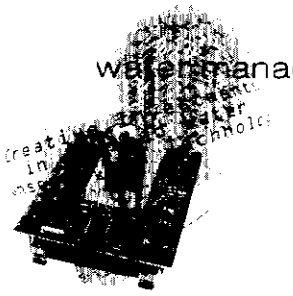
water management services, inc.



Aqura Water Meter Instruction Manual

FCC ID: OV6WMS001

This device complies with Part 15 of the FCC Rules:
Operation is subject to the following conditions:

(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, Including interference that may cause undesired operation

The Aqura system is an apartment sub-metering system that requires a flow meter to be installed on each point of use within an apartment unit. Each meter consists of a flow sensor, and a separately mounted self contained (no wires) electronics package that houses an electronic register, and a radio transmitter. A one bath apartment unit will require 7 Aqura meters, 2 under each sink, and one each under the toilet, at the tub spout inlet, and at the shower.

Each transmitter sends its data three times per day to a transceiver that must be mounted in a secure tamper resistant location no more than 100 feet from the most distant transmitter. Transceivers are powered by a low voltage supply (or a 115 volt plug in power cube), and communicate over a second pair of wires (or a second long distance radio) to a base station located centrally on the property. The base station is an application specific personal computer (though it appears simply as two circuit boards in a box), which stores data, and communicates with a remote billing system through a conventional modem. The base station must also be plugged in to 115 volts, or wired with low voltage, and connected to a phone outlet which it may share with standard voice users.

The Aqura system installation process has been carefully engineered, and installation accessories have been designed so that a crew of two can complete an apartment in less than 45 minutes. The installing process is also engineered for one person, and for larger crews of 5 or 10. Crew members require very little plumbing or electrical experience, but they need basic mechanical skills, and they need to be diligent in their attention to detail, with a diplomatic demeanor. This work is being done in people's homes, often while they watch.

After installation, each meter location must be inspected to record the serial number in the billing data base, and to test for a valid radio link between the transmitter and the transceiver.

Installation of the Aqura system requires the assignment of a project manager from the metering service company who is responsible for the system, and two skilled teams – one is normally licensed to run low volt communication wiring – the other to do plumbing. The installation process design for each component of the Aqura system is discussed below, along with the allocated target time for completion of each task.

Site Survey (4 hours)

The project manager for the metering service company must survey the site to determine the best location for base station and transceivers, and the connections size used at the stop valves under sinks and toilets. Radio propagation is tested with a sample transceiver, a small 12 volt battery and a meter transmitter. A second test is required if radio is selected as the means of communicating from transceivers to the base station. This second test requires a sample base station, plugged into a 115 volt outlet, and a sample transceiver as before. The choice of a telephone line for the base station must be made, either shared with the property manager, or a dedicated line. If dedicated, arrangements must be made to provide phone service. Such a survey will take less than two hours. Materials are ordered accordingly, based on survey information.

Preparing for the Project (2 hours)

The list of apartment numbers, and the meter sites for each apartment number must be established as an excel spreadsheet. This list of meter locations is then fed into the installation tool that the project manager or crew supervisor will use at the jobsite to match serial numbers with each meter location. The data is later transferred into the billing data base.

The required materials list needs to be checked, to be certain everything is available (example below). Materials are not large, but there needs to be an easy way to transport materials from apartment to apartment – a grocery store shopping cart, or equivalent works well.

Sample Materials List

(all material is available from Water Management Services)

In the Apartment

- Aqura flow sensors – do you have the correct number per apartment unit?
- Aqura Meter Electronics – one is required for each flow sensor
- 9" Supply lines – flow sensor to faucet inlet - two for each faucet (hot and cold)
- 9" Supply lines – stop valve to flow sensor – two for every faucet, one for every toilet (be certain supply line terminals match the stop valve size)
- Toilet Adapters – one for every toilet
- ½" short nipple & ½" Inlet Adapter (or inlet adapter for ½" copper) for each shower
- ½" short nipple & ½" Inlet Adapter (or inlet adapter for ½" copper) for each tub spout
- Chrome Shower fitting(s)
- Replacement tub spout(s) (with or without diverter)
- ½" brass coupling and short PVC nipple for inside tub spout
- Escutcheons – one for every tub spout and another for every shower outlet
- Polished Stainless Escutcheon Face Plate – optional – one for every escutcheon (optional)
- Short Nipples – Advisable to provide several lengths – one needed for each shower inlet, and one for each tub spout, and a third (3.25") for inside the tub-spout.

