open. All valves shall be resilient seated and conform to AWWA C515 Standards.

2.3.3 Hydrants shall be East Jordan Iron Works 5-BR traffic model

2.3.4 Restrained joints shall be Mega-Lug or Field-Lok gaskets.

2.4 *Installation*

2.4.1 All water main shall be installed with a minimum cover of five (5) feet below finish grade. When water mains must dip to pass under another utility, the sections which are deeper than normal shall be kept to a minimum length by the use of vertical bends properly restrained.

2.4.2 The contractor will fill, disinfect and pressure test all new water main construction under the supervision of the Milford Township and/or its agent.

2.4.3 Before any water main will be accepted by the Township, it must pass a pressure test complying with the current specifications and procedures of the Township. The maximum loss of water for the 2 hour hydrostatic test shall be 11.65 gallons, per inch diameter of main, per mile of pipe over a 24 hour period.

2.4.4 Before any water main system will be accepted by the Township, the fire hydrants must be brush coated with Glamortex 501 enamel, Color 314 Vermillion fire hydrant red paint or approved equal.

2.4.5 Gate well covers shall be East Jordan Iron Works No. 1040 or approved equal with the text “Milford Township Water” embossed on the surface.

3. SANITARY SEWER

3.1 *General*

3.1.1 If the proposed improvements include the construction of public sanitary sewer, the developer shall submit nine (9) sets of sanitary sewer only plans with a completed Part 41 MDEQ permit application. This information will be forwarded by the Township's Engineer to the MDEQ for permitting.

3.1.2 All sanitary sewer improvements shall be design in accordance with the current edition of "Recommended Standards for Wastewater Facilities" (a/k/a Ten State Standards).

3.1.3 A grease interceptor will be required for all food service operations. No connections for domestic waste will be allowed to the interceptor.

3.1.4 Downspouts, weep tile, footing drains, sump pump discharges, or any conduit, that carries storm or ground water shall not be allowed to discharge into a sanitary sewer.

3.2 *Design Requirements*

3.2.1 At all connections to the Township 's Sanitary System or extension thereto, in the first manhole upstream from the connection, provide a water-tight bulkhead with a 1" diameter pipe through the bulkhead for measuring infiltration immediately upstream. Also a one foot sump at the base of the manhole shall be provided.

3.2.2 The minimum allowable size of a public sanitary sewer is 10" diameter.

3.2.3 The following table of minimum slopes for sanitary sewers shall be adhered to:

Size	Minimum Grade
10"	0.28%
12"	0.22%
15"	0.15%
18"	0.12%
21"	0.10%

3.2.4 The last upstream run of sewer must be at a grade of 1.00% or greater.

3.2.5 The minimum slope for 6" building leads is 1.00%.

3.2.6 A monitoring manhole is required on the sanitary lead for all non-residential connections to the sanitary sewer system. The monitoring manhole can only have one (1) lead running through it. It must be located on a straight run of lead and can not be a manhole on a public sewer main.

3.2.7 Each building structure shall have a separate individual sanitary service lead connected to a public sanitary sewer.

3.2.8 Sanitary sewer manholes shall not exceed the spacing listed below:

Diameter of Sewer	Maximum Manhole Spacing
10"	300 feet
12" to 21"	350 feet
24" and larger	400 feet

3.2.9 Sanitary sewers must be placed in standard minimum 20 foot easements. The easement width may be increased depending on the proposed sewer depth, soil conditions or adjacent facilities.

3.2.10 Generally, sanitary sewers will not be approved in a rear lot easement.

3.2.11 The following information shall be indicated on the sanitary sewer profile:

a. Length of run between manholes.
b. Type, class, size and slope of pipe and leads.
c. Class of bedding.
d. Rim elevation of all manholes.
e. Existing and proposed ground elevation line above the route of the sewer.
f. A logical numbering system for manholes shall be included.
g. Invert elevations of all sewer at manholes.
h. Location and limits of sand backfill where required.
i. Location and elevations of crossings with other utilities.

3.2.12 Provide a minimum depth from top of curb (or road centerline if uncurbed) to the top of any sanitary sewer of 9 feet at locations where the sewer grade is parallel to the road grade. Under any design the sewer shall be deep enough to reasonably serve, by gravity, a standard depth basement.

3.2.13 Sanitary sewer shall be placed on the opposite side of the street from the water main, and shall have a horizontal separation of at least 10 feet.

3.2.14 External drop connections are required at manholes where the invert of the outlet pipe is 18 inches or more below the invert of the inlet pipe. Internal drop connections will not be allowed.

3.2.15 Where the proprietor must extend the sanitary sewer from off-site, the proprietor shall extend sanitary sewer leads to the property line of all adjacent property on both sides of the right-of-way the entire length of the off-site sanitary sewer installation.

3.2.16 In new subdivisions, all service leads shall be sand backfilled and extended a minimum of ten (10) feet past the property line or to the easement line.

3.2.17 The plan and profile view of the proposed sanitary sewer shall generally be shown on the same sheet.

3.2.18 Maximum flow velocity for pipe flowing full shall be maintained by matching the 0.80 of the diameter depth above invert for pipe size increases.

3.2.19 Provide a drop of 0.10 feet in the downstream sewer invert for a direction change of 30 degrees or greater to compensate for velocity head loss of the incoming flow.

3.3 *Materials*

3.3.1 Service leads installed with the lateral sewer shall be a minimum of 6" in diameter and shall be Schedule 40 PVC or SDR 23.5.

3.3.2 New sanitary sewer manholes must be water-tight and shall be pre-cast sections with modified grooved tongue joints with rubber gaskets, conforming to A.S.T.M. Designation, C-478. Also, a butel rubber coating around the casing and cone shall be provided for all new manholes as noted on the Township 's standard detail sheet.

3.3.3 Main line sewer shall be PVC Truss pipe, PVC Solidwall SDR26, or RCP, C-76, Class IV or V, or approved equal.

3.4 *Installation*

3.4.1 No sanitary sewer installation or portion thereof shall have infiltration exceeding 100 gallons per inch diameter per mile of pipe per 24 hour period.

3.4.2 Each end of a service lead shall be marked by setting a 2" square wooden stake vertically above the end of the lead.

3.4.3 Each tee or end of service lead shall have water-tight and airtight stopper of compatible joint material and shall be adequately braced to withstand exfiltration and/or air test pressure.

3.4.4 When existing manholes are to be tapped, a hole of the appropriate diameter shall be core drilled through the wall of the manhole. A watertight fitting shall be used to connect the pipe into the manhole.

3.4.5 All sewers shall be subjected to infiltration, air or exfiltration tests, or a combination thereof, in accordance with the following requirements, prior to acceptance of the system by the Milford Township and prior to removal of the bulkhead.

a. All sewers over 24" diameter shall be subjected to infiltration tests. All sewers of 24" diameter or smaller, where ground water level above the top of sewer is over seven (7) feet, shall be subjected to an infiltration test.

b. All sewers of 24" diameter or less, where the ground water level above the top of the sewer is seven (7) or less, shall be subjected to air tests or exfiltration tests.

3.4.6 A minimum of 30 days after installation and prior to the acceptance of new mainline sanitary sewer systems, a televised inspection of each section of the mainline shall be conducted from manhole to manhole. Videotape and log of this inspection shall be submitted to the Township's Engineer to document the current condition of the sanitary system at the time of the utility acceptance. The videotape and log shall be consistent with the Standards of the Township of Milford.

4. STORM SEWER

4.1 *Design Requirements*

4.1.1 In no event will maximum design rate or volume of discharge exceed the maximum capacity of the downstream land, channel, pipe or watercourse to accommodate the flow. It is the applicant's obligation to meet this standard. Should a storm water system, as built, fail to comply, it is the applicant's responsibility to redesign, reconstruct, or make modifications at his/her expense to storm water management facilities. Such modifications or additional facilities will be subject to the Township's review and approval.

4.1.2 Storm drainage systems shall be designed for a ten year intensity rainfall. The Rational Method for arriving at storm sewer runoff shall be used. An "n" value of 0.013 shall be used for concrete pipe.

4.1.3 The formula for a ten (10) year rainfall intensity shall be equivalent to I = 175/(T+25) in which T is the time of concentration in minutes, and I is the intensity of inches per hour.

4.1.4 The initial T is generally 20 minutes for residential areas and 15 minutes for high runoff areas.

4.1.5 The consulting engineer shall use the following minimum values for "C", the runoff coefficient, in the "Rational Formula" of computing storm water flows (Q = CIA).

Impervious Hard Surfaces	C = 0.70
Gravel Surface	C = 0.50
Vegetated/Turf Surface	C = 0.20

Other values of the runoff coefficient may be used or required at the discretion of the Township's Engineer for such areas as parks and open-spaces or unusual sites.

4.1.6 Sufficient capacity shall be provided in the storm sewer system to take fully developed upstream drainage into the system. When a storm sewer is designed to provide capacity for upstream areas, the hydraulic gradient shall remain in the pipe.

4.1.7 Storm sewer design calculations, including a drainage area map shall be submitted with the construction plans. The storm district map shall show all on-site and off-site drainage districts. A minimum 1" = 50' scale is allowed. The district limits must be over laid on a proposed grading plan for the site.

4.1.8 All public storm sewers must be located in a public right-of-way or an easement. The minimum storm sewer easement shall be 12 feet. The easement size will vary as required for maintenance and access. Any storm sewer that accepts runoff from abutting property or public right-of-way must be placed in a minimum 12 foot storm sewer easement.

4.1.9 If a storm sewer is designed to take on-site drainage only, the hydraulic gradient must be no higher than one (1) foot below ground. When the hydraulic gradient is above the top of the sewer pipe, the design elevation of the hydraulic gradient shall be indicated on the profile at each manhole.

4.1.10 Storm water detention is necessary for all developments in the Township. See Section 5, Detention / Retention Facilities, for details.

4.1.11 Manholes shall be located as follows:

a. All changes in alignment
b. Points where the size of the sewer changes
c. Points where the grade of the sewer changes
d. The junction of sewer lines
e. Street intersections or other points where catch basins or inlets are to be connected.

4.1.12 Manhole spacing for storm sewers shall be as follows:

Diameter of Sewer	Maximum Manhole Spacing
12" - 15"	330 ft.
18" - 30"	350 ft.
36" & 42"	400 ft.
48"	450 ft.
54" & 60"	500 ft.
66" & larger	600 ft.

4.1.13 The minimum size of a public storm sewer is 12" diameter. 10" diameter pipe will be allowed for sewer lines that pick up footing drain or roof conductor drainage. No open covers will be permitted for a 10" diameter storm sewer.

4.1.14 Connection must be made at manholes, blind taps are not allowed.

4.1.15 The following information shall be indicated on the storm sewer profile:

a. Length of run between manholes.
b. Type, class, size and slope of pipe and leads.
c. Class of bedding.
d. Rim elevations of all manholes.
e. Existing and proposed ground elevations above the route of the sewer.
f. A logical numbering system for manholes shall be included.
g. Invert elevations of all sewers at manholes.
h. Locations and limits of sand backfill, where required.
i. Locations and elevations of crossing with other utilities.

4.1.16 The following table of minimum slopes for storm sewers shall be adhered to:

Size and Minimum Slope

12" @ 0.32%
15" @ 0.24%
18" @ 0.18%
21" @ 0.14%
24" @ 0.12%
27" @ 0.10%
30" @ 0.09%
36" @ 0.07%
42" @ 0.06%
48" @ 0.05%

4.1.17 The minimum velocity may not be less than 2.5 feet per second in a pipe flowing full. The maximum velocity in storm sewers shall be ten (10) feet per second. The contents of a larger pipe will never be discharged into a smaller line even though the slope may be steeper for the smaller line. This principle does not apply, however, to a restricted opening or discharge.

4.1.18 Where possible provide a minimum of three (3) feet of cover from the top of curb (or road centerline) to the top of any storm sewer.

4.1.19 For subdivisions, storm sewers shall be located in the public road right-of-way or in easements adjacent to the public road right-of-way. Storm sewers shall not be located in rear yards except t o pick up rear yard drainage or for sump pump discharge lines.

4.1.20 At all pavement catch basins and inlets, forty (40) lineal feet (twenty in each direction) of 6" edge drain shall be constructed at the back of curb line in each direction, backfilled with pea gravel.

4.1.21 No more than 1.0 acre of area shall be tributary to one standard catch basin. Catch basins may be placed side by side in order to provide for additional capacity.

4.1.22 A maximum of 900 feet of drainage is allowed from two (2) directions.

4.1.23 Where lateral storm sewers are proposed, all new homes must be constructed with sump pumps which discharge to an underground pipe connected to an underground public rear yard drain or an approved alternate storm drain. The sump pump discharge lead shall be a minimum of four (4) inch diameter and shall be constructed to each lot in a new subdivision from the rear yard under drain. The lead shall be constructed at a minimum 1.0% grade.

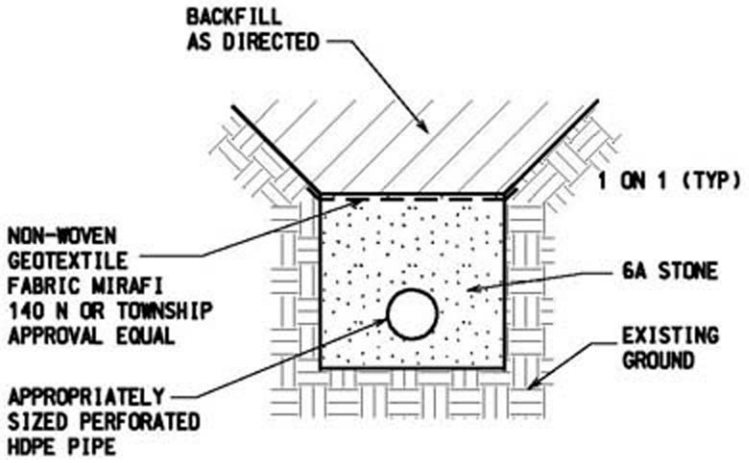
4.1.24 The minimum grade for swales shall be 1%.

