SECTION 4: DESIGN OF BOOSTER PUMP STATION

4.1. PURPOSE

MUPB's intent of this section describes the minimum requirements for the design of booster pump stations to augment existing water pressures for a proposed development. These requirements are listed to ensure that any development/extensions have adequate pressure while not having a negative impact upon other existing water facilities and customers.

4.2. DESIGN APPROACH

Proposed construction or expansion of water facilities, within the MUPB Service Area shall be in compliance with the Recommended Standards for Water Works (Commonly referenced as the 10 State Standards), the Kentucky Administrative Regulations (KAR) and guidelines defined in this Manual.

Any person, company, corporation, or other entity proposing to develop land or proposing to install new or replacement water main(s) and/or booster pump station(s) within the MUPB Service Area must prepare, for review and approval by MUPB, planning and design documents according to the standards and requirements of this Manual.

Planning and construction documents must be prepared and certified by a Professional Engineer licensed in the Commonwealth of Kentucky. The service level of proposed facilities shall be according to design standards referenced in these documents.

4.3. ESTIMATED CUSTOMER DEMANDS

MUPB has established the tables in SECTION 3 to be utilized to determine the customer demand of proposed developments. These tables shall be considered the minimum demands. Consideration of alternative demand calculations may be presented to MUPB for consideration. MUPB determination is final on alternative demand calculations.

4.4. HYDRAULIC MODEL

MUPB requires a hydraulic model to be presented with the submittal of plans for review. The hydraulic model shall be based upon a two-point flow test at the nearest available fire hydrant to the development/extension, or model shall include all associated connections and include the nearest water storage facility. MUPB will provide OWNER/DEVELOPER the necessary information regarding a two-point flow test, conducted by MUPB or assigned representatives.

As an alternate to providing a hydraulic model to MUPB, the OWNER/DEVELOPER may elect to have MUPB develop the required hydraulic model of the development/extension with all associated connections and facilities necessary. In order for MUPB to develop the required hydraulic model, the OWNER/DEVELOPER acknowledges that the cost for

developing the model will be paid by the OWNER/DEVELOPER at the rate described below.

DEVELOPMENT SIZE (# of Lots)	FEE
Small Development (<5 lots)	$ 1,500
Medium Development (6 to 20 Lots)	$ 2,500
Large Development (> 20 lots)	$ TBD

The hydraulic model shall follow guidelines set forth by Kentucky Division of Water (KDOW) in the Construction Permit Application (DW-1). OWNER/DEVELOPER shall submit the Hydraulic Model Information Sheet in Appendix G.

4.4.1. KDOW REQUIREMENTS

KDOW DW-1 requires at a minimum the following hydraulic information to be provided with the hydraulic model:

A. Provide pump sizing calculations and the proposed pump's characteristics curve along with the efficiency, horsepower, and NPSHR data, if applicable.

B. The model must demonstrate the availability of 30 psi under peak demand conditions.

C. The model must demonstrate that the proposed water lines are capable of providing a flushing velocity of 2.5 ft per second while maintaining a minimum of 20 psi at all times.

4.4.2. MUPB REQUIREMENTS

MUPB requires the following information to be included in addition to KDOW requirements:

A. A written hydraulic model summary, area map, and electronic copy of the model for review. Identify the computer modeling software utilized and provide all related database files to ensure model will import to PIPE 2020 or latest version.

B. Provide a system map showing the modeled pipe network. Label all pipes, nodes, road names, north arrow, scale, number of units, unit type, demands, elevation contours, and outline of the phasing, if applicable.

C. Save files such that each file demonstrates that the development meets KDOW

criteria separately. This ensures that during the review by MUPB it is an accurate representation of the model prepared by the ENGINEER.

D. The model must represent the entire development, including all known future phases.

E. All existing demands shall be represented in the model to accurately represent system flows and pressures.

F. Identify the source of water (i.e. pressure zone) and type of pressure source being modeled (tank, PRV or two-point flow test curve).

G. Provide a node report to display name, elevation, corresponding connected pipes, demand, hydraulic grade line (HGL), and pressure.

H. Provide a pipe report to display name, diameter, flow, velocity, length, and head loss.

I. Provide a conclusion of results, table listing nodes with maximum and minimum pressures for all situations modeled. The table of Max/Min shall include 10% of the number of nodes within development, minimum of 5 for each.

J. Provide booster pump results table listing each pump, flowrate, inlet head, outlet head, pump head, and available NPSH.

