FLOW MONITORING STATION

STANDARDS & SPECIFICATIONS MANUAL

MOORE COUNTY PUBLIC WORKS DEPARTMENT

AMENDED: June 2017

PREFACE

This Manual is for the Moore County Public Utilities and the East Moore Water District water and sewer systems, all of which are operated by the Moore County Public Works Department (MCPW).

These standards are for design and construction of general construction activities related to water mains, wastewater mains, pump stations, force mains, and flow metering stations, which will come under the jurisdiction of Moore County Public Works (MCPW). **These standards alone do not constitute a complete set of construction documents. The owner's or developer's Professional Engineer is responsible for providing plans that encompass all the needs of the project and comply with the standards within this manual.** These standards are set forth as the minimal requirements to achieve a suitable quality level for utilities which will become the property of MCPW.

The standards do not include a complete commentary on methods or installation and detailed information or quality of workmanship in place. The owner's or developer's Professional Engineer must include detailed information on methods of construction and should expand on the testing and any of the special requirements to the engineer's satisfaction, subject to the approval of MCPW.

From time to time, these standards will be amended and/or expanded at the pleasure of the MCPW Engineering Division. It will be the responsibility of the owner or developer to contact the MCPW to obtain updated standards.

There may be circumstances whereby the design engineer may wish to propose changes or modifications to these standards, when this occurs permission from the County Engineer shall be obtained prior to submission to NCDEQ.

Disclaimer

To the best of their ability, the authors have insured that material presented in this manual is accurate and reliable. The design of engineered facilities, however, requires considerable judgment on the part of designer. It is the responsibility of the design professional to insure that techniques utilized are appropriate for a given situation. Therefore, neither Moore County Public Works, nor any author or other individual, group, etc., associated with production of this manual, accepts any responsibility for improper design, any loss, damage, or injury as a result of the use of this manual.

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STANDARD & SPECIFICATIONS MANUAL – FLOW MONITORING STATIONS

1.0 GENERAL

This manual describes two types of Flow Metering Stations, the Parshall Flume and Magnetic Flow-Meter (Mag Meter). The Parshall Flume measures flow in an open channel (gravity flow). Its advantage is its capabilities for self-cleaning, its relatively low head loss and its ability to function over a wide operating range while requiring only a single head measurement. The Mag Meter measures flow in a force main (under pressure).

Sewer Flow Metering Stations shall include a fifteen (15) foot minimum access road easement to the station and a thirty (30) foot minimum turn-around easement at the station that is stabilized with six (6) inches of ABC stone.

2.0 PARSHALL FLUME

A. Design Factors

There are three basic criteria for a Parshall Flume device to function properly:

1. Flow entering the flume must be laminar, non-turbulent and have sub-critical velocity.
2. The flow range of the stream to be measured must fit within the recommended operating range of chosen flume.
3. Water must exit the flume in a free-flow manner. Submerged flow conditions should be avoided whenever possible.

Laminar flow is defined as "regular, continuous, non-turbulent movement in a specific direction". This factor in conjunction with "sub-critical velocity" dictates that inlet slope should be kept to a minimum, and that the approach to the flume should be free from bends, irregularities or obstructions.

Submerged flow occurs when discharge is obstructed and the tail water backs into the throat area to alter the free-flow discharge.

Where the inlet pipe is larger than the flume entrance, a flared transition is recommended. The inlet pipe shall be installed at the floor of the flume.

The exit pipe must be at or below the outlet elevation of the flume. It must also slope away from the flume, and be sized to handle the expected peak flows. Outlet transitions are normally only required to help direct flow into a pipeline where entrance losses can create a problem. This is especially important when peak flows are expected to be more than 75% to 80% of the pipe's capacity and/or the outlet slope is relatively flat. In new construction, the outlet pipeline can often be set 1" to

2 inches lower than the flume outlet, or sometimes a larger diameter pipe can be used to help carry the flow away from the flume.

B. Calculations

The first calculation should be to determine the Flow Rate, existing and/or proposed, from the entrance sewer line, by the Manning Equation.

The second action should be to select the Flume size needed to handle the Flow Rate by the chart below.

