January 2015

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Introduction

Energy Systems Group (ESG) was selected by City of Cleveland Heights in September, 2014 to perform a detailed engineering evaluation of the water utility. The intent of this evaluation is to reduce non-revenue water loss and develop a program that allows the utility to be financially sustainable. Areas of the evaluation focus in three areas:

1. Metering
2. Billing anomalies
3. Real losses, or leaks in underground pipes

The financial goal of the project is for the energy and operational savings, avoided future costs and increased revenues identified to produce a positive annual cash flow greater than $250,000 against the costs associated with the design, installation, commissioning, measurement and verification and financing of the scope described below and including all other annual operating costs incurred and paid for within the water utility fund.

The project ESG has developed will exceed the requirements outlined in the Project Development Agreement. It is anticipated that this project will be implemented under a guaranteed savings contract.

Summary of Existing Conditions

Project Area - The project area, predominately the City of Cleveland Heights, was reported to contain 170 miles of water distribution piping. There is no geographic information system (GIS), hydraulic model or detailed analysis of pipeline lengths available so this amount may vary upon final engineered analysis. There are an estimated 15,900 accounts within the city's service area.

Water Resources - All water is supplied by the City of Cleveland's Water Department. There are reportedly 21 operational import meters at various locations around the City of Cleveland Heights.

Transmission and Distribution System- There is no transmission piping known within the City's system other than those owned and operated by the Cleveland Water Department (CWD) to provide water to the City and to those communities around the City.

Most of the large distribution pipe is reported to be 6 or 8-inches whereas the service pipe is 1- to 4-inches in diameter. The distribution system is reported to be totally open (no boundary valves) except on the edges of the City's system with the surrounding communities.

There are no elevated or ground storage tanks within the City. All the water is fed directly from the pressure supplied by CWD. There is no SCADA control system for the water utility.

Current Water Supply Situation – Import and Export (Credit) Meters. The current import meters were tested in June and July 2014 by CWD at high flows. The data reported suggested that all import meters were reading accurately at high flow. However, the meters were not tested at low flows, so the overall average accuracy is unknown. All the export meters were tested at the same time. However, these were not tested at low flows either and since these are generally within low flow areas of the system, the accuracy of these meters is an area for improvement.

Retail Meters and Meter Reading Information- Currently the average bills for the residential customers are reportedly approximately 6 hundred cubic feet (CCF) usage per month. All the meters are currently on an AMR system (Badger meters with either the "Trace" or "Orion" reading systems). The City did not conduct meter testing prior to the initial evaluation by ESG. Almost all the meters were reportedly installed in 1993 and 1994 (both large and small).

GIS -There are no levels of electronic mapping currently available from the City. Printed map books are utilized. The accuracy of these maps is not well understood.

Pressure Zones - The system is currently completely open within the City's area. The boundaries to the system are reportedly closed.

Metering

The City of Cleveland Heights has water meters manufactured by Badger Water Meter Company. The water meters were installed in 1994 resulting in an average age of 20 years. These devices are positive displace measurement using a nutating disk. This is an appropriate type of the meter for this application. All of the meters have radio transmitters on them and are read using a drive by system. Approximately thirty percent are Orion transmitters and the rest are an older vintage Trace system. The existing meter reading system is adequate and there were no reported transmitters there unable to be read. Badger meters is a quality product and there is no compelling reason to switch to another brand.

ESG sampled water meters for accuracy. 57 5/8" residential water meters were removed and sent to ME Simpson testing lab in Valparaiso, Indiana. Each meter was put on a calibrated test bench and a volume of water was sent through each unit at different rates to establish the accuracy a low, medium and high flows. The results of the meter test are in Section 7. All residential meters tested within American Water Works Association (AWWA) recommendations; greater than 98.5% accuracy.

The chart below is a breakdown of the meter sizes and billed consumption.

Meter Replacement	Number of Water Meters Affected	Total Annual Gallons (Baseline period) 12-1-13 to 11-30-14
5/8-inch	14425	763,788,784
3/4-inch	99	7,479,252
1-inch	925	95,651,248
1.5-inch	188	66,180,048
2-inch	238	132,081,840
3-inch	20	9,893,048
4-inch	12	29,347,780
6-inch	8	16,225,616
8-inch	10	5,422,252
Total		1,126,069,868

The average age of the commercial meters are at least 20 years and many are older. Exact dates of installation are unknown. Thirty commercial meters were tested in-situ using a calibrated meter to compare volume of water passed through the device. The meters were selected based on being the largest volume consumers in the City. In general the meters were found to be in poor condition and not accurate. Most importantly all of the meters in the City are turbine meters and do not have good accuracy at low flow rate. The expected technology for this application is a compound meter. The benefit of the compound meter set is that two flow meters housed in one body allow for very accurate measurement at low and high flows. It is unusual for there to be no compound meters. Table below illustrated the difference.

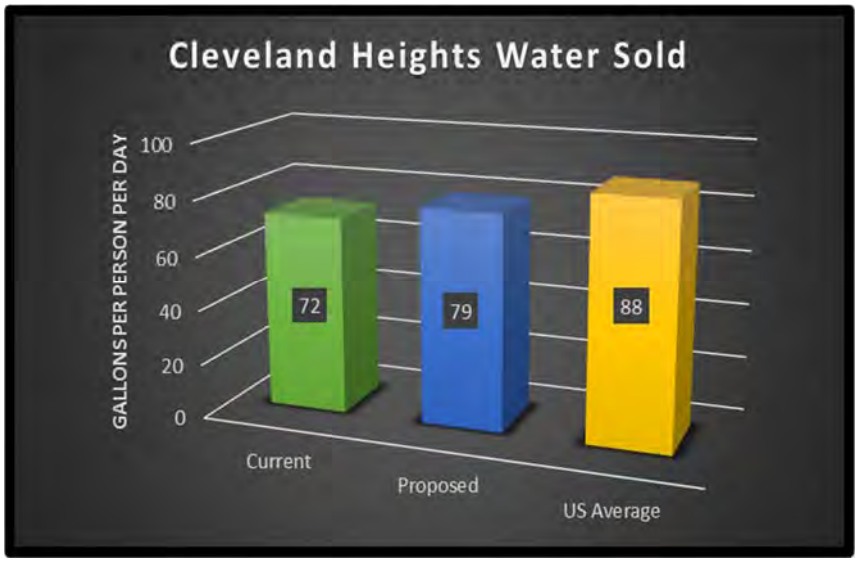
Meter Size	Low Flow Turbine (gpm)	Low Flow Compound (gpm)	Current Weighted Average Accuracy
2″	2.5	0.5	98.5%
3″	4	0.5	38.6%
4″	6	0.75	71.9%
6″	12	0.75	78.5%

Gpm – gallons per minute

Because of the inaccuracy and meter type there is a significant volume of water that is not being read by the meter.

Considering all of the water metered and sold and comparing to national average we conclude that Cleveland Heights is not far off from expected values as shown in the figure right.

Current sold water is less than expected because not all of the water consumed is being metered and billed. After replacing the commercial meters and lowering other apparent water losses these values will be very close to equal.

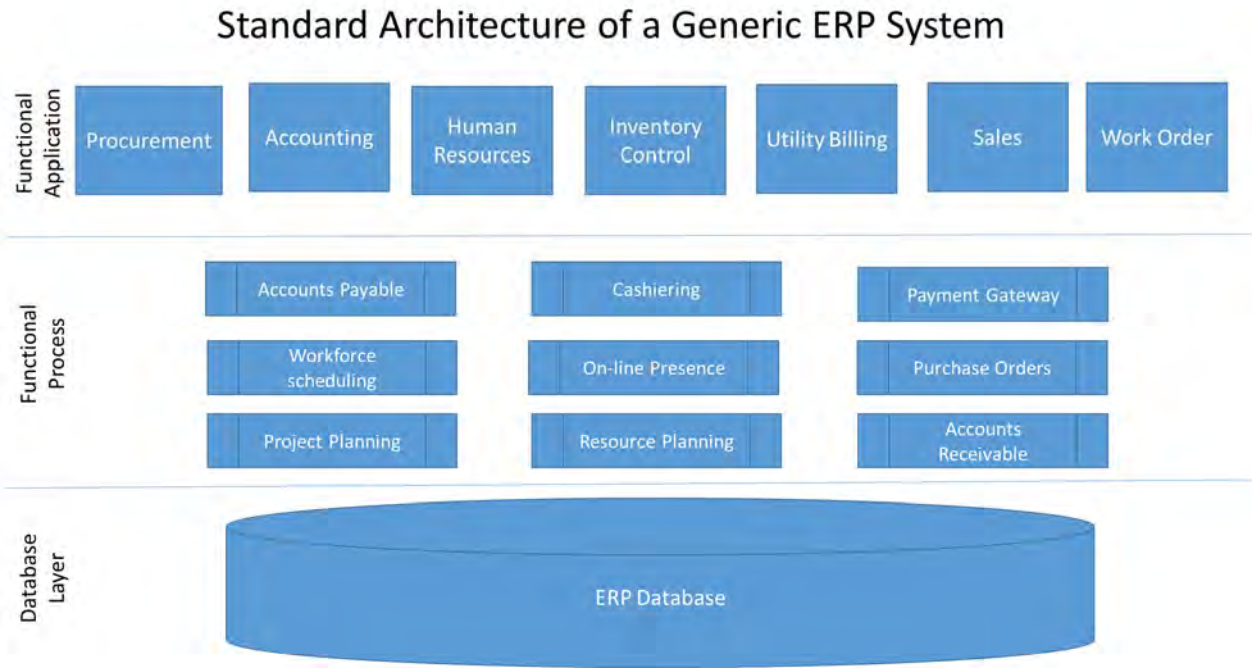


***Recommendation**: Replace all water meters 1" and larger. Replace all transmitters with fixed mast system to provide daily read capability and full Automated Metering Infrastructure (AMI).*

Billing and Accounting Procedures

The billing software system is a customer built IBM array based platform over 20-years old. While it is functional there are extra steps required to produce bills and because of the difficulty in accessing the data it is nearly impossible to cross check against other data bases. The benefit of cross checking is to verify integrity of the billing data base against other known and trusted sources.

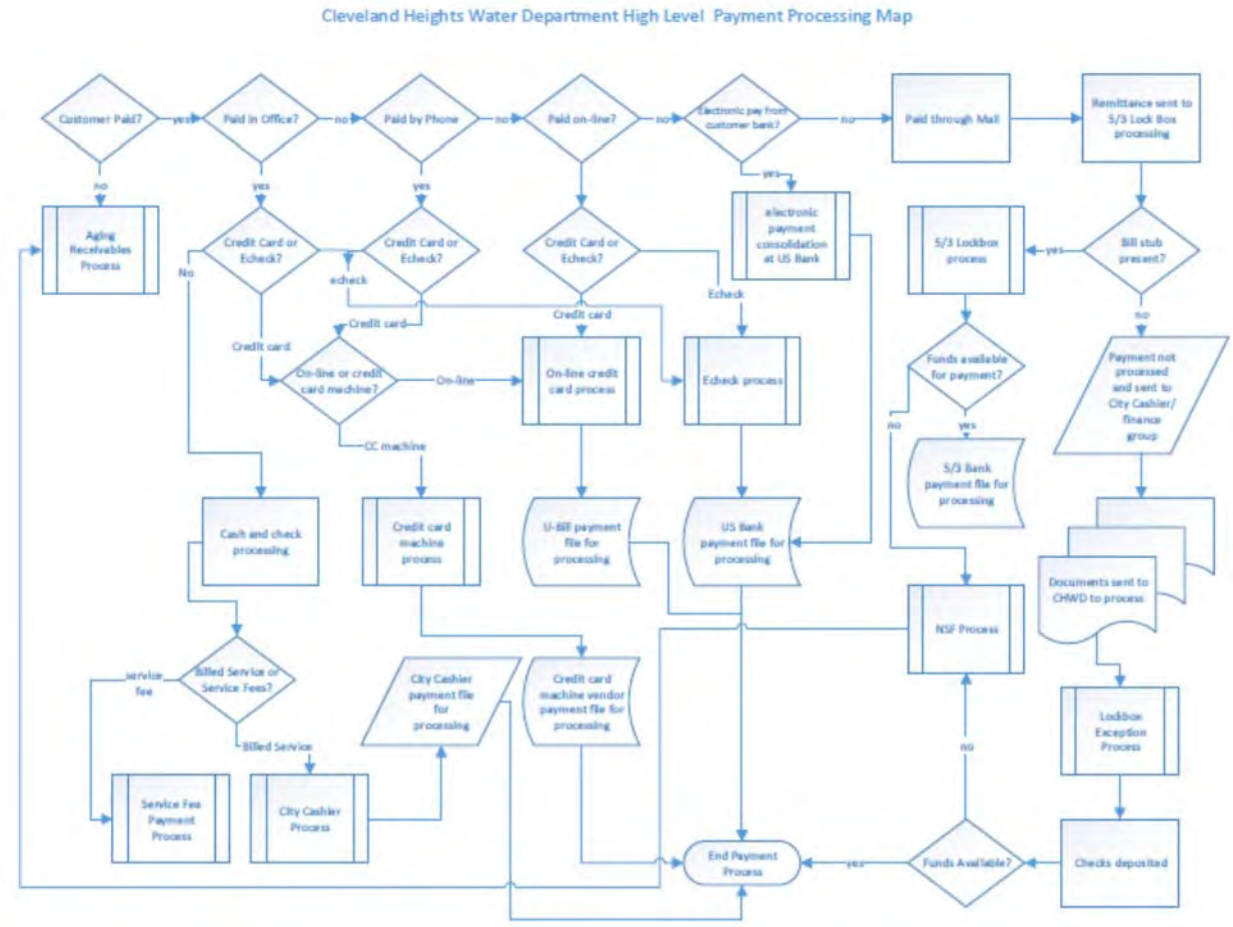
In the near future ESG recommends replacing the existing billing software with a modern system. There will be many benefits and cost efficiencies that will be realized with this upgrade. ESG evaluated five (5) software vendors: Cognera, Advanced Utility Systems, Tyler Munis, New World, and BS&A. The table provides a summary of each supplier's capabilities.



Comparison of Functionality In Vendor Solution					
	Cognera	Advanced Utility Systems	Tyler Munis	New World	BS&A
Billing	A	A	A	A	A
Bill Presentment	A	A	A	‡	A
Service Order	B	A	A	A	A
Work Order	B	A	±	±	±
Field Tablet	B	A	A	A	±
GIS	B	A	±	±	A
Web Presence	A	A	A	A	A
Pay Processing	A	A	A	‡	A
Interval Data Storage	A	A	F/U	B	B
Workflow & Escalation	B	A	A	B	A
IVR	B	A	A	±	±
OB Call	B	A	‡	±	B
Analytics & Reporting	A	A	A	A	A
Meter Inventory	B	A	A	A	A
Correspondence	A	A	‡	A	A

	A	Indicates functionality exists in core solution or in additional module Included in vendor quote
	B	Indicates functionality does not exist in core solution nor in any additional module available from vendor
	±	Indicates functionality exists in additional module from vendor that was not included in quote
	‡	Indicates base functionality exists in core solution but enhanced functionality is available in additional module not included in quote
	F/U	Items marked for follow-up from vendor. Vendor needed to investigate further after initial conversation

The schematic below is an overview of how Cleveland Heights currently manages the billing for water.



ESG believes this could be simplified with a new software system and reduce the number of steps to produce and mail monthly water bills.

Recommendation: Due to cost constraint and lengthy payback this option is not included in the recommended program but it is identified as a high priority item and should be addressed in the near future.

During the evaluation several errors in master meter reads were discovered. Error are in three categories:

1. Dropped zero – some of the meter were incorrectly setup when the encoders were replaced in 2008 and therefore the transmitter was sending a value that was off from the actual reading.

2. Several of the meters are dual meters in the same vault. One meter is an import meter and one is an export. In two cases theses were reversed and incorrect values applied to the bills.

3. Several of the export, or credit, meters have never been applied to the wholesale water bill.

The data for these errors goes back to 2008 and revised values have been provided by CWD to reconcile the accounts. ESG has evaluated the CWD information and while the accounting is essentially correct with respect to the recorded data we believe there are questions remaining on the validity of the recorded data and under recording of volumes on the export meters that could further reduce the total value owed to CWD.

The table below illustrates the changes.

Meter Ending	Name	Change in Condition	Multiplier Error	Notes
780	Noble	export	n/a	Never shown on CWD bill
764	Carlton	import	n/a	Changed from export to import meter
783	Qulliams	import	X10	Changed from export to import meter
727	Northvale	export	n/a	Never shown on CWD bill
787	Murray hill/cedar	n/a	X10	Dropped zero
760	Carlton	export	n/a	Changed from import to export
721	Quarry and Bluestone	n/a	X100	Dropped two zeros
762	Renfield & Bluestone	n/a	X100	Dropped two zeros
774	Lancashire	n/a	X10	Dropped zero
782	Qulliams	export	n/a	Changed from import to export

The magnitude of the errors vary with annual flows through each meter. ESG projected for 2014 what the annual consumption and costs for water would have been using the corrected values from above. This analysis is shown in the following page. The net effect of all of these changes is an estimate increased in water consumption of 32,975 mcf (thousand cubic feet) and a corresponding annual cost increase of $1,150,081. This equal to an 8.5% increase in wholesale water purchases.

The average rate charged by CWD for wholesale water was 31.5 $/Mcf in 2013 and 32.5 $/Mcg in 2014. The value is expected to increase annually.

City of Cleveland Heights

Revised baseline with meter multiplier error correction and estimated value for future consumption

Results	Baseline	Revised	Delta
Mcf	388,101	421,076	32,975
Costs	$12,745,414	$13,895,495	$1,150,081

ESG ENERGY SYSTEMS GROUP — Building Performance with Energy

CURRENT BASELINE

	Read Date	Due Date	774	752	780	767	235	766	772	764	782	773	771	769	783	112	765	753	758	727	787	234	721	760	761	779	498	763	781	762	756	232	Total	Dollars
Dec-13	Jan-13	Jan-14	0	3743		0	2510	43	4604	-15	0	13	1597	234	-110	219	6686	866	198		3	1384	4	0	2372	995	0	0		1	3615		28,962	$ 913,205.00
Jan-14	Jan-14	Jan-14	0	4284		0	4139	41	5145	-15	0	21	2207	417	-125	268	8513	1239	227		4	3404	5	0	2700	1058	0	0		2	3951		37,485	$ 1,219,407.00
Feb-14	Feb-14	Mar-13	0	4096		0	2630	55	4730	-10	0	33	1389	264	-103	252	7811	837	239		13	2636	4	0	2565	996	0	0		1	3700		32,138	$ 1,046,351.00
Mar-14	Mar-14	Apr-14	0	4441		0	3615	58	5160	-17	0	50	1920	300	-112	301	8438	1167	240		15	2908	4	0	2787	1116	0	0		2	4000		36,393	$ 1,184,766.00
Apr-14	Apr-14	May-14	0	3865		0	3236	199	4741	-131	0	44	1670	278	-104	262	7590	1060	203		4	3862	5	0	2447	998	0	0		1	3789		34,019	$ 1,107,540.00
May-14	May-14	Jun-14	0	3046		0	2335	180	5564	-143	5	29	1263	282	-115	231	5635	949	166		1	2829	4	1	1981	832	0	0		2	5100		30,177	$ 982,560.00
Jun-14	Jun-14	Jan-00	451	3161		0	2841	181	5049	-131	0	26	1551	276	-104	265	7010	990	173		1	3157	5	0	2058	947	0	0		1	5100		33,008	$ 1,055,719.00
Jul-14	Jul-14	Aug-14	142	3329		0	3029	190	4649	-153	-14	18	1721	201	-90	212	7571	999	191		1	2993	5	0	2155	879	0	0		2	3909		31,939	$ 1,040,788.00
Aug-14	Aug-14	Sep-14	136	2933		0	2750	197	4301	-159	0	15	1597	184	-85	130	6959	936	164		2	2541	4	0	1915	796	0	185		2	3649		29,152	$ 949,216.36
Sep-14	Sep-14	Oct-14	1510	3357	0	61	2824	182	4028	-167	-0.3	17	1740	225	-841.6	151	7823	1004	196	-683	5	2987	510.7	0.1	2178	914	0	72	0	181	3434	-118	31,590	$ 1,094,134.26
Oct-14	Oct-14	Nov-14	1412	2897.3	0	0	1832	158	4560.6	-41.2	-0.6	12.2	1551.2	193	-936.6	141	7057	900	161.2	-453	26.5	2617	544.7	0.4	1912.1	599.5	0	48	0	196	4012.2	-118	29,283	$ 1,017,096.75
Nov-14	Dec-14	Dec-14	1627	3849.3	-0.8	0	3140	80.2	4141.1	-23.4	0	13.3	1848.9	251.8	-1287.7	164	9481.2	1186.1	232.6	-979.9	52.3	2456	588.5	10.1	2471.8	420.7	0	1	852.7	211.7	3299.9	-133.2	33,955	$ 1,134,630.86
																																Total	388,101	$ 12,745,414.23

PROPOSED BASELINE

			Lancashire x10	Mayfield & Warren South	Noble Export	Murray Hill - fire line	North woodland	Murryl Hill - Wall	Mayfield & Taylor East	carlton (x1)	quilliams Credit	Keystone & Bluestone	Fairhill & North park	Grosvenor	Quilliams Import x10	NorthPark & Lee	Cedar & Goodnor	Fairhill & NorthPark	Warrensville & Oakwood	Northvale	Murray hill/cedar x10	Fairmont & Eaton	quarry & Bluestone x100	carlton exporrt	Mayfield & Warrensville	Brookline & rugby		Murray Hill North	Supperior Export	Remfiled & Bluestone x100	Mayfield & Taylor	Owls Nest		
	Read Date	Due Date	774	752	780	767	235	766	772	764	782	773	771	769	783	112	765	753	758	727	787	234	721	760	761	779	498	763	781	762	756	232	Total	Dollars
Dec-13	Jan-13	Jan-14	*1500*	3743	0	0	2510	43	4604	15	0	13	1597	234	1100	219	6686	866	198	*-500*	30	1384	400	0	2372	995	0	0	0	100	3615	*-90*	31,724	$1,046,892
Jan-14	Jan-14	Jan-14	*1500*	4284	0	0	4139	41	5145	15	0	21	2207	417	1250	268	8513	1239	227	*-500*	40	3404	500	0	2700	1058	0	0	0	200	3951	*-90*	40,619	$1,340,427
Feb-14	Feb-14	Mar-13	*1500*	4096	0	0	2630	55	4730	10	0	33	1389	264	1030	252	7811	837	239	*-500*	130	2636	400	0	2565	996	0	0	0	100	3700	*-90*	34,903	$1,151,799
Mar-14	Mar-14	Apr-14	*1500*	4441	0	0	3615	58	5160	17	0	50	1920	300	1120	301	8438	1167	240	*-500*	150	2908	400	0	2787	1116	0	0	0	200	4000	*-90*	39,388	$1,299,804
Apr-14	Apr-14	May-14	*1500*	3865	0	0	3236	199	4741	131	0	44	1670	278	1040	262	7590	1060	203	*-500*	40	3862	500	0	2447	998	0	0	0	100	3789	*-90*	37,055	$1,222,815
May-14	May-14	Jun-14	*1500*	3046	0	0	2335	180	5564	143	5	29	1263	282	1150	231	5635	949	166	*-500*	10	2829	400	-1	1981	832	0	0	0	200	5100	*-90*	33,329	$1,099,857
Jun-14	Jun-14	Jan-00	*1500*	3161	0	0	2841	181	5049	131	0	26	1551	276	1040	265	7010	990	173	*-500*	10	3157	500	0	2058	947	0	0	0	100	5100	*-90*	35,566	$1,173,678
Jul-14	Jul-14	Aug-14	*1500*	3329	0	0	3029	190	4649	153	-14	18	1721	201	900	212	7571	999	191	*-500*	10	2993	500	0	2155	879	0	0	0	200	3909	*-90*	34,795	$1,148,235
Aug-14	Aug-14	Sep-14	*1500*	2933	0	0	2750	197	4301	159	0	15	1597	184	850	130	6959	936	164	*-500*	20	2541	400	0	1915	796	0	185	0	200	3649	*-90*	31,881	$1,052,073
Sep-14	Sep-14	Oct-14	1510	3357	0	61	2824	182	4028	167	-0 3	17	1740	225	841.6	151	7823	1004	196	-683	50	2987	511	-0.1	2178	914	0	72	0	181	3434	-118	33,770	$1,114,407
Oct-14	Oct-14	Nov-14	1412	2897	0	0	1832	158	4561	41	-1	12	1551	193	937	141	7057	900	161	-453	27	2617	545	-0.4	1912	600	0	48	0	196	4012	-118	31,355	$1,034,725
Nov-14	Dec-14	Dec-14	1627	3849	-0.8	0	3140	80	4141	23	0	13	1849	252	1288	164	9481	1186	233	-980	52	2456	589	-10 1	2472	421	0	1	853	212	3300	-133	36,690	$1,210,783
																																	421,076	$13,895,495
Annual Increase			12771	0	0	0	0	0	0	2011.2	0	0	0	0	16560	0	0	0	0	-4500	441	0	3960	-23.2	0	0	0	0	0	1386	0	-810		