4.5. BOOSTER PUMP STATION SITE

A. Booster pump station sites will be determined with input from MUPB. Booster pump station shall be located outside of flood prone areas. If the station must be located within a flood prone area specific precaution shall be made to protect the station. All finished floors, tops of all structures (below ground), and equipment shall be above the 100-year flood elevation, at minimum of one-foot.

B. Booster pump station shall have a dedicated paved access drive, security fence, landscape, and exterior lighting. All booster pump station sites shall be deeded to MUPB prior to MUPB assuming ownership, operational and maintenance controls. An easement may be permitted at MUPB sole discretion. An easement for ingress/egress for an access road would be permissible.

C. Booster pump station shall be placed in an area with ease of access for maintenance equipment including but not limited to the following: crane, excavation equipment (backhoe, excavator, etc.), and maintenance trucks.

D. The need for and quantity of exterior lighting shall be determined on a case-by-case basis. Wherever possible, booster pump stations shall be hidden from view of nearby neighbors and roads. If necessary, booster pump stations shall be hidden through the use of tree plantings or privacy fencing. Quantity and type of

tree must be approved by MUPB and meet the requirements set forth by MRCP&Z. Required buffers shall comply with MRCP&Z.

E. The booster pump station's lot will be fenced and screened/landscaped per MUPB and MRCP&Z requirements.

F. A 12-foot wide, paved access road with gravel shoulders shall be provided to the station. The minimum road section will consist of a compacted sub-grade, 8 inches of DGA stone, and 2 inches of bituminous pavement. The gradient of the roadway centerline shall not exceed 5 percent. Unrestricted ingress and egress will be granted to MUPB from a public right of way to the booster pump station.

G. An unrestricted, all weather access road to the station shall be maintained by the CONTRACTOR/DEVELOPER until the permanent access road is complete and accepted by MUPB. MUPB must have access to the station at all times.

H. A 6-foot high, chain link security fence topped with angle arms pointing out and 3 strands of barbed wire shall be provided around the booster pump station lot. The total height of this assembly is 7 feet. The fence shall be equipped with a top rail and a bottom tension wire. Access into the station will be through a minimum 14-foot wide, lockable gate. Depending upon the location of the booster pump station an alternative fencing system may be required by MUPB.

I. All door locks and padlocks in the station will be keyed to MUPB's standard keys.

J. Adequate provisions will be made for parking and turning large vehicles around at the station.

K. The project specifications will specify a paint or other protective coating for all corrodible materials not otherwise protected. The type, color, and thickness of the paint or other protective coating are subject to the approval of MUPB.

4.6. BOOSTER PUMP STATION DESIGN CRITERIA

The following parameters have been established by MUPB to ensure that future booster pump station(s) and modifications made to existing booster pump station(s) meet a minimum standard. The parameters listed in the following paragraphs are not a complete listing of all situations that may be encountered but is a minimum standard to be met. Any variance from these parameters requires MUPB approval and at MUPB discretion. Booster pump stations shall meet the following parameters:

4.6.1. PUMP SIZING

A. The pump shall be sized in accordance with KDOW, Ten State Standards, KAR, and industry standards to supply the necessary average day demand, peak hourly demand, and flushing flow rates.

B. Pumps shall be sized accordingly to all future development not just the initial phase.

C. Pumps shall be vertical multi-stage centrifugal type.

4.6.2. MOTOR SIZING

A. Motor shall be sized to ensure the pump is non-overloading when operating on the specified pump curve.

B. Motor shall be totally enclosed fan cooled (TEFC) with a NEMA C face design with a minimum service factor of 1.15.

C. Motor shall be premium efficient for suitable use with variable frequency drive (VFD) unit.

4.6.3. INTERNAL PIPING

A. All internal piping shall be flanged ductile iron class 350 for pipe diameters 3-inch and larger and SCH 40 welded steel pipe or threaded pipe for pipe diameters less than 3-inch.

B. Pipe entering/exiting the booster station building shall be sized same size as the main water main. Pipe shall only be reduced within the building.

C. All internal piping shall be supported by pipe supports, anchored to the concrete floor slab.

4.6.4. EXTERNAL PIPING

A. All external piping shall be mechanical joints (restrained) until the piping has exited the booster station slab/foundation. Once outside the slab/foundation of booster station shall be material that meet the pressure requirements of operating pressure ranges.

B. All external piping shall be backfilled according to this MANUAL.

4.6.5. PRESSURE GAUGES

All booster pump stations shall have suction and discharge pressure gauges panel mounted off of the pipeline and be connected to their respective sensing point. The gauge panel shall include isolating and vent valves. Tubing to each gauge shall be arranged as to easily vent air and facilitate gauge replacement. Gauges shall not be mounted directly to the pipeline or at the sensing point.