PARSHALL FLUME GENERAL FLOW RANGE

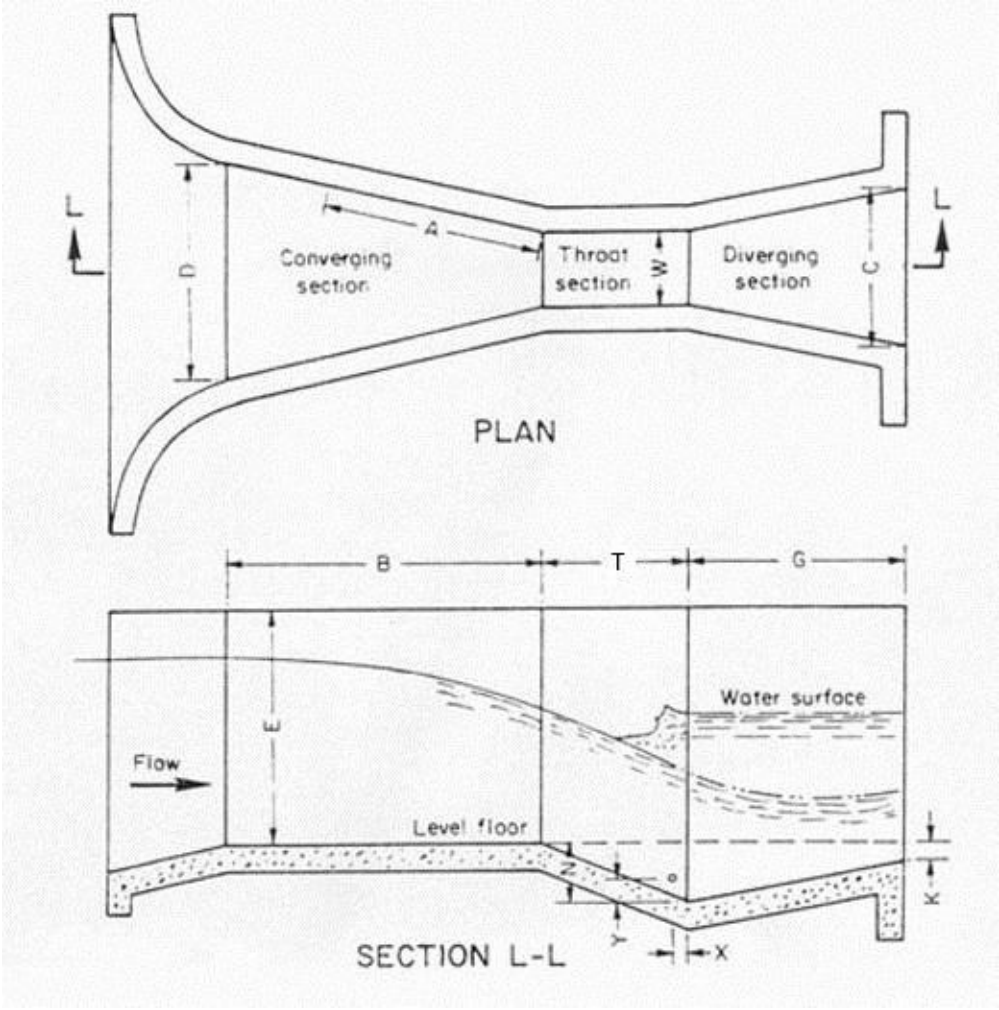
Following is a list of general flow ranges and equations for the most common sizes of Parshall flumes. The actual capability of the flume may reach somewhat higher or lower than listed below.