Delta	32,975	$1,150,081

8.50% increase

Notes:

1. cells in yellow are estimated
2. cells in green indicate a change
3. Lancashire x10 and estimated for flows using average of 1500 Mcf per month
4. Carlton meter #764 converted from export meter to import
5. Quilliams meter #783 converted to import and x10
6. Renfield & Bluestone x100
7. Quarry & Bluestone x100
8. Murray Hill meter #787 x10
9. Northvale meter #727 estimated to be 500 Mcf credit per month
10. owlsnest three year annual average is 1000 MCf therefore 90 mcf/month estimated
11. Carlton meter #760 converted to export

Import	3149.645 MG/yr
Export	-52.096 MG/yr

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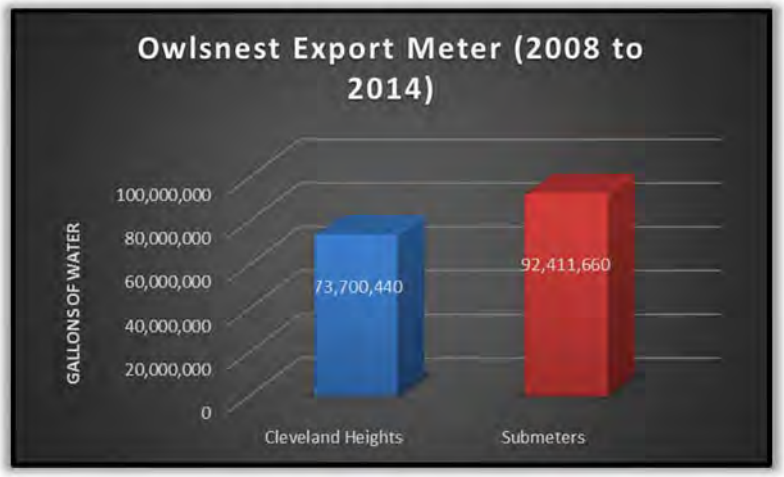
Another source of error that has not been fully accounted for is the export meters. Similar to the commercial meter issue these export meters should be compound meters as well. ESG believes that the export meters are under reporting flow and therefore Cleveland Heights is missing revenue they should be receiving.



One data point to consider it's the Owls Nest meter. The City was able to obtain sub-metered billing data for the nine water meters downstream of the export meter. Over the last seven years the export meter has under reported over 18 million gallons representing $76,974 in lost revenue. This revenue is reported as deduct or credit on the CWD monthly bill. If the 6 $/Mcf wheeling fee is added that CWD pays the city of Cleveland Water for all exported water then this value is $91,819. The graph to the right shows the differences in metered water.

ESG recommends that all of the export meters that are owned by Cleveland Heights be replaced with compound meters as soon as possible.

ESG believes that there is further apparent water losses in the billing system. There are currently over 1,100 zero read accounts within the billing system. While a number of these are certainly vacant or abandoned building further investigation is justified to verify each one has zero consumption.

Other potential sources of apparent water losses that require further investigation are systematic data handling errors which are defined as accounting omission, errant computer programming, gaps in policy, procedure, and new account activation; and any data lapse that results in under-stated customer water consumption in billing reports. Based upon the AWWA audit, review of current produces and policies and comparison to other utilities of similar sized, ESG estimated that there are 215 million gallons per year in total losses associated with this category of loss. Apparent losses are valued at 9.38 dollars per thousand gallons of water which is twice the wholesale rate for real losses making this category the most valuable.

Recommendation: Further billing anomaly analysis to reduce apparent losses in revenue. Replace all export / credit meters with new compound water meters.

Real Losses

Based on the AWWA water audit tool approximately 61% of the water Cleveland Heights purchases is never billed. The largest contributor is real losses in the system. Real losses comprise loss of water from transmission mains, storage facilities, distribution mains or service connections. ESG believe this value to be approximately 1.6 billion gallons per year.

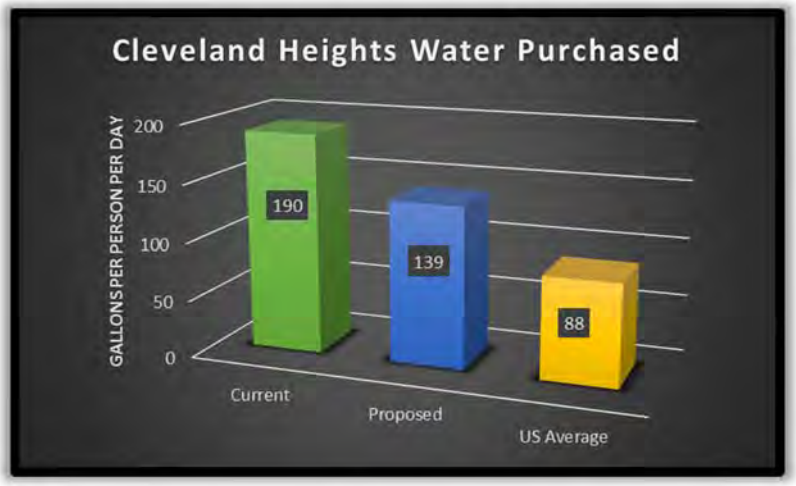
There are two contributing factors in this situation. First, the distribution piping is uncontrolled and receives whatever pressure is sent from CWD. Due to topography of the City the western half is at a lower elevation than the eastern half and water pressure rises as you approach the boundary. A pressure map is shown in Section 5. Readings were taken at two months apart and did not vary appreciably. The eastern boundary average pressure is 75 psig (pounds per square inch) and on the western boundary the pressure was as found as high as 140 psig. Normal service water requirements is 60 to 70 psig for most customers.

The consequences to high pressure is increased losses from leaks. The volume of water loss is directly proportional to the pressure therefore areas of 140 psig have twice the leakage rates of an area with 70 psig. ESG recommends installing pressure reducing valves in key areas to reduce average water pressure. The exact determination of locations will require further engineering and analysis of hydraulics within the distribution system.

The second contributing factor is age of the system. Most of the piping is over 40 years old. There is no existing condition assessment or prioritized capital improvement program to replace water mains or ascertain where the high problem area are. Cleveland Heights has performed acoustic leak detection in 2014 and performed repairs on those leaks that were found. In their September 2014 report Consulting Engineering, Inc. documented 18 main leaks and 15 service leaks.

Comparing all of the water purchased wholesale and comparing to national average for water consumption provides a view of how much water is being lost in the distribution system.

The value of real losses are 4.35 dollar per thousand gallons. Overall this is seven million dollars of opportunity costs if these losses can be reduced. While there is a minimum loss that is economic to reach Cleveland Heights is many times above this value.



Recommendation: ESG recommend an aggressive leak detection program be started for the City of Cleveland Heights. This will consist of three areas:

1. Outsourced surveys – supplement in-house work with vendors to focus on critical areas that are found to produce larger than average losses
2. Self-performing services – ESG will supply acoustic listening tools for Cleveland Heights staff to conduct acoustic listening surveys.
3. Training and engineering support – ESG will provide one week of training on techniques for conducting leak audits, listening surveys and prioritization of activities.

This work will be supplemented by monthly one-on-one coaching session conducted on site with a leak detection expert to further refine skills. Other work will include developing management reports and quantifying savings from leaks.

Scope of Work

Contractor will be responsible for providing all management, installation labor, materials, coordination, customer scheduling, warehousing, tools, gps with sub-meter accuracy, digital camera and equipment necessary for the implementation and installation of a turn-key fully operable water meter system to complete the work per the project schedule and as detailed below.

Contractor will:

Provide on-site project management to coordinate all installation activities with the customer and be the main point of contact during deployment.

Store at its sole expense in a safe, secure and insured facility, in accordance with all manufacturer specifications, meters (defined as meter, ami equipment and associated appurtenances) and other equipment and materials in agreed-upon quantities so as to have such meters and related equipment available for installation on a timely basis. Meters will be purchased in several separate batch purchases and meters will be installed in a "first in first out" method of installation. All meters shall remain in contractor's care, custody, and control until installation and be delivered to the installation sites in new condition in the manufacturer's original, labeled containers until the approximate time for their installation. Any meters, equipment or materials that become damaged or deteriorated from any cause while at the warehouse shall be replaced by new and satisfactory items at contractor's expense.

Verify meter operation and interface with the Owner's utility billing system.

Schedule and perform meter installation in commercial, industrial and residential customer's meter boxes per American Water Works Association (AWWA) guidelines. Some commercial and industrial installations will performed during non-working hours. The timing for these installations shall be agreed upon by the property Owner and contractor.

Record each meter installation with before and after (to include meter set) photographs, account number and GPS coordinate readings, and provide such meter installation records to the Owner daily in approved electronic format reflecting installations made the previous day. A photograph shall also be taken to show the reference of the meter to the building and shall also include the account number in the photograph. Photographs must be able to be seen clearly. If for any reason the register is clouded or otherwise cannot be cleaned to be able to see, register glass will be broken to take clear picture of current register reading. Glass will be disposed of properly.

Contractor shall be responsible for entering data into the utility billing database within 1-business day of meter installation; and revisit any installed meters or transmitters which do not register on the reading system within this time to verify proper installation and setup. Contractor will be responsible for transmitting accurate data to the utility billing software. If inaccurate data is submitted to the Owner,

Contractor shall provide support in correcting these issues in the utility billing system. Contractor shall provide technical support to resolve all issues resulting from the installation process and transmission of inaccurate installation data. Contractor shall provide a route saturation report on a daily basis, which shall include, at minimum, aggregate values of the following data fields:

- Cycle/route
- Retrofits installed
- Date route entered
- Total complete
- Meters scoped
- Meters/retrofits remaining
- Meters installed

Field validate each installed meter to assure that each is capable of transmitting via radio signal to a regional collector.

Enter Owner facilities and customer properties only for the purpose of executing the work and only during regular working hours as provided herein, unless otherwise authorized. After hours work will be done in coordination with the Owner.

Reasonably repair and restore any property damaged as a result of any act or omission or neglect.

Hold weekly progress meetings at a location and time selected by the Owner and provide all reports to the Owner. Meeting notes and decisions made during meeting will be documented and distributed as required by the Owner. The typical agenda will include: review and approve notes of previous meeting, review progress of work since last meeting, review proposed 30-day installation schedule; field observations, issues and conflicts; issues that impede progress; corrective measures and procedures; submittal status; pending changes; maintenance of quality and standards; status of community relations and complaint resolution and the like.

Schedule and facilitate multiple training classes for all subcontracted employees prior to installing the first meter. Training will include, but not be limited to, safety, trimble nomad handheld devices (or approved equivalent), communications plan, hazard communications, confined space entry, lockout/tagout, etc.

Conduct and carry out all work in a manner designed to avoid all but short-term disruption of services and to prevent damage to Owner and customer's property, including other utilities.

Notify the Owner immediately (within one hour) by telephone, of any emergency or other situation compromising the safety of persons or property, and follow up such report in writing.

Comply with all applicable laws and regulations (as such term is defined herein) including those regarding employment.

Be solely and completely responsible for conditions for which it has responsibility under this agreement or are within its control of each installation site in connection with the work, including safety of all persons and property. This requirement shall apply continuously and not be limited to regular working hours.

Keep all premises and job installation sites and the surrounding area free from accumulation of waste materials or rubbish caused by the work or on- site crew and, upon completion of each meter or other infrastructure installation, will remove and properly dispose of all waste materials, rubbish, tools, installation equipment, machinery, and surplus materials, including all debris found in meter boxes and dispose of it in a manner approved by the Owner. Replaced meters will be returned to the Owner. Additionally, every reasonable attempt will be made to keep and return rights of way and end user's property appearance as it was before they arrived. This includes landscaping on excavated areas. Landscaping shall include replacement with sod, shrubs, plantings and structures (i.e. Mailboxes, fences, etc.) To match existing conditions within seven (7) calendar days following the work at any site. Any new meter boxes will be equal to an Owner standard box and lid. Contractor may use salvageable meter box parts to repair existing meter boxes. Some areas of concrete and other hard surfaces may need to be broken-up to gain access to meters. In those instances, the area affected will be restored to, at minimum, the condition of the area prior to excavation/demolition. Contractor will be accountable for any work in repairing areas affected, including, but not limited to: masonry/brick, carpentry, asphalt, concrete, etc. Contractor is not responsible for currently broken meter boxes, sidewalks, driveways and roadways

At all times observe and comply with, and cause all of its agents, employees and subcontractors to comply with, all federal, state, and local laws, statutes, ordinances, and codes, including all applicable laws regarding employment, hazardous substances and the environment and all lawful orders, rules, regulations, standards and lawful orders of public authorities ('laws and regulations').

All work shall be performed between the hours of 7 a.m. And 6 p.m. (EST) Monday through Friday and between the hours of 9 a.m. And 6 p.m. On Saturdays and holidays, provided all activity ends before dusk ('regular work hours'). In the event of an emergency, work may be performed outside of these hours with the prior approval of the Owner, consistent with laws and regulations. Exceptions to these times for work must be approved by the Owner and the parties understand it may be required for commercial and industrial areas that are not reasonably accessible during normal business hours. Access to residential areas outside of regular work hours may be required based on the needs of an

individual end user and will be approved at the sole discretion of the Owner. All work shall be conducted in accordance with all applicable local, state and federal rules and regulations.

All work will be undertaken in accordance with the project schedule. Contractor shall be responsible for notifying end users of the dates work will be performed in their meter boxes in accordance with the timing notification, and private property access procedure. In the case of large commercial and industrial customers such as schools, hospitals, nursing homes, any other large commercial or industrial manufacturing customers, special efforts will be made to ensure minimum disruption to their utility needs and with a minimum 24 hour notice. The Owner will also work with Contractor to coordinate such efforts with large customers to provide meter access and schedule service disruption. To prevent any damage from running flush valves or any other plumbing fixtures that are sensitive to water shutoff's, Contractor shall schedule the replacements with these large commercial and industrial customers and will notify the maintenance personnel when turning the water back on to the customer's facilities. Ultimately the responsibility of operating fixtures inside the buildings is the responsibility of the customer. In addition to any other reporting obligations set forth in agreement, Contractor shall promptly, during the same business day, unless otherwise provided, report to the Owner any of the following:

Immediately

media contacts immediately by telephone

Daily

any apparent leaks located on either side of the meter;
any Owner facilities or property, and any private facilities or property, damaged by subcontractor;
any errors discovered in the Owner's database, such as meters not in Owner's database or meters that are different in size from that recorded in the database;
any meter bypasses that are found in open position, in which instance subcontractor shall also immediately take corrective action;
customer concerns and damage claims and actions subcontractor has taken or will take in response to such concerns;
unusual conditions (leaks, corrosion, theft, etc.)

Weekly

provide installation schedule updates

Contractor will respond to one hundred percent (100%) of general citizen project inquiries and customer concerns received by Contractor, or the Owner. Inquiries and concerns will be forwarded to the subcontractor, within one day, 24 hours a day, 7 days a week. Contractor through their subcontractor is to keep a daily log of calls. Contractor is requiring all subcontractors to maintain a local telephone number (or 800 number) to field these calls.

Contractor will respond to one hundred percent (100%) of customer service issues involving leaks or water availability within three (3) hours of the time the initial call is received from a customer, Contractor, or the Owner. The Owner will make dispatch decision identical to existing service levels. Contractor will respond to one hundred percent (100%) of customer concerns or service issues involving property restoration and the like within one (1) business day of receipt of call from a customer or the city. Contractor will keep a daily log of service issue calls.

The project will require work in customers' meter boxes which are generally in the public rights of way adjacent to private property, and work may require entry onto customer's property. Contractor shall insure that all on-site crews display the highest level of professionalism, courtesy, and respect toward the Owner's customers, staff and citizens and respect the property of others. On-site crew members shall always carry photo identification (supplied by Contractor), the Contractor superintendent's business card and other credentials linking them to the project. Contractor will provide on-site crews with copies of a Owner approved 'fact sheet' to hand out to inquiring citizens. On-site crews shall at all times they are engaged in the work wear uniforms identifying them as part of the work force which shall consist of, at a minimum, hats, shirts, and badges. On-site crews shall properly dispose of all trash and other debris before leaving any property or job site and shall properly dispose of all such trash and debris found in meter boxes. On-site crews shall observe all applicable local, state and federal rules and regulations and keep noise levels as low as reasonably possible and shall refrain from using lewd, improper or otherwise disruptive language at all times. On-site crew shall observe designated smoking areas and always extinguish and dispose of smoking materials properly. Concerns received from the public, customer, or Owner about on-site crews or crew members will not be tolerated. Upon receiving call(s) about crews or crew members, Contractor shall investigate and shall remove on-site crew members who are incompetent, disorderly or otherwise unsatisfactory. Contractor has the authority to remove any on-site crew members who are unsatisfactory to the project. Contractor shall be responsible for replacing crew members who do not maintain an acceptable level of professionalism, courtesy and respect in a timely manner as to not interrupt project progress. Contractor shall ensure that all work areas are clearly marked and shall provide protection to pedestrian and vehicular traffic at all times.

All vehicles used in the work must meet minimum standards of quality and the Owner will maintain the right to object to vehicles that do not appear to meet minimum standards of quality and appearance. All vehicles shall be operated in accordance with all rules of the road. Vehicles must be labeled with the Owner's designed magnetic signs, provided by contractor, identifying the vehicle and crew as working under a contract with contractor and the Owner. Signs shall be removed if vehicle is to be used for

transportation outside of the project scope. Vehicles shall not enter a job site in or near a residential neighborhood before 7am unless otherwise specified in writing by the Owner. Vehicles shall not double park and must turn off engines as soon as possible when stopped or parked. Crew vehicles shall not violate parking laws and shall be in compliance with all applicable local, state and federal rules and regulations at all times. Crew vehicles shall never be parked on private residential lots or block driveways unless they have been given direct, written or verbal permission from the property Owner.

Meter Access Program

For meters located inside residences, customer support will be required during implementation of this Improvement Measure to obtain access to meters and to coordinate utility interruptions. ESG personnel will be responsible for adequate notification and coordination with appropriate Customer personnel and end users to facilitate access and minimal disruption.

ESG shall follow the following Access Program:

Written attempt one. ESG will proceed with meter replacement per a scheduled implementation plan. If the installer cannot gain access to the meter (inaccessible), door hanger with the Installer phone number to make an arrangement for access, will be left on front door.

Note: If a work order cannot be completed due to an unsafe condition such as a damaged or deteriorated meter service, or any other special or unsafe working conditions (to be mutually identified and documented) the work order will be returned to the Customer for follow-up. The work order will be closed and the account removed from the population targeted for ESG completion.

Written attempt two. On a second occasion, ESG will attempt to reschedule and access the meter in an attempt to complete the work. If ESG still cannot gain access to the meter another door hanger will be left.

If access cannot be obtained by ESG representative knocking on doors to contract home Owner, ESG will attempt to contact the customer via telephone to gain access to the meter. A valid telephone attempt is, a) when the customer can be reached, or, b) when a message is left on an answering machine or voice mail. ESG will make a minimum of three telephone attempts utilizing the telephone number supplied by the Customer via the work order data and any other reasonable means available to ESG. A minimum of one telephone call must be attempted on Saturday or on a weekday after 5:00pm.

Written attempt three. On a third occasion, ESG will call for an appointment, and then visit the premise in an attempt to complete the work. If ESG still cannot gain access to the meter another door hanger will be left.

If 10 business days after ESG delivers the third written attempt, the work order has not been completed and an appointment has not been established, the work order will be returned to Customer as a "Can't Complete" order. For project tracking purposes, such orders will be considered complete.

ESG will collect all existing meters and return to the Owner in a dumpster supplied by the Owner at the meter shop, or other assigned location.

Contractor will install the following list of materials:

Item	Quantity
5/8" water meter	577
1" water meter	925
1-1/2" water meter	188
Encoders (residential)	15635
CDMA transmitters (residential)	15635
2" water meter	238
3" water meter	20
4" water meter	12
6" water meter	8
8" water meter	10
CDMA transmitters (commercial)	338

All equipment is manufactured by Badger Meter.