4.1.25 The Township encourages the use of Best Management Practices (BMPs). The use of such will be reviewed and approved on a site by site basis by the Township's Engineer.

4.2 *Materials*

4.2.1 Allowable pipe material for storm sewers shall be:

a. C-76 reinforced concrete pipe conforming to Classes III, IV or V.
b. Perforated High Density Polyethylene with smooth interior and annular exterior corrugation meeting requirements of ASTM F2306. Bedding and backfill shall be as shown in the following detail:



4.2.2 Joints for storm sewer shall be tongue and groove premium joints with rubber gaskets.

4.2.3 All lead material shall be schedule 40 PVC or DR 23.5.

4.3 *Installation*

4.3.1 All RCP storm sewers shall be installed on Class "B" bedding or better.

4.3.2 A pre-fabricated bar screen shall be installed on all storm sewers eighteen (18) inch in diameter and larger.

5. DETENTION / RETENTION FACILITIES

5.1 *General*

5.1.1 Storm water detention is required for all developments in the Township.

5.1.2 Detention basins shall be designed to detain improved storm water over the developed areas on site. The applicant is not required to detain water from off site areas in the drainage district.

5.2 *Design Requirements*

5.2.1 Detention and retention facilities design shall follow the Oakland County Drain Commissioners current standards including forebays, except when amended by the Township in these standards.

5.2.2 The outlet pipe from a detention basin shall be restricted to allow only the agricultural run-off. The allowable discharge rate is limited to 0.2 cfs per acre when the water level in the detention basin is at its design high water elevation.

5.2.3 A minimum of 12 inches of freeboard must be maintained. All building openings must be a minimum of 12" above the freeboard elevation.

5.2.4 All basins shall be required to be designed to drain by gravity unless designed with a permanent water elevation. Detention basins designed to utilize pumps for dewatering will not be permitted.

5.2.5 Where a retention basin will be utilized, it is the developer's engineer's responsibility to provide documentation to confirm that the soils in the area of the basin "perk" at a minimum rate of 6" per hour. This information shall appear on the construction plans. A leaching basin will be required for all retention systems.

5.2.6 The side slopes of all open detention basins must not be steeper than 1 vertical to 5 horizontal.

5.2.7 A 20 foot wide access easement must be provided to all basins.

5.2.8 An agreement for the long term operation and maintenance of detention / retention facilities must be completed by the developer and submitted to the Township prior to final acceptance of the record drawings. Standard maintenance agreement forms can be secured from the Township.

5.2.9 A sediment forebay will be required at the inlet of all storm water management facilities, to provide energy dissipation and to trap and localize incoming sediments.

a. The forebay will be a separate cell, which can be formed by an earthen berm or other acceptable method.

b. Capacity of the forebay shall account for 15 years of sediment accumulation, and will not be included in calculating overall basin storm water storage capacity.

c. A 20' wide direct maintenance access to the forebay for heavy equipment shall be provided.

5.3 *Materials*

5.3.1 Rip-rap is required at all pipe entrances and exits to the basin. The minimum width of the rip-rap shall be twice the outside diameter of the pipe. The rip-rap shall extend from bottom of the basin to the top of the slope. Acceptable material for rip-rap includes field stone or broken concrete of six (6) inch minimum thickness.

6. GRADING

6.1 *General*

6.1.1 A grading plan is required for all developments. Rear yard storm drainage systems are required for all residential projects.

6.1.2 The grading of the proposed development shall not create drainage problems, or make existing drainage problems worse, on adjacent property. If necessary, storm drains shall be extended to the adjacent property to alleviate drainage problems.

6.1.3 A building permit shall not be issued until a grading plan has been submitted to the Township and approved by its Engineer.

6.2 *Design Requirements*

6.2.1 First floor and basement (where applicable) elevations for each proposed structure or building shall be shown on the plans.

6.2.2 The grades of existing adjacent houses, buildings, drainage structures and streets shall be shown. The actual surveyed grades of existing adjacent ground and yards shall be shown on a grid pattern up to a minimum of 100 feet from the property line. The drainage pattern of all adjacent existing land shall be indicated.

6.2.3 The grading plan shall be designed to insure that if a failure or overflow occurs within the storm system, water will drain away in overland swales without flooding houses.

6.2.4 Finish grade shall be compatible with the grades of surrounding existing houses, yards and with the existing ground at the proposed house.

6.2.5 All existing and proposed ground grades are to be in tenths of a foot.

6.2.6 Rear yard swales shall be no longer than 400 feet before being intercepted by a catch basin and shall have a minimum grade of 1.0%.

6.2.7 The proposed side yard swale elevation shall be shown between all houses. This elevation must be a minimum of 0.5 feet below the lower adjacent house grade. The side yard swale must have a minimum slope of 1.0% to the front and rear.

6.2.8 General direction of flow of the rear yard drainage and swales must be indicated with arrows.

6.2.9 The maximum allowable grade shall be 1 vertical to 4 horizontal.

6.2.10 The maximum driveway slope for non-single family sites is 8.0%. All driveway approaches shall not exceed 1.50% for a minimum distance of twenty-five (25) feet from the edge of the roadway. The slope of the driveway shall be labeled on the plans.

6.2.11 All proposed retaining wall designs will require review by the Township Engineer on an individual basis.

7. PAVING

7.1 *General*

7.1.1 For both public and private roadways proposed in the Township, the Road Commission for Oakland County's design standards for subdivisions will be utilized as the basis for the design unless modified in this section.

7.1.2 For roadway serving development sites of twelve (12) acres or less, the private road may follow the design criteria outlined in Ordinance 183.

7.1.3 Alternative paving designs may be submitted to the Township for consideration. They will be reviewed by the Township's Engineer and recommendation will be made to the Township. Such alternative paving designs shall only be acceptable in those instances where the Township finds that the proposed design will provide an acceptable level of serviceability, ease of maintenance and are consistent with other paving in similar areas elsewhere in the Township.

7.1.4 For roads under the jurisdiction of Michigan Department of Transportation or Road Commission for Oakland County (RCOC) all improvements shall be design to meet their requirements.

7.1.5 Acceleration, deceleration and passing lanes are required at all road entrances that front on paved major roads. These improvements shall be designed to RCOC standards.

7.2 *Design Requirements*

7.2.1 The minimum outside radius of a cul-de-sac (back of curb) shall be forty-seven (47) feet. The back of curb inside radius shall be twenty (20) feet. All right-of-way radii shall be sixty (60) feet minimum.

7.2.2 A boulevard section may be allowed in an enlarged right-of-way. Pavement widths shall be at least twenty-four (24) feet for all boulevard streets (back of curb to back of curb). The distance from the property line to curb shall be sixteen (16) feet on boulevards. The minimum island width shall be ten (10) feet and maximum sixteen (16) feet. The nose of the boulevard island shall be set back at least twelve (12) feet from the edge of pavement of the intersecting street.

7.2.3 Vertical curves are necessary when a change in grade of 1.0% or more occurs. The minimum length of vertical curve shall be 100 feet.

7.2.4 The minimum pavement vertical grade for roadways shall be 0.40% when concrete curb and gutter is provided, 1.0% with open ditch and the maximum allowable grade on any roadway is 8.0%.

7.2.5 The maximum cross slope on a cul-de-sac is 3.0%.

7.2.6 All proposed roadways shall be profiled. The pavement profile view shall include:

a. Elevations at each station for the top of curb, or at centerline if not curbed.

b. Existing ground elevations at the center of the right-of-way, and 30 feet either side of the centerline.

c. Station and elevations of all high points, low points, grade-breaks and necessary information at vertical curves. Grades for vertical curves must be indicated at twenty-five (25) foot intervals.

d. The station and top of curb grade of all pavement catch basins and inlets.

7.2.7 The pavement radius at all intersections of all roads shall be a minimum twenty-five (25) feet. Industrial developments will require a minimum radius of thirty-five (35) feet.

7.2.8 Finish grade of all structures shall be indicated in the plan and profile views.

7.2.9 The minimum aggregate cross-section for a gravel road is eight (8) inches. The minimum pavement cross-section for a residential road is three (3) inches of bituminous on eight (8) inches of aggregate.

7.2.10 The minimum parking lot pavement cross-section is three (3) inches of bituminous on eight (8) inches of aggregate or six (6) inches of concrete. The minimum pavement cross-section for industrial developments shall be four (4) inches of bituminous on eight (8) inches of aggregate or eight (8) inches of concrete.

7.2.11 Industrial street cross-sections will be reviewed on an independent basis.

7.3 *Materials*

7.3.1 Roadway surface material for private gravel roadways and for all shoulders shall be 22A or 21AA aggregate or limestone.

7.3.2 The subgrade material for paved private roads shall be 21AA aggregate or limestone.

7.3.3 The bituminous mix for private roads shall be MDOT 1100 or 1300.

7.4 *Installation*

7.4.1 The installation of private roads within the Township shall require inspection by the Township Engineer at the following stages:

a. After the sub grade has been rought cut to the plan elevation.

b. After the placement of the aggregate base or aggregate roadway surface.

c. Full-time during the placement of the bituminous pavement (where applicable).

d. After all the required vegetation has been established.

8. WELL HOUSES

8.1 *General*

8.1.1 These standards are intended to serve as a guide in the design and preparation of well house plans. These standard specifications and plans should facilitate improved operation and maintenance by providing standard maintenance parts and similar mechanical and electrical plans.

8.1.2 All construction work, materials and equipment shall comply with all applicable federal, state, and local laws, ordinances, and regulations or utility company rules.

8.1.3 Equipment and material brand names, types and sizes specified are an indication of design criteria. Other makes, styles, types and sizes may only be used with prior written approval of Milford Township if they are considered equal to the item specified. All deviations must be approved by Milford Township before any construction will be accepted.

8.1.4 An Engineering Review Fee Escrow Account will be created by the developer/builder to cover the cost of plan review and inspection by Milford Township. Presently, the deposit required is **$10,000**. This is subject to change without notice. Please check with the Township for the current fee required.

8.1.5 A hydro-geologic study shall be prepared of the site including drilling a test well. All geological formations encountered while drilling the test well shall be recorded in a well log including the depths at which they are found. A pump shall be placed in the test well and the well shall be pumped for a period of not less than 24 hours in order to determine the amount of water that can be withdrawn from the well for an indefinite period.

8.1.6 As a minimum the following data shall be recorded during the pumping test:

a. Date, time and location of test.
b. Static level which is the distance from the ground surface to the water in the well measured after at least 12 hours without pumping.
c. Pumping rate at which the water is withdrawn from the well.
d. Pumping levels which are the distances from the ground surface to the water in the well measured every five (5) minutes for the first hour of pumping and every ½ hour thereafter for the duration of the test, which shall be at least 24 hours.
e. Recovery levels which are the distances from the ground surface to the water in the well measured every five (5) minutes for the first hour after the pumping stops and every ½ hour thereafter until no change in level is noted.
f. Towards the end of the pumping test, a water sample shall be taken by a qualified technician. The sample shall be delivered to a testing laboratory acceptable to the Township where it shall be tested for total coliform, metals, other inorganic chemicals, VOC, total

trihalomethanes and any other compounds required to obtain approval from the State of Michigan Department of Public Health.

8.1.7 Plans shall be prepared and submitted for review on 24" x 36" drawings conforming to Milford Township Engineering Design Standards. The plan cover sheet shall include project name, township name, town and range, section number, quarter section designation, full property description of the isolation radius or parcel to be deeded to Milford Township, a site plan map with the well in the center at a scale of 1" = 200', a location map, the property address, the name and address of the developer, the name and address of the design engineer. All plans must bear the seal of a licensed professional engineer licensed to practice in the State of Michigan.

The second sheet of the plans shall contain a service district map drawn at a scale of 1" = 200' showing each lot or parcel to be serviced by this well. This sheet shall also show the calculation of the design peak water usage requirement for the entire service area. These calculations shall clearly identify the demand associated with each parcel in the district. The fire flow requirements or provisions of the well system shall be stated and approved by the Milford Township Fire Department.

One, or more sheets of the plans shall be dedicated to and include the pump discharge curves; all well logs and sieve analyses; the diameter, size of opening, and length of the screens; the proposed settings for the screens and pumps; motor name plate data; proposed hydro-pneumatic tank sizing calculations and drawings; and reference to the hydro geologic study.

8.1.8 Prior to construction, a preconstruction meeting shall be scheduled by the Design Engineer. Attendees shall include Milford Township, the Township's Engineering Consultant, the general contractor, the construction contractor, the well driller, and others as appropriate. Prior to final acceptance, a meeting of the same people shall be scheduled by the Design Engineer to address any outstanding punch list items.

8.1.9 All wells shall be properly disinfected by chlorination before being placed into service. After disinfection a water sample shall be submitted to a testing laboratory, satisfactory to the Township, for microbiological analysis. Results obtained shall be acceptable to the Michigan Department of Environmental Quality.

8.2 *Construction*

8.2.1 All applicable Township building permits shall be obtained by the developer/builder, and all inspections performed and approved at the developer/builder's expense.

8.2.2 The pump house foundation footings and foundation walls shall be designed from soil boring data. The foundation shall be minimum 3000 psi. concrete. Foundation walls shall be of sufficient width for the required brick ledges and insulation. Township inspection is required at time of all concrete pours. Concrete trucks load slips shall be supplied to the Township at each pour.

Block drains shall be installed at base of all outside walls to avoid moisture buildup in masonry walls.

8.2.3 All pump house walls shall be minimum 8" masonry block with ties for exterior facing. Exterior wall facings shall be brick or stone. Only 8" glass block window openings will be allowed. All exposed interior wall surfaces shall receive two coats of masonry paint. Foundation walls shall be a minimum of 14" wide to allow for 8" block, 2" insulation, and brick ledge for exterior facing. Soil boring data shall be utilized to ensure that foundation bearing loads are within acceptable limits.