Conversions		
CFS x 448.8 = GPM	MGD x 694.4 = GPM	MGD x 1.55 = CFS
GPM ÷ 448.8 = CFS	GPM ÷ 694.4 = MGD	CFS x 0.646 = MGD

Throat Size	**Flow Range – GPM**	**Equation** *Q = CFS*	**Min H** (H= Head in Feet)	**Max H** (H= Head in Feet)
1" *	2 – 90	$Q = .338\ H^{1.55}$	0.07	0.3
2" *	5 – 175	$Q = .676\ H^{1.55}$	0.07	0.3
3"	15 – 830	$Q = .992\ H^{1.547}$	0.1	1.5
6"	25 – 1,750	$Q = 2.06\ H^{1.58}$	0.1	1.5
9"	45 – 3,900	$Q = 3.07\ H^{1.53}$	0.1	2
12"	160 – 7,200	$Q = 4.0\ H^{1.522}$	0.1	2.5
18"	230 – 11,000	$Q = 6.0\ H^{1.538}$	0.1	2.5
24"	295 – 14,800	$Q = 8.0\ H^{1.55}$	0.15	2.5
30"	365 – 18,700	$Q = 10.0\ H^{1.559}$	0.15	2.5
36"	435 - 22,600	$Q = 12.0\ H^{1.566}$	0.15	2.5
42"	500 – 26,530	$Q = 14.0\ H^{1.572}$	0.2	2.5
48"	565 – 30,490	$Q = 16.0\ H^{1.578}$	0.2	2.5

*1" & 2" Parshall may clog and are not recommended for sanitary waste.

Next, calculate the size of manhole or vault needed to house the selected Parshall Flume from the dimensions below



W	A	2/3A	B	C	D	E	T	G	H	K	M	N	P	R	X	Y
1"	1' 2-9/32"	9-17/32"	1'-2"	3-21/32"	6-19/32"	6" to 9"	3"	8"	8-1/8"	3/4"		1-1/8"			5/16"	1/2"
2"	1' 4-5/16"	10-7/8"	1' 4"	5-5/16"	8-13/32"	6" to 10"	4-1/2"	10"	10-1/8"	7/8"		1-11/16"			5/8"	1"
3"	1' 6-3/8"	1' 1/4"	1' 6"	7"	10-3/16"	1' to 1' 6"	6"	1'	1' 5/32"	1"		2-1/4"			1"	1-1/2"
6"	2' 7/16"	1' 4-5/16"	2'	1' 3-1/2"	1' 3-5/8"	2'	1'	2'		3"	1'	4-1/2"	2' 11-1/2'	1' 4"	2"	3"
9"	2' 10-5/8"	1' 11-1/8"	2' 10"	1' 3"	1' 10-5/8"	2' 6"	1'	1' 6"		3"	1'	4-1/2"	3' 6-1/2"	1' 4"	2"	3"
1'	4' 6"	3'	4' 4-7/8"	2'	2' 9-1/4"	3'	2'	3'		3"	1' 3"	9"	4' 10-3/4"	1' 8"	2"	3"
1' 6"	4' 9"	3' 2"	4' 7-7/8"	2' 6"	3' 4-3/8'	3'	2'	3'		3"	1' 3"	9"	5' 6"	1' 8"	2"	3"
2'	5'	3' 4"	4' 10-7/8'	3'	3' 11-1/2"	3'	2'	3'		3"	1' 3"	9"	6' 1"	1' 8"	2"	3"
3'	5' 6"	3' 8"	5' 4-3/4'	4'	5' 1-7/8"	3'	2'	3'		3"	1' 3"	9"	7' 3-1/2"	1' 8"	2"	3"
4'	6'	4'	5' 10-5/8"	5'	6' 4-1/4'	3'	2'	3'		3"	1' 6'	9"	8' 10-3/4"	2'	2"	3"
5'	6' 6"	4' 4"	6' 4-1/2"	6'	7' 6-5/8"	3'	2'	3'		3"	1' 6"	9"	10' 1-1/4"	2'	2"	3""
6'	7'	4' 8"	6' 10-3/8"	7'	8' 9"	3'	2'	3'		3"	1' 6"	9"	11' 3-1/2"	2'	2"	3"
7'	7' 6"	5'	7' 4-1/4"	8'	9' 11-3/8"	3'	2'	3'		3"	1' 6"	9"	12' 6"	2'	2"	3"
8'	8'	5' 4"	7' 10-1/8"	9'	11' 1-3/4"	3'	2'	3'		3"	1' 6"	9"	13' 8-1/4"	2'	2"	3"
10'		6'	14'	12'	15' 7-1/4"	4'	3'	6'		6"		1' 1-1/2"			1'	9"
12'		6' 8"	16'	14' 8"	18' 4-3/4"	5'	3'	8'		6"		1' 1-1/2"			1'	9"
15'		7' 8"	25'	18' 4"	25'	6'	4'	10'		9"		1' 6"			1'	9"
20'		9' 4"	25'	24'	30'	7'	6'	12'		1'		2' 3"			1'	9"
25'		11'	25'	29' 4"	35'	7'	6'	13'		1'		2' 3'			1'	9"
30'		12' 8"	26'	34' 8"	40' 4-3/4"	7'	6'	14'		1'		2' 3'			1'	9"
40'		16'	27'	45' 4"	50' 9-1/2"	7'	6'	16'		1'		2' 3"			1'	9"
50'		19' 4"	27'	56' 8"	60' 9-1/2"	7'	6'	20'		1'		2' 3"			1'	9"

