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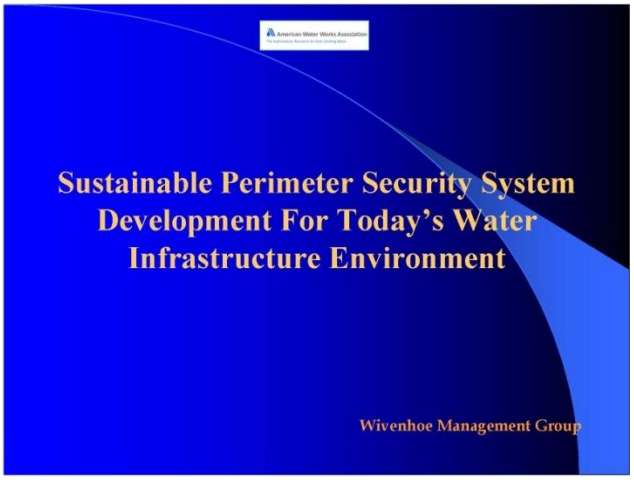
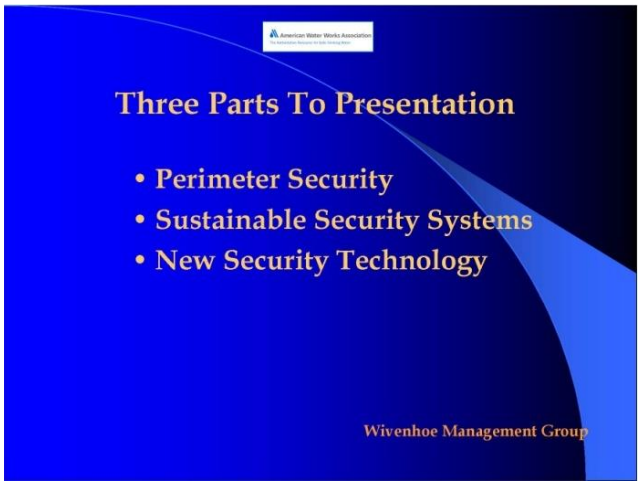
SUSTAINABLE PERIMETER SECURITY SYSTEM DEVELOPMENT FOR TODAY'S WATER INFRASTRUCTURE ENVIRONMENT



Introduction:

This paper is in association with a presentation given to the AWWA 2012 Water Security & Preparedness Conference held at St. Louis in September, 2012 and as titled above. The paper and presentation is in three parts:



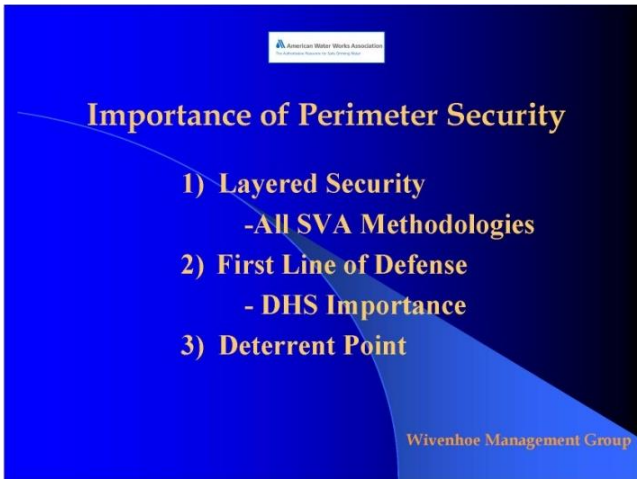
The first part relates to the importance of **Perimeter Security** in devising appropriate security measures to provide an adequate level of protection for a water or wastewater facility (in keeping with accepted

Security Industry standards and practice), meet SVA (Security Vulnerability Assessment) recommendations, and further meet pending and future water security legislation and regulations, such as that being readied by the DHS (Department of Homeland Security) under the Water Security Act.