8.2.4 Roofs shall be of frame construction and shall be hip or gable style. The roof shall consist of 235#, seal down, asphalt shingles, 14 lb. per square felt building paper and 5/8" exterior plywood. All roof trusses shall be 2" x 6" min. 24" on center, 6" x 12" pitch minimum. Ice shields shall be provided and shall comply with Township building codes.

8.2.5 All other areas, such as soffit, fascia, frieze, etc., shall be either an approved vinyl, not less than .044" thick or aluminum with baked-on enamel finish. No exposed exterior woods will be allowed. Either gable attic ventilators with insect screens at each gable or screened ridge vents shall be provided soffit vents, gutters and down spouts shall also be provided.

8.2.6 Polyurethane sealants shall be used to seal all joints between exterior metal frames, siding, etc., and adjacent surfaces.

8.2.7 Insulation is required on the foundation walls, between the brick facing and the block back-up (2" foam between brick and block), and in the well house ceiling area. Insulation shall provide the following minimum value was:

a.	foundation walls	R-10
b.	building wall	R-11
c.	ceiling	R-24

Insulation thickness and type of material shall be detailed on construction plans.

8.2.8 The finished floor shall be 3000 psi. concrete six inches thick reinforced with not less than 6" x 6", W7 x W7 welded wire fabric with a four inch sand base compacted to 95% density and thoroughly moistened (plastic vapor barrier shall be used) before pouring. The floor shall pitch 2" per 10' to the building wall opposite the doors, shall be finished smooth. A floor drain trough for the full length of well house floor 4" wide and 4" deep shall be installed 6" from the building wall opposite the doors. This trough shall drain to a 4" diameter C.I. pipe at the center of the trough length with a screened free fall gravity outlet to the outside. Finish floor elevation shall be a minimum of 12" above finish grade.

8.2.9 Where the water system supply main exits through the pump house floor, there shall be a 24" x 24" floor opening filled with pea gravel.

8.2.10 Removable roof hatches with Township approved lockable covers shall be provided through the pump station roof and ceiling. These hatches shall be designed to facilitate all well, pump and motor maintenance. Hatches shall be "Bilco" type hinged perpendicular to the roof ridge. Latches shall be operable from the inside of the well house only.

8.2.11 Internal pump house ventilation shall be provided by closable, ceiling registers connected by minimum 6" diameter sheet metal duct work to low profile, roof vents. A minimum of two (2) vents shall be provided, one per 4000 cu. ft. of interior building size. In addition an approved through the wall propeller exhaust fan with a aluminum gravity damper in combination with an approved motorized aluminum air intake damper with blade edge and joints seals shall be provided in the vicinity of any planned chemical area. Approved storm proof aluminum louvers shall be provided on the building exterior at the fan and damper locations.

8.2.12 Two "thru-wall" brick vents (minimum size 8" x 16") shall be installed six inches above the finish floor in the wall behind the hydro-pneumatic tank. "Thru-wall" bricks vents shall have cast iron grilles or 5/8" diameter steel rod guards. Insect screen, water stop and interior register with damper control. . A minimum of two (2) vents shall be provided, one per 4000 cu. ft. of interior building size.

8.2.13 A 1/2" exterior grade, plywood or Oriented Strand Board (0SB) ceiling shall be provided at the top of the block wall and secured to the underside of ceiling framing with screws and adhesive. The ceiling section under the hatches may be readily removable on hinges with the insulation sandwiches between the ceiling and another layer of 3/8" exterior grade plywood. The generator room ceiling shall have a layer of one hour fire rated damp proof drywall applied over the plywood ceiling.

8.2.14 Doors shall be 1-3/4" insulated with-no cardboard fillers minimum of 36" x 80" size of-G60 galvanized metal flush type swing doors without louvers or windows as manufactured by Fenestra, Inc., complete with frame, hardware, and threshold. Door frames shall be manufactured from G-60 galvanized metal with mortar-filled jambs. Doors shall be completely weather-stripped and weather-sealed with adjustable metal door sills. All doors shall open to the outside. Locks shall be Fenestra Mortise Lock 1902 with 26D finish and cylinder keyed for master-keying. Doors must have moisture drain holes in bottom. Hydraulic door closures with hold open arms shall be installed on all doors.

8.2.15 A one-half (½) inch minimum expansion joint shall be installed completely around all concrete tank cradles, pump bases, and well house perimeter.

8.2.16 Splash pads, 4' x 10' x 4" with curbs 3 sides 6" high (to direct flow) of 3000 psi. concrete, construction shall be installed outside of the well house centered and extending ten (10) feet from blow off pipe discharge end. Ground shall be swaled in such a fashion as to direct all flow away from building area with the first 6ft being formed from natural stone rip-rap. Air relief valve and pressure relief valve exterior discharges shall be directed

away from pedestrian areas, and pressure relief valve discharge shall also be directed to a splash pad or paved area. Air relief valve shall discharge to the south or east of the building.

8.2.17 Adequate consideration shall be given to the quantity of water that may be discharged during maintenance, testing, or blow off. Suitable drainage shall be provided away from building proper.

8.3 *Electrical*

8.3.1 All electrical work shall meet local, state, and federal requirements and shall conform to the National Electrical Code.

8.3.2 All electrical equipment shall be as manufactured by Allen Bradley, Square D, Cutler-Hammer, General Electric, AC Technology Corporation, BW Controls, Diversified Electronics or approved equal that has a local stocking agency.

8.3.3 The utility service shall enter the building at a main service entrance switch. The main service entrance switch shall be heavy duty, fused type with solid neutral and ground lug. The switch shall have switch blades that are visible when the switch is in the OFF position and the switch door is open. Switch shall be UL listed for use with aluminum or copper conductors. The switch shall utilize Class R fuses. The switch shall have a quick-break operating mechanism. Operating handle and mechanism shall be an integral part of the enclosure (not mounted on the cover). The switch shall have dual cover interlock to prevent unintentional opening of the switch door when the switch is in the ON position or turning the switch ON with the door open. A cover interlock bypass shall be provided. Handle position shall positively indicate if switch is ON or OFF. All terminals or lugs shall be 75°C rated for copper conductors. The main service entrance switch shall be service entrance rated with NEMA 1 enclosure and shall be Cutler-Hammer Type DH, Square D H222N, General Electric, or equal.

8.3.4 When a permanent back-up generator is not required as part of the original well house construction, a three-way (utility-off-generator) manual transfer switch shall be wall mounted inside the pump house. Also an Appleton receptacle (AJA 200 34250RS) for portable generator hook-up shall be installed whenever a generator is not provided. The generator receptacle shall be installed on an interior wall adjacent to the generator parking area. A 6" x 6" through wall double doored access hatch shall be provided adjacent to the receptacle to permit passage of the generator cord. The access hatch doors shall be lockable from the interior of the well house only.

8.3.5 All distribution and control equipment shall be mounted in one location, as practical, to 4' x 8' x 3/4" sheet(s) of exterior grade, pressure treated plywood securely lagged to the wall three feet above the floor. All electrical equipment must be minimum of 24" above finished floor level. A minimum of 3' - 6" clear work space shall be maintained in front of all electrical equipment mounted to the plywood. All heavy electrical equipment such as transformers shall be lag bolted through the plywood into the block wall.

8.3.6 Distribution of three phase power shall be from a distribution panelboard. The distribution panelboard shall be NEMA Type 12 rated and shall have an overall door. The door shall be equipped with flush hinges and cylinder lock. The panelboard shall have a ground bus for terminating ground conductors. The panelboard shall be of the circuit breaker type and shall be designed for the applied service voltage. All panelboard bus work shall be copper and all terminals or lugs shall be 75°C rated for copper conductors. The circuit breakers shall be of the molded case type with thermal magnetic trip and shall be quick-make, quick-break with indicating and 25,000A interrupting capacity minimum. Each circuit breaker shall be provided with a padlockable handle lock hasp. Panelboard shall be Cutler-Hammer Pow-R-Line 4B, Square D I-Line Type HCM, or General Electric Type CCB.

8.3.7 All loads that are not within sight of or within 50 feet of the distribution panelboard or their associated controller, shall be supplied with a disconnect switch. Disconnect switches for 480 volt loads shall be 600 volt rated, NEMA Type 12 or NEMA Type 4 enclosed and shall be Cutler-Hammer, Square D, or General Electric and shall have auxiliary contacts to interrupt the motor control circuit. Disconnect switches for 120 VAC, 240 VAC, or 208 VAC single phase loads and fractional horsepower motors shall be similar to 2 pole manual motor starters, except without overloads, Square D Class 2510, Cutler-Hammer, Arrow Hart, or equal. All disconnect switch terminals or lugs shall be 75°C rated for copper conductors. Fused switches shall utilize Class R fuses.

8.3.8 Each motor shall be controlled by a NEMA rated magnetic motor starter and fusible disconnect of proper size. The starter shall be provided with a built-in switch to provide "Manual", "Off" and "Automatic" control and shall be as manufactured by Allen Bradley with non-adjustable overload relays. All pump motors 40 h.p. and above shall have reduced voltage starting of the part winding auto-transformer or delta-wye types only. This is to reduce generator size and cost. Allen-Bradley Smart motor controllers or a unit of equal design as approved by the Township are also acceptable where a slow start and stop are required.

8.3.9 Variable Frequency Drives (VFD) shall be provided for all water booster pumps and ground storage tank pumps. The drives shall be MCH Series as manufactured by AC Technology Corporation (Uxbridge, MA), Cutler-Hammer, or Rockwell (Allen-Bradley). The drives shall include a door interlocked disconnect, AC line reactor, and current limiting fuses (equivalent to Bussmann Type KTK-R and rated 200,000 AIC). The variable frequency drives shall be furnished by a single vendor, who has actively been manufacturing drives (VFDs) for a period of at least five (5) years. The drives shall be UL and CSA certified and shall comply with the latest applicable standards of ANSI, IEEE, and NEMA. As a minimum, the full load output current of the drives shall be equal to the equivalent motor horsepower as listed by the National Electrical Code Table 430.150. The variable frequency drive manufacturer shall maintain, as part of a national network, engineering service facilities within 250 miles of project, to provide start-up service, emergency service calls, repair work, service contracts,

maintenance, and troubleshooting training of customer personnel. The VFDs shall be rated for operation at the facility's nominal utilization voltage. The units shall tolerate a 10% overvoltage and 15% undervoltage, a line frequency between 48-62 Hz, and have a 100% load rating. The VFDs shall operate at 100% rated capacity, without derating, up to 3,300 feet MSL. The unit shall operate in environments of 0-95% non-condensing humidity, at an ambient temperature between 0-40°C (32°F to 104°F). The VFDs shall have a displacement power factor of >0.96 and shall have >97% efficiency over the entire speed range. The VFDs shall output a sine-coded pulse width modulation power output to the load over a frequency range of 0-400 Hz. The VFDs shall have a frequency regulation of ±0.4% of maximum output frequency. The VFDs shall have the following protective features: phase-to-ground or 3-phase short circuit, undervoltage, overvoltage, drive overcurrent, high and low line voltage, overtemperature, inverse time, electronic thermal overload, open terminals for external fault conditions, input line noise suppression 0.5 second (30 cycles) power loss control circuit ride through. The drives shall have a human interface module through which operator personnel can manually start/stop drive, manual control speed, jog drive motor, and adjust drive parameters.

8.3.10 Automatic alternating control of starting of pumps shall be provided by means of B/W Controls electrodes and a Diversified Electronics alternator. The electrodes for these controls shall be installed on the front of the tank with gate valves, and unions so electrodes can be removed for cleaning with the tank pressurized.

8.3.11 In general, all conductors or cable shall be 600 volt, 98 percent conductivity copper with code types "THHN, or THWN" for control and code types "XHWW, THHN or, THWN" for power and type MTW for control panel wiring, insulated per National Board of Underwriters. All wire shall be run in rigid steel, hot dipped galvanized conduit below grade or in concrete floors, walls, block, etc. with necessary expansion joints provided. Electrical metallic tubing (thin wall), or SCH 40 PVC conduit may be used above grade except for building exterior where only rigid steel galvanized conduit and fittings may be used. Flexible liquid tight metallic conduit may be used where rigid conduit is impractical and shall be Sealtite or others approved by Underwriter's Laboratories. All motors shall be hooked up with a 24" section of liquid tight flexible conduit directly adjacent to the motor. Conduit for pump motors shall be cast into concrete floor and brought up to motors. The generator connector shall be wired with type "G" cable to allow freedom of movement of the connector pins.

8.3.12 All electrical panels, starters, and switches shall be identified by permanent ½" letters as to the equipment they serve and applicable voltage. All wiring shall be numbered, and a corresponding as-built electrical ladder diagram for all electrical shall be provided. This ladder diagram shall be complete showing all switches, relays, etc. per well house installation. Attached to the electrical diagram shall be an equipment listing giving brand names and model or part numbers. Manufacturer's diagrams are not acceptable. Ladder diagram and list shall be provided on one 24" x 36" mylar sheet suitable for reproduction. The contractor shall provide three (3) copies of **all**

operations manuals for **all** equipment bound in three ring binders to the Township.

8.3.13 Two natural gas unit heaters with blowers shall be ceiling, swivel mounted in each pump house with BTUH rating adequate to maintain 55 degree F. minimum inside temperature at outside temperature of -20 degrees F. Heating shall be controlled by a built-in low range thermostat (minimum setting of 50 degree F. must be possible) calibrated in degrees. Unit heaters shall be all gas with electric spark ignitions. Generator room shall have electric unit heaters with fans and built-in low range thermostats.