- Pipe Dope – **DO NOT USE TEFLON TAPE –** excess tape can affect flow sensor accuracy
- 9" Wash Machine Supply – Hose bib to Flow Sensor – two per wash machine
- 20" Wash Machine Supply – Flow Sensor to Wash Machine – two per machine

Outside the Apartment

- Transceivers as required, so that every meter is within 100' of a transceiver, or less if radio
  test indicates a shorter distance
- Base Station or Stations as required, so that every transceiver can move its data to the base station by either radio or a pair of low volt wires.

Re-Using Existing Supply Lines

We advise against the re-use of existing supply lines. In many cases, these lines are old, and may leak after they have been moved about and twisted during the meter installation process. In other cases, handymen may have used cheap inferior quality supply lines. If these supply fail, the affect can be catastrophic. The risk makes investment in a replacement worthwhile.

In some parts of the country, stop valves with integral supply lines are popular. In these cases, it will not be possible to replace the supply line without also replacing the stop valve. For the same reasons sited above, we require that the stop valves be replaced in these instances. This can raise the cost of the project considerably. It should be pointed out that supply lines do not last forever, and that eventually, these lines will fail necessitating their replacement. Because their failure often involves water damage and expensive repair, the net cost of replacing all supplies and stop valves pre-maturely must be compared against the cost of repairs and eventual replacement at a later date, and the continued risk to the property associated with supply line failure.

Base Station Installation (2 hours to mount and wire)

The base station is normally mounted near the management office, or in a telephone switch room where phone lines terminate from the entire property. Its location must be dry and conditioned (50 to 90 degrees F), and it must be close enough to all transceivers to receive their signals. This radio link is roughly 1000 feet inside a building, or up to two miles in the free field with elevated antennae.

If the ideal base station location is too distant from transceivers, there are three possible solutions to try before deciding to use a second base station:

1. The base station is normally shipped with one transceiver inside its enclosure, with unit mounted antennae. Consider using ultra-low-loss antennae cable to place the antennae outside, or in a better location.

2. A second tranceiver may be used to "spread" the coverage of the base station. Use a remote transceiver to feed data to the base station, wiring between the two. Locate this second transceiver as high in the building as possible.

3. The transmit antennae (one of the three) on the most remote transceivers may be mounted remotely, provided no more than 20' of WMS special cable is used.

The phone line used by a base station can be shared with the property management office voice line, provided that the line is not used during the night when Aqura is required to communicate. Like any personal computer, the base station also requires a surge protected power supply of 115 volts, or a wired supply of AC or DC up to 24 volts and 15 watts. The computer includes battery back-up, so that it will not loose its real time clock, nor any data in the event of a power failure. It is suggested that if the base station is plugged into a wall socket, the plug for the base station be secured to the outlet, by removing and re-installing the screw from the center of the outlet, through the fitting provided on the base station plug. This will prevent inadvertent un-plugging of the base station.

The base station modem must be connected to a telephone line. This may be a line that is shared with the property manager, or a dedicated line. Tying into a tenant's line is presents no technical problems, but the lack of permanency and control over the phone number is troubling, so use of tenants lines is not recommended.

Data moves from the transceivers and the base station by one of two methods – radio, or RS-485 wired link. In the event a wired link is chosen, a pair of shielded low voltage wires must be run from each transceiver to the base station. Often, it will be convenient to use spare phone lines that have been run, but are not in use, to move data from the transceivers to the base station. That is why we advise that the best site for the base station may be near the point where spare phone lines are terminated.

If a radio link is selected for at least some transceivers, a remote mounted transceiver may be wired to the base station. The transceiver should be located at a high point in the building that is dry. Temperature conditions will affect the life of the transceiver, so that a temperature controlled environment is preferred – the transceiver is qualified to operate between minus 40 and 85 degrees C (minus 40 to 185 degrees F). The three antennae must be mounted as close to the transceiver as possible, and no more than 25 feet away connected with special antennae cable provided by Water Management Services. Ideally, the antenna should be located outside, on the roof or chimney stack, as high as possible, unobstructed by sources of interference. If the antennae are located inside, they should be mounted directly on the transceiver or as close to it as possible.

The ½ watt radio link between the transceivers and the base station is capable of transmitting nominally 1000 feet through normal building structure, or up to 2 miles in the free field with elevated antennae. In most installations, the radio path between the transmitters and the transceiver will require penetrating some building structure, so the allowed distance will vary. In high rise buildings, transceiver signals probably will not penetrate metal floor pans,

and will be substantially attenuated by reinforced concrete. To use the radio link in these buildings, it will be necessary to mount the base station antenna in a stairwell or elevator shaft, and to be certain transceivers share the same transmission pathway.