The scope of work includes:

1. Setup of the Beacon database and formatting of data into form agreed to by Owner
2. Three (3) attempts to arrange appointment for entry into home
3. GIS data point and exterior location photo for every point of installation
4. Meters in pits will have a hole burned into the lid and a traffic rated cover plate installed for transmitter antennae
5. Allowance for 800 points to have transmitter moved to exterior in the event of basement mounted meters with inability to be read by cellular network
6. Five consecutive days of training from Badger on new software

Customer Responsibilities

In order for ESG to perform its obligations under this Agreement with respect to the Work, the Performance Guarantee, and the M&V Services, Customer shall be responsible for:

- Providing ESG, its subcontractors, and its agents, reasonable and safe access to all facilities and properties that are subject to the Work and/or M&V Services;
- Providing for shut down and scheduling of affected locations during installation as needed to accomplish the Work and/or M&V Services;
- Providing timely reviews and approvals of design submissions, proposed change orders, and other project documents;
- Providing the following information with respect to the project and project site as soon as practicable following ESG's request:
    - Copy of billing database with phone numbers, account numbers, meter and transmitter numbers
    - Meter reading routes
    - Maps for water distribution system
    - Any available surveys describing the property, boundaries, topography and reference points for use during construction, including existing service and utility lines;
    - geotechnical studies describing subsurface conditions, and other surveys describing other latent or concealed physical conditions at the project site;
    - temporary and permanent easements, zoning and other requirements and encumbrances affecting land use, or necessary to permit the proper design and construction of the project and enable ESG to perform the Work;
    - a legal description of the project site;
    - as-built and record drawings of any existing structures at the project site; and
- Environmental studies, reports and impact statement describing the environmental conditions, including hazardous conditions or materials, in existence at the project site.
- Securing and executing all necessary agreements with adjacent land or property Owners that are necessary to enable ESG to perform the Work;
- Providing assistance to ESG in obtaining any permits, approvals, and licenses that are ESG's responsibility to obtain as set forth in Exhibit A;
- Obtaining any permits, approvals, and licenses that are necessary for the performance of the Work and are not ESG's responsibility to obtain as set forth in Exhibit A;
- Properly maintaining, and performing appropriate preventative maintenance on, all equipment and building systems affecting the Performance Guarantee in accordance with manufacturers' standards and specifications;

- Providing the utility bills, reports, and similar information reasonably necessary for administering ESG's obligations under the Performance Guarantee within five (5) days of Customer receipt and/or generation or ESG's request thereof;
- Providing all records relating to energy and/or water usage and related maintenance of the premises and relevant equipment requested by ESG;
- Promptly notifying ESG of any change in use or condition described in Exhibit C or any other matter that may impact the Performance Guarantee;
- Taking all actions reasonably necessary to achieve the Agreed upon Project Benefits;
- In addition to the foregoing, the Customer is responsible for the items set forth below in connection with utility meter projects:
- Isolating the utility system to allow for meter/valve change out, including identification of all shut-off valves;
- Scheduling shutdowns, downtimes, and relocation of new commercial vaults;
- Ongoing care and maintenance of the utility system, including all meters, AMR equipment and systems, meter boxes, and meter vaults at or above manufacturers' specifications and recommendations beginning at route acceptance;
- Provide routine maintenance of all Owner systems and equipment affected by this agreement.
- Maintain installed equipment using the same manufacturer and specifications that were installed or equivalent as approved by contractor.
- All Energy Conservation Measures (ECMs) will be maintained, and kept in operation with equal or better replacement components.
- At a minimum, the Owner shall be responsible for maintaining the existing water and sewer rate schedules. Any reduction in monthly base charges, monthly allowable minimum base consumption, or monthly volume charges may reduce the anticipated project benefits to be recovered from improving meter accuracy.
- The Owner acknowledges that the implementation of any water rationing programs will serve to decrease consumption and therefore decrease water and sewer revenue and will be addressed in Exhibit C as a baseline adjustment.
- The Owner acknowledges that the projected benefits to be received through improved meter accuracy are based upon the existing water and sewer rate schedule. Should the Owner choose to forgive or reduce water bills as a service to its citizens, the Owner accepts responsibility for the decreased water and sewer revenue. Any credits to water and sewer bills are the full responsibility of the Owner during installation of project. Contractor will not be responsible for any type of monetary payment to the Owner.
- The Owner is responsible for the continued maintenance of the water system including all water meters, meter boxes, and large water meter vaults.

- The Owner is responsible for providing access to designated ESG employees for the purpose of verifying, adjusting and/or maintaining the facility improvement measures employed at the various facilities.
- The Owner assumes responsibility for any damage to the water meters by foreign objects as well as any intentional damage to the water meters by others than ESG personnel or their subcontractors.
- The Owner assumes responsibility for authorizing any non-metered water usage.
- The Owner assumes responsibility for maintaining water quality. Any water quality issues that affect the water meter manufacturers' warranty are the responsibility of the Owner.
- The Owner assumes responsibility for maintaining the average system pressure that was present during the baseline consumption period. A decrease in system pressure may cause subsequent decreases in both billed consumption and water and sewer revenue.
- The Owner acknowledges that weather may effect water consumption. Changes in the number of degree-days and/or annual rainfall amounts may serve to either increase or decrease billed consumption and its associated water and sewer revenue.
- The Owner acknowledges that demographic shifts (population growth or shrinkage) and changes in commercial business, industrial business and wholesale accounts may affect water consumption and its associated water and sewer revenue.
- The Owner assumes responsibility for any damage resulting from acts of war and terrorism.
- The Owner is responsible for maintaining current meter reading practice until one month after route acceptance.
- Owner is responsible for water line repairs further than 24" away from the meter. ESG is not liable for damages outside of this 24" zone, either on the water distribution side or on the customer side, incurred from the meter replacement process (i.e., shutoff, temporary outage, and restart of water service).
- Adequate personnel to assist in the shutting off of any meters where isolation valves are not functioning properly
- Locking meter box covers have not been included in this project. Any requirements for locking lids will be the responsibility of the Owner
- Owner shall provide a list of inactive accounts at the time of construction
- Reasonable assistance in locating meters as required
- Provide guidance and support in either the repair or replacement of sidewalks, curb stops, and roadways damaged by ESG during this project
- Assurance that water fixtures are running properly after the replacement of corresponding water meter will be the coordinated responsibility of ESG, Owner and said End User

Notes:

The quantities of existing water meters with "Active" accounts are based upon data provided to ESG by the Owner. Any additional existing meters that are found during installation will not be replaced as part of this Contract. Any excess materials will be left with the Owner to be used as bench stock. If ESG is requested to install additional quantities of water meters to complete this project, the total installed unit price per meter will be negotiated at that time.

ESG cannot guarantee the performance of radio reads on meters that are under water. If ESG is requested to install additional transmitter equipment for meters in flooded pits, the total installed price per meter will be negotiated at that time.

All water meters will be installed at the depth dictated by current water service line depth. Any change in water service line depth is the responsibility of the Owner.

Infrastructure Repairs

The contract included a contractor controlled allowance of $9,400,000 for repairs to the water distribution infrastructure. Such repairs include water main replacement, repairs and modifications such that losses associated with leaks and other non-revenue water losses are reduced. All repairs will comply with engineering and construction standards of the Owner. A report shall be generated at the conclusion of the project which states what work was completed, costs and includes drawings, notes and details such that good engineering documentation is provided.

Leak Detection

The following equipment manufactured by Fluid Conservation Services will be provided to the Owner: one Xmic System ground listening microphone (w/filters), two Lmic Ground Microphone Systems, and one TriCorr Touch Correlator.

Training will be provided for five consecutive days by ESG subcontractor experienced in acoustic leak detection for Owner staff. Any staff selected by Owner shall have hearing test prior to training.

Monthly training will be provided for two days on-site in the field with ESG representative for twelve consecutive months for further refinement of skills in leak detection. The scheduling of these training periods will be completed four weeks prior to each event. If Owner fails to provide staff time during these agreed upon days then they shall be considered lost and shall not be rescheduled. Contractor will coordinate with Owner on documenting repairs, analyzing real loss savings, and make recommendations for best management practices to further reduce real losses within water distribution system.

The Owner is responsible for repairing all leaks in a reasonable time frame. Failure to repair leaks after ninety days shall be considered a baseline adjustment under terms of Exhibit C.

Contractor shall perform two complete acoustic surveys of hydrants and water distribution system with the intent of locating water distribution leaks. At the discretion of contractor some service areas may be omitted to focus on high priority areas with large potential losses.

Pressured Reducing Vaults

ESG will install ten new underground vaults to house pressure reducing valves in the water distribution system. The intent of these new valves is to reduce average system pressure in order to reduce leaks. The location and size of these valves will be determined after completion of further investigation and engineering. All of the valves will be manually set at high enough pressure to provide adequate water distribution and fire protection services. Some service interruption may be required to accomplish this scope and will be coordinated in advance with Owner and any affected parties to minimize inconvenience.

The scope of work for each PRV vault includes the following:

- Flagging and traffic control
- OSHA approved barricades and nighttime flashers
- Pavement Saw Cutting as needed
- Site Excavation
- Temporary Isolation of Water Line
- Cut out required section of water line
- Install all required Ductile Iron Piping and valves along with pre-assembled valve vault
- One new Cla-Val model E-90-01 pressure reducing valve or equal
- Isolation gate valves
- Performance of chlorination procedure/ disinfection as agreed upon prior between Contractor and Owner
- Test for leaks and re-energize line
- Backfill with Premium Fill
- Replace/repair Pavement
- Record drawings
- O&M Manuals
- One day training in operation and maintenance for Owner's staff

Engineering Services

A Graphical Information System (GIS) will be developed for Owner in ESRI ArcGIS software. Contractor will perform physical survey to establish GPS coordinates of water distribution system. Data points to be included are:

- Main line valves
- Hydrants
- Import & export points
- PRV vaults

All the GIS information available (for the service centers and distribution system) will be analyzed and, where necessary, field verified by Contractor staff up to 10 man-days of field verification time. This data will be referenced and validated against any existing hard copy maps of the service centers or distribution system. Any areas either without GIS data, or with incorrect data will be corrected and/or added to.

A hydraulic model will be generated using the GIS data in InfoWater software modeling package. Construction of the model will take into account the pressure dependent demands within the system. The compatibility of ground level data obtained from field analysis will be checked against pressure data collected under this task, or previous analyses conducted by Owner staff. Customer demands and demand profiles used in the model will take into account the different configurations of usage.

The model will be calibrated to field data using the InfoWater auto calibration tools. Once all the models have been calibrated, and merged into a single system model, it will be used to support the requirements of the project.

Identify Distribution System Problems - When the model shows significant calibration issues, this data will be analyzed to determine if it is a model problem, or a distribution system issue or anomaly. If it is a distribution system issue or anomaly, then this will be discussed with The Owner staff and plans put in place to rectify it.

10 Year Plan for Demand and Supply - Supply levels and anticipated demands will be calculated during the project. The current supply situation will be discussed and any discrepancies in data analyzed. New water sources will not be examined in this project.

Identify Most Equitable Distribution Plan for Import Structure - Assuming that there is the possibility to reduce the number of import (and/or export locations) locations, an analysis of the possibilities for re-configuration of the network will be developed. Consideration of new pressure districts will be evaluated.

The AWWA/IWA water balance is a method which has been used across the world for over ten years. Contractor will use the AWWA Water Audit Software version 5.0 to analyze and detail the major water loss characteristics and target resources.

An updated report on the water balances and the resulting performance indicators for each area (if applicable) and the overall project area will be submitted within 120 days of completion of the GIS and any boundary changes to the system.

A validation of parcel data (developed through the GIS) and customer information will be conducted in random areas to determine locations without service or incorrectly billed as appropriate. Further investigation will focus on billing anomalies in order to reduce systematic data handling errors.

On completion of the above tasks, Contactor will submit a Final Diagnosis of the System report which collects all the findings of the various activities in the above tasks of this component and recommends future work to sustain the revenue gains.

Media Relations

Contactor will provide comprehensive public relations program which will include the following:

- Website hosted by ESG describing project, benefits to city residents, contact information implementation schedule
- Press kit with one page description of project and benefits
- Newspaper advertisement notifying residents of projects
- Coordination with Owner on notification program for meter replacement program

Exclusions include:

1. Replacement of any 5/8" and/or ¾" water meters
2. Replacement of any galvanized pipe or other piping material not meeting Owner local requirements
3. Unless otherwise specified, this project assumes exchange of like for like size and type meters, at same depth, within same meter setting. Installation of new boxes/services, isolation valves, test valves, bypasses or piping modifications are not included
4. Additional meter inventory is not included in the project
5. Meters beyond the mutually agreed upon meter data (number, type and size) as shown in the scope of work of this contract are not included

6. Monthly fees for cellular data meter reading is the sole responsibility of Owner.
7. Asbestos survey and remediation, hazardous remediation of contaminated soil or groundwater
8. Ohio state sales tax
9. Cost of electricity consumed by contractors
10. Landscape plantings
11. Buy-American requirements
12. Operation of any supplied equipment or services after substantial completion unless specifically included in scope
13. Costs associated with any work associated with unexpected subsurface conditions including but not limited to stabilizing soils which are unable to support design bearing pressure or removal of rock discovered during excavations

City of Cleveland Heights
Operational Savings Summary

Contract Year	Year	Existing Meter Readers to be Reallocated				Meter Repair & Replacement Cost Reduction	Endpoint Repair	Meter Re-Reads	New Handheld Devices
		Compensation	Vehicle Cost (Annual)	New / Replacement Vehicle Cost	Misc. Costs (Annual)	Material	Material (Expense)	Reduction in Meter Re-reads	New / Replacement Cost
Install	2014	$0	$0	$0	$0	$0	$0	$0	$0
1	2015	$229,868	$25,493	$0	$2,929	$142,963	$0	$21,218	$19,158
2	2016	$236,764	$26,257	$68,676	$3,017	$147,252	$0	$21,855	$1,530
3	2017	$243,867	$27,045	$0	$3,107	$151,669	$0	$22,510	$1,575
4	2018	$251,183	$27,856	$0	$3,201	$156,219	($4,574)	$23,185	$1,623
5	2019	$258,718	$28,692	$0	$3,297	$160,906	($4,711)	$23,881	$1,671
6	2020	$266,480	$29,553	$0	$3,396	$165,733	($4,852)	$24,597	$22,209
7	2021	$274,474	$30,439	$79,615	$3,497	$170,705	($4,998)	$25,335	$1,773
8	2022	$282,708	$31,353	$0	$3,602	$175,826	($5,148)	$26,095	$1,826
9	2023	$291,189	$32,293	$0	$3,710	$181,101	($5,302)	$26,878	$1,881
10	2024	$299,925	$33,262	$0	$3,822	$186,534	($5,461)	$27,685	$1,938
11	2025	$308,923	$34,260	$0	$3,936	$11,571	($5,625)	$28,515	$25,747
12	2026	$318,190	$35,288	$92,295	$4,055	$11,918	($5,794)	$29,371	$2,056
13	2027	$327,736	$36,346	$0	$4,176	$12,276	($5,968)	$30,252	$2,117
14	2028	$337,568	$37,437	$0	$4,301	$12,644	($6,147)	$31,159	$2,181
15	2029	$347,695	$38,560	$0	$4,430	$13,023	($6,331)	$32,094	$2,246
16	2030	$358,126	$39,716	$103,879	$4,563	$13,414	($6,521)	$33,057	$29,848
17	2031	$368,870	$40,908	$0	$4,700	$13,817	($6,717)	$34,049	$2,383
18	2032	$379,936	$42,135	$0	$4,841	$14,231	($6,918)	$35,070	$2,454
19	2033	$391,334	$43,399	$0	$4,987	$14,658	($7,126)	$36,122	$2,528
20	2034	$403,074	$44,701	$116,917	$5,136	$15,098	($7,340)	$37,206	$2,604
		$6,176,628	$684,993	$461,382	$78,705	$1,771,559	($99,533)	$570,136	$129,348

Operational Savings Summary

Annual Operational Sav	$ 234,829.58
Wages	$ 147,022
Benefits	$ 76,151
Total Annual Operational Savings	**$ 458,002**

City of Cleveland Heights

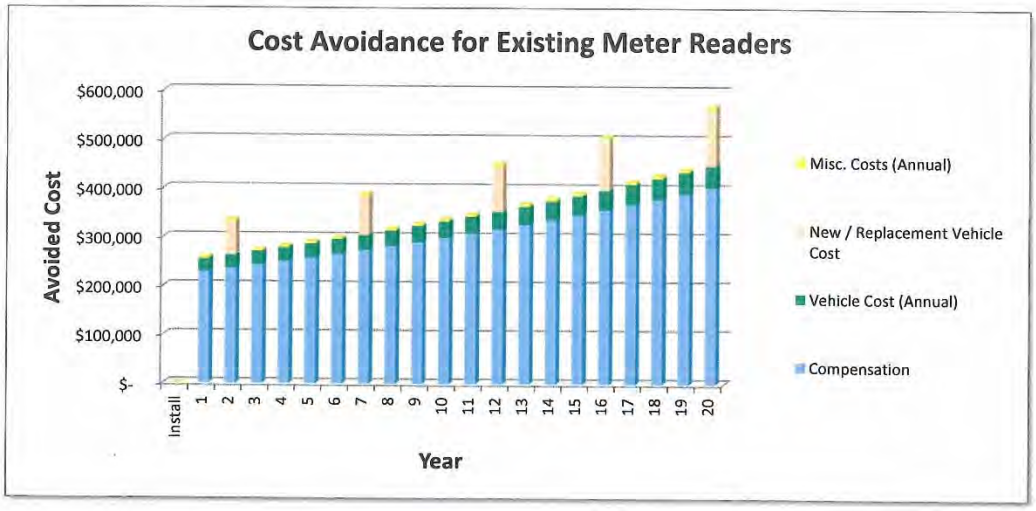
Meter Reader Annual Costs

	FY13	Description	Notes
# OF MTR READERS TO BE REALLOCATED	3		
AVERAGE SALARIES / PERMANENT	$ 49,007	Meter Reader Salary	Average salary for current meter readers
FICA, RETIREMENT, HEALTH, WORK COMP	25,384	Meter Reader Benefits	
MAINTENANCE AND REPAIR - VEHICLES/EQUIPMENT	$ 8,250	fuel and maintenance cost	
EQUIPMENT / VEHICLE	$ 22,078	Truck, Pickup, 1/4 ton, Extended Cab	Present Value (one time cost)
OPERATIONS & MAINTENANCE / TOOLS	$ 100	Tools (pliers, screw drivers, pipe wrench)	Estimated
OPERATIONS & MAINTENANCE / TELEPHONE	$ 876	Cell Phones	Annual Cost for two meter reader phones
OPERATIONS & MAINTENANCE / BLUE LOCATE PAINT		Marking Meter Locations	Unknown

Total	**$**	**105,695**

ANNUAL SUMMARY

Compensation	$	223,172
Additional Meter Reads	$	-
Vehicle Cost - Annual	$	24,750
Vehicle Cost - One-Time	$	66,234
Misc. Costs (Annual)	$	2,929
Average Salvage Value of a Vehicle	$	500



		Existing Meter Readers to be Relocated (Qty. 1)			
Contract Year	Year	Compensation	Vehicle Cost (Annual)	New / Replacement Vehicle Cost	Misc. Costs (Annual)
Install	2014	$ -	$ -	$ -	$ -
1	2015	$ 229,868	$ 25,493	$ -	$ 2,929
2	2016	$ 236,764	$ 26,257	$ 68,676	$ 3,017
3	2017	$ 243,867	$ 27,045	$ -	$ 3,107
4	2018	$ 251,183	$ 27,856	$ -	$ 3,201
5	2019	$ 258,718	$ 28,692	$ -	$ 3,297
6	2020	$ 266,480	$ 29,553	$ -	$ 3,396
7	2021	$ 274,474	$ 30,439	$ 79,615	$ 3,497
8	2022	$ 282,708	$ 31,353	$ -	$ 3,602
9	2023	$ 291,189	$ 32,293	$ -	$ 3,710
10	2024	$ 299,925	$ 33,262	$ -	$ 3,822
11	2025	$ 308,923	$ 34,260	$ -	$ 3,936
12	2026	$ 318,190	$ 35,288	$ 92,295	$ 4,055
13	2027	$ 327,736	$ 36,346	$ -	$ 4,176
14	2028	$ 337,568	$ 37,437	$ -	$ 4,301
15	2029	$ 347,695	$ 38,560	$ -	$ 4,430
16	2030	$ 358,126	$ 39,716	$ 103,879	$ 4,563
17	2031	$ 368,870	$ 40,908	$ -	$ 4,700
18	2032	$ 379,936	$ 42,135	$ -	$ 4,841
19	2033	$ 391,334	$ 43,399	$ -	$ 4,987
20	2034	$ 403,074	$ 44,701	$ 116,917	$ 5,136

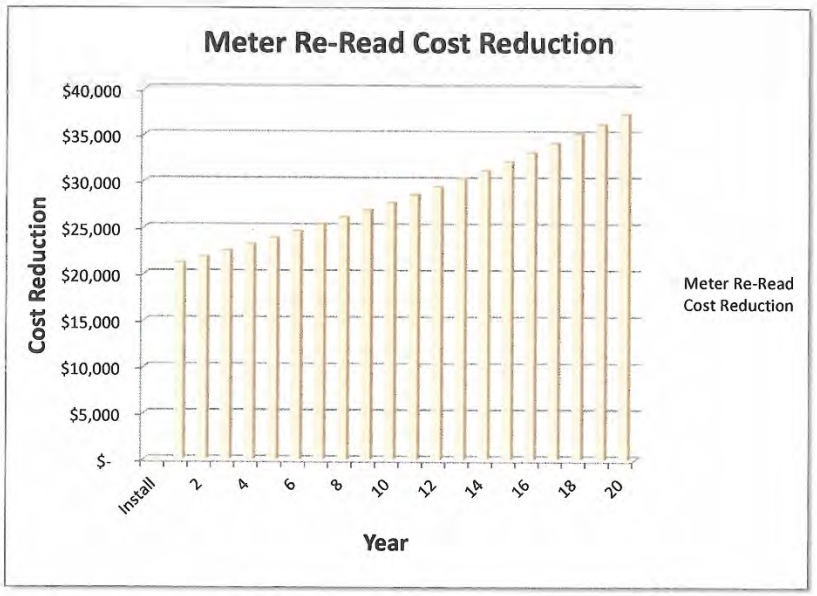
Notes:

1 This analysis is based on data provided by the city
2 Total of (3) meter readers will be relocated by implementation of this project
3 Standard escalation (3%) applied to all the items except "Misc. Costs (Annual)" column
4 The standard useful life for the vehicle assumed to be 5 years and these vehicles will be replaced at the end of their useful life
5 Present salvage value of $500 used for the vehicle replacements only
6 Annual compensation escalation of (3%)

City of Cleveland Heights

Meter Re-Read Cost Reduction

FY13 Number of Meter Re-Reads	515.00	
Estimated Cost of Meter Re-Reads	$50	
Estimated Reduction in Meter Re-Reads with AMR System	80%	
Annual Avoided Cost From Reduction in Meter Re-Reads		**$20,600**



Contract Year	Year	Meter Re-Read Cost Reduction
Install	2014	$ -
1	2015	$ 21,218
2	2016	$ 21,855
3	2017	$ 22,510
4	2018	$ 23,185
5	2019	$ 23,881
6	2020	$ 24,597
7	2021	$ 25,335
8	2022	$ 26,095
9	2023	$ 26,878
10	2024	$ 27,685
11	2025	$ 28,515
12	2026	$ 29,371
13	2027	$ 30,252
14	2028	$ 31,159
15	2029	$ 32,094
16	2030	$ 33,057
17	2031	$ 34,049
18	2032	$ 35,070
19	2033	$ 36,122
20	2034	$ 37,206