8.3.14 Lighting:

a. Inside: All building indoor lighting shall be with fluorescent open strip fixtures equipped with electronic ballasts and 2-T8 energy saving cool white bulbs in each location. Minimum 6 in main building, 2 in generator room. Generator room lights shall be switched at all entrance doors. Switches for the inside lighting shall be provided at all building entrances.

b. Outside: One (1) each 150 watt HPS fixture and lamp with photo cell at each building entry door, controlled through 3- or 4- way switch, as needed from inside of each door. Light fixtures will have vandal-resistant lens covers, Lexan or equal material.

8.3.15 As a minimum, a duplex, wall-mounted 120 volt, 20 amp. electrical duplex outlet shall be provided at or immediately adjacent to each pump, in the vicinity of hydro-pneumatic tank controls, at the control panel, and at each doorway. All utility outlets shall have ground fault protection.

8.3.16 Running time meter shall be installed in the electrical panel with readings available from the panel face for each pump. The read out should be in hours and tenths, Cramer 635K or equal.

8.3.17 A 120V A.C. electric clock shall be provided and mounted with the electrical equipment.

8.3.18 Each 3 phase motor shall be protected by a phase monitor as manufactured by Diversified Electronics, Model #SLA 440-ALE.

8.3.19 A programmable time delay relay such as diversified electronics TDU-120 AKA or Omron H3CA-A shall be provided to delay pump motor start after pre-lube solenoid activation. Motors shall be protected from phase problems due to switch over from gen/normal power with time delay in transfer unit that will allow sufficient time for phase to stabilize before motors are restarted. Motors and pumps as a unit shall be mounted in a level manner.

8.3.20 A liquid level sensor such as "Flygt ENH-10" shall be installed inside the pump house to interrupt all electrical service from a water level 1' - 0" above finished floor level. A liquid level sensor bypass shall be installed in the control panel. This will also shut down the generator unit.

8.3.21 The pump house shall be provided with a secondary lightning arrestor such as Square D SDSA-3650.

8.3.22 An electrical duplex outlet energized with the pump motor for each well shall be provided on the pump house wall opposite the electrical control panels for the operation of chemical injection pumps.

8.3.23 If the well house is required to be equipped with a permanent standby generator, it shall be sized and equipped to automatically operate all well pumps and all associated equipment during any electrical power failure. This will be a permanently mounted unit sized to operate all equipment and loads necessary to keep facility at 100% operation.

8.3.24 The well house shall be equipped with a telemetering system approved by Milford Township. An indicating pilot light for each incoming utility power leg shall be located on the control panel visible from the auxiliary power receptacle. The indicating lights shall be of the transformer type with low voltage lamps. Allen Bradley model 800T or equal.

8.3.25 An automatic transfer switch/exerciser shall be provided for generator and shall be set up to exercise generator with or without load. Transfer switches shall be equipped with a means of preventing out of phase transfer of loads such as Programmed Transition or an in-phase monitor.

8.3.26 Pilot devices shall be full size NEMA 13 with engraved name plates. Indicator lights shall be push to test, transformer type with low voltage lamps. Selector switches shall have standard operators and replaceable contact blocks. Allen Bradley 800T or equal.

8.3.27 Pressure switches shall be of the sealed mercury type as manufactured by Honeywell and shall be type L404A for add air and low pressure alarm and type L404B for void air control.

8.3.28 Solenoid valves shall be Nema 4 pilot operated with forged brass bodies as manufactured by ASCO or equal.

8.4 *Mechanical*

8.4.1 Pumps

a. Pumps shall be capable of delivering water at 90 psi. Pumps shall be Peerless, Layne, Deming, or other Township approved deep well turbines, 1750 RPM, with water lubricated bearings open or semi-open impellers. Clearance between impellers and bowls shall be adjusted by a nut on top of motor. Closed impeller pumps are not acceptable. The pumps shall be equipped with a close coupled shaft with anti-reversing ratchets. Manufacturer's certified test curves and physical dimension sheets shall be furnished for approval. Pumps shall be subject to field testing to assure performance in accordance with specifications. Motors shall be G.E., Westinghouse, or U.S. with

final horsepower requirements determined after analysis of manufacturer's curves. No aluminum windings allowed in any motors.

b. Stainless steel or nylon altimeter lines with direct reading altitude gauges, and air valves shall be installed at the elevation of the discharge pipe centerline for each well. The altimeter gauges on each pump shall be supplied with air by means of a nylon 3/8" O.D. 200 psi. line, valved at hydro-pneumatic tank and valved at altimeter gauge. This line shall be capable of providing sufficient air to drive altimeter line for accurate readings. A valved connection shall also be provided at each pump to permit the use of a hand operated pump. One hand operated air pump shall be provided. This line is required on deep well vertical turbines as well as all submersibles. No tail pieces allowed on pumps. Pump bowl shall be set 5' above top of screen.

c. A capped 3" observation pipe is required, mounted on a 45 degree upward angle on each well casing cap. This cap shall contain a minimum 1" vent mounted with the screen pointed down; a brass foot valve minus the check flapper is suitable for this application. This shall protrude from the base a sufficient length to permit easy removal of the cap. This may not be under pipes or in the aisle-way.

d. Sample cocks shall be installed at each pump and in discharge piping from storage tank. All sample cocks shall be ½" corporation stop with ½" 90 degree copper elbow attached. Chemical injection taps and necessary sampling points shall be provided for each well. The water main sampling tap shall be located five feet beyond the well house outside wall with a direct one inch corporation tap (no saddles allowed) to the water main. A one inch, type K copper line shall be run a minimum of five feet deep under the well house foundation to a typical sample cock located three feet above the pump house floor.

e. A permanently installed eye wash and separate sample sink shall be installed at each well house. Drains from these fixtures may discharge to the building exterior.

f. Each pump shall have four stainless steel ½" diameter minimum (set 6" into pedestal) anchor bolts installed on concrete pump foundation. The well casing shall extend one inch above the concrete pump foundation. Each pump shall be grouted at pump base after installation.

8.4.2 Pressure Tank

a. The pressure tank shall have minimum 1/4" steel plate sides and 5/16" plate ends. All tanks shall have a minimum acceptable certified 150 psi. test by manufacturer and shall be tagged with

ASME code. The tank shall be lined with an epoxy lining, NSF approved for use in potable water supplies.

b. A minimum of two 11" x 15" manholes (one on side near end and one on opposite end) and sufficient taps for sight glasses, controls, relief valves, compressor, etc. shall be located in the front end of tank. One (1) 2"diameter capped opening shall be provided at the top of the tank.

c. A 6" bottom drain and gate valve shall be located near the rear end of the tank in the bottom and piped to outside the pump house. No stand pipes inside tank will be allowed. Tanks over 10,000 gallons shall have 8" drains.

d. All openings in the tank including those required for sight glasses and controls, except the manhole, shall have a gate valve immediately adjacent to the tank. All pressure gauges shall have snubber valves in front of them. All gauges shall be liquid filled with stainless steel case and brass movements. All valves 3" and larger shall be flanged.

e. A minimum 4" Trerice, Ashcroft, or Wika pressure gauge, 0-150 psi. range with gauge lock for pressurized gauge removal shall be installed in the top of the front face of the tank.

f. A minimum of four steel, properly sized saddles shall be provided on each tank. Saddles shall be set on reinforced concrete stub walls. Steel saddles shall be set on non-shrink grout on top of stub walls.

g. An adequate air pressure relief valve shall be provided at the pressure tank. This shall be vented to the outside at ceiling height and a suitable muffler installed to reduce the noise level below 75db (A). This relief valve shall be gate valved for removal from a pressurized tank. A typical setting shall be 10 psi. above the high operating pressure, generally 80 psi. Void air pressure switch shall control a solenoid valve which will open at high air level to void all excess air.

h. An air compressor of adequate size shall be securely wall mounted above the floor, equipped with self unloader, as a Quincy, Gardner-Denver, or Township approved alternate compressor, with 3/4 h.p., 3-phase, 480 V.A.C., motor, with minimum of 3 C.F.M. at 100 psi required ratings. Located 3-4 feet above floor.

i. Generally, the operating pressure range shall be 60 psi to 80 psi. However, considerable ground elevation variation throughout the system will require the pressure range to be adjusted accordingly.

j. Tank size shall be such that a minimum three minute running cycle for the production well is provided. Calculations showing running cycle for the largest production well and corresponding tank water

levels shall be provided for tank size to be approved. Tank sizing from the "Recommended Standards for Water Works", Great Lakes-Upper Mississippi River Board of State Sanitary Engineers is also acceptable. Controls for tank shall be wall mounted and not on tank face.

8.4.3 Piping

a. Steel "Dresser" couplings with 5/8" minimum tie rods shall be used on discharge lines from both pumps and from the tank. Where uni-flange style pipes and fittings are used, tie rods ½" minimum diameter are required across all joints. Middle rings at dresser couplings shall be sandblasted and coated with coal tar epoxy suitable for use in potable water systems. Ridge victaulic style grooved couplings are also acceptable.

b. Propeller type meters as manufactured by Sparling or Water Specialties with readings in gallons shall be installed on the discharge piping of each pump. A straight length of pipe recommended by the manufacturer shall be installed on each side of the meter. One blank plate/cover (to factory specifications) for each water meter in building shall be provided to allow for continued operation of plant while meters are out for repair.

c. Check valves shall have externally weighted arms, as manufactured by Crispin, M&H, Apco or Valve and Primer, with brass trim. Check valves 8" and larger shall have a soft style stop or anti-slam device.

d. Underground water main shall be in accordance with the Township's water main specifications. Pump house water main shall be all flanged joint. Steel pipe shall be ASTM spec. A-53, schedule 40. Ductile iron water main shall extend a minimum of ten feet outside the pump house foundation wall. One fire hydrant shall be located in an isolation area beyond the well house isolation valves.

e. Pumping equipment, piping, and all appurtenances shall be arranged with a minimum of 48" clearance from walls, except minimum 36" clearance from back side of hydro-pneumatic tank to back wall. Clearance from floor to bottom of tank shall be a minimum of 24" and clearance from ceiling to top of tank shall be a minimum of 18", for tank maintenance. All 4" through 8" plumbing shall be kept at the same plane except blow-off lines to outside.

f. A minimum 2" air relief valve for deep wells as Crispin D 210 or Apco Series 140 shall be provided between the check valve and pump. Minimum 2" air relief piping shall be sloped to an easterly or a southerly building elevation, at 7'-6" minimum elevation with a brass screen fitting pointing downward one foot from the pump house exterior wall. Air release shall have a defuser mounted internally to reduce slam.

g. All blow-off lines and hydro-pneumatic tank drains shall have exterior pipe caps installed. Exterior pipe caps shall have four, minimum 1/4" diameter holes for freezing protection. The water pressure relief line shall have a flap valve at discharge and outside of building.

h. All valves on 4” and larger piping shall be flanged end cast iron, bronze trimmed, solid resilient wedge gate valves meeting the requirements of AWWA standard C-509. A fusion bonded epoxy coating confirming to AWWA C-550 shall be applied to the interior and exterior ferrous surfaces of the valves. The coating shall be NSF approved for drinking water use. Valves shall be as manufactured by East Jordan, US Pipe, Mueller, M&H, or American Series 2500.

i. Vertical discharge piping through the floor of the pump house shall be tied with four 5/8" minimum diameter stainless steel rods and thrust.

j. Adequate pipe supports shall be provided on minimum ten foot spacing, under bends, under all valves, under heaving fittings or as required by the Township. Concrete pedestals shall be provided under check valves and water meters 12" diameter and larger.

k. A ½" copper tubing pre-lube system with gate valves shall be installed to the pressure side of the check valve for each well. Pump pre-lube shall be activated 15 seconds to 2 minutes before pump motor start through a solenoid valve in the pre-lube piping.

l. A Trerice, Ashcroft, or Wika pressure gauge, 0-100 psi range, minimum 4" diameter dial and snubber valve shall be installed by tapping the top of the pipe adjacent to each well before the check valve.

8.5 *Painting*

8.5.1 The tank and all piping and blow-off lines shall be given one prime coat of 769 Damp-Proof Red Primer, one second coat of 960 Zinc Chromate Primer, and one third coat of color coded piping enamel as manufactured by Rust-Oleum Corporation.

8.5.2 The floor shall be provided with a non-skid finish.

8.5.3 The color coded scheme shall be:

a.	Pressure Tank	-	Green
b.	Water Piping	-	Blue
c.	Water Valves	-	Red
d.	Water Blow-Off, Piping	-	Orange
e.	Air Blow-Off Piping	-	Gray

8.5.4 The pump house interior walls and ceiling must receive prime and finish coats of paint. Paint color shall be semi-gloss white or light gray.

8.6 *Well Isolation Area*

8.6.1 The well isolation area including access road if any shall be deeded to Milford Township.

8.6.2 No construction or buildings are allowed on isolation areas per state requirements. No sanitary or storm sewers may intersect the isolation area radius.

8.6.3 The entire well isolation area shall be properly graded, minimum 3" top soil provided, fertilized and seeded or sodded. The pump site shall be landscaped with bushes and/or trees to be compatible with the proposed development.

8.6.4 A 12-foot wide drive shall be provided with a minimum of 8" compacted 21AA limestone road base with 4" asphalt from the existing road to the well house. This drive shall be properly drained and have a maximum grade of (7%). Culverts shall be installed across all drainage ditches. An asphalt parking area shall be provided adjacent to pump house and well maintenance hatches. A turn around shall be provided with sufficient space to permit a generator pulled by a stake truck to conveniently enter and exit the well isolation area, while parking the generator adjacent to the well house.

8.6.5 The drive shall be secured by a 4" diameter post on each side with a minimum 3/8" cable ready for padlock by Milford Township. Posts to be set in 12" x 12" x 36" deep concrete bases.