Transceivers (1.67 hours allowed to mount and wire per transceiver)

While the base station may be installed at any time, transceivers need to be installed and powered before meters and transmitters are installed. (Communication wiring can be left until after Aqura meters and transceivers are installed.) Secure locations must be found where transceivers will not be vandalized, such that every transmitter will be within 100 feet of a transceiver. In high rise apartments, where floors are concrete, a minimum of one transceiver must be located on every floor. Typical locations are in utility closets, above ceiling tile, under stair landings, in telephone closets, attics, and in outside utility closets. Every transceiver must be powered from a 115 volt power cube plugged into an outlet, or be wired to 24 volts, AC or DC with 5 watts of capacity. The temperature conditions surrounding the transceiver will affect its life – ideal conditions will limit temperatures to moderate levels (50 to 90 degrees F). Transceivers are qualified to operate from minus 40 to 85 degrees C (minus 40 to 185 degrees F). They can be located in unconditioned space.

The maximum distance of an Aqura meter radio transmission will vary from site to site. We have selected 100 feet because we know that in normal building construction, Aqura will transmit 100 feet 97% of the time. Your project may be require less distance due to odd circumstances, or it may be more. It is important to test the Aqura radio transmission distance during the site survey. If there is some doubt, it is wise to site an extra transceiver at a more conservative distance (50 feet) on the first floor or two that is installed in case the 100 foot distance is too great for your job. If 100 feet turns out OK on the first, remove the extra transceivers and use 100' on the second floor. If 100' is too far, leave the extra transceivers in on the first, and try 80 feet on the second, and so on until the right distance for your particular project is determined.

Also, please bear in mind, that radio signals do not penetrate metal. Metal doors, metal pan ceilings, metal pan support for concrete floors, and foil faced wall paper will affect signal transmission paths. Metal will reflect the Aqura radio signal, which is good. Metal studs pose no problem, for example. But large flat expanses of metal located between the transceiver and the transmitters will cause problems. That's why we advise that in buildings with concrete floors, at least one transceiver be located on each floor.

The transceiver is housed in a metal case, nominally 6" square by 1.5" deep. The circuit board is mounted on the back plate of the metal enclosure, which is secured to the wall with fasteners through the two holes provided.

There are two choices to power the transceiver. A low volt (no more than 24 volt) power supply may be connected as shown on the drawing. If the Water Management Services power cube is used, we strongly suggest that it be secured to the outlet using the fastener in the center of the outlet cover plate to prevent inadvertent unplugging of the transceiver.

If the communication link between the transceiver and the base station is wired, communication wires should be connected, though it is not critical to complete this step before the meters are installed. If any Aqura radio unit cannot be heard during its test, the transceiver may have to be moved. This possibility encourages us to recommend that communication wires be run after the Aqura meters are installed and tested to assure adequate signal strength.

The cover plate of the transceiver is then installed, and three short (6") antennae are mounted on the three fittings that protrude through the cover plate.

In systems that employ a radio link between the transceiver and the base station, the siting of the transceiver presents a challenge. Selection of a site that is ideal for communication to the meters may be less than ideal for communication to the base station, and visa versa. We recommend against remote mounting transceiver antennae. Antennae cable costs $1.50 per foot – three such cables cost $4.50 per foot, and the use of remote cabling diminishes signal strength. For the ½ watt signal that is sent to the base station, the burden of a short cable may not be detrimental. For the much weaker 1/100 watt signal from the Aqura meters, such cabling represents too great a burden.

If forced to choose, it is always more costly to move transceivers than to move the base station transceiver, site a second base station transceiver, raise the antennae, or if required, site a second base stations closer to the transceivers. Choose transceiver locations to optimize the radio link to the meters, not to the base station.

The last step of transceiver installation is to test for signal strength. Access should be provided to an apartment unit that is furthest from the transceiver. An Aqura meter transmitter should be held close to the furthest installed location, and placed into test mode with a permanent magnet. The transceiver, upon hearing an adequate signal, should beep. If it does not beep, the transceiver is located too far from the transmitter, and must be moved.

Installing the Aqura Point-of Use Sub-meter units

Aqura meters are installed at each point of use within an apartment. Most are one bathroom units, with no laundry connections – these units require 7 meters. Two meters are mounted in replacement flex lines (hot and cold) leading to each faucet. One meter is mounted at the inlet to the toilet tank, the tub spout and the shower arm. In some installations, the hot water feed to the dishwasher is separate, and requires a separate meter. Clothes washer feed lines will also require two Aqura units (one for hot, and another for cold), with replacement supply lines.