The second part of this paper concerns **Sustainable Security Systems,** encompassing the strides that have taken place in the last few years to provide "off-grid" power sources for security systems and equipment, particularly in the wireless video and video motion detection areas that form the backbone to virtually every perimeter security system being installed today.

Part three of this paper and presentation discusses the **New Security Technology** now available that permits perimeter security systems to be realized at water and wastewater facilities utilizing wireless concepts, stand-alone sustainable power sources, and security systems, particularly camera surveillance equipment with vastly improved features such as low power and low light requirements.

Part three also includes new Deterrent Technology, very applicable to water and wastewater facilities, as well as the latest Remote Monitoring Services covering virtually any surveillance system, and significantly reducing the cost and manpower requirements that would otherwise be required to meet 24/7 monitoring.



The Importance of Perimeter Security:

Most SVA methodologies stress the need for **Layered Security,** where the intent is to provide a series of security layers that present a series of obstacles to an adversary attempting to access a specific area within a facility's infrastructure. The more layers and difficulty, the longer it will take an adversary to reach their objective, and the more time local law enforcement have to neutralize the individuals before they can carry-out their goal whatever it might be.

However, a facility's perimeter security is also its **First Line of Defense**. This is where any intrusion system will first indicate that the perimeter has been breached by unauthorized parties, and it is also the first point at which a planned response begins to take effect. Action cannot be taken to neutralize a situation, if no one is aware of the security breach.

Perimeter security is also considered very important within the requirements of the DHS (Department of Homeland Security), CSAT methodology and their corresponding Standards of Performance, as used in

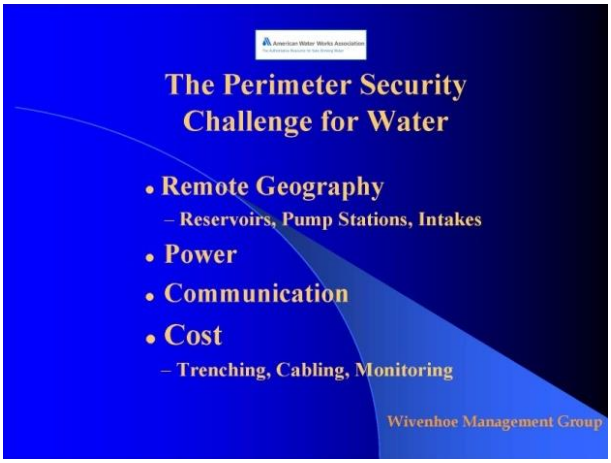
the CFATS regulations for the Chemical Industry. These same DHS standards are likely to be used under the proposed Water Security Act, and as already being applied by NERC for Energy Utilities.

The most important point related to Perimeter Security may well be that of the **Deterrent Point**.

The Security Industry for many years has successfully deployed what is often called the Deterrent Approach to security, where solid, well thought-out perimeter security measures can act as a deterrent to adversaries and criminals, in keeping with security industry accepted standards and practices, and induce such individuals to seek another target elsewhere, where security appears to be far less inhibitive.

Under the EPA mandated Water Industry SVA program, many security vulnerability assessments were carried-out under the RAM-W SVA methodology created by the Sandia National Laboratory section of the Department of Energy. Sandia does not recognize the Deterrent Approach in their principle of **Detect, Delay, Respond**, which can reduce the cost of securing a Water or Wastewater facility by very significant amounts.

The DHS do recognize the Deterrent Approach and employ the principle of **Deter, Detect, Delay, Respond.** Thus, it is possible with good perimeter security to adequately protect water, and wastewater facilities and systems, meet budget constraints in terms of cost, and meet both current and pending security legislation and regulations.