8.7 *Generator Requirements*

8.7.1 Natural gas driven units are preferred. Diesel units may be supplied only where natural gas is not available.

8.7.2 The maximum dip allowed when equipment is activated will be 20%. All data shall be supplied by company supplying unit. This data must confirm the engineering data supplied by project design firm.

8.7.3 Entire unit must come with a full 100% warranty for not less than five full years from date of acceptance. Parts and labor inclusive.

8.7.4 Only liquid cooled units are allowed. Each unit shall have a thermostatically operated block heater to maintain unit at starting temperatures. The critical ambient outside temperature shall be -20 degrees F.

8.7.5 The natural gas fuel system shall include all required components and accessories including but not limited to the following:

a. Primary and Secondary Regulators

b. Low Gas Pressure Switch
c. Solenoid Valve
d. Fuel Filter
e. Supply Line Flexible Connector

8.7.6 Propane and diesel driven units shall have a minimum (72) seventy-two hours of fuel in storage tank calculated at 50% load. Diesel units shall have a double-wall, steel storage tank. The tank shall meet MDEQ standards as well as any local codes and shall include a leak alarm sensor. Minimum tank size is 450 gallons with fuel level indicator. A screened, 2" outside fuel tank vent and an outside emergency vent shall be provided. The fuel tank shall have an outside 2" fill port with pad lockable spill containment.

8.7.7 To maintain environmental quality, the engine shall be equipped with suitable emission control equipment to meet, as a minimum, current Environmental Protection Agency specifications for stationary, industrial engines. Verification of the ability to meet these emission specifications shall be provided by the engine manufacturer.

8.7.8 Units shall be equipped with critical silencing mufflers. Battery charger shall be permanently mounted and hard wired into unit.

8.7.9 All louvers and shutters on generator air intake shall be mechanically operated, mounted on interior of building. The exterior of building shall be provided with fixed storm proof louvers with screens to prevent insects and bug infestation of room proper. These are to cover intake and exhaust louvers entirely.

8.7.10 A complete instrument package shall be provided on engine monitoring board. All engine monitoring gauges shall be affixed to main generator unit or an adjacent wall within reach of unit. When available, gauges shall be supplied in lieu of lights. Minimum instrument package shall include: engine temp., water temp, engine RPM, gen hz., oil pressure, voltage of battery, exciter voltage and current, auto/man operator switch, panel lights, latching type unit, trouble lights with acknowledge switch. Field circuit breaker and all normal systems operations shall be monitored in such a fashion that they will protect unit from failure. Include overcrank, overspeed, and overrun circuitry for shut down.

8.7.11 Maximum RPM on engine shall not exceed 1800 RPM. Gear boxes to reduce engine/to/generator RPM are not acceptable under any circumstances.

8.7.12 Import units are acceptable only if a local distributor is available and that distributor has original equipment parts for entire unit in stock as well as factory authorized service and factory trained personnel on full time staff. Local distributor is defined as one in Greater Detroit Metropolitan area. Distributor must also provide 24 hour emergency service.

8.7.13 Four sets of parts and service manuals shall be supplied and turned over to Milford Township before unit is to be accepted, in addition to warranty documents and as built drawings.

8.7.14 Load test will be conducted at developer's expense. This will consist of 3 hours at full load. Developer will supply manpower and all necessary fuels. This test shall be witnessed by a Milford Township representative with not less than 72 hours notification to Township authorized representative.

8.7.15 Diesel and other fuel tanks, propane, etc. shall be turned over to Milford Township full of fuel before final acceptance of facility will be given.

8.7.16 All generator units shall be mounted on skid rails and shall have sufficiently large vibration isolators to put as little vibration to building floor as possible.

8.7.17 Generator units shall be mounted no less than 16" above finished floor. Remainder of electrical equipment shall be mounted no less than 24" above finished floor to bottom of panel or any other electrical device. Adequate room shall be provided to service unit including the draining of oil pans. Oil pans on engines shall be provided with a drain plumbed to outside perimeter of unit where oil can be captured in a container.

8.7.18 Concrete floor beneath generator unit shall be 6 sack 3,500 psi concrete.

8.7.19 Unit-Mounted Radiator Cooling:

a. Duct work should be as short, straight, and as unobstructed as possible. Static pressure of more than ½ inch (1.27 cm) water column on the fan from inlet or exhaust restrictions will reduce air flow to the point of limiting maximum power and/or ambient temperature at which overheating will occur, and will not be allowed.

b. The connection from the radiator duct flange to the duct work shall be heavy canvas or similar flexible material to prevent noise and vibration transmission. In general, the outlet duct shall have an unrestricted area 150% greater than that enclosed by the radiator duct flange. The inlet opening shall be at least as large and preferably 50% larger than the outlet. If screens, louvers, or filters are used in the inlet or outlet openings, the openings shall be increased in size to compensate for restriction. In general, when louvers are used, increased by 50%; when insect screening is used, the opening area shall be increased by 80%; when furnace filters are used, the opening area shall be increased by 120%.

c. Air inlet and outlet locations shall be chosen to prevent air recirculation inside or outside the enclosure. Consideration should also be given to prevailing winds, facing inlets into the expected winds, and outlets on the down wind side where possible. Inlets and outlets shall be located where they will not be blocked by accumulated snow or any other obstruction. The bottom of any air

intake or exhaust louvers shall be located not less than 16" above floor level to prevent snow intrusion.

d. Any temperature controlling louvers shall be designed so that inlet air is not restricted to the point that pressure inside the building is reduced. The generator room and well house shall be designed to permit the generator to be removed from the building without major building demolition.

8.7.20 It is the intent of this specification to secure an emergency generator system that has been prototype tested, factory built, production tested, site tested, of the latest commercial design, together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein. The equipment supplied and installed shall meet the requirements of the National Electric Code and all applicable local codes and regulations. All equipment shall be new, of current production by a national firm which manufactures the generator, controls, and transfer switch; and assembles the generator set as a matched unit. The intent of this requirement is to provide the owner with one-source responsibility for warranty, parts and service through a local representative with factory-trained service personnel. Generator sets shall be as manufactured by Kohler, Cummins, Caterpillar, or Township approved alternate.

8.7.21 SUBMITTAL: Submittal shall include specification sheets showing all standard and optional accessories to be supplied, schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and other remote devices if included elsewhere in these specifications.

8.7.22 TESTING: To assure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer shall be responsible for design prototype tests as described herein: Components of the emergency system, such as the engine/generator set, transfer switch, and accessories shall not be subjected to prototype tests since the tests are potentially damaging. Rather, similar design prototypes which will not be sold, shall be used for these tests. Prototype test programs shall include the requirements of NFPA-110 and the following:

a. Maximum power (kw).

b. Maximum starting (kva) at 35% instantaneous voltage dip.

c. Alternator temperature rise by embedded thermocouple and by resistance method per NEMA MG1-22.40 and 16.40.

d. Governor speed regulation under steady-state and transient conditions.

e. Voltage regulation and generator transient response.

f. Fuel consumption at 1/4, ½, 3/4 and full load.

g. Harmonic analysis, voltage waveform deviation, and telephone influence factor.

h. Three-phase line-to-line short circuit test.

i. Cooling air flow.

j. Torsional analysis testing to verify that the generator set is free of harmful torsional stresses.

k. Endurance testing.

8.7.23 WARRANTY: The emergency generator system shall be warranted by the manufacturer for five years or 1,000 hours, whichever occurs first, from the date of the site start-up. Parts and labor included.

8.7.24 The standby generator set shall be rated continuous standby (defined as continuous for the duration of any power outage)___volts,___phase,___wire, .8 power factor,____kw, ____kva,____amperes at 1,000 feet altitude, 104 degrees Fahrenheit. Vibration isolators shall be provided between the engine-generator and welded steel base or between the base and the floor. Data required above shall be provided by the Developer as required for each specific well house.

8.7.25 Final Production Tests: Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:

a. Single-step load pickup.

b. Transient and steady-state governing.

c. Safety shutdown device testing.

d. Voltage regulation.

e. Rated power.

f. Maximum power.

8.7.26 Upon request, arrangements to witness this test will be made or a certified test record will be sent prior to shipment.

8.7.27 ENGINE: The____cubic inch displacement engine shall deliver a minimum of ___hp at a governed speed of 1800 rpm. The engine shall be equipped with the following:

a. Fuel supply equipment as specified hereinbefore.

b. Isochronous governor capable of 0.25% steady-state frequency regulation.

c. 24 volt positive engagement solenoid shift-starting motor.

d. 35-ampere minimum automatic battery charging alternator with solid-state voltage regulation.

e. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.

f. Dry-type replaceable air cleaner elements.

Note: Engines requiring glow plugs will not be acceptable.

g. A unit-mounted radiator, blower fan, water pump, thermostat, and radiator duct flange (unhoused only) shall properly cool the engine with up to 0.5 inches water external static pressure on the cooling system.

8.7.28 GENERATOR

a. The alternator shall be salient-pole, reconnectable 10 lead, self-ventilated of drip-proof construction with amortisseur rotor windings, made from copper and skewed for smooth voltage waveform. The insulation material shall meet the NEMA standard (MGI-22.40 and 16.40) for Class H and be vacuum impregnated with epoxy varnish to be fungus resistant per MIL I-24092. Temperature rise of the rotor and starter shall be limited to NEMA Class F. The excitation system shall be of brushless construction controlled by a solid-state voltage regulator with adjustable Volts-per-Hertz operation capable of maintaining voltage within + or -0.5% at any constant load from 0 to 100% or rating. The regulator shall be sealed from the environment and isolated from the load to prevent tracking when connected to SCR loads.

b. On application of any load up to the rated load, the instantaneous voltage dip shall not exceed 10% and shall recover to + or - 0.5% of rated voltage within one second.

c. The generator shall be capable of sustaining at least 250% of rated current for at least 10 seconds under a 3 phase symmetrical short by inherent design or by the addition of an optional current boost system.

d. The generator shall be capable of delivering ___KVA, ___kw with a maximum instantaneous voltage dip of 20% when loads are started as specified elsewhere or on the drawings.

e. A resettable line current sensing circuit breaker with inverse time versus current response shall be furnished and shall not

automatically reset preventing restoration of voltage if maintenance is being performed. This breaker shall protect the generator from damage due to its own high current capability and shall not trip within the 10 second specified above to allow selective tripping of down-stream fuses or circuit breakers under a fault condition.

f. The generator, having a single maintenance-free bearing, shall be directly connected to the flywheel housing with a semiflexible coupling between the rotor and the flywheel.

8.7.29 CONTROLLER**:** Set-Mounted controller capable of facing right, left, or rear shall be vibration isolated on the generator enclosure. The microprocessor control board shall be moisture proof and capable of operation from -40°C to 85°C. Relays will only be acceptable in high current circuits. Circuitry shall be of plug-in design for quick replacement. Controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall include:

a. Fused DC circuits.

b. Complete two-wire start/stop control which shall operate on closure of a remote contact.

c. A speed sensing system and a second independent starter motor disengagement system shall protect against the starter engaging with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.

d. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then reengage the starter.

e. Cranking cycler with four 15-second ON and OFF cranking periods.

f. Overcrank protection designed to open the cranking circuit after 105 seconds, if the engine fails to start.

g. Circuitry to shut down the engine when signal for high coolant temperature, low oil pressure, or overspeed are received.

h. Engine cool down timer factory set at five minutes to permit unloaded running of the standby set after transfer of the load to normal.

i. Three-position (Automatic - OFF - TEST) selector switch. In the test position, the engine shall start and run regardless of the position of the remote starting contacts. In the automatic position, the engine shall start when contacts in the remote control circuit close and stop five minutes after those contacts open. In the off position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an

emergency. Reset of any fault lamp shall also be accomplished by putting the switch to the off position.

j. Indicating lights to signal:

1) Not-in-auto (flashing red)
2) Overcrank (red)
3) High engine temperature/low coolant level (red)
4) Overspeed (red)
5) Air damper (red)
6) Battery charger malfunction (red)
7) Low battery voltage (red)
8) *Low fuel (red)
9) System ready (green)
10) Pre-alarm high engine temp. (yellow)
11) Pre-alarm low oil pressure (yellow)
12) Low coolant temp. (red)
13) *Fuel tank leaking (red)

*for diesel units only

k. Test button for indicating lights.

l. Alarm horn with silencer switch per NFPA-110.

m. Terminals shall be provided for each signal in j. above for connection to remote monitoring devices.

8.7.30 INSTRUMENT PANEL**:** A set mounted instrument panel shall include:

a. Dual range voltmeter, 3-1/2 inch,, + or -2% accuracy.

b. Dual range ammeter, 3-1/2 inch, + or - 2% accuracy.

c. Volt meter-ammeter phase selector switch.

d. Lights to indicate high or low meter scale.

e. Direct reading pointer-type frequency meter, 3-1/2 inch, + or - 5% accuracy, 45 to 65 Hz scale.

f. Panel illuminating lights.

g. Battery charging meter.

h. Coolant temperature gauge.

i. Oil pressure gauge.

j. Running time meter.

k. Voltage adjust rheostat (+ or - 5% range).

l. A solid state instrument panel with selectable digital displays is also acceptable.

8.7.31 ACCESSORIES**:** The following accessories shall be provided:

a. Overvoltage protection which shall shut down the unit after one second of 15% or more overvoltage.

b. Battery rack, battery cables, 12-volt battery(ies) capable of delivering the minimum cold-cranking amps required at zero degrees Fahrenheit per SAE Standard J-537.

c. Gas proof, seamless, stainless steel, flexible exhaust connector(s) ending in pipe thread.

d. Flexible fuel line(s) rated 300 degrees F and 100 psi ending in pipe thread.

e. Engine exhaust silencer, coated to be temperature and rust resistant, rated for critical applications. Exhaust noise shall be limited to 85 dba as measured at 10 feet in a free-field environment.

f. Block heater of proper wattage and voltage, thermostatically controlled to maintain engine coolant at 90 degrees Fahrenheit (32 degrees Celsius) to meet the start-up requirement of NFPA-99 or NFPA-110 Regulations.

g. 10-Ampere automatic float and equalize battery charger with +- 1% constant voltage regulation from no load to full load over +-10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambients from -40 degrees C to +60 degrees C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected. Optional alarm circuit board to meet the requirements of NFPA-110 for low battery voltage, high battery voltage, and battery charger malfunction shall be provided.

h. 16 - light remote annunciator shall monitor all controller functions described in the controller section plus line power and generator power monitoring. An integral lamp test and horn silence switch shall be included that meets NFPA-110.