Each installation point is discussed separately, along with the target installation time allotted by our engineered process design. A skilled crew will be able to install Aqura systems in less time than allotted – a new crew will take longer, especially at the beginning of a project. The average project will involve 225 apartment units, and over 2000 Aqura meters. Experience grows quickly. Even an inexperienced crew should be able to hit the target numbers after a week of experience.

The division of work among the crew, and the role of the supervisor is a matter that will vary from crew to crew. The key to success is flexibility. If one crew member gets behind, others need to pitch in, and visa versa. Every crew member needs to be capable of doing the work of others, so that people can flex to fill the demands of the job, rather than waiting for their peers to catch up. We recommend productivity incentives be provided to installation crews as a group, to keep people focused and active, pitching in as needed to speed work along.

Preparing the Site (30 minutes)

One person needs to arrive before the others, to prepare the site. Water should be shut off to the apartments that will be worked on, and lines drained. It is possible to install Aqura meters by turning water off at the stop valve. This is ill advised, however, because it introduces several difficulties:

1. Water in the supply line escapes onto the floor when the existing supply lines are removed.
2. Older stop valves may not hold, necessitating that the riser system be shut down anyway.
3. Valve stems are notorious for leaking after they have been used.

It is far better to not touch the valve handle during installation, and thus avoid the liability of its failure.

A sample Aqura transmitter should be used to test the transceiver, to be certain it is operable, and it is emitting a "beep" that can be clearly heard when a test signal is received. This is done by placing a permanent magnet near the Aqura transmitter, while standing at the doorway of the furthest apartment unit assigned to the transceiver. Once you are certain that the transceiver is working, and the water lines are drained, you are ready to begin inside the apartment units.

Gaining Access to Each Unit (5 minutes)

Nothing is more important to control cost than this subject. Ideally, the property manager will work with the crews to open doors as required, to keep everyone busy. Of course, tenants will have been given notice that your team will be doing work in their apartment unit – you should be expected. Tenants will be told to clean out personal effects from under the sinks. Most will. Some will not.

If working as a team of more than one, the person who finishes in an apartment early should arrange access, providing advance warning that the installation crew will be entering in X minutes, or should simply move on to the next apartment unit, with the second person following. If one person is consistently finishing early, he should pitch in to help the other, so that the gap in work time is not perpetuated.

Bath & Kitchen Sink (15 minutes per sink)

Generally, every apartment unit will be the same. Supply line assemblies should have been measured during the initial audit, and the right materials (length and fitting size) should be available. You may choose to make up replacement supply line assemblies that include the Aqura meter in advance. If not, this is your first step to installation.

The two supply line assemblies each consist of an Aqura flow sensor, and two braided flexible supply lines (each normally 9" long). One supply line runs from the meter to the faucet, and is terminated by ½" female fittings on both ends. The other supply line has a ¾" female fitting that attaches to the meter inlet, and a female fitting to match the stop valve on the other end (normally a 3/8" compression coupling).

The 20" length of these two assemblies must be sufficient to reach from the stop valves to the faucet inlets. Longer (and shorter) supply lines are available if 20" will not work comfortably.

Installation requires the simple removal and replacement of the 2 existing supply lines (hot and cold) with the 2 supply line assemblies that include the Aqura flow sensor.

Please use pipe dope – NOT Teflon Tape !! Excess tape can interfere with flow sensor !!

The electronics assemblies are then placed over the flow sensors, and the clips installed with a channel lock pliers to lock the radio electronic assembly in place.

Toilet (10 minutes)

The supply line assembly for the toilet uses a 9" flexible braided supply at the flow sensor inlet, with a ¾" female fitting at the flow sensor inlet, and a fitting to match the stop valve at the other end. The outlet of the flow sensor is attached to a brass toilet adapter supplied by Water Management Services. As with the faucet, the existing toilet supply line is removed and discarded. The new assembly is fitted into place, using pipe dope as required. **DO NOT use teflon tape!!** An electronics assembly is placed over the flow sensor, and made secure with the clip, pressed into place with a channel lock pliers.

Shower & Tub (25 minutes)

The shower arm, tub spout and tub spout nipple are removed. Special care must be taken in this process, to be certain that these fittings are removed without damage to the receiving fittings behind the wall. A nipple extractor that fits inside the nipple and tightens via a cam is suggested.

Replacement short nipples are attached first to the brass adapters provided, then to the flow sensor inlets. The length of the nipple and adapter must be just short enough so that the flange face of the flow sensor closest to you as you install the assembly, is between _____ and _____ from the finish wall surface. If the first nipple is too long, or too short, use a different length. It is important that the flow sensor flange be properly positioned for the escutcheon to work properly. Use pipe dope as required. **DO NOT use Teflon Tape!!**

Some tub spouts will be the slip on type, fitting over a ½" copper line. In this case, the copper line is cut back to 3/8" inside the wall opening, and a special adapter is secured (5/8" OD compression fit to tube, with ¾" female to flow sensor.) If this is your situation, cut the tube and install the adapter first, then the flow sensor.