1. Data for Year 2013 used for this analysis
2. 80% reduction assumed for the reduction in forgiven bills

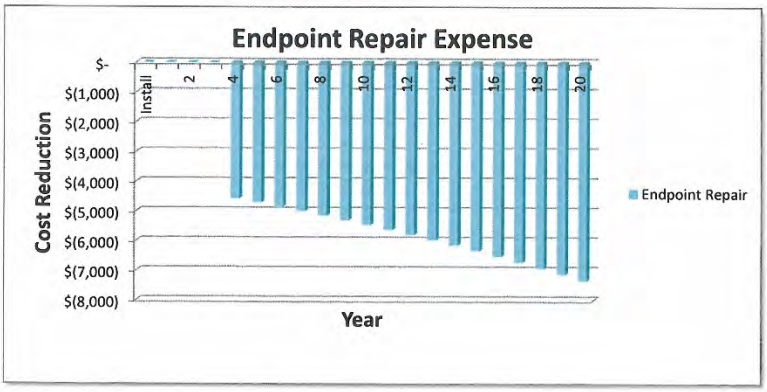
City of Cleveland Heights

Endpoint Repairs

Endpoint Repair		
Anticipated Percentage of Endpoint Damage per year	0.30%	
Material Cost for Endpoint	$86.40	

		Endpoint Repair		
Contract Year	Year	Meter Population	Anticipated Endpoint Damage	Material (expense)
Install	2014	15678	0	$ -
1	2015	15678	0	$ -
2	2016	15678	0	$ -
3	2017	15678	0	$ -
4	2018	15678	47	$ (4,574)
5	2019	15678	47	$ (4,711)
6	2020	15678	47	$ (4,852)
7	2021	15678	47	$ (4,998)
8	2022	15678	47	$ (5,148)
9	2023	15678	47	$ (5,302)
10	2024	15678	47	$ (5,461)
11	2025	15678	47	$ (5,625)
12	2026	15678	47	$ (5,794)
13	2027	15678	47	$ (5,968)
14	2028	15678	47	$ (6,147)
15	2029	15678	47	$ (6,331)
16	2030	15678	47	$ (6,521)
17	2031	15678	47	$ (6,717)
18	2032	15678	47	$ (6,918)
19	2033	15678	47	$ (7,126)
20	2034	15678	47	$ (7,340)

1. Meter population growth is asumed to be static
2. Percentage of endpoint damage per year taken is estimated
3. Increased labor needed for replacement of damaged endpoints not included because of reduced labor on meter repair and replacement tab



City of Cleveland Heights

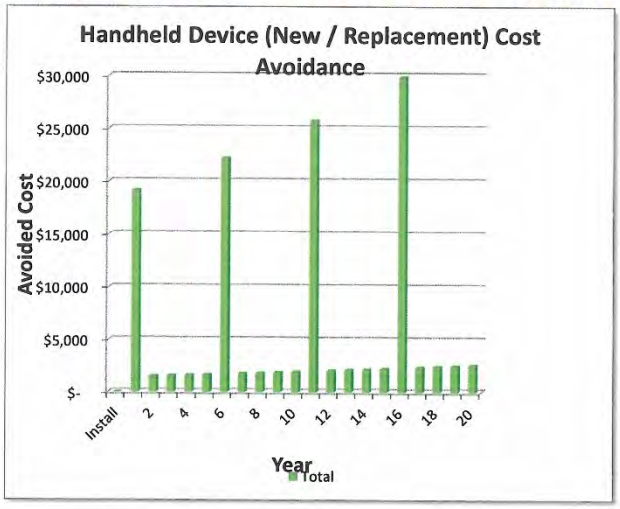
Handheld Cost Avoidance

Total Number of Existing Meter Readers	3
Handheld Device Price (Each)	$ 6,200
Handheld Service Agreement	$ 495

		Handheld Device		
Contract Year	Year	New Equipment	Service Agreement	Total
Install	2014	$ -	$ -	$ -
1	2015	$ 17,673	$ 1,485	$ 19,158
2	2016	$ -	$ 1,530	$ 1,530
3	2017	$ -	$ 1,575	$ 1,575
4	2018	$ -	$ 1,623	$ 1,623
5	2019	$ -	$ 1,671	$ 1,671
6	2020	$ 20,487.85	$ 1,722	$ 22,209
7	2021	$ -	$ 1,773	$ 1,773
8	2022	$ -	$ 1,826	$ 1,826
9	2023	$ -	$ 1,881	$ 1,881
10	2024	$ -	$ 1,938	$ 1,938
11	2025	$ 23,751.03	$ 1,996	$ 25,747
12	2026	$ -	$ 2,056	$ 2,056
13	2027	$ -	$ 2,117	$ 2,117
14	2028	$ -	$ 2,181	$ 2,181
15	2029	$ -	$ 2,246	$ 2,246
16	2030	$ 27,533.96	$ 2,314	$ 29,848
17	2031	$ -	$ 2,383	$ 2,383
18	2032	$ -	$ 2,454	$ 2,454
19	2033	$ -	$ 2,528	$ 2,528
20	2034	$ -	$ 2,604	$ 2,604

Note:

1. Purchase (3) new handheld devices in Year #1 for existing meter readers
2. Existing (Qty: 3) handheld devices will be replaced with new ones in Year 2022 and 2029



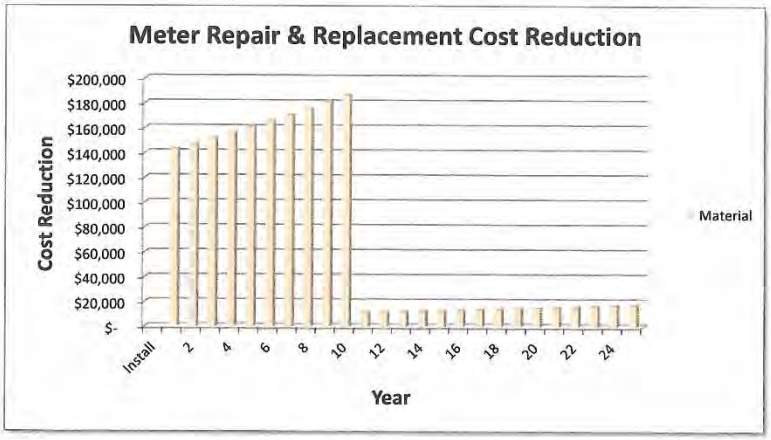
City of Cleveland Heights

Meter Repair & Replacement Cost Avoidance

		Orion Comunications review	Meter Repair & Replacement Cost Reduction	Total
Contract Year	Year	Material	Material	Material
Install	2014	$ -		
1	2015	$ 134,353	$ 8,610	$ 142,963
2	2016	$ 138,383	$ 8,868	$ 147,252
3	2017	$ 142,535	$ 9,134	$ 151,669
4	2018	$ 146,811	$ 9,408	$ 156,219
5	2019	$ 151,215	$ 9,691	$ 160,906
6	2020	$ 155,752	$ 9,981	$ 165,733
7	2021	$ 160,424	$ 10,281	$ 170,705
8	2022	$ 165,237	$ 10,589	$ 175,826
9	2023	$ 170,194	$ 10,907	$ 181,101
10	2024	$ 175,300	$ 11,234	$ 186,534
11	2025	$ -	$ 11,571	$ 11,571
12	2026	$ -	$ 11,918	$ 11,918
13	2027	$ -	$ 12,276	$ 12,276
14	2028	$ -	$ 12,644	$ 12,644
15	2029	$ -	$ 13,023	$ 13,023
16	2030	$ -	$ 13,414	$ 13,414
17	2031	$ -	$ 13,817	$ 13,817
18	2032	$ -	$ 14,231	$ 14,231
19	2033	$ -	$ 14,658	$ 14,658
20	2034	$ -	$ 15,098	$ 15,098
21	2035	$ -	$ 15,551	$ 15,551
22	2036	$ -	$ 16,017	$ 16,017
23	2037	$ -	$ 16,498	$ 16,498
24	2038	$ -	$ 16,993	$ 16,993
25	2039	$ -	$ 17,502	$ 17,502
			Total	$ 1,854,120

Note:

1. Based on City data of neediung to upgrade 10,923 meters with the Orion Comunications devices over the next 10 years (1,040 upgrades per year)
2. 3% escalation used each year
3. The cost for replace ment is $118 for the transponder, and $5 in materails (30 minutes of labor time not included to avoid doub;e counting of labor savings)
4. The city installs approximatly 80 new meters per year, but the material costs of $169 is passed on to the customer
5. In 2013 the city replaced 169 meters, 92 of these meters were paid for by customers, and 77 were paid



Term	20
Interest Rate	4.15%
Financed Amount	$ 19,980,667

Year	Increased Water Revenues	Reduction in Wholesale Water	Operational Savings	New Operating Costs	Net Annual Savings	Annual Debt Payment	Cash Flow	Cumlative Cash Flow
Increase	0%	0%	0%	0%				
Construction 2015	$535,690	$1,548,733	$89,835	($64,172)	$2,110,085		$2,110,085	$2,110,085
Construction 2016	$948,424	$2,730,865	$545,580	($197,792)	$4,027,077	($830,000)	$3,197,077	$5,307,162
2017	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$8,783,099
2018	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$12,259,036
2019	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$15,734,973
2020	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$19,210,910
2021	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$22,686,846
2022	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$26,162,783
2023	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$29,638,720
2024	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$33,114,657
2025	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$36,590,594
2026	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$40,066,531
2027	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$43,542,468
2028	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$47,018,404
2029	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$50,494,341
2030	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$53,970,278
2031	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$57,446,215
2032	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$60,922,152
2033	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$64,398,089
2034	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$67,874,026
2035	$948,424	$3,682,865	$545,580	($211,126)	$4,965,743	($1,489,806)	$3,475,937	$71,349,963
Total	**$19,504,170**	**$74,254,033**	**$11,001,435**	**($4,273,352)**	**$100,486,286**	**($29,136,323)**	**$71,349,963**	

City of Cleveland Heights
Project Financial Summary
1/12/2015

Functional Area	ID	Project	Estimated Total Cost	Water (New Revenue)	Annual Operational Savings	Total Guaranteed Annual Savings	Recommended Future Annual Fees/Services	Local Sewer Annual Benefit	NEORSD Benefit
Metering	1	Export/Import Meter Adjustment	$56,220	($1,150,081)		($1,150,081)	$0	0	0
	2	Replace 600 residential meters + 14,500 encoders & transmitters	$5,182,599	$34,319	$497,580	$531,899	($171,126)	$5,427	$31,639
	3	Replace 14,500 5/8" residential meters	$0	$0	$0	$0	$0	$0	$0
	4	Replace commercial meters 1" and larger (1400)	$1,101,563	$664,319	$0	$664,319	$0	$110,565	$635,280
Distribution	5	(10) PRV Vaults / Active Pressure Management	$1,957,507	$998,248	$0	$998,248	$0	$0	$0
	6	Leak Detection and Training	$320,144	$684,617	$48,000	$732,617	$0	$0	$0
Billing & Support	7	Infrastructure Improvements (leaks)	$9,400,000	$2,000,000	$0	$2,000,000	($40,000)	$0	$0
	8	Billing System Replacement	$0	$0	$0	$0	$0	$0	$0
	9	Development Costs	$120,000	0	0	$0	$0	$0	$0
	10	Engineering, GIS, Hydraulic Model, Project Management, SOP's, Commissioning, M&V	$1,842,634	$249,786		$249,786	$0	$3,950	$258,900
		Total	$19,980,667	$3,481,208	$545,580	$4,026,788	($211,126)	$119,942	$925,819

RESULTS			
Term		20	
Interest Rate		4.15%	
Financed Amount		$19,980,667	
Annual Payment	$	(1,489,806)	
NEORSD Contribution			
Positive Cash Flow		$2,445,798	*Savings - payment - ongoing fees $250,000 over baseline*
Cash Flow Goal		$1,565,227	
		pass	

Project Baseline

	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL					
RESOURCES - FUND 601	**AS OF 12/31/2013**	**AS OF 1/31/14**	**AS OF 2/28/14**	**AS OF 3/31/14**	**AS OF 4/30/14**	**AS OF 5/31/14**	**AS OF 6/30/14**	**AS OF 7/31/14**	**AS OF 8/31/14**	**AS OF 9/30/14**	**AS OF 10/31/14**	**AS OF 11/30/14**	**TOTAL**	**New Costs**	**Water (New Revenue)**	**Operational**	**Totals**
Sales to Residents	$951,793	$925,032	$965,773	$1,068,341	$1,016,649	$999,035	$1,030,542	$989,633	$1,167,932	$933,843	$1,058,831	$807,412	$11,914,816		$948,424		$12,863,240
Penalty/Delinquent Water Bills	$19,271	$19,068	$20,895	$27,768	$34,471	$26,090	$24,200	$21,311	$24,909	$24,081	$25,591	$16,363	$284,019				$284,019
Special Assessment Property Certifications	$0	$0	$0	$130,989	$0	$0	$0	$0	$0	$0	$100,059	$0	$231,048				$231,048
Administrative Fees as Billing Agent for NEO Sewe	$0	$0	$85,049	$0	$84,979	$0	$0	$85,119	$0	$0	$85,173	$0	$340,319				$340,319
Other Revenue	$5,450	$4,508	$5,514	$8,624	$26,687	$19,955	$27,341	$19,243	$25,010	$18,656	$43,430	$12,118	$216,538		$119,942		$336,480
Note Proceeds	$0	$0	$0	$0	$0	$0	$0	$185,000	$0	$0	$0	$0	$185,000				$185,000
FUND RESOURCES	$976,515	$948,608	$1,077,231	$1,235,722	$1,162,786	$1,045,080	$1,082,084	$1,300,307	$1,217,851	$976,580	$1,313,084	$835,893	$13,171,741	$0	$1,068,366	$0	$14,240,107
OBLIGATIONS - FUND 601																	
Wholesale Water Purchases from Cleveland	$754,520	$722,797	$913,205	$850,000	$1,046,351	$1,184,766	$1,107,540	$982,559	$1,055,719	$1,040,788	$949,216	$1,094,134	$11,701,595	$1,150,081	($3,682,865)		$9,168,811
Portion related to payment plan with CWD	$0	$0	$0	$369,407	$0	$0	$0	$0	$0	$0	$0	$0	$369,407				$369,407
Wages	$70,446	$106,789	$68,515	$92,267	$61,663	$60,403	$59,847	$61,370	$90,675	$60,924	$59,926	$71,107	$863,933			($229,868)	$634,065
Benefits	$23,951	$21,641	$26,431	$39,227	$44,456	$25,216	$22,136	$28,356	$40,359	$23,445	$29,150	$28,005	$352,373			($76,152)	$276,221
Operating Costs -Other Than Personal Services	$41,433	$45,985	$72,303	$56,792	$65,388	$96,659	$48,114	$94,630	$20,223	$55,483	$49,001	$30,125	$676,137	$211,126		($239,560)	$647,702
Ohio Public Works Loan Repayment	$10,103	$32,707	$0	$0	$0	$0	$42,811	$0	$0	$0	$0	$0	$85,621	$1,489,806			$1,575,428
Capital Projects & Purchases	$0	$44,642	$0	$146,933	$0	$0	$0	$1,044	$13,171	$0	$0	$0	$205,790				$205,790
Bond Anticipation Note Principal	$0	$0	$0	$0	$0	$0	$0	$185,000	$0	$0	$0	$0	$185,000				$185,000
Bond Anticipation Note Interest	$0	$0	$0	$0	$0	$0	$0	$1,850	$0	$0	$0	$0	$1,850				$1,850
Transfer to Fund 234 - Earned Benefits	$15,025	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$15,025				$15,025
Water Deposit Refunds & Operating Refunds	$1,477	$5,418	$1,961	$1,685	$1,906	$1,479	$2,432	$2,194	$3,138	$891	$3,076	$4,581	$30,238				
														$2,851,013	($3,682,865)	($545,580)	$13,079,298
FUND OBLIGATIONS	$916,955	$979,979	$1,082,415	$1,556,312	$1,219,764	$1,368,524	$1,282,879	$1,357,004	$1,223,284	$1,181,531	$1,090,370	$1,227,952	$14,486,968				
CASH SURPLUS + / DEFICIT ()	**$59,560**	($31,371)	($5,184)	($320,589)	($56,978)	($323,444)	($200,795)	($56,697)	($5,433)	($204,950)	**$222,714**	($392,059)	($1,315,227)			**Goal**	**$250,000**
																Deficient/Surplus	**$1,160,809**

Wholesale Water Purchases from Cleveland for November 2014 was not paid in that month due to potentially working out a payment plant with CWD. This is the current amount due that would have normally been paid in that month.

BASE CASE

RESOURCES - FUND 601	Escalation	Base Year	1	2	3	4	5	6	7	8	9	10
			12/31/2014	12/31/2015	12/30/2016	12/30/2017	12/30/2018	12/30/2019	12/29/2020	12/29/2021	12/29/2022	12/29/2023
Sales to Residents	1.5%	$	11,914,816	$ 11,914,816	$ 11,914,816	$ 11,914,816	$ 12,093,538	$ 12,274,941	$ 12,459,066	$ 12,645,952	$ 12,835,641	$ 13,028,175
Penalty/Delinquent Water Bills	0%	$	284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019
Special Assessment Property Certifications	0%	$	231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048
Administrative Fees as Billing Agent for NEO Sewer District	0%	$	340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319
Other Revenue	0%	$	216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538
Note Proceeds	0%	$	185,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
FUND RESOURCES		$	13,171,741	$ 12,986,741	$ 12,986,741	$ 12,986,741	$ 13,165,463	$ 13,346,866	$ 13,530,991	$ 13,717,876	$ 13,907,566	$ 14,100,100
OBLIGATIONS - FUND 601												
Wholesale Water Purchases from Cleveland	1.5%	$	11,701,595	$ 13,220,000	$ 13,418,300	$ 13,619,575	$ 13,823,868	$ 14,031,226	$ 14,241,695	$ 14,455,320	$ 14,672,150	$ 14,892,232
Portion related to payment plan with CWD	0%	$	369,407	$ 1,580,637.80	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Wages	2%	$	863,933	$ 863,933	$ 863,933	$ 863,933	$ 881,212	$ 898,836	$ 916,813	$ 935,149	$ 953,852	$ 972,929
Benefits	1%	$	352,373	$ 346,841	$ 346,841	$ 348,575	$ 350,318	$ 352,070	$ 353,830	$ 355,599	$ 357,377	$ 359,164
Operating Costs -Other Than Personal Services	2%	$	676,137	$ 703,920	$ 717,998	$ 732,358	$ 747,006	$ 761,946	$ 777,185	$ 792,728	$ 808,583	$ 824,754
Ohio Public Works Loan Repayment	0%	$	47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044
Transfer to Fund 234 - Earned Benefits	0%	$	15,025	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500
Bond Anticipation Note Principal	0%	$	185,000		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OPWC Loan for Meadowbrook BLVD Project	0%	$	18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372
Bond Anticipation Note Interest	0%	$	1,850		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OPWC Loan for Runnymede/Quilliams Project	0%	$	20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207
Capital Projects and Purchases	0%	$	205,790	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000
Water Deposit Refunds & Operating Refunds	0%	$	30,238	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850
FUND OBLIGATIONS		$	14,486,970	$ 16,881,305	$ 15,513,046	$ 15,730,414	$ 15,968,377	$ 16,210,051	$ 16,455,495	$ 16,704,770	$ 16,957,935	$ 17,215,053
CASH SURPLUS + / DEFICIT ()		$	(1,315,229)	$ (3,894,564)	$ (2,526,305)	$ (2,743,673)	$ (2,802,913)	$ (2,863,184)	$ (2,924,505)	$ (2,986,893)	$ (3,050,369)	$ (3,114,952)
Cumlative				$ (3,894,564)	$ (6,420,869)	$ (9,164,542)	$ (11,967,455)	$ (14,830,640)	$ (17,755,144)	$ (20,742,037)	$ (23,792,407)	$ (26,907,359)

Proposed ESPC by ESG

RESOURCES - FUND 601	Escalation	Base Year 0 12/31/2014	Construction Period 1 12/31/2015	Construction Period 2 12/30/2016	Partial Construction Period 3 12/30/2017	4 12/30/2018	5 12/30/2019	5 12/29/2020	8 12/29/2021	9 12/29/2022	10 12/29/2023
Sales to Residents	1.5%	$ 11,914,816	$ 12,450,506	$ 12,863,240	$ 12,863,240	$ 13,056,189	$ 13,252,032	$ 13,450,812	$ 13,652,574	$ 13,857,363	$ 14,065,223
Penalty/Delinquent Water Bills	0%	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019
Special Assessment Property Certifications	0%	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048
Administrative Fees as Billing Agent for NEO Sewer District	0%	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319
Other Revenue	0%	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538
Note Proceeds	0%	$ 185,000		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
NEORSD Shared Revenue											
FUND RESOURCES		$ 13,171,741	$ 13,522,431	$ 13,935,165	$ 13,935,165	$ 14,128,114	$ 14,323,957	$ 14,522,737	$ 14,724,499	$ 14,929,288	$ 15,137,148
***Local Sewer benefit is not included in the above**											
OBLIGATIONS - FUND 601											
Wholesale Water Purchases from Cleveland	1.5%	$ 11,701,595	$ 12,254,601	$ 10,687,435	$ 9,936,710	$ 10,085,760	$ 10,237,047	$ 10,390,602	$ 10,546,461	$ 10,704,658	$ 10,865,228
Portion related to payment plan with CWD	0%	$ 369,407	**$ 1,580,638**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Wages	0%	$ 863,933	$ 863,933	$ 634,065	$ 634,065	$ 634,065	$ 634,065	$ 634,065	$ 634,065	$ 634,065	$ 634,065
Benefits	1%	$ 352,373	$ 352,373	$ 276,221	$ 277,602	$ 278,990	$ 280,385	$ 281,787	$ 283,195	$ 284,611	$ 286,035
Operating Costs -Other Than Personal Services	2%	$ 676,137	$ 436,577	$ 445,308	$ 454,214	$ 463,299	$ 472,565	$ 482,016	$ 491,656	$ 501,489	$ 511,519
Ohio Public Works Loan Repayment	0%	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 23,522			
Transfer to Fund 234 - Earned Benefits	0%	$ 15,025	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500
Bond Anticipation Note Principal	0%	$ 185,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OPWC Loan for Meadowbrook BLVD Project	0%	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372
Bond Anticipation Note Interest	0%	$ 1,850	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OPWC Loan for Runnymede/Quilliams Project	0%	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207
Capital Projects and Purchases	0%	$ 205,790	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000
Water Deposit Refunds & Operating Refunds	0%	$ 30,238	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850
Perfomance Contract Payment	0%	$ -		$ 830,000	$ 1,489,806	$ 1,489,806	$ 1,489,806	$ 1,489,806	$ 1,489,806	$ 1,489,806	$ 1,489,806
Perfomance Contract Related Expenses	0%		$ 64,172	$ 197,792	$ 211,126	$ 211,126	$ 211,126	$ 211,126	$ 211,126	$ 211,126	$ 211,126
FUND OBLIGATIONS		$ 14,486,970	$ 15,718,266	$ 13,236,794	$ 13,169,496	$ 13,329,019	$ 13,490,966	$ 13,631,853	$ 13,775,239	$ 13,944,685	$ 14,116,708
CASH SURPLUS + / DEFICIT ()		**($1,315,229)**	**($2,195,835)**	**$698,371**	**$765,669**	**$799,095**	**$832,990**	**$890,884**	**$949,260**	**$984,602**	**$1,020,440**
Cumlative			**($2,195,835)**	**($1,497,464)**	**($731,795)**	**$67,300**	**$900,290**	**$1,791,174**	**$2,740,433**	**$3,725,036**	**$4,745,476**

2 - Financial Approach

ESG used a baseline period of December 1, 2013 to November 30, 2014 to establish costs. Changes in revenue or costs were applied to this baseline to arrive at the proposed water utility budget. The intent of this project is to move the utility from a revenue shortfall each year to a cash flow positive enterprise that funds itself and allows for reinvestment in infrastructure.