8.7.32 EXECUTION**:**

a. The equipment shall be installed as shown on the plans, in accordance with the manufacturer's recommendations and all applicable codes.

8.7.33 SITE TESTS**:** An installation check, start-up, and building load test shall be performed by the manufacturer's local representative. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:

a. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations under the environmental conditions present and expected.

b. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. This shall include: engine heaters, battery charger, generator strip heaters, remote annunciator, etc.

c. Start-up under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and phase rotation.

d. Automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper systems coordination. Engine temperature, oil pressure and battery charge level along with generator voltage, amperes, and frequency shall be monitored throughout the test.

e. Labor, fuel, and load bank for 3 hour test shall be supplied at developer's/builder's expense.

8.8 *Supervisory Control and Data Acquisition (SCADA)*

8.8.1 SCADA Equipment

a. Each well house or booster station shall be provided with a SCADA System Remote Terminal Unit (RTU), and a radio modem with antenna, compatible with the existing system based at the City of Wixom Wastewater Treatment Plant.

b. The new RTU’s shall be Healy Ruff Modu-PRO/Mini-PRO with eight (8) minimum digital inputs, four (4) minimum digital outputs, two (2) minimum analog inputs, one RS-232 port and one modem port. New RTU’s for booster facilities shall have additional digital inputs and outputs and analog inputs and outputs as required.

c. The radio-modem shall be fully compatible with the RTU and shall be as manufactured by Microwave Data Systems or equal. The radio-modem antenna shall be point-to-point “YAGI” or Omni-directional type as required and shall be protected by a gas tube discharge lighting arrestor. The radio-modem shall operate at 12 VDC and shall provide an RS232 asynchronous interface. The modem shall meet all applicable FCC standards. The well house data system

shall operate at half-duplex mode on a frequency-hopping radio transceiver capable of operating on a spread spectrum in the unlicensed frequency of 902 to 980 MHz or 2.4 to 2,483 GHz range. The radio-modem shall be a new current model 2-way radio suitable for transmitting and receiving data at 1200 to 19,200 BPS rate.

d. The existing SCADA system is centered around the City of Wixom Wastewater Treatment Plant (WWTP) south of Charms Road and west of Wixom Road. The Contractor shall reconfigure, modify and reprogram the existing SCADA system software to accommodate the new water pumping facility's operator's interface including all graphic and reporting screens, data logging, alarms and control functions to provide a complete and operating system, and shall provide documentation for all programming and setup. New graphic screens and reporting forms shall be as approved by the City of Wixom WWTP personnel and shall be similar to those already in use. One half day training of WWTP personnel shall be provided for all SCADA system modifications.

9. SANITARY PUMP STATIONS

9.1 *General*

9.1.1 The Standards herein apply to all pumping stations that discharge sanitary flow to force mains, sewers, or interceptors that are owned, operated and/or maintained by Milford Township.

9.1.2 In addition to the minimum required standards specified herein, the design and construction of all sanitary pumping stations within Milford Township shall comply with the following additional requirements, codes and standards:

a. Michigan Department of Environmental Quality (MDEQ).

b. "Recommended Standards for Sewage Works" as prepared by the Great Lakes-Upper Mississippi River Board of State and Provincial Health and Environmental Managers, also commonly referred to as the "Ten States Standards."

c. Applicable State and Federal safety regulations including the Occupational Safety and Health Act (OSHA/MIOSHA).

d. Applicable Local, State and Federal electrical codes including the National Electrical Code (NEC).

e. Applicable Local, State and Federal building and plumbing codes.

9.1.3 All required permits (MDEQ, Building, Plumbing, Electrical, etc.) must be obtained from the Township prior to the start of construction of any sanitary pump station.

9.2 *Design Requirements*

9.2.1 Location of Sanitary Pumping Stations

a. Sanitary pumping stations shall generally be located within a suitable easement or property dedicated or deeded to the Township. The easement description or deed shall contain restrictions against the use or occupation of easements by the property owners and/or by other utilities in any manner which would restrict access, operation, maintenance, and/or repair of the pumping station.

b. Easements or property for pumping stations shall be of sufficient dimensions to accommodate the facility and its appurtenances, and to provide access for service vehicles.

c. Sanitary pumping stations should be located and sited logically to accommodate gravity sewer service while minimizing the depth of the wet well and minimizing the number of pumping stations

required. Lower lying locations are often desired for this purpose; however, pump stations must be located so as not to be affected by the 100-year flood plain.

d. All pumping stations and outdoor control panels shall be accessible from a paved access driveway with sufficient parking area provided for two vehicles. If the station is of the size to be served by a portable generator, then a paved parking area for the generator shall be provided in addition to required vehicle parking. The access driveway alignment shall be such that it is convenient for installing, removing and turning around of the portable generator in its parking location.

9.2.2 Pumping Station Sizing

a. Sanitary pumping stations shall be designed to serve all areas within the defined tributary area, anticipating full development of such areas, with due consideration given to topography, existing natural features, established zoning and the Master Land Use Plan.

b. For design purposes, population shall be based on a minimum of 3.5 persons per detached single-family dwelling unit, and 2.8 persons for each multiple-family dwelling unit. Submissions for review shall include a tabulation of occupancy (usage) types and the conversion of these into terms of equivalent single-family (or residential equivalency) units. The area of the site, in acres, may be used to calculate population and equivalent single family units based on density allowed in the Master Land Use Plan. Please note that these calculations may be shown on the sanitary sewer plans, in which case, only the overall population or residential equivalency units need be shown on the pumping station plans if submitted separately.

c. The average daily sanitary flow shall be based on 100 gallons per capita (person) per day (gpcd).

d. The pumping station shall have the capacity for pumping peak flows with the largest pump out of service. Peak flow is defined as the average daily flow multiplied by a peaking factor. The average and peak flows may be calculated as follows:

1) Q_{avg} (gpm) = Average Daily Flow = (Population) x (100 gpcd) / 1440

a) P_f = Peaking Factor = $\frac{18 + \sqrt{P}}{4 + \sqrt{P}}$ where,

b) P = Design population expressed in thousands

c) Q_{peak} (gpm) = Peak Flow = (Q_{avg}) x (P_f)

e. The pumping station must be capable of supplying the required system total dynamic head at the station design capacity. The total dynamic head (TDH) is defined as the total head due to the summation of the static elevation difference, frictional pipe losses, and minor (fitting and valve) losses.

1) Frictional pipe losses should be calculated using either the Hazen-Williams or the Darcy-Weisbach equations. When using the Hazen-Williams equation, the MDEQ will typically require that a pipe roughness coefficient ("C" value) of 100 be used for unlined pipe and 120 for lined pipe. The use of alternate higher C values, such as that for plastic pipe, must be approved by the MDEQ.

2) Minor fitting and valve losses may be calculated using the fitting and valve loss coefficient ("k" value) or equivalent pipe length method. Fitting and valve losses as well as equivalent lengths may be obtained from reference sources including the Hydraulic Institute Engineering Data Book, Cranes Technical Paper No. 410, Cameron Hydraulic Data, and other engineering references. Please note that entrance and exit losses must be included along with valve and fitting losses.

f. Wet wells shall be sized such that the operational volume allows a maximum filling time during average flow of not greater than 30 minutes. The minimum operational volume of the wet well shall be based on the maximum number of pump cycles (starts/stops) allowed by the pump or motor manufacturer per hour. The maximum number of pump cycles will occur when the influent sanitary flow is exactly half of the pumping capacity; therefore, the minimum wet well volume may be calculated by the following equation:

1) $V_{min} = (Q_p \times T) / 4$ Where,

a) V_{min} = Minimum Wet Well Volume (gallons)
b) Q_p = Pump Capacity (gpm)
c) T = Cycle Time (min) = 60 minutes / maximum # of pump starts

g. Wet wells shall be of sufficient size to permit not less than two (2) hours of storage at average station design flow above the high water alarm elevation prior to any basement or structures being flooded or wastewater overflowing from any structure.

9.2.3 Pumping Station Types

a. It is not the intention of these Standards to mandate any particular pumping station type(s) except as may be required based on special design circumstances, site conditions, or operating requirements. The Township acknowledges the following pumping station types to

be acceptable:

1) Conventional Wet Well/Dry Well Solids Handling
   a) Flooded Suction Vertical Centrifugal
   b) Self-Priming Suction Lift (excludes vacuum prime)
2) Wet Well Submersible Solids Handling
3) Dry Well Submersible Solids Handling
4) Simplex Grinder Pumps (Multiple connections, less than 80 gpm) for residential use only.
5) Simplex Grinder Pumps (Individual residential, less than 15 gpm) for residential use only.

The above pumping station types may be either of the built-in-place or prepackaged/ prefabricated type suitable for municipal sanitary applications.

b. Pumping station types other than those listed in Item 3.3 A. above should be discussed with the Township and their Engineering Consultant prior to submittal of the construction plans.

c. Table 1 below provides a design matrix showing each of the pumping station types listed in Item 3.3 A. and the varying conditions under which each may be suitable. The design matrix is not all encompassing; therefore, other conditions not listed may further affect the suitability of the use of each station type.

Table 1 – Pumping Station Type Design Matrix

	Flows < 15 gpm	Flows 15-80 gpm	Flows 81-1,500 gpm	Flows > 1,500 gpm	Heads ≤ 90'	Heads > 90'	Wet Well Depths ≤ 40'	Wet Well Depths > 40'	Suction Lift[1]	Horsepower Req'd ≤ 150 hp[2]	Horsepower Req'd > 150 hp[3]	Troublesome Debris[4]
Wet Well/Dry Well												
Flooded Suction			X	X	X	X	X	X		X	X	
Suction Lift			X		X		X	X	X	X		
Submersible Dry Pit			X	X	X	X	X	X		X	X	
Wet Well Submersible			X	X	X		X			X		
Grinder - Centrifugal		X										X
Grinder - Residential	X											X

Notes:

1. Suction lift shall be limited to 18' maximum and shall based on the net positive suction head

available (NPSHa).

2. Motors 150 hp and smaller shall be limited to 1,200 or 1,800 nominal rpm or less depending on motor size and motor manufacturer requirements. Motors 2 hp and smaller may be rated at 3,600 rpm nominal depending on application (i.e. Grinder Pumps).
3. Motors greater than 150 hp shall be limited to 1,200 nominal rpm or less.
4. Troublesome debris refers to that typically unsuitable for normal solids handling pump use.

9.2.4 Pumping Station Requirements – General

a. **Clearance –** Clearance around all equipment shall be adequate for easy maintenance and removal. Lifting hooks, eyes, or beams shall be furnished over major items of equipment to facilitate removal and installation. Clearances in front of electrical panels, equipment and devices shall conform to the requirements of the current National Electric Code.

b. **Corrosion Resistance** – All fasteners, pipe and cable supports, guide rails/cables, lifting chains, etc. located within the wet well shall be manufactured of Type 316 Stainless Steel. Safety landings or platforms located in wet wells shall be of stainless steel or fiberglass reinforced plastic (FRP) construction. Alternate corrosion resistant materials may be considered on a case by case basis depending on application.

c. **Dry Well/Valve Chamber Ventilation** – Dry wells, especially packaged below grade pumping stations, shall be provided with permanent forced ventilation. Valve chambers, such as those utilized with submersible stations, shall utilize either portable or permanent forced ventilation depending on the size of the chamber. Forced ventilation shall be sized to provide 30 complete air changes per hour intermittent or at least 6 air changes per hour for continuous ventilation. Alternatively, permanent forced ventilation may be provided with a timer that allows high speed intermittent operation for 10 minutes and then low speed continuous operation for the duration of personnel occupancy.

d. **Emergency Pump Connection** – An emergency valved pump connection with minimum 4” diameter quick connect fittings shall be provided on the force main in or near the pumping station to facilitate the connection of emergency portable pumping equipment. The emergency connection shall be located downstream of any pump check and isolation valves preferably within the valve chamber or dry well, or terminating above grade with a lockable quick connect cap.

e. **Equipment Access** – Pumping stations shall be provided with suitable access openings sized to allow for the removal of pumps, piping, valves, and other equipment for maintenance.

f. **Firm Capacity** – Pumping stations shall be equipped with not less than two pumps with capacities such that the station can handle peak flows with the largest pump out of service.

g. **Hazardous Location Ventilation** – Those hazardous areas classified as Class I Division I (such as the wet well) requiring periodic personnel access for the inspection or maintenance of mechanical equipment shall be provided with permanent forced ventilation. Forced ventilation shall be sized to provide a minimum of 30 complete air changes per hour for intermittent operation, or 12 complete air changes per hour for continuous operation.

h. **Odor Control** – Odor control systems may be required at those locations affected by high concentrations of hydrogen sulfide (H_2S) or other odor causing compounds in the sanitary stream. This requirement will be reviewed on a site-by-site basis and will take into consideration the proximity of the pumping station to adjacent residential or commercial establishments.

i. **Pumps Minimum Size** – On non-grinder pumping stations, each pump shall have minimum 4" diameter suction and discharge openings and shall be capable of passing a minimum 3" solid without clogging.

j. **Secondary Power** – All pumping stations shall be provided with a secondary or backup power source. This may be accomplished by any one of the following methods:

1) Onsite emergency natural gas, liquid petroleum gas, or diesel powered generator with automatic transfer switch. Diesel or liquid petroleum gas driven units shall only be provided when natural gas is not available at the site.