Next, place the electronics packages around the flow sensors, so that the electronics packages are flush against the wall, up to a 3/8" gap from the finished wall surface. Make the electronics assemblies secure to the flow sensors with the clips provided, pressed into place with a channel-lock pliers.

Remove one of the barcode labels from the electronics package, and place it on the outside of an escutcheon. Place the escutcheon over the meter assembly with the threaded male fitting of the flow sensor protruding out of the escutcheon, and the antenna nestled inside. If a chrome metal plate has been provided to cover the face of the escutcheon, place it in location. Install the replacement tub spout provided onto the flow sensor outlet threads, using a ½" coupling and a second short nipple inside the spout. **Use pipe dope to assure a water-tight fit.**

Remove one of the barcode labels from the electronics package installed at the shower level, and place it on the other escutcheon provided. Install the escutcheon and optional face-plate as with the tub spout. Install the chrome shower adapter provided, onto the flow sensor outlet. To secure the escutcheon, engage the chrome locking ring provided over the chrome shower adapter and tighten, being careful not to damage the chrome plating on the locking ring. Install the shower head onto the shower adapter.

Testing the Radio and Recording the Serial Number (15 minutes per Apartment)

Each meter installation must now be tested to assure there is a valid radio link from the meter to the transceiver. Place a large permanent magnet along side the electronics package where indicated, on the side opposite the antenna. This closes a switch on the circuit board that places the transmitter into test mode, transmitting a diagnostic code every 2 seconds. Each time a radio signal is heard at the transceiver with adequate signal strength, the transceiver will beep loudly. If the beep is heard, the signal is good, and the radio has been activated.

If you fail to test a radio, it will remain in its "sleep" mode as shipped from the factory, to preserve battery life. The quality assurance test described above is necessary to wake the unit up.

Next the bar code that appears on the meter must be "wanded" and fed into the hand held installation computer. The serial number will appear on the screen. This serial number must be matched against the location of the meter, which is part of the installation list loaded into the computer prior to the beginning of site work. "Drop and drag" the serial number into the right slot. This activity is critical – a mistake in this activity will cause the billing data base to be in error, and bills will not be accurate.

Restoring Water, Bleed and Inspect for leaks (10 minutes + 5 minutes per apartment)

After all apartments serviced by one set of stop valves are completed, the water should be turned back on. Air must be bled from the lines in each apartment, and all joints inspected to assure there are no leaks. Hot and cold lines should be bled at the same time, to avoid the possibility that compressed air in one line causes water from the other line to hammer upon discharge.

Commissioning the System

At this point, the installation of all components and wiring is complete, the serial numbers of each meter has been identified by location in the installation tool. The next step is to e-mail the serial number data to the billing service. Their data base must be set up using this information. The system must be then be tested by the metering service company. This can be done from their billing center. If everything is connected properly, data from each and every meter will appear in the billing data base.

Problems in receiving data can be easily isolated to particular transceivers or meters, making the job of tracking down problems quick and easy.

Planning the Division of Work

There are three skill sets involved in an Aqura system installation:

1. The project manager must have overall knowledge of the system, and basic computer skills. He or she is responsible to select the sites for the transceivers, base station and the transceiver for the base station. He or she must also assure

that the installation is done correctly, and that the billing data base is properly recorded. The project manager normally works directly for the metering service company, who is responsible for the success of the project.

2. An electrician, licensed to run low voltage communication wires should be responsible to install transceivers, base stations, antennae, run low voltage power and make communications connections. In a smaller crew, the electrician also tests to assure the radio link is made from each transmitter, and records the serial number of each unit.

3. A plumber or plumbing technician, operating under a qualified license is required to do rudimentary plumbing work. A more experienced plumbing technician is most appropriate for the tub-shower installation. A less skilled plumber's helper, is needed to remove and replace flexible supply lines under sinks and toilets.

Of course, one person, or two could easily possess all of these skills. The division of work will vary with the skill set of the crew that is assigned to complete the system installation.

The table on the following page breaks down the work to balance the time in each apartment, based on the crew size.