ESG used the findings in this evaluation to design a program that would allow for this transformation. Based upon the scope of work outlines in Section 1 the costs to implement this program are shown in the table below.

Table 2.1: Project Financial Summary

ID	Project	Total Installed Cost	Water (New Revenue)	Annual Operational Savings	Total Guaranteed Annual Savings	Recommended Future Annual Fees/Services	Local Sewer Annual Benefit
1	Export/Import Meter Adjustment	$56,220	($1,150,081)	$0	($1,150,081)	$0	0
2	Replace 600 residential meters + 14,500 encoders & transmitters	$5,182,599	$34,319	$497,580	$531,899	($171,126)	$5,427
3	Replace 14,500 5/8" residential meters	$0	$0	$0	$0	$0	$0
4	Replace commercial meters 1" and larger (1400)	$1,101,563	$664,319	$0	$664,319	$0	$110,565
5	(10) PRV Vaults / Active Pressure Management	$1,957,507	$998,248	$0	$998,248	$0	$0
6	Leak Detection and Training	$320,144	$684,617	$48,000	$732,617	$0	$0
7	Infrastructure Improvements (leaks)	$9,400,000	$2,000,000	$0	$2,000,000	($40,000)	$0
8	Billing System Replacement	$0	$0	$0	$0	$0	$0
9	Development Costs	$120,000	0	0	$0	$0	$0
10	Engineering, GIS, Hydraulic Model, Project Management, SOP's, Commissioning, M&V	$1,842,634	$249,786	$0	$249,786	$0	$3,950
	Total	$19,980,667	$3,481,208	$545,580	$4,026,788	($211,126)	$119,942

Total Installed Cost – All costs for labor, material, engineering and project management to deliver the scope of work.

New Revenue – Increase in water sold from reducing apparent losses due to meter accuracies or billing errors, and decreases in wholesale water purchases form reductions in real losses.

Operational Savings – decreases in costs from redeployment of staff, vehicles, and material purchases

Total Savings - new revenue + operational savings

Recommended Services – Costs for new services recommended by ESG

Local Sewer benefit – New revenue based on the increase in water sold from the 11.05 $.Mcf 2014 water rates

Financing Plan

On the City's behalf, ESG requested preliminary financing proposals from six financial institutions. Four responded with proposals or expressions of interest. The one that appears most consistent with the City's requirements is a proposal for a 20-year limited tax general obligation financing from Capital One at a rate of 4.15%. This is a type of financing that calls for a "full faith and credit" repayment promise from the City, as opposed to an appropriation-based financing or some type of a revenue-pledge financing. Since the Capital One rate is subject to fluctuation, we have assumed a rate of 4.25% in our cash flow model. We anticipate that the financing will call for an "interest only" payment one year after funding, with repayment of principal starting two years after funding; exact terms of the financing will be determined through discussion between the City and the lender.

ESG is not a financial advisor or a "municipal advisor" in the context of the Dodd-Frank Wall Street Reform and Consumer Protection Act. In the course of its business, ESG sometimes assists customers by introducing project lenders or requesting financing proposals for customers. ESG expresses no opinion and makes no recommendation with respect to financing projects.

The other spreadsheets enclosed include:

- Operational savings analysis for automated metering infrastructure project
- Estimated construction savings as the project is implemented
- Annual revenue and costs for the water utility for future years
- Project cash flow with zero escalation
- Baseline water utility budget

City of Cleveland Heights
Project Financial Summary
1/16/2015

Functional Area	ID	Project	Estimated Total Cost	Water (New Revenue)	Annual Operational Savings	Total Guaranteed Annual Savings	Recommended Future Annual Fees/Services	Local Sewer Annual Benefit	NEORSD Benefit
Metering	1	Export/Import Meter Adjustment	$56,220	($1,150,081)		($1,150,081)	$0	0	0
	2	Replace 600 residential meters + 14,500 encoders & transmitters	$5,182,599	$34,319	$458,002	$492,321	($171,126)	$5,427	$31,639
	3	Replace 14,500 5/8" residential meters	$0	$0	$0	$0	$0	$0	$0
	4	Replace commercial meters 1" and larger (1400)	$1,101,563	$664,319	$0	$664,319	$0	$110,565	$635,280
Distribution	5	(10) PRV Vaults / Active Pressure Management	$1,957,507	$998,248	$0	$998,248	$0	$0	$0
	6	Leak Detection and Training	$320,144	$684,617	$48,000	$732,617	$0	$0	$0
Billing & Support	7	Infrastructure Improvements (leaks)	$9,400,000	$2,000,000	$0	$2,000,000	($40,000)	$0	$0
	8	Billing System Replacement	$0	$0	$0	$0	$0	$0	$0
	9	Development Costs	$120,000	0	0	$0	$0	$0	$0
	10	Engineering, GIS, Hydraulic Model, Project Management, SOP's, Commissioning, M&V	$1,842,634	$249,786		$249,786	$0	$3,950	$258,900
		Total	$19,980,667	$3,481,208	$506,002	$3,987,210	($211,126)	$119,942	$925,819

RESULTS	
Term	20
Interest Rate	4.15%
Financed Amount	$19,980,667
Annual Payment	$ (1,489,806)
NEORSD Contribution	
Positive Cash Flow	$2,406,220
Cash Flow Goal	$1,565,227
	pass

Savings - payment - ongoing fees $250,000 over baseline

Term	20
Interest Rate	4.15%
Financed Amount	$ 19,980,667

Year	Increase	Increased Water Revenues	0%	Reduction in Wholesale Water	0%	Operational Savings	0%	New Operating Costs	0%	Net Annual Savings	Annual Debt Payment	Cash Flow	Cumlative Cash Flow
Construction 2015		$535,690		$1,548,733		$106,061		($64,172)		$2,126,311		$2,126,311	$2,126,311
Construction 2016		$948,424		$2,730,865		$506,002		($197,792)		$3,987,499	($830,000)	$3,157,499	$5,283,810
2017		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$8,720,169
2018		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$12,156,528
2019		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$15,592,887
2020		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$19,029,245
2021		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$22,465,604
2022		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$25,901,963
2023		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$29,338,322
2024		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$32,774,681
2025		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$36,211,040
2026		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$39,647,399
2027		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$43,083,757
2028		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$46,520,116
2029		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$49,956,475
2030		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$53,392,834
2031		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$56,829,193
2032		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$60,265,552
2033		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$63,701,911
2034		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$67,138,270
2035		$948,424		$3,682,865		$506,002		($211,126)		$4,926,165	($1,489,806)	$3,436,359	$70,574,628
Total		$19,504,170		$74,254,033		$10,226,101		($4,273,352)		$99,710,952	($29,136,323)	$70,574,628	

Project Baseline

	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL	MTD ACTUAL					
RESOURCES - FUND 601	AS OF 12/31/2013	AS OF 1/31/14	AS OF 2/28/14	AS OF 3/31/14	AS OF 4/30/14	AS OF 5/31/14	AS OF 6/30/14	AS OF 7/31/14	AS OF 8/31/14	AS OF 9/30/14	AS OF 10/31/14	AS OF 11/30/14	TOTAL	New Costs	Water (New Revenue)	Operational	Totals
Sales to Residents	$951,793	$925,032	$965,773	$1,068,341	$1,016,649	$999,035	$1,030,542	$989,633	$1,167,932	$933,843	$1,058,831	$807,412	$11,914,816		$948,424		$12,863,240
Penalty/Delinquent Water Bills	$19,271	$19,068	$20,895	$27,768	$34,471	$26,090	$24,200	$21,311	$24,909	$24,081	$25,591	$16,363	$284,019				$284,019
Special Assessment Property Certifications	$0	$0	$0	$130,989	$0	$0	$0	$0	$0	$0	$100,059	$0	$231,048				$231,048
Administrative Fees as Billing Agent for NEO Sewe	$0	$0	$85,049	$0	$84,979	$0	$0	$85,119	$0	$0	$85,173	$0	$340,319				$340,319
Other Revenue	$5,450	$4,508	$5,514	$8,624	$26,687	$19,955	$27,341	$19,243	$25,010	$18,656	$43,430	$12,118	$216,538		$119,942		$336,480
Note Proceeds	$0	$0	$0	$0	$0	$0	$0	$185,000	$0	$0	$0	$0	$185,000				$185,000
														$0	$1,068,366	$0	$14,240,107
FUND RESOURCES	$976,515	$948,608	$1,077,231	$1,235,722	$1,162,786	$1,045,080	$1,082,084	$1,300,307	$1,217,851	$976,580	$1,313,084	$835,893	$13,171,741				
OBLIGATIONS - FUND 601																	
Wholesale Water Purchases from Cleveland	$754,520	$722,797	$913,205	$850,000	$1,046,351	$1,184,766	$1,107,540	$982,559	$1,055,719	$1,040,788	$949,216	$1,094,134	$11,701,595	$1,150,081	($3,682,865)		$9,168,811
Portion related to payment plan with CWD	$0	$0	$0	$369,407	$0	$0	$0	$0	$0	$0	$0	$0	$369,407				$369,407
Wages	$70,446	$106,789	$68,515	$92,267	$61,663	$60,403	$59,847	$61,370	$90,675	$60,924	$59,926	$71,107	$863,933			($147,022)	$716,911
Benefits	$23,951	$21,641	$26,431	$39,227	$44,456	$25,216	$22,136	$28,356	$40,359	$23,445	$29,150	$28,005	$352,373			($76,151)	$276,222
Operating Costs -Other Than Personal Services	$41,433	$45,985	$72,303	$56,792	$65,388	$96,659	$48,114	$94,630	$20,223	$55,483	$49,001	$30,125	$676,137	$211,126		($282,829)	$604,433
Ohio Public Works Loan Repayment	$10,103	$32,707	$0	$0	$0	$0	$42,811	$0	$0	$0	$0	$0	$85,621	$1,489,806			$1,575,428
Capital Projects & Purchases	$0	$44,642	$0	$146,933	$0	$0	$0	$1,044	$13,171	$0	$0	$0	$205,790				$205,790
Bond Anticipation Note Principal	$0	$0	$0	$0	$0	$0	$0	$185,000	$0	$0	$0	$0	$185,000				$185,000
Bond Anticipation Note Interest	$0	$0	$0	$0	$0	$0	$0	$1,850	$0	$0	$0	$0	$1,850				$1,850
Transfer to Fund 234 - Earned Benefits	$15,025	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$15,025				$15,025
Water Deposit Refunds & Operating Refunds	$1,477	$5,418	$1,961	$1,685	$1,906	$1,479	$2,432	$2,194	$3,138	$891	$3,076	$4,581	$30,238				
														$2,851,013	($3,682,865)	($506,002)	$13,118,876
FUND OBLIGATIONS	$916,955	$979,979	$1,082,415	$1,556,312	$1,219,764	$1,368,524	$1,282,879	$1,357,004	$1,223,284	$1,181,531	$1,090,370	$1,227,952	$14,486,968				
CASH SURPLUS + / DEFICIT ()	**$59,560**	($31,371)	($5,184)	($320,589)	($56,978)	($323,444)	($200,795)	($56,697)	($5,433)	($204,950)	**$222,714**	($392,059)	($1,315,227)				

Wholesale Water Purchases from Cleveland for November 2014 was not paid in that month due to potentially working out a payment plant with CWD. This is the current amount due that would have normally been paid in that month.

Goal $250,000
Deficient/Surplus $1,121,231

BASE CASE

RESOURCES - FUND 601	Escalation	Base Year	1 12/31/2014	2 12/31/2015	3 12/30/2016	4 12/30/2017	5 12/30/2018	6 12/30/2019	7 12/29/2020	8 12/29/2021	9 12/29/2022	10 12/29/2023
Sales to Residents	1.5%	$	11,914,816	$ 11,914,816	$ 11,914,816	$ 11,914,816	$ 12,093,538	$ 12,274,941	$ 12,459,066	$ 12,645,952	$ 12,835,641	$ 13,028,175
Penalty/Delinquent Water Bills	0%	$	284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019
Special Assessment Property Certifications	0%	$	231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048
Administrative Fees as Billing Agent for NEO Sewer District	0%	$	340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319
Other Revenue	0%	$	216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538
Note Proceeds	0%	$	185,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
FUND RESOURCES		$	13,171,741	$ 12,986,741	$ 12,986,741	$ 12,986,741	$ 13,165,463	$ 13,346,866	$ 13,530,991	$ 13,717,876	$ 13,907,566	$ 14,100,100
OBLIGATIONS - FUND 601												
Wholesale Water Purchases from Cleveland	1.5%	$	11,701,595	$ 13,220,000	$ 13,418,300	$ 13,619,575	$ 13,823,868	$ 14,031,226	$ 14,241,695	$ 14,455,320	$ 14,672,150	$ 14,892,232
Portion related to payment plan with CWD	0%	$	369,407	$ 1,580,637.80	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Wages	2%	$	863,933	$ 863,933	$ 863,933	$ 863,933	$ 881,212	$ 898,836	$ 916,813	$ 935,149	$ 953,852	$ 972,929
Benefits	1%	$	352,373	$ 346,841	$ 346,841	$ 348,575	$ 350,318	$ 352,070	$ 353,830	$ 355,599	$ 357,377	$ 359,164
Operating Costs -Other Than Personal Services	2%	$	676,137	$ 703,920	$ 717,998	$ 732,358	$ 747,006	$ 761,946	$ 777,185	$ 792,728	$ 808,583	$ 824,754
Ohio Public Works Loan Repayment	0%	$	47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044
Transfer to Fund 234 - Earned Benefits	0%	$	15,025	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500
Bond Anticipation Note Principal	0%	$	185,000		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OPWC Loan for Meadowbrook BLVD Project	0%	$	18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372
Bond Anticipation Note Interest	0%	$	1,850		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OPWC Loan for Runnymede/Quilliams Project	0%	$	20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207
Capital Projects and Purchases	0%	$	205,790	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000
Water Deposit Refunds & Operating Refunds	0%	$	30,238	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850
FUND OBLIGATIONS		$	14,486,970	$ 16,881,305	$ 15,513,046	$ 15,730,414	$ 15,968,377	$ 16,210,051	$ 16,455,495	$ 16,704,770	$ 16,957,935	$ 17,215,053
CASH SURPLUS + / DEFICIT ()		$	(1,315,229)	$ (3,894,564)	$ (2,526,305)	$ (2,743,673)	$ (2,802,913)	$ (2,863,184)	$ (2,924,505)	$ (2,986,893)	$ (3,050,369)	$ (3,114,952)
Cumlative				$ (3,894,564)	$ (6,420,869)	$ (9,164,542)	$ (11,967,455)	$ (14,830,640)	$ (17,755,144)	$ (20,742,037)	$ (23,792,407)	$ (26,907,359)

Proposed ESPC by ESG

	Escalation	Base Year 0 12/31/2014	Construction Period 1 12/31/2015	Construction Period 2 12/30/2016	Partial Construction Period 3 12/30/2017	4 12/30/2018	5 12/30/2019	5 12/29/2020	8 12/29/2021	9 12/29/2022	10 12/29/2023
RESOURCES - FUND 601											
Sales to Residents	1.5%	$ 11,914,816	$ 12,450,506	$ 12,863,240	$ 12,863,240	$ 13,056,189	$ 13,252,032	$ 13,450,812	$ 13,652,574	$ 13,857,363	$ 14,065,223
Penalty/Delinquent Water Bills	0%	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019	$ 284,019
Special Assessment Property Certifications	0%	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048	$ 231,048
Administrative Fees as Billing Agent for NEO Sewer District	0%	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319	$ 340,319
Other Revenue	0%	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538	$ 216,538
Note Proceeds	0%	$ 185,000		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
NEORSD Shared Revenue											
FUND RESOURCES		$ 13,171,741	$ 13,522,431	$ 13,935,165	$ 13,935,165	$ 14,128,114	$ 14,323,957	$ 14,522,737	$ 14,724,499	$ 14,929,288	$ 15,137,148
***Local Sewer benefit is not included in the above**											
OBLIGATIONS - FUND 601											
Wholesale Water Purchases from Cleveland	1.5%	$ 11,701,595	$ 12,254,601	$ 10,687,435	$ 9,936,710	$ 10,085,760	$ 10,237,047	$ 10,390,602	$ 10,546,461	$ 10,704,658	$ 10,865,228
Portion related to payment plan with CWD	0%	$ 369,407	**$ 1,580,638**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Wages	0%	$ 863,933	$ 863,933	$ 716,911	$ 716,911	$ 716,911	$ 716,911	$ 716,911	$ 716,911	$ 716,911	$ 716,911
Benefits	1%	$ 352,373	$ 352,373	$ 276,222	$ 277,603	$ 278,991	$ 280,386	$ 281,788	$ 283,197	$ 284,612	$ 286,036
Operating Costs -Other Than Personal Services	2%	$ 676,137	$ 393,308	$ 401,174	$ 409,197	$ 417,381	$ 425,729	$ 434,243	$ 442,928	$ 451,787	$ 460,823
Ohio Public Works Loan Repayment	0%	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 47,044	$ 23,522			
Transfer to Fund 234 - Earned Benefits	0%	$ 15,025	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500
Bond Anticipation Note Principal	0%	$ 185,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OPWC Loan for Meadowbrook BLVD Project	0%	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372	$ 18,372
Bond Anticipation Note Interest	0%	$ 1,850	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OPWC Loan for Runnymede/Quilliams Project	0%	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207	$ 20,207
Capital Projects and Purchases	0%	$ 205,790	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000	$ 36,000
Water Deposit Refunds & Operating Refunds	0%	$ 30,238	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850	$ 31,850
Perfomance Contract Payment	0%	$ -		$ 830,000	$ 1,489,806	$ 1,489,806	$ 1,489,806	$ 1,489,806	$ 1,489,806	$ 1,489,806	$ 1,489,806
Perfomance Contract Related Expenses	0%		$ 64,172	$ 197,792	$ 211,126	$ 211,126	$ 211,126	$ 211,126	$ 211,126	$ 211,126	$ 211,126
FUND OBLIGATIONS		$ 14,486,970	$ 15,674,997	$ 13,275,507	$ 13,207,326	$ 13,365,948	$ 13,526,977	$ 13,666,928	$ 13,809,359	$ 13,977,830	$ 14,148,859
CASH SURPLUS + / DEFICIT ()		($1,315,229)	($2,152,566)	$659,658	$727,839	$762,165	$796,979	$855,809	$915,141	$951,458	$988,290
Cumlative			($2,152,566)	($1,492,908)	($765,069)	($2,904)	$794,075	$1,649,885	$2,565,025	$3,516,483	$4,504,773

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Badger Meter

ORION® Water Endpoints

Cellular Endpoint

DESCRIPTION

The ORION® Cellular endpoint is an innovative, two-way water endpoint that utilizes existing cellular infrastructure to efficiently and securely deliver meter reading data to the utility via the reliable cellular network.

The Cellular endpoint is a member of the time-tested ORION family of products from Badger Meter, designed for maximum flexibility. Since 2002, the ORION product family has provided comprehensive Advanced Metering Analytics (AMA) for interval meter reading and data capture using both one-way and two-way communications.

FUNCTIONALITY

Operation: The ORION Cellular endpoint communicates with the encoder and captures readings and meter status information. At a predetermined interval, the endpoint broadcasts this data via the cellular network and the information is captured and analyzed using the BEACON AMA software.

Activation: All ORION endpoints are shipped in an inactive, non-transmitting state. ORION Cellular endpoints are designed for easy activation and installation with either the smartphone installation application or Trimble® Ranger handheld.

Broadcast Mode: ORION Cellular endpoints broadcast their fixed network reading data through the secure existing cellular network within the service area.

Data Profiling: To build data redundancy within the system, the ORION Cellular endpoint stores 120 days of hourly data for capture via two-way communication.

Output Message: The endpoint broadcasts its unique serial number, current meter reading and applicable status indicators. Each message is encrypted to meet AES 256 encryption standards.

APPLICATION

Configurations: The ORION Cellular endpoint is a multi-purpose endpoint that can be deployed in indoor, outdoor and pit applications. The endpoint electronics and battery assembly are fully encapsulated in epoxy for environmental integrity. The ORION Cellular endpoint is available with the connector assembly for ease of installation.

Meter Compatibility: When attached to a Badger Meter high resolution encoder, the ORION Cellular endpoint is compatible with all current Badger Meter Recordall® Disc, Turbo Series, Compound Series, Combo Series and Fire Service meters and assemblies, and with E-Series® Ultrasonic and M-Series® Electromagnetic Flow meters.

Encoder Compatibility: The ORION Cellular endpoint is suitable for use with Badger Meter high resolution encoders as well as the following Badger Meter approved three-wire encoder registers that have a manufacture date of 2000 or newer, are programmed into the AMR/AMI three-wire output mode and have three-wires connected: Elster InVISION and ScanCoder® encoders and evoQ4 meter (encoder output); Hersey® Translator; Master Meter® Octave® Ultrasonic meter encoder output; Metron-Farnier Hawkeye; Neptune® ProRead, E-Coder® and ARB-V®; and Sensus® Electronic Register encoder (ECR) and ICE.

ORI-DS-00561-EN-07 (October 2014)

Product Data Sheet

SPECIFICATIONS

Dimensions	5.125" (H); 1.75" (W) at top; 2.125" (W) at bottom
Broadcast Network	CDMA cellular network
Operating Temperature Range ***Storage and Meter Reading*** ***Communications***	 -40°…60° C (-40°…140° F) -20°…60° C (-4°…140° F)
Humidity	0% …100% condensing
Battery	One (1) lithium thionyl chloride C cell (nonreplaceable)

Construction: All ORION Cellular endpoints are housed in an engineered polymer enclosure with an ORION RF board, battery and antenna. To ensure long-term performance, the enclosure is fully potted to withstand harsh environments and to protect the electronics in flooded or submerged pit applications.

FEATURES

Communication Type	Two-Way
Application Type	Control/Monitor
Reading Interval Type	Hourly
Encoder Compatibility	Absolute
Fixed Network Reading	✓
Premise Leak Detection	✓
Cut-Wire Indication	✓
Reverse Flow Indication	✓
No Usage Indication	✓
Encoder Error	✓
Low Battery Indication	✓
Remote Programming	✓
Remote Clock Synchronization	✓
Firmware Upgrades	✓

License Requirements: ORION Cellular endpoints comply with Part 15, Part 22 and Part 24 of the FCC Rules. No license is required by the utility to operate an ORION meter reading system.

Transportation: The Federal Aviation Administration prohibits operating transmitters and receivers on all commercial aircraft. The ORION endpoint is considered an operating transmitter and cannot be shipped by air.

Caution: Changes or modifications to the equipment that are not expressly approved by Badger Meter could void the user's authority to operate the equipment.