2) Onsite secondary engine driven pump driver with automatic starting and switch over controls.

3) Emergency generator receptacle with manual transfer switch. (Note: The acceptance of the method will depend on the pumping station location, availability of portable generator units, response time, and other variables).

9.3 *Materials*

9.3.1 General

a. The items, components, manufacturers, model numbers, etc., described in this section convey a minimum level of build, quality and performance. All pumping stations are required to meet the minimum requirements as described.

b. Where the words “or Township approved alternate” are used, the item provided must meet or exceed the build, quality, performance, etc., of the manufacturers listed for that item. Where the words “or Township approved alternate” are not used, requests for substituted manufacturers must be submitted to Milford Township prior to submittal of the construction plans.

9.3.2 Warranties

a. General Components, Maintenance and Guaranty: two (2) years after final acceptance.

b. Major Components: two (2) years after final acceptance.

c. Pumps: two (2) years non-prorated; or five (5) years prorated.

d. Prepackaged Systems: two (2) years after final acceptance.

e. Engine Generator Set: Five (5) years, with biannual (twice-yearly) inspection and annual load bank test.

9.3.3 Operation and Maintenance Manuals

a. Shall include copies of all final approved shop drawings and the basis of design for the specific pump station constructed. Operation and Maintenance manuals will also need to be supplied. Two (2) copies of this information will need to be submitted to the Township.

9.3.4 Pumps

a. **General**

1) Pump casings and volutes shall be of cast or ductile iron construction.

2) All pumps shall be provided with double mechanical seals of the flushless design where available depending on the pump type. Those pump types requiring seal water shall utilize municipal water provided through a reduced pressure backflow preventer installed above ground level and regulating system. Where no municipal water is available, a manually replenished hydropneumatic system may be provided. Acceptable brands of mechanical seals shall be J.F. Crane, Durametalic, or Township approved alternate.

3) Unless otherwise specified herein, all pump shafts shall be of the heavy-duty type designed to minimize shaft deflection and constructed of Type 316 Stainless Steel or high-grade, high-strength alloy steel furnished with a replaceable corrosion and wear resistant stainless steel sleeve through the mechanical seal.

4) Where the pump design allows, pumps shall be provided with replaceable brass or stainless steel wear rings or wear plates on the impeller and/or volute to allow periodic adjustment of the impeller to maintain pumping efficiency.

5) Non-submersible, non-clog and chopper pump motors shall be of shielded drip proof or totally enclosed fan cooled construction, premium efficiency, 1.15 service factor, and with a nominal speed of not more than 1,800 rpm. Motors larger than 2 hp shall be suitable for operation on 240/480 volt, 3 phase, 60 Hz electrical service. Motors that are to be used with variable frequency drives shall be inverter-duty rated.

6) Submersible pump motors shall be rated explosion-proof and shall be provided with leak detection, winding overtemperature protection devices and associated motor protection relays.

7) Pump and motor bearings shall be of the ball type, oil or grease lubricated with an AFBMA minimum B-10 life of not less than 100,000 hours.

8) Prior to shipping, the pump manufacturer shall submit for review and approval, certified pump performance tests certifying actual pump performance. Upon installation in the field but prior to acceptance by the Township, installed pump performance shall be verified by the design engineer and witnessed by the Township's Engineering Consultant.

b. **Flooded Suction Pumps** – Flooded suction pumps shall be of the vertical non-clog centrifugal, close-coupled type, complete with pump support frame and suction elbow with cleanout port. Flooded suction pumps used in locations that may be subject to accidental submergence or flooding shall utilize submersible type motors. Flooded suction pumps shall be as manufactured by Fairbanks-Morse, ITT A-C, Paco, or Township approved alternate.

c. **Grinder Pumps**

1) Residential grinder pumps (<15 gpm) shall be of the semi-positive displacement, progressing-cavity type as manufactured by Environment-One, Crane, or Township approved alternate.

2) Grinder pumps for larger, non-residential applications (15-80 gpm), shall be of the submersible centrifugal type as manufactured by ABS, Hydromatic, Crane, or Township approved alternate.

d. **Submersible Pumps** – Submersible pumps shall be of the non-clog centrifugal, explosion-proof rated type and complete with sliding bracket, discharge base elbow, and pump removal system. Submersible pumps shall be as manufactured by ABS, KSB, Flygt, Fairbanks Morse, or Township approved alternate.

e. **Suction Lift Pumps** – Suction lift pumps shall be of the self-priming centrifugal type with solids-handling impeller, removable cover plate and rotating assembly, shimless impeller adjustment, and V-belt drive. Suction lift pumps shall be as manufactured by Gorman-Rupp, ITT A-C, or Township approved alternate.

9.3.5 Valves

a. **General**

1) Valves 3" and smaller shall be screwed or solder fitting type for brass valves, or Tru-Union type for PVC valves. Valves 4" and larger shall be flanged in conformance to ANSI B16.1 Class 125. Grooved end valve connections may be considered depending on application.

2) Isolation valves in contact with the sanitary flow shall be of the eccentric plug or resilient-wedge gate type.

b. **Air and Air/Vacuum Release Valves** – Sewage style air or air/vacuum release valves shall be provide at all high points in the system. Valves shall be cast or ductile iron body with stainless steel floats and trim and complete with flushing hose and attachments. Valves shall be as manufactured by Apco, Crispin Valve, Valmatic, or Township approved alternate.

c. **Ball Valves** - Ball valves, for use on compressed air, seal water systems, or pressure gauge isolation, shall be of the two piece type with bronze body, brass trim, PTFE seat ring, threaded ends, lever operator, and adjustable packing gland. Valves shall be Watts Regulator Series B-6000, Crane Figure 9302, or Township approved alternate.

d. **Check Valves**

1) Check valves 3" diameter and smaller shall be screwed, regrindable swing type, 200 lb. bronze, Hammond IB944, Jenkins Model 762C, Stockham Model B-345, or Township approved alternate.

2) Check valves 4" and larger shall be of the swing type meeting or exceeding AWWA C-508, cast or ductile iron body, ductile iron disk, stainless steel shaft and trim, Buna-N disk seat, removable inspection/cleanout cover, and complete with lever arm and weight and adjustable air-

cushioned cylinder. Check valves shall be Crispin Valve Series SWC, Golden Anderson Model 250-D, M&H, or Township approved alternate.

e. **Gate Valves**

1) Gate valves 3" and smaller shall be of the bronze body type with screwed ends and solid wedge. Crane Model 428, Jenkins Model 47C, Stockham Model B 105, or Township approved alternate.

2) Gate valves 4" and larger shall be of the resilient wedge type, ductile iron body, in conformance with AWWA C-509. Valves shall be U.S. Pipe Metroseal, American Flow Control, Mueller A-2360, M&H, or Township approved alternate.

f. **Plug Valves** – Plug valves shall be of the non-lubricated quarter-turn eccentric type with cast iron body, cast iron plug completely encapsulated in Buna-N, permanently lubricated stainless steel upper and lower bearings, and multiple V-ring packing of Buna-N. Valves 4" and smaller shall be lever operated. Valves 6" and larger shall be handwheel gear operated. Plug Valves shall be as manufactured by DeZurik, Valmatic, Clow, or Township approved alternate.

9.3.6 Piping & Fittings

a. All pump station piping (except sump pump, compressed air, or seal water piping) shall be Ductile Iron Class 53 (exposed) or Class 54 (buried) in conformance with ANSI A21.51, (AWWA C151). Ductile Iron Fittings shall be in conformance with ANSI A21.10 (AWWA C110). Ductile iron pipe and fittings shall have bituminous seal coated double thickness cement mortar internal lining with tapered ends in conformance with ANSI A21.4 (AWWA C104). Exterior coating for buried piping and fittings shall be two coats of coal-tar varnish, applied by the hot-dip method. Exterior surfaces of pipe and fittings installed above grade shall be epoxy coated.

b. Exposed ductile iron pipe shall be flanged or made with grooved pipe couplings. Flanges shall conform to ANSI B16.1 Class 125. Buried piping shall have Tyton style push on joints. Buried fittings shall have push-on or mechanical joints. Joints shall be restrained at bends, tees, dead ends, or other changes in direction using restrained fittings or thrust blocks. The method of pipe and fitting restraint shall be reviewed with the Township's Engineering Consultant.

c. Force main piping shall be constructed of Ductile Iron Class 53 or 54 as specified or high density polyethylene (HDPE) pipe (subject to prior approval by the Township). Where approved HDPE pipe shall be minimum SDR 11. HDPE pipe material shall meet with the latest

ASTM D3350 with a cell classification of PE345464C, shall meet the manufacturing requirements of ASTM F714. Pipe sizes 4”-24” shall equivalent ductile iron pipe outside diameters. Fittings shall be butt (ASTM D326) or electrofusion (ASTM F1055) type, PE3408 HDPE, pressure ratings equal to or exceeding that of the pipe. Flanged and mechanical joint adapters shall be PE3408 HDPE and in conformance with ASTM D3216 with pressure rating equal to or exceeding that of the pipe. Mechanical restraint shall be in accordance with the pipe manufacturer’s requirements.

d. Sump pump discharge piping shall be Schedule 10 type 304 stainless steel (prepackaged pump stations) inside the pump station and Schedule 40 PVC below grade. Unions shall be provided at all pump and valve locations to facilitate maintenance.

e. Compressed air and seal water piping shall be copper tubing in conformity with the current ASTM Designation B 88, "Seamless Copper Tube," Type K soft temper (buried), or Type K hard temper (exposed). Annealed tubes shall be used with flared joint fittings. Drawn temper tube shall be used with solder joint type fittings. Flared joint fittings shall be brass SAE type.

9.3.7 Miscellaneous Mechanical

a. **Access Hatches** – Wet well and valve chamber access hatches shall be of the aluminum single or double door type as required per application and shall be gas tight. Access hatches shall have slam locks and a recessed padlock and hasp cover. Hatch hardware shall be stainless steel. Hatches shall be H-20 rated where required due to potential vehicle loading. At dry well or valve chamber locations, the hatches shall be of the drainable channel type with the drain outlet piped to the dry well or valve chamber sump. Consideration shall be given to the provision of secondary fall protection devices on hatches installed over a wet well. Access hatches shall be as manufactured by Bilco, Halliday, or Township approved alternate.

b. **Backflow Preventers –** Backflow prevention shall be provided for any pumping station utilizing a municipal water based seal water system. The backflow preventer shall be of the reduced pressure principle type complete with isolation valves and shall be listed as an approved model by the local water supplier.

c. **Compressors** – Where required for bubbler level control or hydropneumatic based seal water systems, dual compressors of the oilless type shall be provided and mounted on a suitably sized ASME rated pressure tank. The compressors shall automatically alternate upon the completion of each cycle.

d. **Pressure Gauges** – Pressure gauges shall be provided upstream and downstream of each pump (downstream of each submersible pump) and downstream of a check valve (one required) to measure

force main pressure. Gauges shall be 4", stainless steel case, ring, socket and movement, liquid filled, and range as appropriate. Gauges located on the discharge of submersible pumps shall be of the combination type (pressure and vacuum) to prevent gauge damage due to the suction created on pump shutdown. All gauges shall be mounted to a stainless steel gauge isolator with Buna-N diaphragm. The gauge shall be factory glycerin filled as a unit. The gauge shall be as furnished by Red Valve Series 742 with Ashcroft, Trerice, or Wika gauge. A shut-off valve shall be provided for the gauge so it can be isolated from the system when it is not in use.

e. **Sump Pumps** – Sump pumps shall be of the submersible centrifugal type, cast iron or bronze motor housing and casing, bronze or thermoplastic impeller, stainless steel shaft with upper and lower oil lubricated ball bearings, single or dual Type 21 mechanical seal, 1½" NPT discharge, thermal overload protection, ½ hp, 115/230 volt, single phase, 60 herts, 3,450 rpm. A single pump with automatic piggyback plug float switch shall be provided in a minimum 18" diameter sump in small dry wells or valve chambers. Two pumps with automatic alternation controls shall be furnished in a minimum 18" x 30" rectangular sump for larger locations. Each sump discharge shall contain a minimum of two check valves upstream of the isolation valve. The sump discharge shall be piped to the wet well. Pumps shall be as manufactured by Hydromatic, Barnes, Myers, Goulds, or Township approved alternate.

f. **Ventilation Fan** – Ventilation fans where utilized shall be of precision resin injection molded glass reinforced and corrosion-resistant construction. The fan shall be of the centrifugal, direct or belt drive type meeting minimum Class II construction. Fans used to ventilate the wet well or other hazardous location shall be non-sparking. Fan motors shall be totally enclosed fan cooled sized to be non-overloading. Fans shall be as manufactured by Duall, Hartzell, or Township approved alternate.

9.3.8 Prefabricated/Prepackaged Pumping Stations

a. Prefabricated/prepackaged sanitary pumping stations shall be acceptable as provided by experienced manufacturers having not less than ten (10) years experience in the manufacture, assembly, and packaging of municipal sanitary pumping station experience. Prefabricated/prepackaged stations may be of the below grade or above grade type designed to meet all pumping capacity, electrical, instrumentation, control, and applicable structural loading requirements. Pumps, valves, piping, ancillary equipment, electrical systems and controls furnished as part of the pumping station shall meet all required Township Engineering Design Standards.

b. Structural design for the prefabricated/prepackaged stations shall be sealed by a professional engineer registered in the State of Michigan. Above-grade building enclosures will be subject to review and approval by the Township Building Department.

c. Packaged pumping stations shall meet all applicable NEC requirements and shall be UL listed.

d. Packaged pumping facilities located below grade shall be of steel construction, minimum 10' diameter with a steel access riser of not les than 3'-6" diameter. Safety landings shall be installed in accordance with OSHA requirements. Where elevator access is provided, a secondary access shall also be provided.

e. Below-grade or buried portions of above-grade steel facilities shall have applied to its exterior a coal tar epoxy coating with a minimum dry-film thickness of 18 mils. Interior coatings shall be a two-coat epoxy paint system total minimum dry film thickness of 8 mils. Coatings shall be Tnemec, Carboline, or Township approved alternate. Below-grade steel structures shall be further protected against corrosion by an impressed current type cathodic protection system.

f. Acceptable prefabricated/prepackaged pump station manufacturers include, but may not be limited to, the following:

1) Dakota Pump
2) Gorman Rupp
3) Smith & Loveless – Stainless Steel
4) USEMCO

Manufacturers other than those listed above shall be required to receive prior approval from the Township before submittal of the construction drawings.

g. Shop drawings for packaged pumping stations shall include all major equipment, components and devices, and shall include electrical and controls diagrams, plan and sections of the facility and other data as may be requested by the Township's Engineering Consultant.