Aqura System Installation Planning Guide

2 Bath Apartment Units, 10 to 25 units per shut-off valve

Aqura System Installation Planning Guide

1 Bath Apartment Units, 10 to 25 units per shut-off valve

Apartment Work, which varies with the Number of Apartment Units
Time shown in minutes per day

General Work Assigned at the Project Level

Project Manning	Units per day			Water Off	Mount Receiver	Gain Access	Kitchen Sink	Bathroom Sinks	Toilets	Tub Shower	Test Radio Wand Ser.#	Water On	Bleed & Inspect	Total Minutes	Total Hours
	Project Manager (working for metering service company)		per apartment unit	depends	0	5	15	15	10	25	15	depends	5	150	2.5
1	Site Survey			4 hours incl. travel time											
	Day 1	2.5	Preparing the Data Base	2 hours	100	15	30	60	40	150	40	10	15	490	8.17
	Day 2,3,4	3.5		15		20	60	120	80	150	50	10	20	525	8.75
	Ave.	3	per man day	22.5	50	17.5	45	90	60	150	45	20		500	8.33
	Electrician														
2	Electrician mounts one station, does all testing, and assists plumbing in sink and toilet, complete 6 units per day														
	Day 1	6	plumber	30		10	15	105	20	300		10	10	500	8.33
	Day 1	6	electrician / helper	8 hours	100	20	75	75	100		90		20	480	8.00
	Day 2	6	plumber	15		15		90		300		10	10	440	7.33
	Day 2	6	electrician / helper			15	90	90	120		90		20	425	7.08

Apartment Work, which varies with the Number of Apartment Units
Time shown in minutes per day

Project Manning	Units per day			Water Off	Mount Receiver	Gain Access	Kitchen Sink	Bathroom Sinks	Toilet	Tub Shower	Test Radio Wand Ser.#	Water On	Bleed & Inspect	Total Minutes	Total Hours
5	Electrician mounts 2 receivers and wands bar code & tests system, 16 units per day														
		8	plumber 1	30		35	120	240	100	400			20	515	8.58
		8	plumber's helper			15			60				20	515	8.58
		8	per apartment unit	depends	10	5	15	120	10	25	10	depends	5	95	1.6
		8	plumber 2			35	120	240	100	400		10	20	505	8.42
		8	plumber's helper			25			60				20	505	8.42
1			electrician		200						240			440	7.33
	Day 1	4		30	100	20	60	60	40	100	40	10	20	480	8.00
	Day 2	6	3.2 Units per man day	15		30	90	90	60	150	60	10	20	525	8.75
	Ave.	5	per man day	22.5	50	25	75	75	50	125	50	10	20	502.5	8.38
7.5	Supervisor records and manages, all trades focus, complete 24 units per day														
		8	plumber	30					80	400			20	530	8.83
2	Electrician mounts one receiver, does all testing, and assists plumbing in sink and toilet, complete 10 units per day														
		8	plumber's helper		100	50	120	240	80	400		10	20	500	8.33
		10	plumber	30			75	75	50	250			25	505	8.42
		10	electrician / helper		100	50	75	75	50		100	10	25	485	8.08
	Ave.	5	per man day						60	400			20	480	8.00
		8	plumber's helper				120	240	100				20	480	8.00
5	Electrician mounts 2 receivers and wands bar code & tests system, 25 units per day					240								240	4.00
		12	plumber	30		50			120	300	30		30	510	8.50
		12	plumber's helper			65	195	195					25	480	8.00
		13	plumber 2						60	325	32.5		40	477.5	7.96
		13	plumber's helper			60	180	180	50			10		480	8.00
			electrician		250						188		30	468	7.79
	Ave.	5	per man day												
10	Supervisor records and manages, all trades focus, complete 50 units per day														
		12	plumber	30					120	300			35	485	8.08
		12	plumber's helper			60	180	180				10	25	455	7.58
		13	plumber			5			130	325			25	485	8.08
		13	plumber's helper			60	195	195					35	485	8.08
		12	plumber	30					120	300			35	485	8.08
		12	plumber's helper			60	180	180				10	25	455	7.58
		13	plumber			5			130	325			25	485	8.08
		13	plumber's helper			60	195	195					30	480	8.00
			electrician		480									480	8.00
			project manager								500		10	510	8.50
	Ave.	5	per man day												

Productivity Incentives

Water Management Services, who designed the Aqura system, has been selling and managing water conservation upgrades in apartment buildings for several years. Key to

success of this business has been our work with plumbing contractors to improve their jobsite productivity, and engineer the installation process, the way one engineers a factory production process. In the conservation services business, the toilet in each apartment is replaced, along with the shower head, and two faucet aerators. Plumbing contractors who work with Water Management Services regularly, budget 8 apartment units per man day for this work. This includes the movement of new toilets to the unit, and removal of the old to a dumpster.