Making Water Visible®

www.badgermeter.com

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Badger Meter

Recordall® Disc Meters

Lead-Free Bronze Alloy, Sizes 5/8", 5/8" x 3/4", 3/4" & 1"
NSF/ANSI Standards 61 and 372 Certified

Model LP—5/8", 5/8" x 3/4"

Model 25—5/8", 5/8" x 3/4"

Model 35—3/4"

Model 55—1"

Model 70—1"

DESCRIPTION

The Recordall Disc Series meters meet or exceed the most recent revision of AWWA Standard C700 and are available in a lead-free bronze alloy. The meters comply with the lead-free provisions of the Safe Drinking Water Act, are certified to NSF/ANSI Standards 61 and 372 (Trade Designations: MLP-LL, M25-LL, M35-LL, M55-LL, M70-LL) and carry the NSF-61 mark on the housing. All components of the lead-free bronze alloy meter (housing, measuring element, seals, and so on) comprise the certified system.

Applications: For use in measurement of potable cold water in residential, commercial and industrial services where flow is in one direction only.

Operation: Water flows through the meter's strainer and into the measuring chamber where it causes the disc to nutate. The disc, which moves freely, nutates on its own ball, guided by a thrust roller. A drive magnet transmits the motion of the disc to a follower magnet located within the permanently sealed register. The follower magnet is connected to the register gear train. The gear train reduces the disc nutations into volume totalization units displayed on the register or encoder face.

Operating Performance: The Recordall Disc Series meters meet or exceed registration accuracy for the low flow rates (95%), normal operating flow rates (100 ± 1.5%), and maximum continuous operation flow rates as specifically stated in AWWA Standard C700.

Construction: Recordall Disc meter construction, which complies with ANSI/AWWA standard C700, consists of three basic components: meter housing, measuring chamber, and permanently sealed register or encoder. The meter is available in a lead-free bronze alloy with externally-threaded spuds. A corrosion-resistant engineered polymer material is used for the measuring chamber.

Magnetic Drive: Direct magnetic drive, through the use of high-strength magnets, provides positive, reliable and dependable register coupling for straight-reading or AMR/AMI meter reading options.

Tamper-Proof Features: Unauthorized removal of the register or encoder is inhibited by the option of a tamper detection seal wire screw, TORX® tamper-resistant seal screw or the proprietary tamper-resistant keyed seal screw. Each can be installed at the meter site or at the factory.

Maintenance: Badger Meter Recordall Disc Series meters are designed and manufactured to provide long-term service with minimal maintenance. When maintenance is required, it can be performed easily either at the meter installation or at any other convenient location.

To simplify maintenance, the register, measuring chamber, and strainer can be replaced without removing the meter housing from the installation. No change gears are required for accuracy calibration. Interchangeability of parts among like-sized meters and meter models also minimizes spare parts inventory investment. The built-in strainer has an effective straining area of twice the inlet size.

Connections: Tailpieces/Unions for installations of meters on various pipe types and sizes, including misaligned pipes, are available as an option.

Meter Spud and Connection Sizes

Model	Size Designation	×	"L" Laying Length	"B" Bore Dia.	Coupling Nut and Spud Thread	Tailpiece Pipe Thread (NPT)
LP	5/8"	×	7-1/2"	5/8"	3/4" (5/8")	1/2"
	5/8" x 3/4"	×	7-1/2"	5/8", 3/4"	1" (3/4")	3/4"
25	5/8"	×	7-1/2"	5/8"	3/4" (5/8")	1/2"
	5/8" x 3/4"	×	7-1/2"	5/8", 3/4"	1" (3/4")	3/4"
35	3/4"	×	7-1/2"	3/4"	1" (3/4")	3/4"
	3/4"	×	9"	3/4"	1" (3/4")	3/4"
	3/4" x 1"	×	9"	3/4"	1-1/4" (1")	1"
55	1"	×	10-3/4"	1"	1-1/4" (1")	1"
70	1"	×	10-3/4"	1"	1-1/4" (1")	1"

RDM-DS-00464-EN-02 AWWA (June 2014)

Product Data Sheet

Recordall® Disc Series Meters

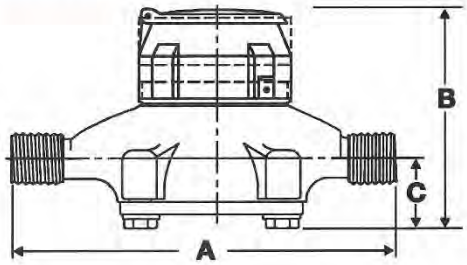
SPECIFICATIONS

	Model LP (5/8" & 5/8" x 3/4")	Model 25 (5/8" & 5/8" x 3/4")	Model 35 (3/4")	Model 55 (1")	Model 70 (1")
Typical Operating Range (100% ± 1.5%)	0.5…20 gpm (0.11…4.5 m³/hr)	0.5…25 gpm (0.11…5.7 m³/hr)	0.75…35 gpm (0.17…7.9 m³/hr)	1…55 gpm (0.23…12.5 m³/hr)	1.25…70 gpm (0.28…16 m³/hr)
Low Flow	0.25 gpm (0.057 m³/hr) Min. 95%	0.25 gpm (0.057 m³/hr) Min. 98.5%	0.375 gpm (0.085 m³/hr) Min. 97%	0.5 gpm (0.11 m³/hr) Min. 95%	0.75 gpm (0.17 m³/hr) Min. 95%
Maximum Continuous Operation	10 gpm (2.3 m³/hr)	15 gpm (3.4 m³/hr)	25 gpm (5.7 m³/hr)	40 gpm (9.1 m³/hr)	50 gpm (11.3 m³/hr)
Pressure Loss at Maximum Continuous Operation	**5/8" size:** 2 psi @ 10 gpm (0.14 bar @ 2.3 m³/hr) **5/8" x 3/4" size:** 1.5 psi @ 10 gpm (0.10 bar @ 2.3 m³/hr)	**5/8" size:** 3.5 psi @ 15 gpm (0.24 bar @ 3.4 m³/hr) **5/8" x 3/4" size:** 2.8 psi @ 15 gpm (0.19 bar @ 3.4 m³/hr)	5 psi @ 25 gpm (0.37 bar @ 5.7 m³/hr)	3.4 psi @ 40 gpm (0.23 bar @ 9.1 m³/hr)	6.5 psi @ 50 gpm (0.45 bar @ 11.3 m³/hr)
Maximum Operating Temperature	80° F (26° C)				
Maximum Operating Pressure	150 psi (10 bar)				
Measuring Element	Nutating disc, positive displacement				
Meter Connections	*Available in NL bronze and engineered polymer to fit spud thread bore diameter sizes:*				
	5/8" or 3/4" (DN 15 mm)	**5/8" size:** 5/8" (DN 15 mm) **5/8" x 3/4" size:** 3/4" (DN 15 mm)	3/4" (DN 20 mm)	1" (DN 25 mm)	1" (DN 25 mm)

MATERIALS

	Model LP (5/8" & 5/8" x 3/4")	Model 25 (5/8" & 5/8" x 3/4")	Model 35 (3/4")	Model 55 (1")	Model 70 (1")
Meter Housing	Lead-free bronze alloy				
Housing Bottom Plates	Lead-free bronze alloy, cast iron, engineered polymer		Cast iron, lead-free bronze alloy		
Measuring Chamber	Engineered polymer				
Disc	Engineered polymer				
Trim	Stainless steel				
Strainer	Engineered polymer				
Disc Spindle	Engineered polymer	Stainless steel	Stainless steel	Engineered polymer	Stainless steel
Magnet	Ceramic	Ceramic	Ceramic	Polymer bonded	Ceramic
Magnet Spindle	Engineered polymer	Stainless steel	Stainless steel	Engineered polymer	Stainless steel
Register Lid and Shroud	Engineered polymer, bronze				

DIMENSIONS



Meter Size	Model	A Laying Length	B Height Reg.	C Centerline Base	Width	Approx. Shipping Weight
5/8" and 5/8" x 3/4" (15 mm)	LP	7-1/2" (190 mm)	3.70" (94 mm)	1.26" (32 mm)	3.75" (95 mm)	3 lb (1.4 kg)
5/8" (15 mm)	25	7-1/2" (190 mm)	4-15/16" (125 mm)	1-11/16" (42 mm)	4-1/4" (108 mm)	4-1/2 lb (2 kg)
5/8" x 3/4" (15 mm)		7-1/2" (190 mm)	4-15/16" (125 mm)	1-11/16" (42 mm)	4-1/4" (108 mm)	4-1/2 lb (2 kg)
3/4" (20 mm)	35	7-1/2" (190 mm)	5-1/4" (133 mm)	1-5/8" (41 mm)	5" (127 mm)	5-1/2 lb (2.5 kg)
3/4" (20 mm)		9" (229 mm)	5-1/4" (133 mm)	1-5/8" (41 mm)	5" (127 mm)	5-3/4 lb (2.6 kg)
3/4" x 1" (20 mm)		9" (229 mm)	5-1/4" (133 mm)	1-5/8" (41 mm)	5" (127 mm)	6 lb (2.7 kg)
1" (25 mm)	55	10-3/4" (273 mm)	6" (152 mm)	2-1/32" (52 mm)	6-1/4" (159 mm)	8-3/4 lb (3.9 kg)
1" (25 mm)	70	10-3/4" (273 mm)	6-1/2" (165 mm)	2-5/16" (59 mm)	7-3/4" (197 mm)	11-1/2 lb (5.2 kg)

REGISTERS / ENCODERS

Standard—Sweep-Hand Registration

The standard register is a straight-reading, permanently sealed magnetic drive register. Dirt, moisture, tampering and lens fogging problems are eliminated. The register has a six-odometer wheel totalization display, 360° test circle with center sweep hand, and flow finder to detect leaks. Register gearing is made of self-lubricating engineered polymer, which minimizes friction and provides long life. The multi-position register simplifies meter installation and reading. The register capacity is 10,000,000 gallons (1,000,000 ft³, 100,000 m³).

A Model 25 register is used in the following example:

Model	Gallon	Cubic Feet	Cubic Meter
LP	10	1	0.1
25 (5/8")	10	1	0.1/0.01
25 (5/8" x 3/4")	10	1	0.1/0.01
35	10	1	0.1
55	10	1	0.1
70	10	1	0.1

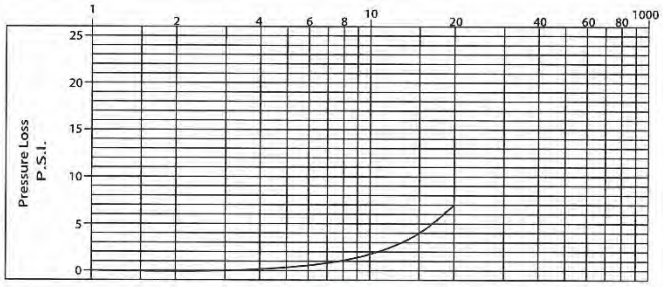
Optional—Encoders for AMR/AMI Reading Solutions

AMR/AMI solutions are available for all Recordall Disc Series meters. All reading options can be removed from the meter without disrupting water service. Badger Meter encoders provide years of reliable, accurate readings for a variety of applications and are also available pre-wired to Badger Meter approved AMR/AMI solutions. See details at **www.badgermeter.com**.

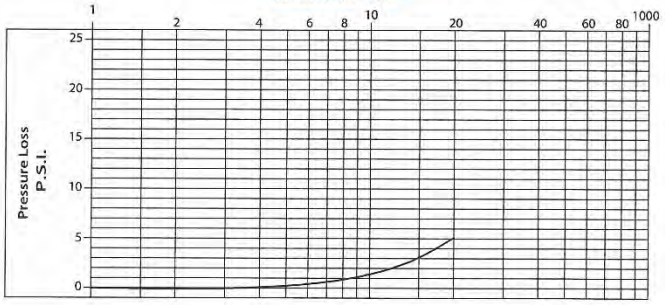
PRESSURE LOSS CHARTS

Rate of Flow in Gallons per Minute

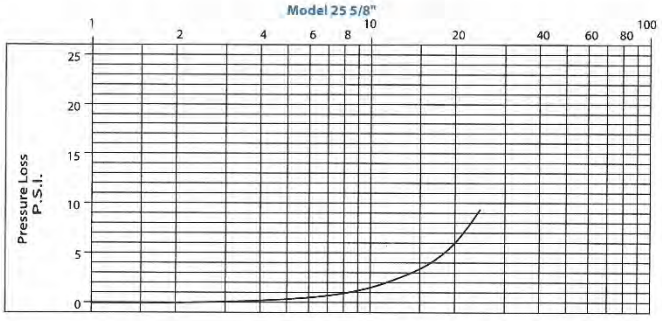
Model LP 5/8"



Model LP 5/8" × 3/4"



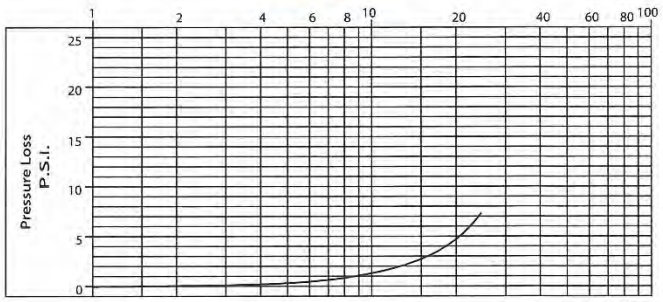
Model 25 5/8"



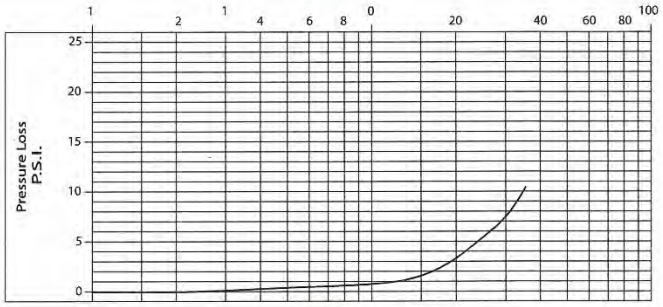
PRESSURE LOSS CHARTS (CONTINUED)

Rate of Flow in Gallons per Minute

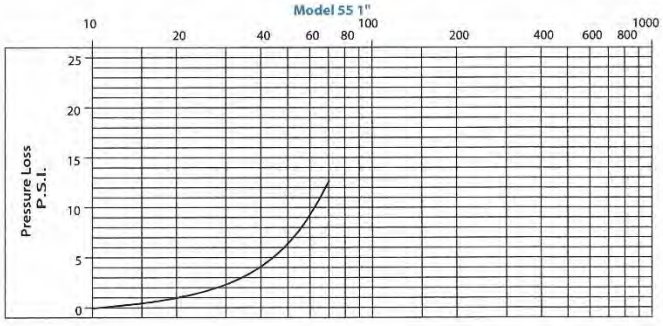
Model 25 5/8" x 3/4"



Model 35 3/4"



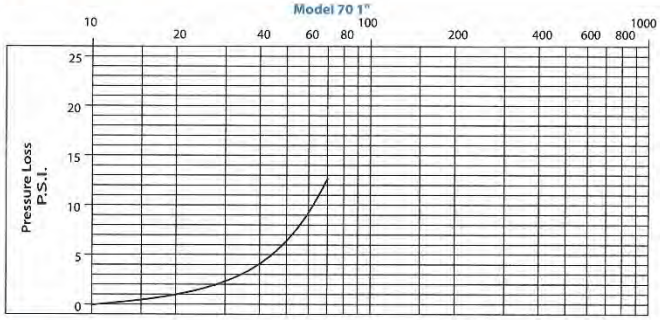
Model 55 1"



PRESSURE LOSS CHARTS (CONTINUED)

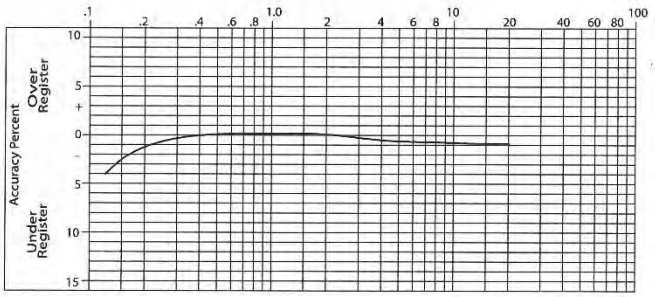
Rate of Flow in Gallons per Minute

Model 70 1"

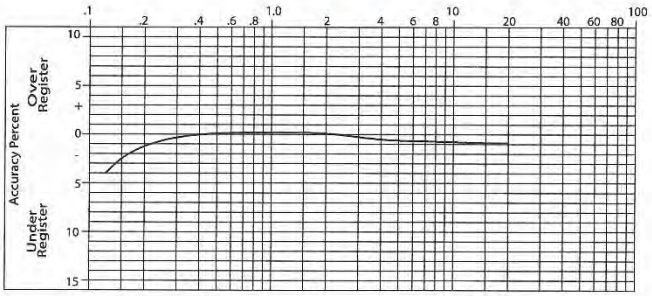


ACCURACY CHARTS

Model LP 5/8"

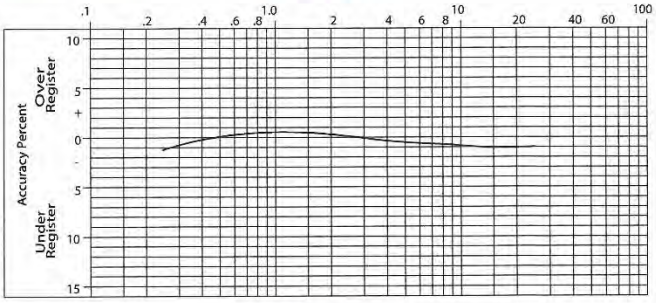


Model LP 5/8" x 3/4"

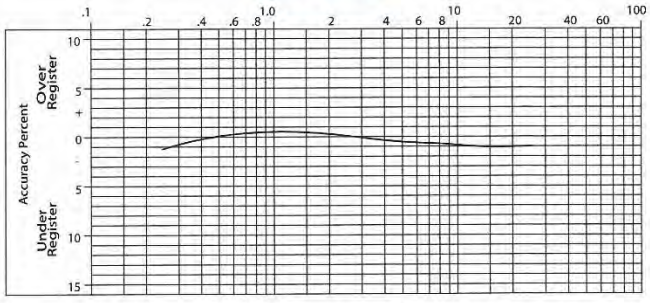


ACCURACY CHARTS (CONTINUED)

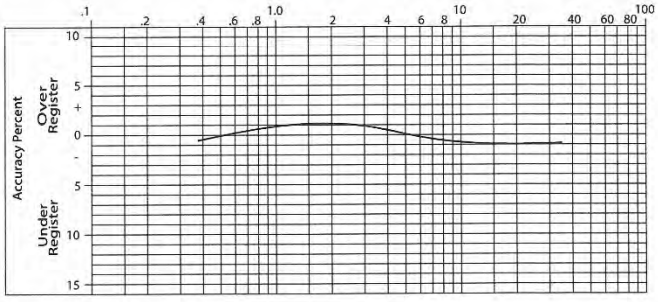
Model 25 5/8"



Model 25 5/8" × 3/4"

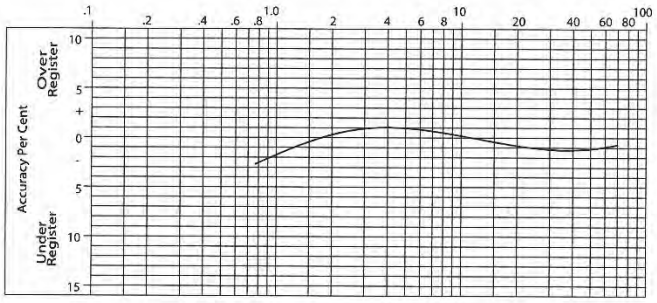


Model 35 3/4"

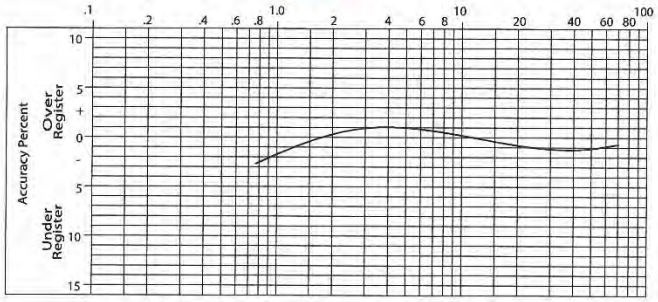


ACCURACY CHARTS (CONTINUED)

Model 55 1"



Model 70 1"



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Legacy Document Numbers: RDM-DS-00062, 63, 64, 65, 66, and 73

Badger Meter

E-Series® Ultrasonic Meter

Cold Water Stainless Steel Meter, 1-1/2" and 2"
NSF/ANSI Standard 61 Certified, Annex G

DESCRIPTION

The E-Series® Ultrasonic meter uses solid-state technology in a compact, totally encapsulated, weatherproof, and UV-resistant housing, suitable for residential and commercial applications. Electronic metering provides information—such as rate of flow and reverse flow indication—and data not typically available through traditional, mechanical meters and registers. Electronic metering eliminates measurement errors due to sand, suspended particles and pressure fluctuations.

The Ultrasonic 1-1/2" and 2" meters feature:

- Minimum extended low-flow rate lower than typical positive displacement meters.
- Simplified one-piece electronic meter and register that are integral to the meter body and virtually maintenance free.
- Sealed, non-removable, tamper-protected meter and register.
- Easy-to-read, 9-digit LCD display presents consumption, rate of flow, reverse-flow indication, and alarms.
- High resolution industry standard ASCII encoder protocol.

The Ultrasonic meter is available with a wired lead, in-line connector or fully prewired to AMR/AMI devices.

APPLICATIONS

Use the Ultrasonic meter for measuring potable cold water in residential, commercial and industrial services. The meter is also ideal for non-potable, reclaimed irrigation water applications or less than optimum water conditions where small particles exist.

The Ultrasonic meter complies with applicable portions of ANSI/AWWA Standard C700 and NSF/ANSI Standard 61, Annex G. There is currently no AWWA standard that specifically addresses ultrasonic meters for residential applications.

OPERATION & PERFORMANCE

As water flows into the measuring tube, ultrasonic signals are sent consecutively in forward and reverse directions of flow. Velocity is then determined by measuring the time difference between the measurement in the forward and reverse directions. Total volume is calculated from the measured flow velocity using water temperature and pipe diameter. The LCD display shows total volume and alarm conditions and can toggle to display rate of flow.

In the normal temperature range of 45…85° F (7…29° C), the Ultrasonic "new meter" consumption measurement is accurate to:

- ±1.5% over the normal flow range
- ±3.0% from the extended low flow range to the minimum flow value

CONSTRUCTION

E-Series Ultrasonic meters feature a stainless steel, lead-free meter housing, an engineered polymer and stainless steel metering insert, a meter-control circuit board with associated wiring, LCD, and battery. Wetted elements are limited to the pressure vessel, the polymer/stainless steel metering insert and the transducers. The electronic components are housed and fully potted within a molded, engineered polymer enclosure, which is permanently attached to the meter housing. The transducers extend through the stainless steel housing and are sealed by O-rings.

The metering insert holds the stainless steel ultrasonic reflectors in the center of the flow area, enabling turbulence-free water flow through the tube and around the ultrasonic signal reflectors. The metering insert's patented design virtually eliminates chemical buildup on the reflectors, ensuring long-term metering accuracy.