The Perimeter Security Challenge for Water:
There are however, specific problems, particularly for the Water Industry in deploying good perimeter security that can be summarized as follows:

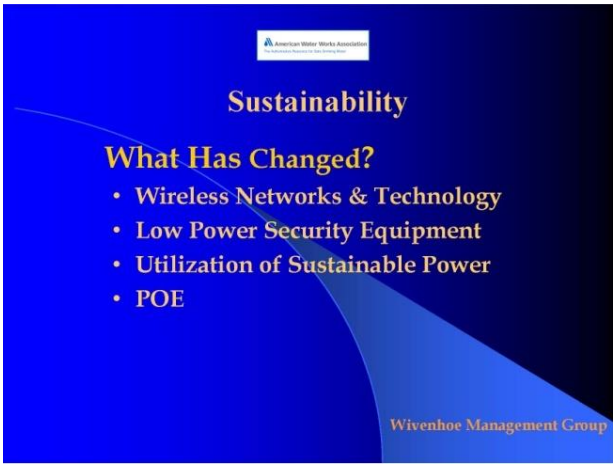
1). **Remote Geography** – Water systems include clean water and raw water reservoirs, pump stations, main intakes and other components that are often quite remote, and even more difficult to cover from a perimeter security point of view due to sheer geography.

2). **Power** – In many cases, particularly the more remote components of a water system, there may be limited power resources, if any, necessitating difficult and expensive installation of same.

3). **Communication** – As mentioned earlier, it is vital that there be communication of a breach in perimeter security, otherwise there can be no response from local law enforcement. Again, in the case of more remote facilities and infrastructure, it is not unusual to have no telephone communication, or other form of communication such as process control systems reporting back to a central point.

4). **Installation Cost** – Perhaps the most intimidating challenge of all is the cost of installing perimeter security systems where it may be necessary to run cabling via trenching, provide adequate power, install equipment, install some form of communication, and include ancillary components such as poles for cameras, etc. Monitoring of the systems also becomes a factor in cost.

Given developments in Security, Power, and Communication Technology, the Perimeter Security Challenge is no longer the "Goliath" faced by the Water Industry, and such security is now both practical and very affordable.



Sustainability:

What Has Changed?

Several factors have changed the problems previously faced with Perimeter Security, and they can be summarized as follows

A. Wireless Networks and Technology

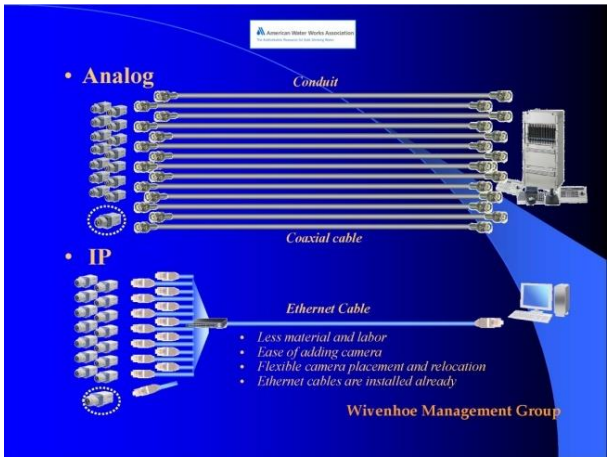
A major change in today's perimeter security is the increasing use of **Wireless Networks** and **Wireless Mesh Networks**. Shown below is a typical Wireless Mesh Network, where three Backhaul Signal Repeaters (Items 802.11A) provide a Wireless Hotspot (WiFi area) that effectively covers the field of operation.

Utilizing this **Wireless Mesh Network** it would be possible to install a perimeter security system comprising wireless camera surveillance and detection units where the only requirement from an installation point of view would be the need for suitable camera mounting locations, which could include the three Signal Repeater poles.

Wireless Mesh Network

Note: One element of Wireless Mesh Networks is that signal direction is multi-directional and should there be a failure in signal transmission within the "Mesh," the wireless system will find an alternative path to direct and transmit the signal.

Another change is that of **IP (Internet Protocol) Addressable Devices**, particularly in the camera field, where it is now possible to connect cameras or other security devices via existing (typically the case), or new computer networks and view the results over the **Internet**. One important benefit in the use of IP addressable devices is that they can be **POE (Powered over Ethernet)**.