C. Parshall Flume Description

Parshall Flume shall have a throat width as shown above. The flume shall have end couplings sized to mate with the outside diameters of incoming and outgoing pipe.

Two neoprene boots with stainless steel clamps sized to connect inlet and outlet pipes to the flume adapter shall be supplied by the manhole or vault manufacturer and the manhole or vault will be equipped with down brackets for anchoring the unit to a reinforced concrete slab. A ½ inch thick expanded polystyrene bead board will be supplied for placement on the concrete slab.

The flume inside surface shall be smooth and white with aisophthalic gelcoat of 10 to 20 mil thickness. Flume shall be constructed of orthophthalic polyester resin reinforced with fiberglass. The minimum glass content shall be 30 percent exclusive of gelcoat surfaces. Nominal wall thickness shall be a minimum of ¼". The interior dimensions of the flume shall conform to that shown above. The flume shall be furnished with an adjustable stainless steel ultrasonic mounting bracket to accept the ultrasonic sensor. (See Std. No. FMS-2)

D. Flume Flusher

A flume flusher shall be installed in all new installations where an ultrasonic sensor will be the means of flow measurement. It should be located prior to the ultrasonic sensor to prevent buildup of solids and/or trash. (See Std. No. FMS-3)

1. Dual Control Timer: The timer must be a 1/16 DIN style timer which can be panel mounted or plug-in using an 8-pin octal mounting socket with timing ranges from 1 second to 30 hours and include universal voltage operation (20 to 240VAC 50/60 Hz and 12-240VDC).
    - On Delay / Interval
    - 12 Timing Ranges
    - Universal Supply Voltage
    - Compact Size
    - IP 40 Rated Front
    - LED Power On, Relay On
2. Timer Enclosure: Nema 4X
3. Ball Valves: Stainless Steel with Threaded Ends
4. Fittings: Stainless Steel with Threaded Ends
5. Solenoid Valve: U. S. Solid Normally Closed Electric Solenoid Valve with 3/4" threaded connections and stainless steel body
    - Viton seal
    - 12 volt DC, voltage range + or – 10%
    - 18 Watt power rating
    - Semi-direct lift valve operates from 0 to a maximum pressure of 145 PSI
    - Permits a unidirectional flow capacity of 4.8 gallons per minute of water at 60 degrees Fahrenheit with a pressure drop of 1 PSI
    - Operational temperature range is 14 to 248 degrees Fahrenheit
    - Suitable for outdoor use

- Suitable for use with hot or cold water

6. Nozzle: Stainless Steel Flat Spray Nozzle. Provides a specific low-volume water flow pattern for dampening or watering wide areas. Ideal for wetting agent applications and infield conditioning. Allows spot control for treating drought stress. 1 inch NPSH female inlet. USA made.
7. Water Line: ¾ inch PVC
8. Electrical Junction Box: Must meet Building Code
9. Electrical Wiring: Must meet Building Code
10. Conduit: 1 inch PVC

3.0 MAGNETIC FLOW METER (MAG METER)

A. Principle Of Operation

A Mag Meter is a volumetric flow meter which does not have any moving parts and is ideal for wastewater applications. They are ideal for applications where low pressure drop, low flow and low maintenance are required. The Mag Meter is sized based on the Operating Characteristics as shown in the table below.