METER INSTALLATION

The meter is completely submersible and can be installed using horizontal or vertical piping, with flow in the up direction. The meter will not measure flow when an "empty pipe" condition is experienced. An empty pipe is defined as a condition when the flow sensors are not fully submerged.

ESM-DS-00672-EN-04 (June 2014)

Product Data Sheet

E-Series® Ultrasonic Meter, Cold Water Stainless Steel Meter

SPECIFICATIONS

E-Series Ultrasonic Meter Size	1-1/2" (40 mm)	2" (50 mm)
Operating Range	1.25…100 gpm	1.5…160 gpm
Extended Low-Flow Rate	0.40 gpm	0.50 gpm
Maximum Continuous Operation	100 gpm	160 gpm
Pressure Loss at Maximum Flow	3.8 psi	5.2 psi
Reverse Flow – Maximum Rate	12 gpm	18 gpm
Operating Performance	In the normal temperature range of 45…85° F (7…29° C), new meter consumption measurement is accurate to: • ±1.5% over the normal flow range • ±3.0% from the extended low flow range to the minimum flow value	
Storage Temperature	– 40…140° F (– 40…60° C)	
Maximum Ambient Storage (Storage for One Hour)	150° F (72° C)	
Measured-Fluid Temperature Range	34…140° F (1…60° C)	
Humidity	0…100% condensing; meter is capable of operating in fully submerged environments	
Maximum Operating Pressure of Meter Housing	175 psi (12 bar)	
Register Type	Straight reading, permanently sealed electronic LCD; digits are 0.28" (7 mm) high	
Register Display	• Consumption (up to nine digits) • Rate of flow • Alarms • Unit of measure factory programmed for gallons, cubic feet and cubic meters	
Register Capacity	• 100,000,000 gallons • 10,000,000 cubic feet • 1,000,000 cubic meters	
Totalization Display Resolution	• Gallons: 0.X • Cubic feet: 0.XX • Cubic meters: 0.XXX	
Battery	3.6-volt lithium thionyl chloride; battery is fully encapsulated within the register housing and is not replaceable; 20-year battery life	

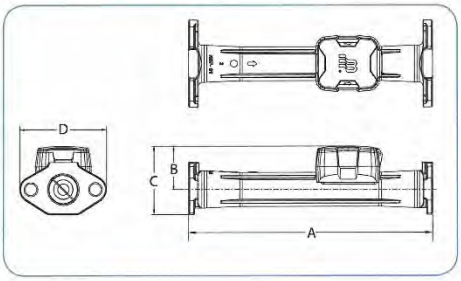
MATERIALS

Meter Housing	316 stainless steel
Measuring Element	Pair of ultrasonic sensors located in the flow tube
Register Housing & Lid	Engineered polymer
Metering Insert	Engineered polymer & stainless steel
Transducers	Piezo-ceramic device with wetted surface of stainless CrNiMo

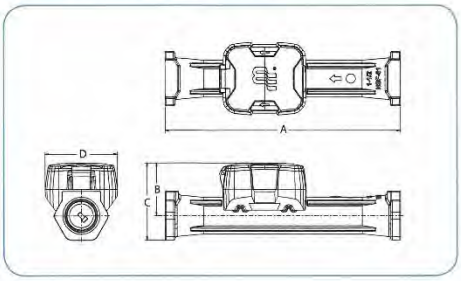
PHYSICAL DIMENSIONS

E-Series Ultrasonic Meter Size	1-1/2" (40 mm)	1-1/2" (40 mm)	2" (50 mm)	2" (50 mm)
Housing	**Elliptical**	**HEX**	**Elliptical**	**HEX**
Size Designation X Lay Length	1-1/2" x 13"	1-1/2" x 12.62"	2" x 17"	2" x 15.25"
Weight (without AMR)	8.2 lb	6.5 lb	11.9 lb	8.9 lb
See illustration below for Measurement Designations.				
Length (A)	13"	12.62"	17"	15.25"
Height (B)	2.80"	2.84"	3.01"	3.06"
Height (C)	4.55"	4.15"	4.76"	4.68"
Width (D)	5.50"	3.90"	6.08"	3.90"
Bore Size	1-1/2"	1-1/2"	2"	2"
Two-Bolt Elliptical Flange (AWWA)	1-1/2"	—	2"	—
Companion Flange	1-1/2"	—	2"	—
Internal Thread Size	—	1-1/2" NPT	—	2" NPT

Elliptical Measurement Designations

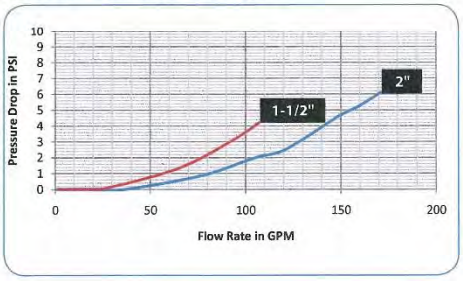


HEX Measurement Designations



PRESSURE LOSS CHART

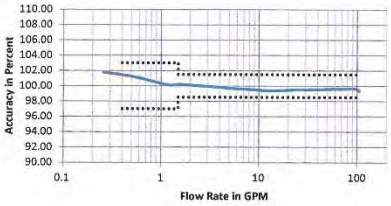
Rate of Flow in Gallons per Minute (gpm)



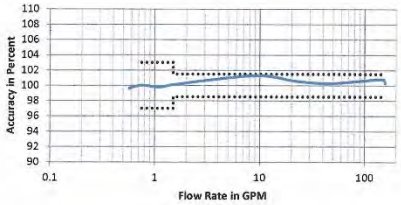
ACCURACY CHARTS

Rate of Flow in Gallons per Minute (gpm)

1-1/2" Meter



2" Meter



Making Water Visible®

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Legacy Document Number: ESM-T-10-EN

Badger Meter

Recordall® Compound Series Meter

Lead-Free Bronze Alloy, Sizes 2", 3", 4" & 6"
NSF/ANSI Standards 61 and 372 Certified

DESCRIPTION

The Recordall Compound Series meters meet or exceed the most recent revision of AWWA Standard C700 and are available in a lead-free bronze alloy. The Compound Series meters comply with the lead-free provisions of the Safe Drinking Water Act, are certified to NSF/ANSI Standards 61 and 372 (Trade Designation: LL-NS) and carry the NSF-61 mark on the housing. All components of the lead-free bronze alloy meter (housing, measuring element, seals, and so on) comprise the certified system.

Badger Meter Recordall® Compound Series meters combine two metering technologies in one innovative package. A positive displacement chamber measures low flow, while a turbine chamber records high flow.

Offered in four sizes, the Compound Series meter features:

- Patented design that eliminates the need for a trigger valve and maintains crossover accuracy.
- Permanently sealed, tamper-resistant register or encoder.
- Meters and encoders that are compatible with Badger Meter AMR/AMI systems and other approved reading technologies

Badger Meter ORION® and GALAXY® AMR/AMI meter reading systems are available for all Compound Series meters. Itron® ERT reading systems are also available. An optional summator can be provided as an integral part of the register assembly. All register options are removable from the meter without disrupting water service.

TAMPER-PROOF FEATURES

Unauthorized removal of the register or encoder is inhibited by the use of an optional tamper detection seal wire screw, TORX® tamper-resistant seal screw or the proprietary tamper-resistant keyed seal screw. Each can be installed at the meter site or at the factory.

APPLICATIONS

Use the Recordall Compound meter for measuring potable cold water in commercial and industrial applications where flow is in one direction only. The meter is an ideal choice for facilities that experience rapid and wide fluctuations in water demand, such as hospitals, universities, residential complexes and manufacturing or processing facilities.

OPERATION

At low flow rates, the Compound Series meter diverts water up through a bypass to the disc chamber. Leaving the chamber's outlet port, water flows beyond the turbine element and main valve. As the flow rate increases, a pressure differential is created that opens the main valve. The water then flows straight through the turbine chamber. In addition, a portion still flows through the disc chamber before exiting the meter.

RCS-DS-00078-EN-03 (April 2014)

Rotor and disc movements are transmitted by magnetic drive couplings to individual register odometers. The direct magnetic drive provides a positive, reliable and dependable register coupling for straight-reading or remote reading options. The self-lubricating thermoplastic register gearing is designed to minimize friction and provide long life.

OPERATING PERFORMANCE

The Recordall Compound Series meets or exceeds registration accuracy for low, normal operating, maximum continuous operation, and changeover flow rates as specified in AWWA Standard C702.

CONSTRUCTION

The Recordall Compound Series meter's construction complies with ANSI and AWWA C702 standards. It consists of three basic components: meter housing, interchangeable measuring elements, and sealed direct reading registers. The measuring element consists of the disc measuring chamber, turbine head assembly, and high flow valve assembly. To simplify maintenance, the registers and measuring elements can be removed without removing the meter housing from the line.

METER INSTALLATION

The meter is designed for installations where flow is in one direction only. A separate strainer is required to ensure optimum flow conditioning and protection of the measuring element. Companion flanges for installation of meters on various pipe types and sizes are available in cast iron or NL bronze as an option.

Product Data Sheet

Recordall® Compound Series Meters, Sizes 2", 3" 4" & 6"

REGISTERS / ENCODERS

Standard—Sweep-Hand Registration

The standard register is a straight-reading, permanently sealed magnetic drive register. Dirt, moisture, tampering and lens fogging problems are eliminated. The register has a six-odometer wheel totalization display, 360° test circle with center sweep hand, and flow finder to detect leaks. Register gearing is made of self-lubricating engineered polymer, which minimizes friction and provides long life. The multi-position register simplifies meter installation and reading. The register capacity is 100,000,000 gallons (10,000,000 ft³, 1,000,000 m³).

Optional—Encoders for AMR/AMI Reading Solutions

AMR/AMI solutions are available for all Recordall Compound Series meters. All reading options can be removed from the meter without disrupting water service. Badger Meter encoders provide years of reliable, accurate readings for a variety of applications and are also available pre-wired to Badger Meter approved AMR/AMI solutions. See details at www.badgermeter.com.

SPECIFICATIONS

Compound Series Model	2" (50 mm)	3" (80 mm)	4" (100 mm)	6" (150 mm)
Meter Flanges, Class 150	2" elliptical or round	3" round	4" round	6" round
	(50 mm)	(80 mm)	(100 mm)	(150 mm)
Typical Operating Range	0.5…200 gpm	0.5…450 gpm	0.75…1000 gpm	0.75…2000 gpm
(100% ± 1.5%)	(0.1…45 m³/h)	(0.1…102 m³/h)	(0.17…227 m³/h)	(0.17…454.4 m³/h)
Low Flow Registration (97% minimum)	0.25 gpm (0.06 m³/h)	0.25 gpm (0.06 m³/h)	0.375 gpm (0.09 m³/h)	0.375 gpm (0.09 m³/h)
Maximum Continuous Flow	170 gpm (38.3 m³/h)	400 gpm (90.3 m³/h)	800 gpm (181.6 m³/h)	1500 gpm (340.5 m³/h)
Pressure Loss at Maximum Continuous Flow	5.4 psi at 170 gpm	6.0 psi at 400 gpm	11.0 psi at 800 gpm	9.3 psi at 1500 gpm
	(0.38 bar at 38.3 m³/h)	(0.41 bar at 90.3 m³/h)	(0.75 bar at 181.6 m³/h)	(0.64 bar at 340.5 m³/h)
Crossover Flow Rate, Typical	12 gpm	12 gpm	20 gpm	30 gpm
Pressure Loss at Crossover	3.5 psi (0.24 bar)	4.0 psi (0.28 bar)	4.0 psi (0.28 bar)	5.0 psi (0.35 bar)
Minimum Crossover Accuracy	97%	97%	97%	95%
Maximum Operating Pressure	150 psi (10 bar)			
Maximum Operating Temperature	105° F (41° C)			
Test Plug	1-1/2"		2"	

Materials

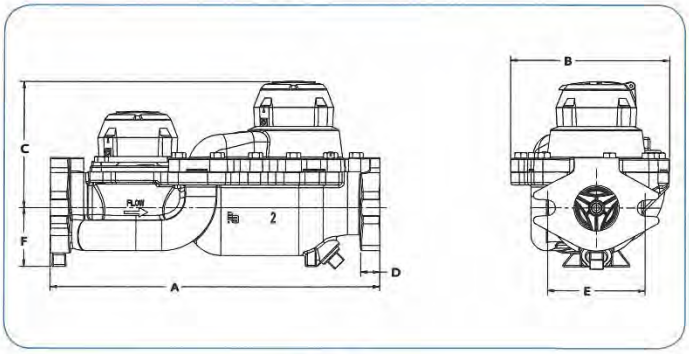
Meter Housing & Cover	Lead-free bronze alloy
Turbo Cast Head	Lead-free bronze alloy
Nose Cone & Straightening Vanes	Thermoplastic
Rotor	Thermoplastic
Rotor Radial Bearings	Lubricated thermoplastic
Rotor Thrust Bearing	Sapphire jewels
Rotor Bearing Pivots	Passivated 316 stainless steel
Calibration Mechanism	Stainless steel & thermoplastic
Measuring Chamber & Disc	Thermoplastic
High Flow Valve	Stainless steel & thermoplastic
Magnets	Ceramic
Register Lens	Glass
Register Housing & Cover	Thermoplastic or bronze
Trim	Stainless steel
Drain Plug (3/4")	Stainless steel or lead-free bronze alloy
Test Plug	Stainless steel or lead-free bronze alloy

PHYSICAL DIMENSIONS

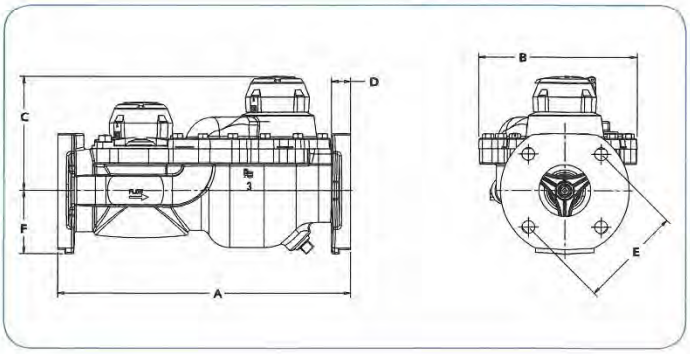
Compound Series Model	2" Elliptical (50 mm)	2" Round (50 mm)	3" (80 mm)	4" (100 mm)	6" (150 mm)
Meter & Pipe Size	2" (50 mm)		3" (80 mm)	4" (100 mm)	6" (150 mm)
Net Weight	45 lb (20.4 kg)		71.5 lb (32.4 kg)	85 lb (38.4 kg)	152 lb (68.7 kg)
Shipping Weight	63 lb (28.5 kg)		99.5 lb (45 kg)	120 lb (53.8 kg)	200 lb (90.4 kg)
Length (A)	15-1/4" * (387 mm)		17" (432 mm)	20" (508 mm)**	24" (610 mm)
Width (B)	7-3/8" (187 mm)		9-1/4" (235 mm)	9-1/8" (232 mm)	12-3/8" (314 mm)
Height (C)	5-7/8" (149 mm)		6-5/8" (168 mm)	7-1/4" (184 mm)	8-7/8" (225 mm)
Flange (D)	5/8" (16 mm)		3/4" (19 mm)	7/8" (22 mm)	15/16" (24 mm)
Bolt Circle (E)	4-1/2" (114 mm)	4-3/4" (121 mm)	6" (152 mm)	7-1/2" (190.5 mm)	9-1/2" (241 mm)
Centerline (C) to Base (F)	2-3/4" (70 mm)		3-5/8" (92 mm)	4-1/4" (108 mm)	5-3/8" (137 mm)
Number of Bolts	2	4	4	8	8

* Adapter available to increase total length to 17" (432 mm).
**Adapter available to increase total length to 24" (610 mm).

Elliptical Flange (2" Only)



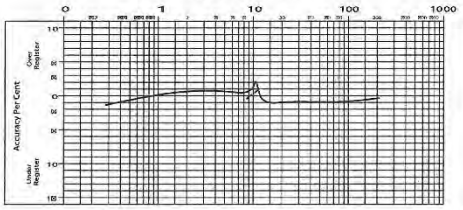
Round Flange



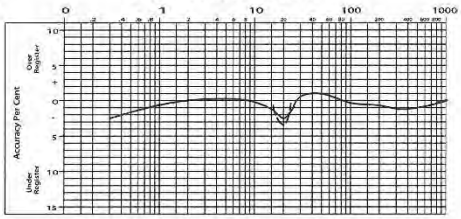
ACCURACY CHARTS

Rate of flow in gallons per minute (gpm)

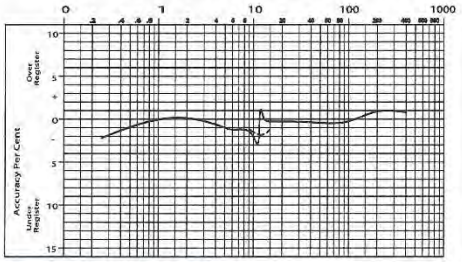
2" COMPOUND SERIES METER



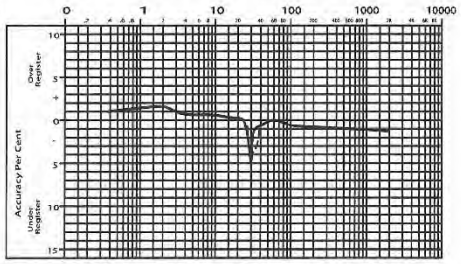
4" COMPOUND SERIES METER



3" COMPOUND SERIES METER

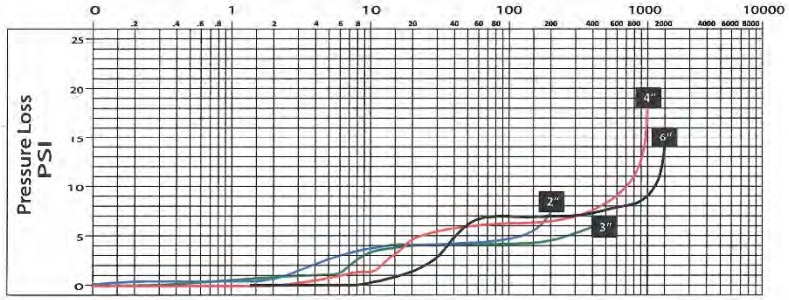


6" COMPOUND SERIES METER



PRESSURE LOSS CHART

Rate of flow in gallons per minute (gpm)



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Legacy Document Number: RCS-T-07

Fluid Conservation Systems

Lmic

Electronic Leak Sounding System

The Lmic is an easy-to-use, low cost, electronic listening stick and ground microphone combined. It is ideal for general leak sounding operations and can be fitted with either a tripod foot (for use as a ground microphone) or probe rods (for sounding at fittings or in soft ground).

The control unit is hand-held with a 'trigger' operation and a volume/sensitivity rotary control. An LED indicates operation and battery status. This lightweight unit can be used to confirm the position of underground leaks audibly from ground level, sound pipe fittings penetrate soft ground to listen for leaks and carry out traditional acoustic surveys.

The new Lmic "i" gives additional electrical insulation by inserting an acetol disc between the shaft and the hand-piece, and adding insulation to the shaft for extra protection.

The Lmic is supplied with a hand held control unit, microphone unit with cable, tripod unit, 2 probe rods, AC adapter, headphones, carry bag and instruction manual. The Lmic "i" is supplied with all of the above, plus an acetol isolation block and insulation for the 2 probe rods.

WARNING: The Lmic is designed for use on water pipes only. FCS cannot guarantee full protection against electric shock. Whilst the Lmic "i" has been designed to provide additional protection, operators must always ensure the safety of their own operation at all times.

KEY BENEFITS

- Lightweight hand-held unit for long term ease of use.
- Low cost.
- Excellent acoustic performance
- Simple "trigger" operation.
- Versatile – ground microphone and hand probe configurations.
- Military specification connectors.
- Rechargeable battery pack with long operation between charges.
- Additional protection from electric shock *(Lmic "i" only)*

Photographs showing the new Lmic "i" with additional insulation properties

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Lmic Hand Held Unit/Sensor Housing	Piezoelectric high sensitivity sensor mounted in PC-ABS (polycarbonate) housing single headphone/charger input socket with automatic sensing of device connected *Acetol insulation block – providing electrical isolation between the hand piece and probe rod (Lmic "i" only)*
Connectors	Amphenol military specification connectors for microphone and headphone/charger connections
Charging	Universal 110-240V AC charger with 12V DC output. Car cigarette lighter adapter with 12V DC output (optional accessory) 4-pin Amphenol connectors to control unit Charge time: Overnight charge
Microphone Housing	High sensitivity piezo-electric sensor mounted in rubber housing with integral strain relief **Low noise 2' 6" (1.5m) cable (detachable)** 4-pin Amphenol connection to control unit Weight: 1lb (400g)
Foot Attachment	Cast metal tripod for ground contact
Hand Probe Attachment	2 aluminum extension rods (each 400mm long) Weight: 0.3lb (150g) *Heavy duty insulation along length of rods (Lmic "i" only)*
Headphones	Lightweight high quality headphones Impedance: 16 Ohms 4-pin Amphenol connector to control unit
LED	Green = normal operation Red = low battery power

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Fluid Conservation Systems

TriCorr Touch

High Performance Correlator

TriCorr Touch represents a breakthrough in leak detection technology. It features new "best in class" sensors designed to be at least twice as sensitive as anything on the market today. This enables it to perform better in traditionally difficult conditions, such as on plastic and large diameter pipes.

TriCorr Touch is the first stand alone correlator to feature a high visibility full color VGA touch screen to greatly improve data entry and the quality of data presentation. The intuitive user interface enables the unit to be operated with the minimum key presses. The large screen, with anti-glare screen protection clearly displays correlation results and supportive information even in bright sunshine.

The tri-filter correlation option performs three correlations at different filter settings at the same time, which is particularly useful when filter settings (pipe material) is uncertain. When the best filter is seen, the correlation switches to focus on this. The outstation is compact with high quality long range radio transmission; it also features a magnet to secure onto metallic street furniture.

The purpose designed robust case not only carries and protects all components but allows the base station and outstations to be charged from a single power lead, and displays charging status. Units can be stowed with sensors still connected for faster deployment in the field. Using our extensive experience of correlator design and manufacture, FCS have created an easy to use system that delivers the best all round performance at a highly competitive price.

KEY BENEFITS

- 6.5" high-visibility color VGA Touch Screen.
- Tri-Filter Correlation.
- Precise, accurate leak location.
- Highly intuitive user interface based on minimum key presses.
- Compact, portable design.
- Robust construction.
- Straps on rear to assist handling.
- Rechargeable batteries.
- Weight - 4.2lb.
- Anti-glare screen protector.
- Mil-spec connectors.
- High Impact PC/ABS Casework.
- Sensor Development (d.c.-5000Hz, High V/g).
- Outstation to base station range - 3000ft LOS.