Pressure gauges shall be sized accordingly to normal operating pressures (average pressures). Gauge ranges shall be no more than twice the operating

pressure. Gauge assemblies shall be furnished with shutoff stops, diaphragm seals and pulsation dampers, which shall be constructed of brass or stainless steel. Gauges shall be 4-1/2-inch in diameter. Gauges shall have the following graduations:

Pressure Gauges (psi)

Maximum *Indications*	*Figure Intervals*	Intermediate Graduations	Minor Graduations
15	1	0.5	0.1
30	5	1	0.2
60	5	1	0.5
100	10	5	1
160	20	5	1
200	20	10	2
300	30	10	2

4.6.6. BACKUP POWER

A. Certain booster pump stations will require on-site backup power via generator. All backup power shall be designed to handle full load application with all ancillary items operating. Automatic transfer switches are required for all pumps where generator and/or engine driven motors are on-site.

B. Standby generators shall be diesel or natural gas driven with fuel storage on the underside of the generator in a double-walled containment tank. The tank shall be sized for 48 hours of continuous use at full load, if possible. Skid mounted tanks are not acceptable. A fuel storage level indicator will be provided on the generator and in the control building via display. Fuel tank shall be refilled after all startup and testing is complete.

C. The generator will be equipped with an alarm indicator and output contacts to display the cause of a generator failure, both locally and remotely. The means for starting an emergency generator shall be completely independent of the normal electric power source. The starting system shall be sufficient to start the generator a minimum of 3 times without recharging. The starting system shall be alarmed and instrumented to indicate a loss of readiness via SCADA System.

4.6.7. ISOLATION VALVES

A. Isolation valves shall be located on the discharge and suction side of each

pump to allow the pump to be isolated. A check valve shall be installed on each discharge line, between the pump and the isolation valve. Isolation and check valves shall be located on the interior of the booster station building. Isolation valves shall be installed in the horizontal position, so that the valve wedge is in the top when open.

4.6.8. SWING CHECK VALVES

A. Swing Check Valves shall be constructed of a heavy-duty body of cast iron conforming to ASTM A126 Class B with integral flanges, faced and drilled per ANSI B16.1 Class 125 or 250. The valve shall have a replaceable stainless steel body seat. The swing check valves shall have limit switch circuitry for pump failure logic.

B. The valve shall be supplied with an outside lever and adjustable counterweight to initiate valve closure. Final closure shall be dampened by means of a single, side-mounted bronze oil-cushion assembly directly mounted to the valve body.

C. MUPB may allow for differing styles of check valves for differing pumping and discharge pressures.

4.6.9. STRAINER

Strainer shall be either a plate strainer or “Y” strainer located on the common suction side of the pump(s).

4.6.10. LIGHTING

Adequate lighting shall be provided throughout the booster pump station. All lighting fixtures shall be rated for the environment in which they are installed. Where applicable LED fixtures shall be installed in accordance with the manufacturer’s recommendations to provide adequate heat dissipation and maximize the life expectancy of the fixture. LED fixtures shall have a 0º F start ballast and have a plastic lens to protect the lamps. All exterior-photoelectric switches shall be intrinsic safe. All lighting shall have an HOA switch.

4.6.11. VARIABLE FREQUENCY DRIVES

All booster pump stations shall have variable frequency drives (VFD) for operation of a pressure-controlled situations. VFDs shall be DANFOSS and most recent model available.

4.6.12. CONTROLS

A. Control panel shall be wall mounted or integrally strut mounted as part of a skid style station.

B. The pumps shall be controlled by means of a pressure transducer or telemetry (SCADA). The pressure transducer shall be programmed to turn the pumps on or off at various pressures (maximum/minimum). A spare transducer shall be provided for each booster station.

C. Check valve limit switch circuitry shall be used for pump failure logic, at MUPB's discretion.

D. An elapsed run time indicator shall be provided for each pump.

E. A press-to-test circuit shall be provided for the control panel indicator lights.

F. All control wiring and interface wiring shall be number coordinated with the schematic drawing. All panel and field wiring shall be identified with non-repeating numbers. All instrumentation and control devices shall be wired with stranded copper conductors.

G. All motor controls shall be equipped with a motor overload indicator light for each motor equipped with a thermal overload protection device.