Meter Size (Inches)	Low Flow (>95%) (GPM)	Operating Range (+ 1.5%) (GPM)	Intermittent Flows (+ 1.5%) (GPM)
1-1/2	0.3	0.7 - 180	25% Over Speed Capability
2	0.4	1.2 - 320	25% Over Speed Capability
3	0.7	2.8 - 720	25% Over Speed Capability
4	1.3	5 - 1,250	25% Over Speed Capability
6	3	11 - 2,850	25% Over Speed Capability
8	6	20 - 5,100	25% Over Speed Capability
10	9	31 - 8,000	25% Over Speed Capability
12	12	45 - 11,500	25% Over Speed Capability
14	49	182 - 15,700	25% Over Speed Capability
16	65	237 - 20,500	25% Over Speed Capability
18	82	300 - 26,000	25% Over Speed Capability
20	101	370 - 32,100	25% Over Speed Capability
24	105	385 - 33,400	25% Over Speed Capability

Mag Meters shall be installed within the pipe line where potable or wastewater flow rates need to be measured. (See Std. No FMS 1)

B. Installation

Select a location for the sensor where the flow profile is fully developed and not affected by any disturbances. A minimum of 10 pipe diameters of straight run upstream and 5 pipe diameters downstream is recommended. Some situations may

require 20 pipe diameters or more upstream to insure a fully developed non- turbulent flow profile. The Mag Meter is sensitive to air bubbles at the electrodes. If there is any question that the pipe is absolutely full, mount the sensor at 45º to 135 º angles. For best Mag Meter performance ground the unit to compensate for the static electricity in plastic pipe.

C. Metering Station

Each metering station shall be a minimum of 60 inches, reinforced concrete or a completely integral unit consisting of a 60 inch corrosive resistant fiberglass reinforced plastic manhole with sealed fiberglass bottom. The unit shall contain an access ladder and internal and/or external instrument appurtenances as required. (See STD No. FMS-1)

4.0 ACCESSORIES

A. Ultrasonic Sensor - For Parshall Flume

The sensor shall consist of a single ultrasonic transducer housed in a rugged, watertight, dust-tight, submersible, corrosion resistant NEMA 4X enclosure. The sensor shall include a temperature probe to automatically compensate for air temperature changes. The sensor shall automatically adjust its gain in response to echo strength to maximize performance in the presence of stream, foam and turbulence. A setup feature shall aid in aligning the sensor by allowing the user to maximize the return echo. The sensor shall include variable blanking distance to ignore echoes from within a programmable distance from the sensor. The sensor shall be placed over the level floor (Converging Section) two-thirds (2/3) back from the Throat Section. The unit shall be Teledyne ISCO, Inc., HACH or approved equal and should be a flow measuring device only and not a multi-meter.

The parshall flume should have a hard mounted stainless steel measuring device (ruler) installed at the same approximate location of the sonic detector for instantaneous flow measurement and a quick check of meter accuracy.

B. Flow Meter

Measured liquid level readings shall be converted into corresponding flow rate readings using internal conversion algorithms.

The flow transmitter shall include a relay for signaling a connected automatic sensor.

The flow transmitter shall be housed in a rugged, lockable, heated, watertight, dust-tight, corrosive resistant NEMA 4X enclosure suitable for conduit connections. The enclosure shall include a wall mounting bracket and a clear polycarbonate window for viewing the LCD and totalizer without opening the enclosure. The unit shall be Krohne or approved equal.

C. Messenger

A Messenger is an integrated monitoring, telemetry and alarm notification system designed to work seamlessly with electronic controller (Flow Transmitter). It sends the programmed information to the internet-based systems base at designated time. It is housed in a Deutsch waterproof enclosure and is connected to the Flow Transmitter through a single Deutsch wiring harness. Moore County has standardized on Antx, Inc., Model SAEJ 1939 with 3G Capacity.