Some contractors choose to give their installation teams incentives for productivity, and create friendly competition among crews with rewards of valuable merchandise and recognition. One contractor in New York City used this approach to inspire his team to average 12 units per man day, with the record best day by one crew at 22 units per man.

We know from our own experience that the Aqura system can be installed at the rate of 5 units per man-day by a well-organized crew. We also know from experience doing conservation work that a new crew will struggle, while one that really clicks will do more than a 5 unit per day.

No matter how you man the job, or what your target productivity rate is (we suggest 5 units per man day for one bathroom apartments, and 3 units per day for two bath units), our recommendation is that you provide incentives for quality and productivity. Our experience suggests that by the end of your first project, production rates will beat the target, and increase your earnings from this work.

Of course, any incentive needs to be net of call backs to repair leaks. Quality matters.

Mixing Conservation Upgrades with Sub-metering

We recommend to owners, that they pay a bit extra to have inexpensive conservation measures installed right along with the sub-meters. This lowers the tenant's cost of water and related energy. One argument is that the owner should not invest in measures to lower the utility bill of the tenant, because the owner incurs the investment, and the tenant receives the return. The counter argument is that if the tenant pays a lower utility bill, they will be more willing to pay for other services, such as garbage removal or their pro-rata share of landscape irrigation, further offsetting the owners' expenses.

The decision is the owner's to make. If they choose to invest in conservation, we can usually guarantee a 20% to 40% reduction in water consumption, depending on the existing conditions. Our goal is to lower water use under 65 gallons per person per day, by changing the shower head, the toilet flapper, and the faucet aerators. (If we change the toilets as well, we can get to under 50 gallons per day per person.)

To plan a project that includes conservation measures, add the following materials to your list, and alter your division of work a bit, as follows.

1. During the site audit, you will want to make flow measurements on a sampling of faucets, showers and toilets, scattered at different levels in the complex. Accurate measurement tools are available from Water Management Services. This will add an hour to your audit time.

    a) a wier type vessel is used to determine faucet and showers, in 10 seconds each.

    b) Tank type toilets require three measurements. First, the depth and width of the tank, and the water line drop during flushing. Second, the time the flapper is open during a flush. Third, the total time the fill valve runs from trip of the handle to the shut-off of flow to re-fill the tank. Third, we need to know the flow rate of the re-fill line that discharges into the overflow tube. This can be measured using the faucet measurement wier vessel.

2. Record the thread size of the kitchen and bath aerators. If in doubt, remove samples and bring them back to your shop for verification.

3. Get copies of the energy, water and sewer bills. Determine the rate per therm the owner pays to heat hot water, and the rate paid for water and sewer, along with the annual consumption.

4. Determine how many people live in the complex. This is critical information.

5. Measure water pressure at the highest and lowest points in the system

6. Report this data to Water Management Services – we will create a software model of the facility, and impose conservation measures on the model to determine the savings. We will provide you with a brief report comparing the monthly cost of water and sewer per apartment unit today, with that following the installation of recommended conservation measures.

Of course, we would recommend you purchase the same conservation devices we use in our business. We can provide these to you as a service, though this is not our core business. The selection of the right devices is important to assure tenant satisfaction with the result. If the tenants are not happy with the measures you install, they will remove them, or complain about them.

The recommended conservation measures will be:

- Replacement shower head – Water Management Services uses our own 1.5 gpm aerated model that gives a very forceful shower, even at this low flow. This head comes in three types, for different dynamic pressure ranges. If you choose to use this head, our price is $16.50 per head.

- Replacement toilet flapper – 20% of all toilets leak through the flapper, according to the AWWA. We use an adjustable flapper made by Fluidmaster, that closes

early to limit use to 3.5 or 1.6 as required by the toilet, and are guaranteed leak-free for 5 years. The setting on this flapper should be determined through experimentation on two or three toilets, and used repeatedly. You do not want your installation crews adjusting to optimize toilet flows – it will slow them down too much. Our price is $11.50 per flapper.

- Replacement aerators – Water Management Services uses a 1 gpm shower spray type in the bathroom, and 1.5 gpm aerated type in the kitchen. Tamperproof versions are recommended. Our price is $3.50 per aerator.

The increment in labor time is "0" for the shower head, 5 minutes for the toilet flapper, and 5 minutes each for the aerators. For a focused crew, these times are generous.

On the following two pages, we have laid out the time balance for various size crews, to install the Aqura system plus conservation measures which are recommended above.