H. Provide an uninterruptible power supply (UPS) with 2-hour battery for the control system.

I. Two sets of laminated drawings of the final wiring schematic(s) shall be provided to MUPB with one set of drawings attached to the inside face of the interior door of the control panel.

4.6.13. TELEMETRY

MUPB shall specify the method of communications and specific brands of hardware and software to be used. MUPB may require additional telemetry at a particular booster pump station. The following signals are required:

Description	Booster Pump Station	
	Monitor	Required Signals
Pump Run for each pump	Yes	Per # of pumps
Power Failure	Yes	1
Phase Failure	Yes	1

Generator or Backup Power Run	Yes	1
Generator or Backup Power Failure	Yes	1
Telemetry Failure	Yes	1
Building Intrusion	Yes	1
Control Panel Intrusion	Yes	1
Low Suction Pressure	Yes	1
Generator Fuel Level	Yes	1
Pump Run Failure	Yes	Per # of pumps

Telemetry equipment shall be housed in a NEMA 4X Stainless Steel enclosure for outdoor use. Costs to modify the master station will be borne by OWNER/DEVELOPER.

4.6.14. HVAC EQUIPMENT

A. Each booster pump station shall include a one piece, wall mounted, factory assembled, pre-charged, prewired, tested and ready to operate HVAC unit. The unit shall be approved and listed by UL.

B. Each booster pump station shall include a dehumidifier that is UL approved and listed by UL and adequately sized for the booster pump station.

4.6.15. ELECTRICAL

A. Electric power shall be provided to the station by distribution lines and by a standby generator. Both power sources shall be sufficient to operate all pumps, critical lighting, and ventilation systems for all operating conditions.

B. The distribution lines and generator shall have a means of being disconnected before the transfer switch. The generator will automatically switch sources in the event of a power failure. The transfer switch will be fully automatic with the ability to sense a single-phase power condition and switch to the generator power system with a minimum time delay. Both power sources shall be protected by fuses or breakers prior to the transfer switch. The transfer switch shall be capable of being operated manually.

C. The station's power supply shall be protected from lightning.

D. A final step-down transformer shall be provided on each electric feed line with adequate physical separation between them to prevent a common mode failure. Separate fuses shall be provided for each power source.

E. The electric distribution line and the standby generator will remain separate and form separate distributions up to the internal fuse system to preclude a common mode failure of both sources.

F. Breaker settings or fuse ratings shall be coordinated to affect sequential tripping such that the breaker or fuse nearest the fault will clear the fault prior to activations of other breakers or fuses to the degree practical.

G. The load distribution panel shall not be an internal part of the transformer.

H. All motors and control enclosures will be adequately protected from moisture, the weather, and water under pressure.

I. All equipment shall be installed in accordance with the manufacturer's recommendations. When laying out the location of the equipment in the control and generator building, the ENGINEER will consider the necessary separation between devices to provide adequate ventilation and the location of doors, hatches, and panel covers to avoid conflicts between these items when they are opened and closed.

J. Provide arc flash study and rating for the facility with design of corresponding safety features. Design system to Class 2 or lower rating for arc flash. Arc flash study shall be performed on the design and again at the substantial completion of the station.

4.6.16. STARTUP

A. Successful test shall include the confirmation of the following:

1. All major equipment operated, as specified.

2. The control systems worked, as specified.

3. The telemetry systems worked, as specified.

4. Adjustments of control settings within the normal operating parameters are allowed as long as the booster pump station remains operational and no unplanned alarm signals are generated.

B. Substantial Completion

1. All successful start-up tests shall be performed by the

CONTRACTOR/DEVELOPER, certified by the ENGINEER, and accepted by MUPB prior to the Certificate of Substantial Completion.

2. MUPB shall be provided with sufficient spare parts for all major equipment. See MUPB's Spare Parts Checklist, APPENDIX K. Special tools may also be required for a given booster pump station that uses special (non-standard) equipment, that has been preapproved by MUPB. Special tools shall be specified during the review of the booster pump station plans by MUPB.

3. Four copies of the approved Operations and Maintenance Manual and one digital copy on CD will be supplied to MUPB prior to completion of the station. The Operations and Maintenance Manual will contain a reduced set of the booster pump station plans including as-built electrical and control schematics, equipment model and serial numbers, installation instructions, maintenance schedules, names, and telephone numbers for local representative for each item of equipment.

4.7 CONSTRUCTION PLAN REQUIREMENTS

Construction Plans are to prepared by licensed Professional Engineer with a valid and current license in the Commonwealth of Kentucky per KRS Chapter 322. Plans shall be submitted per Section 2.