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ISO 9001 ISO 14001

Fluid Conservation Systems

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CONTROL UNIT

Filter selection	Manual, FFT, Coherence and Tri Filter Correlation. Pipe-data related default settings
Resolution	4"(± 0.1m)
Display	High Visibility Full Color VGA
Antennae	External antenna/magmount
Battery type	Rechargeable Lithium ion batteries, field replaceable
Battery life	7 hours (Rechargeable) in Case
Type of keypad	Touch Screen interface coated with Tuff screen anti-glare screen protection
Key functions	Tri-Filter Correlation Combined correlation/survey mode Listen (acoustic survey) Frequency analysis Peak suppression User definable pipe types & velocities Intuitive user interface In case charging
Language	Selectable via menu
Operating software	MS Windows-CE embedded.
Printer output	USB to PC software-enabled printing
PC download	Via PC software, Windows-compatible software
Dimensions	Height to Top: 3.5" (90mm), Width: 9.8" (250mm), Depth: 7.1 (180mm)
Weight	4.5lb (1.9kg)
Operating temp	5°F to 122°F (-15°C to +50°C)
Environmental	IP65
Enclosure	High Impact PC/ABS plastic
Connectors	Military specification Amphenol-Type
Diagnostics	Self-test and auto-calibration on power-on

OUTSTATION

Optional 1 or 2 Radio Outstation Systems

Radio Freq.	Local regulations apply
Connections	Headphones, External antenna, Charging
Battery type	Rechargeable Lithium ion batteries, field replaceable
Battery life	7 hours (Rechargeable)
Antenna	External antenna
Dimensions	L 7.8" (200mm), W 5.3" (135mm), D 2"(50mm)
Weight	1.97lb(0.87kg)
Environment	IP65
Housing	High-impact PC/ABS plastic
Connectors	Military specification Amphenol

SENSOR

Frequency Response	d.c.- 5000Hz, High V/g
Environment	IP68, rubber shroud for shock protection
Connection	6ft/10ft/16ft (2m/3m/5m) cables with strain relief Military spec connector
Hydrophones	Available as option

CASE

Charging	In case charging through mains or 12V vehicle supply. Case indicates charge for all components

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Fluid Conservation Systems

Xmic

Electronic Ground Microphone

Xmic is an advanced, easy to use electronic ground microphone.

Xmic detect and amplifies the noise created by leaks in pressurised pipes, the leak position can be verified by surface sounding for ground surveying or prior to any excavation and repair being carried out. This speeds up repair of the leak, reduces repair costs and ensures that disruption to the water supply is minimised.

Key Features

- Automatic or manual filtering to suppress background noise and target leak noise.
- Lightweight , easily portable system
- Large backlit multi-function display perfect for night work
- 'Analogue' style moving meter gives quick representation of noise level trends.
- Levels of leak noise can be recorded for comparison in a histogram profile (MLP).
- Easy to use magnetic hand probe (optional)
- Long battery life
- Rechargeable
- Noise level graphically and digitally

Simple and Straight Forward Operation
Xmic user friendly filter settings automatically sets filters for the pipe material. To further suppress background noise and find difficult leaks, experienced operators can choose to use manual filtering allowing them to filter band width to be positioned anywhere within the filter range. (The selected band width is displayed graphically.)

MLP – Minimum Level Profiling
MLP checks the readings over the previous 3 seconds and memorizes the lowest noise level, the constant background (leak) noise. As the sensor is moved, a series of readings are taken the last ten readings are memorized and displayed digitally and graphically to clearly show the leak position.

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Xmic

Electronic Ground Microphone

Acoustically shielded "elephants foot" microphone

High sensitivity piezo-electric sensor mounted in windproof, nitrile rubber housing.
Low noise 1.5m cable (detachable).
Weight: 2.9kg

Hand Probe Attachment -Optional

The hand probe is supplied with a tripod foot and two stainless steel probe rods for sounding in soft ground plus magnetic contact for better coupling to fittings.
Each probe rod is 400mm in length

Filter Options

Variable High Pass and Low Pass filters across frequency range
Three filter settings based on pipe material
Metallic – High Pass 350Hz, Low Pass 3000Hz
Plastic – High Pass 75Hz, Low Pass 3000Hz
Broadband – High Pass 30Hz, Low Pass 3000Hz

Headphones

Studio quality headphones are supplied as standard.
Aviation Quality headphones are available as an option (See picture)

Control Unit

Frequency range: 30 to 3000Hz

Battery: 2 x Lithium ion 1.8Ah rechargeable batteries

Battery life: Minimum 25 hours (without backlight)
15 hours (with backlight)

Battery charge: Maximum 8 hours

Charger: Universal 110-240V AC mains charger with 12V DC output

Weight: 1kg

Dimensions: 206mm x 167mm x 86mm

Operating temperature range: -15°C - 50°C

Connection: Military specification Amphenol

Keypad: Membrane with push button

Display: 128 x 128 transflective LCD

Signal level display 0 – 99

Minimum Level Profiling (MLP) – 10 readings

		Headphones			Case		Sensors	
	XMIC Part Number	Phillips	Studio	Dave Clarke	Hard Case	Soft Case	Hand Probe	Elephant Foot
Xmic Lite	XMICLSUK/P/SC	■				■	■	
	XMICLSUK/P/HC	■			■		■	
	XMICLSUK/S/SC		■			■	■	
	XMICLSUK/S/HC		■		■		■	
Xmic	XMICUK/S/HC		■		■			■
	XMICUK/S/SC		■			■		■
	XMICUK/DC/HC			■	■			■
Xmic Plus	XMICUK/S/HC/HP		■		■		■	■
	XMICUK/S/SC/HP		■			■	■	■
	XMICUK/DC/HC/HP			■	■		■	■

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ESG ENERGY SYSTEMS GROUP Building Performance with Energy

Cleveland Heights—Pressure Readings

CLA-VAL™

MODEL X143IP

Intermediate Power Generator

Product Description

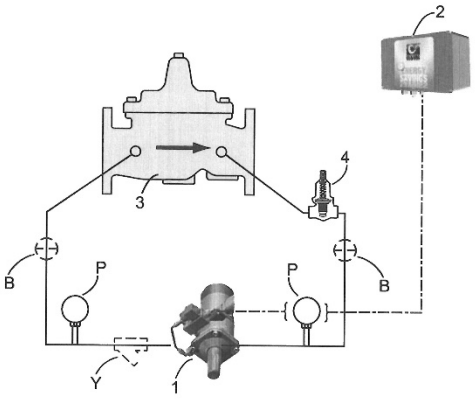
The X143IP Intermediate Power Generator is a self-contained power generation system designed to be mounted on a Cla-Val Automatic Control Valve.

The X143IP uses the pressure drop across the valve to produce up to 14 watts of power to run electronic equipment located at the valve site.

Product Features

- Designed to be installed within the pilot system of a Cla-Val Automatic Control Valve
- Factory installed or field retrofittable to an existing valve
- Up to 14 watts continuous draw
- Up to 42 watts non-continuous draw
- 12 psi differential pressure minimum at 15 gpm
- 12 Volt Battery with 12 and/or 24 VDC Output
- Automatic shutdown of the X143IP when battery is fully charged helps to maximize both battery and generator life span
- Applications include powering electronic valve controls, data loggers, position controls and communications equipment

CE patent pending



Typical Schematic Diagram

Supplied Equipment

1 Power Generator Unit
2 Electronics & Battery Housing
3 Cla-Val Automatic Control Valve
Y Y-Strainer

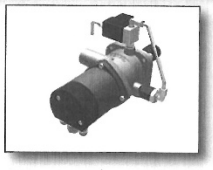
Optional Equipment

P Gauges
B Isolation Valves
4 Pressure Reducing Valve

Note: Maximum inlet pressure is 150 psi.
Please consult factory if pressure is above 150 psi.

Power Generator Specifications

- 12V DC or 24V DC output
- 12 PSI minimum differential pressure required
- Up to 14 watts generator power output
- 3/4-inch female connection
- Upper recharging threshold: 13.5 VDC
- Lower recharging threshold: 12 VDC



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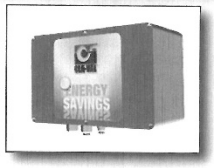

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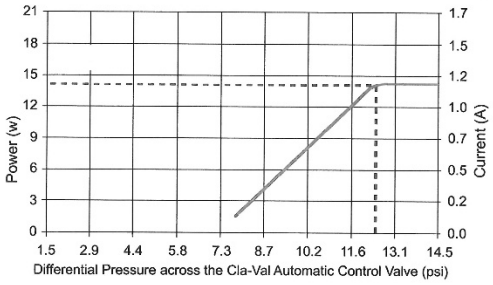
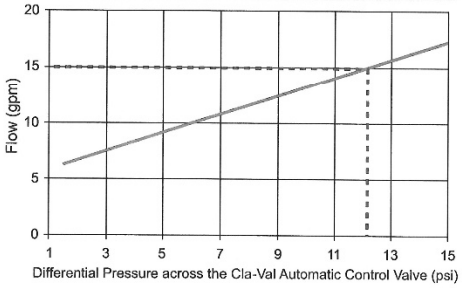
Electronic Products

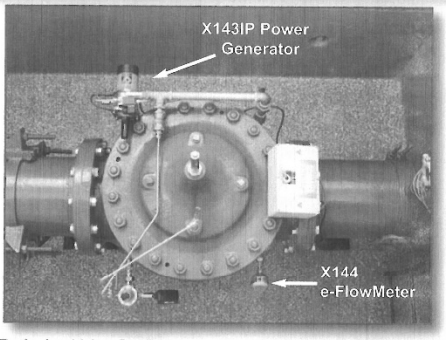
Power Output

Voltage Output	Maximum Continuous (24h/24)	Maximum Non-Continuous
12 volts	1.2 A (14 W)	3.5 A (42 W)
24 volts	0.6 A (14 W)	1.7 A (42 W)

Power and Flow Charts







Typical Installation: Pressure Reducing Valve Station X143IP providing power to operate electronic valve controls, data logger, pressure transducers and the Cla-Val X144 e-FlowMeter™

Easy retrofit: The X143IP Power Generator is installed as part of the pilot system of an existing Cla-Val Automatic Control valve to provide power without compromising valve performance and without tying into to the grid

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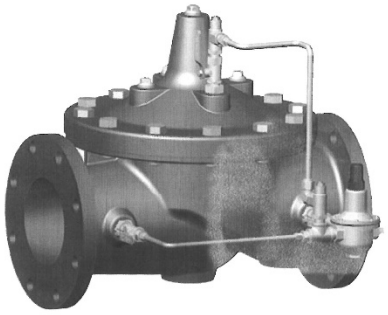
E-X143IP (R-08/2013)

CLA-VAL™

MODEL 90-01 (Full Internal Port) / 690-01 (Reduced Internal Port)

Pressure Reducing Valve



- **Sensitive and Accurate Pressure Control**
- **Easy Adjustment and Maintenance**
- **Tamper Resistant**
- **Optional Check Feature**
- **Fully Supported Frictionless Diaphragm**

The Cla-Val Model 90-01/690-01 Pressure Reducing Valve automatically reduces a higher inlet pressure to a steady lower downstream pressure, regardless of changing flow rate and/or varying inlet pressure. This valve is an accurate, pilot-operated regulator capable of holding downstream pressure to a pre-determined limit. When downstream pressure exceeds the pressure setting of the control pilot, the main valve and pilot valve close drip-tight.

If a check feature is added, and a pressure reversal occurs, the downstream pressure is admitted in the main valve cover chamber, closing the valve to prevent return flow.

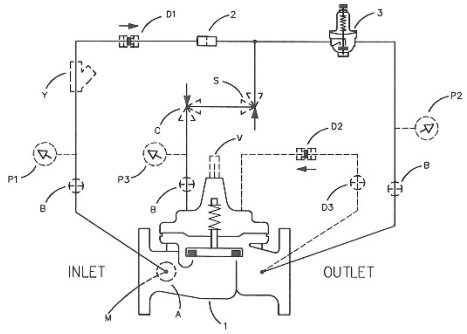
Schematic Diagram

Item	Description
1	Hytrol (Main Valve)
2	X58 Restriction Fitting
3	CRD Pressure Reducing Control

Optional Features

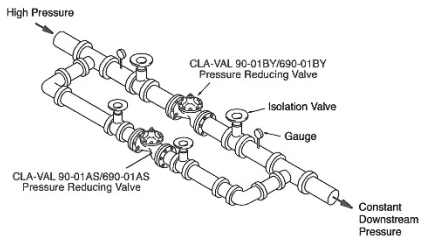
Item	Description
A	X46A Flow Clean Strainer
B	CK2 (Isolation Valve)
C	CV Flow Control (Closing)*
D	Check Valves with Isolation Valve
P	X141 Pressure Gauge
S	CV Flow Control (Opening)
V	X101 Valve Position Indicator
Y	X43 "Y" Strainer

*The closing speed control (optional) on this valve should always be open at least three (3) turns off its seat.



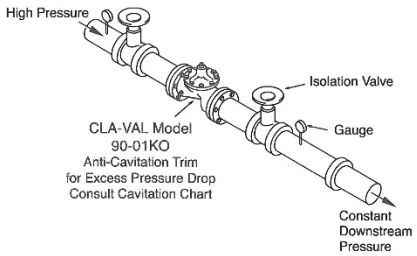
Typical Applications

Typical applications include pressure reducing valve station using Model 90-01BY/690-01BY and Model 90-01AS/690-01AS in parallel to handle wide range of flow rates. Larger Model 90-01BY/690-01BY valve meets requirements of peak loads and smaller Model 90-01AS/690-01AS handles low flows.



Cla-Val Model 90-01KO/690-01KO Pressure Reducing Valve with Anti-Cavitation Trim provides for optimum downstream pressure control while reducing noise and eliminating damage associated with cavitation.

See Cavitation Guide to determine if the valve is a candidate for the KO Anti-Cavitation Trim.



Model 90-01 (Uses Basic Valve Model 100-01)

Pressure Ratings (Recommended Maximum Pressure - psi)

Valve Body & Cover		Pressure Class				
		Flanged			Grooved	Threaded
Grade	Material	ANSI Standards*	150 Class	300 Class	300 Class	End‡ Details
ASTM A536	Ductile Iron	B16.42	250	400	400	400
ASTM A216-WCB	Cast Steel	B16.5	285	400	400	400
ASTM B62	Bronze	B16.24	225	400	400	400

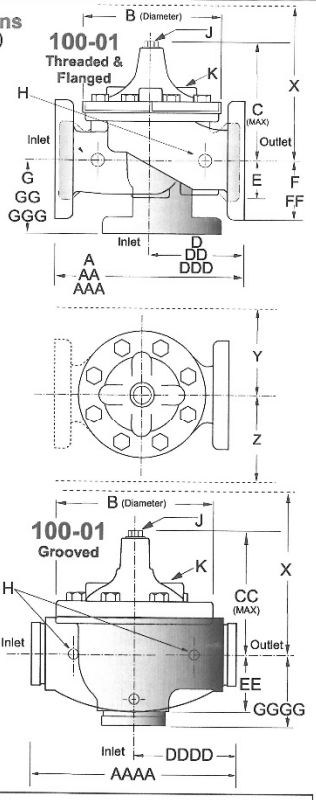
Note: * ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
‡ End Details machined to ANSI B2.1 specifications.
Valves for higher pressure are available; consult factory for details

Materials

Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	1" - 36"	1" - 16"	1" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is Optional		
Disc	Buna-N® Rubber		
Diaphragm	Nylon Reinforced Buna-N® Rubber		
Stem, Nut & Spring	Stainless Steel		

For material options not listed, consult factory.
Cla-Val manufactures valves in more than 50 different alloys.

Dimensions (In inches)



Model 90-01 Dimensions (In Inches)

Valve Size (Inches)	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16	18	20	24	30	36
A Threaded	7.25	7.25	7.25	9.38	11.00	12.50	—	—	—	—	—	—	—	—	—	—	—	—
AA 150 ANSI	—	—	8.50	9.38	11.00	12.00	15.00	20.00	25.38	29.75	34.00	39.00	41.38	46.00	52.00	61.50	63.00	76.00
AAA 300 ANSI	—	—	9.00	10.00	11.62	13.25	15.62	21.00	26.38	31.12	35.50	40.50	43.50	47.64	53.62	63.24	64.50	76.00
AAAA Grooved End	—	—	8.50	9.00	11.00	12.50	15.00	20.00	25.38	—	—	—	—	—	—	—	—	—
B Dia.	5.62	5.62	5.62	6.62	8.00	9.12	11.50	15.75	20.00	23.62	28.00	32.75	35.50	41.50	45.00	53.16	56.00	66.00
C Max.	5.50	5.50	5.50	6.50	7.56	8.19	10.62	13.38	16.00	17.12	20.88	24.19	25.00	39.06	41.90	43.93	54.60	61.50
CC Max. Grooved End	—	—	4.75	5.75	6.88	7.25	9.31	12.12	14.62	—	—	—	—	—	—	—	—	—
D Threaded	3.25	3.25	3.25	4.75	5.50	6.25	—	—	—	—	—	—	—	—	—	—	—	—
DD 150 ANSI	—	—	4.00	4.75	5.50	6.00	7.50	10.00	12.69	14.88	17.00	19.50	20.81	—	—	30.75	—	—
DDD 300 ANSI	—	—	4.25	5.00	5.88	6.38	7.88	10.50	13.25	15.56	17.75	20.25	21.62	—	—	31.62	—	—
DDDD Grooved End	—	—	—	4.75	—	6.00	7.50	—	—	—	—	—	—	—	—	—	—	—
E	1.12	1.12	1.12	1.50	1.69	2.06	3.19	4.31	5.31	9.25	10.75	12.62	15.50	12.95	15.00	17.75	21.31	24.56
EE Grooved End	—	—	2.00	2.50	2.88	3.12	4.25	6.00	7.56	—	—	—	—	—	—	—	—	—
F 150 ANSI	—	—	2.50	3.00	3.50	3.75	4.50	5.50	6.75	8.00	9.50	10.50	11.75	15.00	16.50	19.25	22.50	25.60
FF 300 ANSI	—	—	3.06	3.25	3.75	4.13	5.00	6.25	7.50	8.75	10.25	11.50	12.75	15.00	16.50	19.25	24.00	25.60
G Threaded	1.88	1.88	1.88	3.25	4.00	4.50	—	—	—	—	—	—	—	—	—	—	—	—
GG 150 ANSI	—	—	4.00	3.25	4.00	4.00	5.00	6.00	8.00	8.62	13.75	14.88	15.69	—	—	22.06	—	—
GGG 300 ANSI	—	—	4.25	3.50	4.31	4.38	5.31	6.50	8.50	9.31	14.50	15.62	16.50	—	—	22.90	—	—
GGGG Grooved End	—	—	—	3.25	—	4.25	5.00	—	—	—	—	—	—	—	—	—	—	—
H NPT Body Tapping	.375	.375	.375	.375	.50	.50	.75	.75	1	1	1	1	1	1	1	1	2	2
J NPT Cover Center Plug	.25	.25	.25	.50	.50	.50	.75	.75	1	1	1.25	1.5	2	1.5	1.5	1.5	2	2
K NPT Cover Tapping	.375	.375	.375	.375	.50	.50	.75	.75	1	1	1	1	1	1	1	1	2	2
Stem Travel	0.4	0.4	0.4	0.6	0.7	0.8	1.1	1.7	2.3	2.8	3.4	4.0	4.5	5.1	5.63	6.75	7.5	8.5
Approx. Ship Wt. Lbs.	15	15	15	35	50	70	140	285	500	780	1165	1600	2265	2982	3900	6200	7703	11720
X Pilot System	11	11	11	13	14	15	17	29	31	33	36	40	40	43	47	68	79	85
Y Pilot System	9	9	9	9	10	11	12	20	22	24	26	29	30	32	34	39	40	45
Z Pilot System	9	9	9	9	10	11	12	20	22	24	26	29	30	32	34	39	42	47

Note: The top two flange holes on valve size 36 are threaded to 1 1/2"-6 UNC.

Model 690-01 (Uses Basic Valve Model 100-20)

Pressure Ratings (Recommended Maximum Pressure - psi)

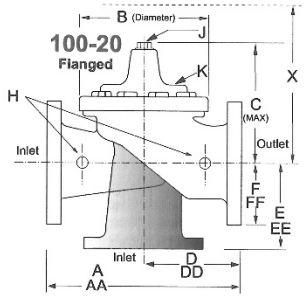
Valve Body & Cover		Pressure Class		
		Flanged		
Grade	Material	ANSI Standards*	150 Class	300 Class
ASTM A536	Ductile Iron	B16.42	250	400
ASTM A216-WCB	Cast Steel	B16.5	285	400
ASTM B62	Bronze	B16.24	225	400

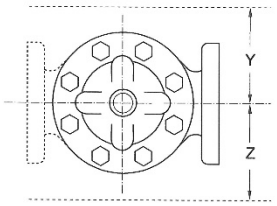
Note: * ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
Valves for higher pressure are available; consult factory for details

Materials

Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	3" - 48"	3" - 16"	3" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is Optional		
Disc	Buna-N® Rubber		
Diaphragm	Nylon Reinforced Buna-N® Rubber		
Stem, Nut & Spring	Stainless Steel		
For material options not listed, consult factory. Cla-Val manufactures valves in more than 50 different alloys.			

Dimensions
(In inches)





Model 690-01 Dimensions (In Inches)

Valve Size (Inches)	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48
A 150 ANSI	10.25	13.88	17.75	21.38	26.00	30.00	34.25	35.00	42.12	48.00	48.00	63.25	65.00	76.00	94.50
AA 300 ANSI	11.00	14.50	18.62	22.38	27.38	31.50	35.75	36.62	43.63	49.62	49.75	63.75	67.00	76.00	94.50
B Dia.	6.62	9.12	11.50	15.75	20.00	23.62	27.47	28.00	35.44	35.44	35.44	53.19	56.00	66.00	66.00
C Max.	7.00	8.62	11.62	15.00	17.88	21.00	20.88	25.75	25.00	31.00	31.00	43.94	54.60	61.50	61.50
D 150 ANSI	—	6.94	8.88	10.69	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
DD 300 ANSI	—	7.25	9.38	11.19	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
E 150 ANSI	—	5.50	6.75	7.25	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
EE 300 ANSI	—	5.81	7.25	7.75	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
F 150 ANSI	3.75	4.50	5.50	6.75	8.00	9.50	11.00	11.75	15.88	14.56	17.00	19.88	25.50	28.00	31.50
FF 300 ANSI	4.12	5.00	6.25	7.50	8.75	10.25	11.50	12.75	15.88	16.06	19.00	22.00	27.50	28.00	31.50
H NPT Body Tapping	.375	.50	.75	.75	1	1	1	1	1	1	1	1	2	2	2
J NPT Cover Center Plug	.50	.50	.75	.75	1	1	1.25	1.25	2	2	2	2	2	2	2
K NPT Cover Tapping	.375	.50	.75	.75	1	1	1	1	1	1	1	1	2	2	2
Stem Travel	0.6	0.8	1.1	1.7	2.3	2.8	3.4	3.4	4.5	4.5	4.5	6.5	7.5	8.5	8.5
Approx. Ship Wt. Lbs.	45	85	195	330	625	900	1250	1380	2365	2551	2733	6500	8545	12450	13100
X Pilot System	13	15	27	30	33	36	36	41	40	46	55	68	79	85	86
Y Pilot System	10	11	18	20	22	24	26	26	30	30	30	39	40	45	47
Z Pilot System	10	11	18	20	22	24	26	26	30	30	30	39	42	47	49

*Consult Factory

Note: The top two flange holes on valve sizes 36 thru 48 are threaded to 1 1/2"-6 UNC.