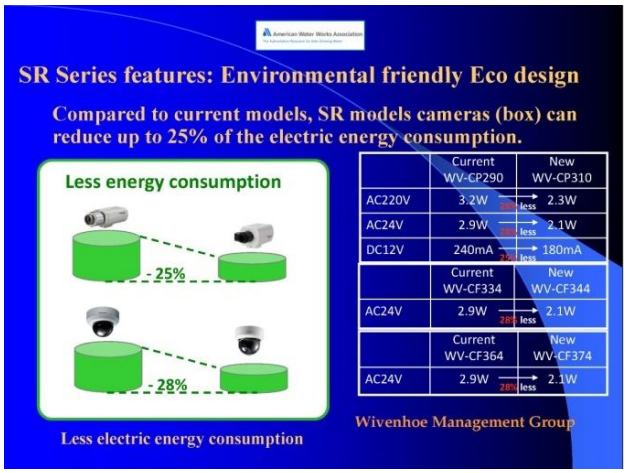


POE (Powered over Ethernet)

As seen in the diagram above, the benefits include less material and labor, where one Ethernet cable (CAT 5 or CAT 6), in this case can act as a backbone for many cameras. Previous analog cameras required a home run coaxial cable for each camera. In addition, power for each camera can also be run over the same Ethernet cable. Analog cameras required a separate power cable either home run to each camera location, or required an individual power supply at each camera location.

Other benefits of IP Camera systems is the ease of adding cameras (plug-in to the network), and providing flexible camera placement and relocation. The cost savings can be very significant. In a wireless network, the use of wireless security equipment will eliminate the need for communication cabling altogether.

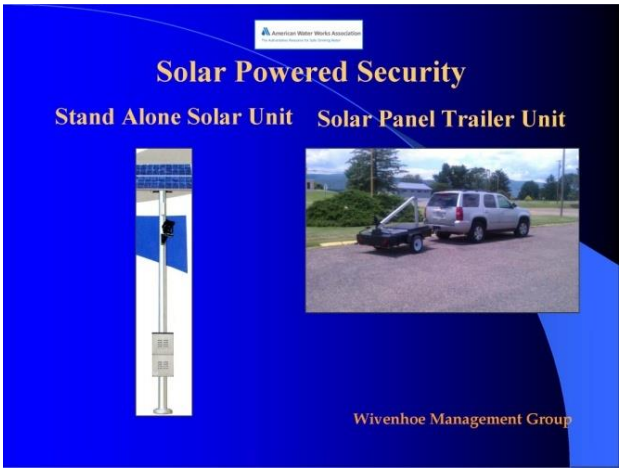
B. Low Power Requirements for Security Equipment



Low Power Camera Development Examples

In this diagram, it is possible to see the development of low power requirements for cameras with reductions of 25% - 28%. It should also be remembered that many of the newer security devices employ green technology making such devices far more environmentally friendly.

C. Utilization of Sustainable Power in Security Systems



Solar Power Examples"

From a water facility point of view, one of the most important changes that has taken place is in the area of Solar Powered Security providing "off the Grid" power for cameras and other security devices via solar panels, wind driven turbines, or a combination of both. Seen above are photos of a standard pole mounted solar panel that is powering a complete **Deterrent Tracking Surveillance System** and a mobile version of the same system. Thus, it would be possible and practical to set-up random camera surveillance systems in a wireless environment on a "stand-alone" basis.

These deterrent tracking surveillance systems are DHS approved and allow water facilities to meet perimeter security requirements at minimal cost and in the most rugged and remote sites.

Security Technology Development:

Security Technology Development:

The primary developments in Security Technology that effect perimeter security as it applies to water and wastewater facilities are centered on the following:

A) **Camera Technology**

There has been a total evolution in camera technology ranging from a move away from Analog cameras to IP and Wireless cameras, HD (High Definition), Advanced Features such as Multiple H.264 streams, DNR (Digital Noise Reduction), ABF (Auto Back Focus), Progressive Scan, Face Detection, Auto Dehumidification, to Wider Dynamic Range.