9.3.9 Packaged Residential Grinder Pumping Stations

a. Packaged residential grinder pump stations shall be furnished as a complete unit, including grinder pump, check valve, tank and all necessary controls packaged into a single unit, ready to connect.

b. The grinder pump basin shall be a tough, corrosion resistant tank of HDPE, sized on the basis of anticipated residential sanitary daily flow. The basin shall have an inlet grommet suitable for connection to a 4" or 6" PVC DWV sanitary lead. The pump discharge termination at the basin shall be 1¼" NPT female thread with

appropriate adaptors for connection to 1¼" PVC or HDPE force main. The basin shall be provided with a concrete ballast, sized and installed per the station manufacturer's requirements, to resist buoyant forces and prevent flotation of the station during or following installation.

c. The internal check valve assembly within the grinder pump basin shall be constructed of glass filled PVC and of non-clogging design. A stainless steel cast or PVC Tru-Union ball isolation valve shall be provided within the basin just ahead of the pump discharge termination at the basin wall. A pump discharge quick-disconnect fitting shall also be furnished to facilitate pump removal from the basin.

d. Level controls shall be integral to the pump (core) or separately mounted floats or pressure switches. Activation levels shall include Pump Stop, Pump Start, and High Level Alarm.

e. The grinder station control panel shall be a separate wall mount unit with a NEMA 4X rated fiberglass enclosure with hinged access panel, padlockable latch, motor starter, circuit breakers, terminal and ground lugs. The control panel shall be furnished with visual and audible alarms, elapsed time meter, manual run and alarm silence pushbuttons, and dry contacts. The panel shall be available for connection to either 120 volt or 240 volt, single phase residential electrical service. It shall be mounted a minimum of 4 feet above grade.

f. Grinder pumps shall be of the semi-positive displacement, progressing cavity type as previously specified, with a 1 HP, 1725 rpm, high torque, capacitor start, thermally protected motor, 240 or 120 volt, 60 hertz, single phase. Pump discharge characteristics shall be 15 gpm at 0 psig, 11 gpm at 40 psig, and 9 gpm at 60 psig.

g. Each grinder pump station force main lead shall terminate at the right-of-way or utility easement with a bronze swing type check valve and stop box.

h. The entire packaged grinder pumping station shall be as manufactured by Environment-One, Crane Pumps and Systems, Zoeller Engineered Products, or Township approved alternate.

9.3.10 Spares

a. Submersible pumping stations shall be provided with one (1) spare pump complete with discharge hardware turned over to the Township for storage.

b. One (1) mechanical seal for each pump size.

c. One (1) volute gasket for each pump size.

d. One (1) each air and oil filters for backup engine-driven power supplies or pump drivers.

e. Relays, light bulbs, etc. for control panels.

9.3.11 Electrical & Controls

a. **Electrical Service** – Electrical service to the sanitary pumping station, except for residential grinder stations, shall be 480 volt, 3 phase, 60 hertz, three wire plus ground wherever possible. Electrical service for lighting, receptacles, etc., shall be 120 volt, single phase, 60 hertz provided from a separate dry-type transformer.

b. **Emergency Generator Set**

1) All pumping stations shall be provided with a stand-by generator housed in a weather and vandal resistant enclosure or masonry building, designed to start and operate sufficient pumps to pump the station design capacity in the event of utility power failure. Power shall transfer to the generator by means of an Automatic Transfer Switch. Each pumping station shall also be provided with a manual transfer switch and a generator receptacle to enable a portable generator to be substituted for the permanently installed generator in the event of problems occurring to the permanent generator.

2) See Section 8.7 for additional generator set requirements.

c. **Intrinsically Safe Wiring** – Intrinsically safe wiring shall not be run in the same raceway with non-intrinsically safe wiring. Physical separation and/or a suitable barrier shall be provided between intrinsically safe and non-intrinsically safe wiring. Intrinsically safe relays shall be used for connection to wet well mounted float switches.

d. **Junction Boxes & Seal-Off Fittings**

1) Junction boxes shall be provided where required to provide access to wiring and splices. Provide one box per pump and one or more boxes for float switches as required to limit conduit sizes to 1 ½".

2) Junction boxes and seal-off fittings (or suitable, protected vented raceway) shall be installed on conduit emanating from a hazardous location such as a wet well prior to entry into an enclosure or control panel. Junction boxes shall be rated as

follows:

a) NEMA 7 for non-intrinsically safe wiring.

b) NEMA 4 cast or 4X stainless steel for intrinsically safe wiring.

e. **Level Control and Alarm Monitoring** – Level control and alarm monitoring shall be accomplished by one of the following methods:

1) Bubbler
2) Ultrasonic
3) Submersible Level Transducer

f. The method of level control chosen shall utilize intrinsically safe systems suitable for use in hazardous locations. Furthermore, the level control method shall be designed so as not to be affected by grease build-up, foaming, or turbulence in the wet well. Float switches shall be used for back-up control and alarm, and shall be as specified under Section 8.

g. **Lighting**

1) Interior – Interior lighting shall be enclosed fluorescent or incandescent.

h. Exterior – Exterior lighting shall be HPS with photocell control.

i. **Panels and Enclosures**

1) Panels and/or enclosures located outdoor or in an unconditioned/unprotected space shall be rated NEMA 12 with a drip lip or gasketed NEMA 3R and constructed of either stainless steel or aluminum. A three-point door latching system with a padlockable handle shall be provided. Outdoor enclosures shall be provided with closable vents, stainless steel door hinges, enclosure heaters with thermostat, GFI type convenience receptacle and switched interior lighting fixture.

2) Panels and enclosures located indoors or in conditioned/protected spaces shall be rated NEMA 12, constructed of steel with a powder-coated painting system.

j. **Wiring and Conduit**

1) Wiring shall be single conductor type THHN-THWN. Conduit shall be rigid heavy wall galvanized steel.

k. **Electrical Components**

1) Motor starters shall be of the combination motor circuit protector type (with ground fault protection for submersible pumps) and shall be NEMA size 1 minimum.

2) Pilot lights shall be press-to-test, transformer type, oil tight, heavy duty type. Push buttons and selector switches shall have 10 amp rated contacts and shall be oil tight.

3) Control relays shall have 10 amp contacts and 120 volt coils. Alternators and timers shall be as specified under Section 8.

4) All electrical equipment shall be manufactured by Allen-Bradley, Square D, Cutler Hammer or Township approved alternate where available.

l. **Remote Alarm System**

1) An alarm dialer shall be provided at each duplex pumping station, Raco Verbatim or other Township approved alternate. Pumping station alarms shall be sent back to the City of Wixom WWTP, with appropriate phone numbers and alarm messages programmed into the alarm dialer.

9.4 *Plan Requirements*

9.4.1 All construction plans for sanitary pumping stations shall be submitted to Milford Township for review and approval. It is recommended that these plans be submitted concurrently with the sanitary collection system plans if applicable.

9.4.2 In addition to the plan requirements for the sanitary collection system, the sanitary pumping station construction plans shall contain, but not be limited to, the following information:

a. Cover Sheet or Site Plan to scale showing the location of the proposed pumping station and force main routing with respect to the tributary sanitary collection system.

b. Site Plan to scale showing the layout of the pumping station, adjacent onsite utilities, structures, parking, and site access.

c. Plan and profile of the force main showing size, length, type and class of pipe, including the locations of air relief or air/vacuum relief valves, cleanouts, and crossings.

d. Plan and sections to scale showing the dimensions, elevations, layout and arrangement of the wet well, dry well, access openings, risers, vents, and any ancillary structures, including equipment, piping, valve, fitting, and hatch locations. The wet well section shall

include the pump operational levels including high and low alarm levels.

e. Direction, size, and invert elevation of all influent sanitary sewers and drain line connections to the wet well.

f. Dimensions from structures to property lines, right-of-way lines, or buildings.

g. Limits of special excavation and backfill requirements.

h. Location of existing or proposed utilities, building, or structures that may affect or impact construction of the pumping station, influent sewers, or force main in plan and profile views.

i. Design calculations for the system head requirements, pump capacity, total dynamic head, wet well sizing, emergency storage, and structure buoyancy. Calculations for the system head shall include static lift, friction losses and minor losses.

j. Electrical plan, including an electrical riser detail, electrical site plan, and appropriate electrical, instrumentation and control details. The electrical plan shall include main service breaker, service voltage, phase, and meter size, total connected horsepower, and total connected amperes.

k. Specifications for the pumps, piping, valves, miscellaneous mechanical equipment, structures, electrical controls, devices, wiring, telemetry equipment, emergency power equipment. Please note that accompanying specification books may also be provided for this purpose.

9.4.3 Detail Sheets

a. Detail sheets shall include specific and complete details for all pumping station appurtenances and structures to be included with the station construction and any special or unusual construction requirements.

b. Scales utilized for special details shall be selected to clearly portray intended construction and component or equipment arrangement. Scales used shall be clearly identified.

9.5 *Construction Standards*

9.5.1 Manhole Materials and Appurtenances – Manholes, materials & appurtenances shall meet the requirements established in Section 3.

9.5.2 Precast and Cast-In-Place Structures

a. Circular precast wet wells and valves chambers shall be in conformance with ASTM C478 or C-76 Class II with circular reinforcement.

b. Structure bases shall extend beyond the outside diameter of the riser section as required to offset the affects of buoyancy on the structure. The base shall be integral to the vertical riser section or installed separately and anchored to the vertical riser section using stainless steel brackets and fasteners.

c. Structures shall be founded on a minimum 3" thick mud mat or 6" angular stone on top of undisturbed soil with a minimum compressive strength of 3,000 psf. Unsuitable material shall be excavated and replaced with mud mat.

d. Top slabs shall be either precast or cast-in-place with reinforcing designed to withstand expected soil loads, overburden, and live traffic loads. Exposed surfaces of cast-in-place top slabs shall have a broomed appearance. Exposed surfaces of precast top slabs shall meet the finish appearance requirements of Precast Concrete Institute (PCI) C3.5.3 Grade B.

e. Cast-in-place structures shall utilize concrete with a minimum 28-day compressive strength of 3,500 psi. Steel reinforcement shall be new billet conforming to ASTM A615 Grade 60. Reinforcement steel for ties and stirrups may be new billet steel conforming to A615 Grade 40.

f. The exposed edges of all concrete structure shall receive a ¾" to 1" chamfer all around.

g. Contoured concrete fill used to form the contoured bottom of wet wells or sloped floors in dry well/valve chambers shall be concrete of 3,500 psi 28-day compressive strength reinforced with 1.5 lbs per cubic yard of polypropylene fibers 1½" long (Fibermesh or Township approved alternate).

h. All structures shall be founded on undisturbed soil to reduce differential settlement between structures. Where structure are located within close proximity of each other to preclude founding one or more structures on undisturbed soil, the station designer shall utilize braced excavation, excavation with engineered stone or flowable fill, or combinations thereof so that differential settlement is minimized.

i. Backfill surrounding structures shall be MDOT Class II material compacted to 95% of maximum density at optimum moisture content.

9.5.3 Test for Alignment

a. All equipment shall be tested and adjusted for proper alignment.

10. RECORD DRAWINGS

10.1 *General*

10.1.1 All projects within the Township which go through site plan and/or construction plan review shall be required to submit record drawings. The drawings will need to be reviewed and approved by the Township Engineer prior to final acceptance of the project by Milford Township.

10.1.2 The initial submittals shall be of two (2) sets of black line prints providing the applicable information shown on the attached checklist. The minimum scale shall be 1"=50' and shall bear the seal of a registered professional engineer or surveyor licensed to practice within the State of Michigan. All record lengths and elevations must be labeled as record.

10.1.3 After the record drawings have been approved by the Township Engineer, the applicant shall submit two (2) mylar copies of the approved drawings. A CD shall also be provided which contains a .pdf version of each sheet of the plan set.

MILFORD TOWNSHIP

RECORD DRAWING REQUIREMENTS CHECKLIST

SANITARY, STORM & WATER MAIN In Plan & Profile, Show:	**Completed**	**Outstanding**	**N/A**
All invert & rim elevations to USGS Datum			
Actual laying length between structures			
Type of pipe used			
Actual slope of pipe			
Size of pipe			
Tie all structures to property corners using an X-Y coordinate system			
Lead information (distance from downstream manhole, tie down end, invert elevation, etc.)			
DETENTION PONDS	**Completed**	**Outstanding**	**N/A**
Letter required by the design engineer stating that the pond is properly sized according to approved plans, and the outlets are properly located and sized.			
ROADS / PARKING LOTS	**Completed**	**Outstanding**	**N/A**
Roadway centerline spot elevations			
Edge of road tied to ROW/easement			
Curbing and parking lot spot elevations			
Spot elevations on parking lot structures			
MISCELLANEOUS	**Completed**	**Outstanding**	**N/A**
Plans noted as record drawings & dated in title block			
Record drawings sealed			

Additional information may be required at the discretion of the Township Engineer.