Aqura System Installation Planning Guide
WITH CONSERVATION MEASURES
1 Bath Apartment Units, 10 to 25 units per shut-off valve

General Work Assigned at the Project Level

Project Manager (working for metering service company)

Site Survey	5 hours incl. travel time
Preparing the Data Base	2 hours

Electrician

Base Station Installation	2 hours
Total	9 hours

Apartment Work, which varies with the Number of Apartment Units
Time shown in minutes per day

Project Manning	Units per day		Water Off	Mount Receiver	Gain Access	Kitchen Sink	Bathroom Sink	Toilet	Tub Shower	Test Radio Wand Ser.#	Water On	Bleed & Inspect	Total Minutes	Total Hours
	per apartment unit		depends	10	5	20	20	15	25	10	depends	5	110	1.8
1														
Day 1	3		30	100	15	60	60	45	75	30	10	15	440	7.33
Day 2	5		15		25	100	100	75	125	50	10	25	525	8.75
Ave.	4	per man day	22.5	50	20	80	80	60	100	40	10	20	482.5	8.04
2	Electrician mounts one receiver, does all testing, and assists plumbing in sink and toilet, complete 8 units per day													
	8	plumber	30			80	80	60	200			20	470	7.83
	8	electrician / helper		100	40	80	80	60		80	10	20	470	7.83
Ave.	4	per man day												
5	Electrician mounts 2 or 3 receivers and wands bar code, plumber tests system, 26 units per day													
	10	plumber 1	30					150	250	25	10	25	490	8.17
	10	plumber's helper			50	200	200					25	475	7.92
	11	plumber 2			10			165	275	27.5		30	507.5	8.46
	11	plumber's helper			45	220	220					25	510	8.50
	5	plumber 3 (working alone)			25	100	100	75	125	12.5		25	462.5	7.71
Day 1		electrician (with overtime)		300						240			540	9.00
Day 2		electrician		200						240			440	7.33
Ave.	4.2	per man day												
10	Supervisor records and manages, all trades focus, complete 42 units per day													
	10	plumber	30					150	250	14	10	30	484	8.06
	10	plumber's helper			50	200	200			19		20	489	8.16
	11	plumber			15			165	275	25		20	500	8.33
	11	plumber's helper			5	220	220			35		20	500	8.33
	10	plumber	30					150	250	14	10	25	479	7.98
	10	plumber's helper			50	200	200			19		20	489	8.16
	11	plumber			15			165	275	25		20	500	8.33
	11	plumber's helper			5	220	220			35		20	500	8.33
		electrician		400	80							20	500	8.33
		project manager			60					420		20	500	8.33
Ave.	4.2	per man day												

Aqura System Installation Planning Guide
WITH CONSERVATION MEASURES
2 Bath Apartment Units, 10 to 25 units per shut-off valve

Apartment Work, which varies with the Number of Apartment Units
Time shown in minutes per day

Project Manning		units per day		Water Off	Mount Receiver	Gain Access	Kitchen Sink	Bathroom Sinks	Toilets	Tub Shower	Test Radio Wand Ser.#	Water On	Bleed & Inspect	Total Minutes	Total Hours
			per apartment unit	depends	10	5	20	20	15	25	15	depends	5	175	2.9
1															
	Day 1	2		30	100	10	40	80	60	100	30	10	10	470	7.83
	Day 2,3,4	3		30		15	60	120	90	150	45	10	15	535	8.92
	Ave.	2.3	per man day												8.65
2	Electrician mounts one receiver, does all testing, and assists plumbing in sink and toilet, complete 5 to 6 units per day														
	Day 1	5	plumber	30		25		20	150	250		10	10	495	8.25
	Day 1	5	electrician / helper		100		100	180			75		15	470	7.83
	Day 2	6	plumber	30		30			150	300		10	10	530	8.83
	Day 2	6	electrician / helper				120	240	30		90		20	500	8.33
		2.3	per man day												
5	Electrician mounts 2 receivers and wands bar code & tests system, 13 units per day														
		6	plumber 1	30		30			105	300		10	10	485	8.08
		6	plumber's helper				120	240	105				15	480	8.00
		7	plumber 2						120	350			10	480	8.00
		7	plumber's helper				140	280	60				10	490	8.17
			electrician		200	35					195		20	450	7.50
		2.5	Units per man day												
7.5	Supervisor records and manages, all trades focus, complete 21 units per day														
		7	plumber	30					150	350			15	545	9.08
		7	plumber's helper				140	280	60			10	20	510	8.50
		7	plumber						150	350			15	515	8.58
		7	plumber's helper			15	140	280	60				20	515	8.58
		7	plumber			0			150	350			15	515	8.58
		7	plumber's helper			15	140	280	60				20	515	8.58
			electrician		210	(electrician works ahead, independently)								210	3.50
			project manager			75					315	10		400	6.67
		2.8	units per man day												