D. Rain Hood

A stainless steel rain hood shall be suitable in all respects for housing the flow metering equipment. The shelter shall be equipped with a four (4) foot, florescent light with a rugged, watertight, dust-tight cover and GFCI receptacle. (See Std. No. FMS 4)

E. Yard Hydrant

Yard hydrant shall be located near the flow meter vault for the purpose of cleaning the flume, vault, concrete surface area, etc. The water line supply shall consist of a one (1) inch service, with an approved RPZ type backflow preventer installed above ground. An insulated and heated enclosure shall be provided to protect the RPZ from freezing. (See Std. No FMS 6 & 7)

5.0 CONSTRUCTION

A. General

Flow metering station equipment shall be provided by a single supplier, to the extent possible. The supplier(s) shall assume complete responsibility for proper operation of the equipment, including that of coordination of all signals and furnishing all appurtenant equipment.

The contractor shall verify and coordinate process equipment power supply and voltage, compatibility of control signals, details of equipment installation and interconnection. Coordination shall include distribution of approved shop drawings to all vendors, subcontractors, etc., involved in the control interface.

B. Electrical

1. All wiring and electrical equipment shall conform to all applicable sections of the National Electrical Code's latest edition (NEC), and local electrical codes.
2. All electrical fixtures are to be explosive proof and located in serviceable locations. Interior electrical conduit shall be plastic coated rigid metal or approved PVC conduit. All conduits shall be non-corrosive.
3. Unless otherwise specified, all control circuits and instruments shall be provided for operation from a normal 115V, 60 Hz power source.
4. Unless otherwise specified, instruments shall be solid-state, electronic, using enclosures to suit conditions.
5. Surge protection for all 115V power inputs and all 4-20 MADC output signals shall be provided.

6. Where elements and transmitters are required, they shall be fully matched and special cables or equipment shall be supplied by the manufacturer. Wiring between sensor and transmitter shall be installed and connections made by the instrumentation supplier.

C. Handling

Special care shall be observed during delivery, distribution and storage of the materials to prevent damage. Storage of instrumentation and control equipment, prior to use, shall be in accordance with the following requirements:

Equipment shall be stored in a waterproof building away from any exposure to adverse weather conditions or corrosive gases or liquids. The place of storage should be enclosed, preferably with temperature and humidity controlled atmosphere allowing no possibility of condensation action occurring.

D. Security

The following security measures will be required.

1. **Access to Metering Station** structures/equipment/appurtenances shall be restricted by fence of six (6) feet in height and of sufficient material to deter entry. A minimum of 12 feet wide lockable gate shall be provided to allow vehicular access, if required by the Engineer.
2. **Identification Sign** shall be posted, with the name, emergency number, station address and instructions to call in the event of an alarm condition or other emergency. (See Std. No FMS 6)
3. **Safety Placards** as required by OSHA, shall be provided and be readily visible. (See Std. No FMS 5)

E. As-Built Drawings

As-built drawings for record purposes shall be provided showing electrical controls with wiring and manhole structure detail with Parshall Flume. The diagrams shall be color coded showing connections from numbered terminal blocks to external equipment. Unless otherwise shown or specified, all equipment shall be installed in accordance with the manufacturer's drawings and instructions.

F. Field Testing

All equipment shall be factory field tested and calibrated to demonstrate that it provides the specified functions. Such services shall be provided through the successful installation and operation of all instruments and controls as approved by the Engineer. A calibration letter shall be provided upon completion.

G. Spare Parts

The Contractor shall furnish all required special tools and all spare parts recommended by the manufacturer of each piece of equipment. The Contractor shall

also furnish three (3) copies of the Operation and Maintenance Manual for each piece of equipment installed.

6.0 POST-CONSTRUCTION AND OWNERSHIP

If the County is collecting wastewater from others, the supplying organization shall design and construct a Flow Monitoring Station per the Moore County Specifications. The station should not be activated until there is enough flow entering the unit to for the station to provide accurate measurements. The station shall be warranted by the supplying organization **once the station has been activated** for two (2) years before the County will accept ownership. The County will operate and maintain the unit.

If at any time during the two (2) year warranty the unit needs upsizing for additional flows, the supplying organization shall design and construct the upsizing and provide an additional one (1) year warranty consecutively with the two (2) year warranty.