Examples of camera technology are discussed in more detail commencing on **Page 9**.

B) **Surveillance Deterrent Systems**

The importance of being able to deter adversaries away from a facility, were discussed earlier in this paper. The latest development of this approach is that of new Surveillance Tracking Deterrent Systems. Future Sentry (www.futuresentry.com), an American manufacturer of the First Responder surveillance deterrent system has developed a unique system in this area.

The system is described commencing on **Page 18** of this paper.

C) **Video Motion**

Developments here include the ability to mask specific areas around an object, differentiate between animals and humans, operate in extreme weather conditions, zone trigger, flow control, and pattern matching to name a few.

D) **Low Light/Low Power Surveillance**

It is almost standard with today's IP cameras to have a high sensitivity Day/Night function. In as little as 1.3 Megapixel mode at F1.4, it is possible to have 0.3 lux (Color) and 0.08 lux (B/W).

E) **Video Analytics/Recording**

Tremendous strides have been made in Video Analytics, where it is possible to measure pixel movements that cannot be seen by the human eye as the basis for detecting breaches of security by long range cameras at distances up to one to two miles.

Features include Motion Tracking, Target Size Filtering, Wrong Way Direction, Object Left Behind, Speed Alarm Detection and many others.

Video recording of one or more cameras can be digitally enhanced to provide zoom enable where there was no zoom lens on the camera, or provide camera coverage that was not visible on the camera monitor in live mode.

Security Technology Development (Continued):

F) **Remote Monitoring Management**

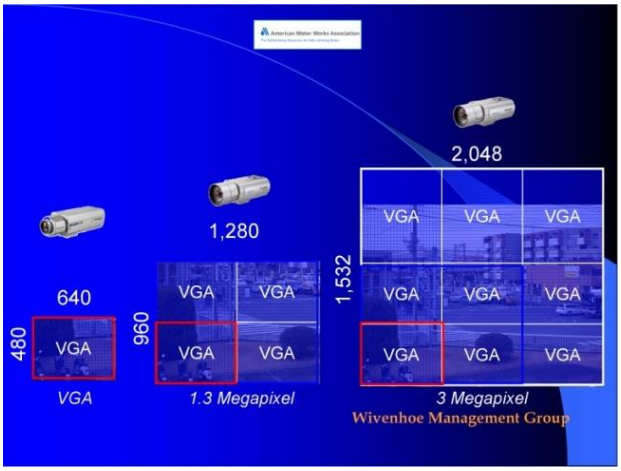
It is now possible utilizing IP Digital Video Recorders and associated cameras, together with a separate IP address, to monitor all cameras on a system, either on a passive 24/7 basis, or via video events as they occur. This has great significance for water and wastewater facilities, where manpower is at a premium, and where many remote infrastructure elements are not manned at night, or during weekends.

Camera Technology:

The most significant developments in camera technology include the following:

1) **Megapixel Development**

Applicable to IP camera systems, the advent of megapixel design can best be described in the diagram below.



The Megapixel Camera Difference

Camera Technology (Continued):

The view from a standard non-megapixel camera is measured in terms of its VGA (Video Graphics Array), an area of 480 by 640 pixels with that area being shown as a single rectangle at the far bottom left of the diagram.

1). **Megapixel Development**

The advent of Megapixel cameras which typically start at 1.3 Megapixel provides four times the VGA area, or an area of 960 by 1,280 pixels, and as demonstrated to the right of the standard camera in the diagram. Using a 3 Megapixel camera, which within the last year, has now become effectively the minimum level, expands a single camera VGA to 1,532 by 2,048 pixels.

With 10 and 20 specialty Megapixel cameras now available, the standard Megapixel camera will continue to increase in VGA area. It should also be noted that Megapixel cameras, even at the 1.3 level are able to read vehicle license plates at a distance.

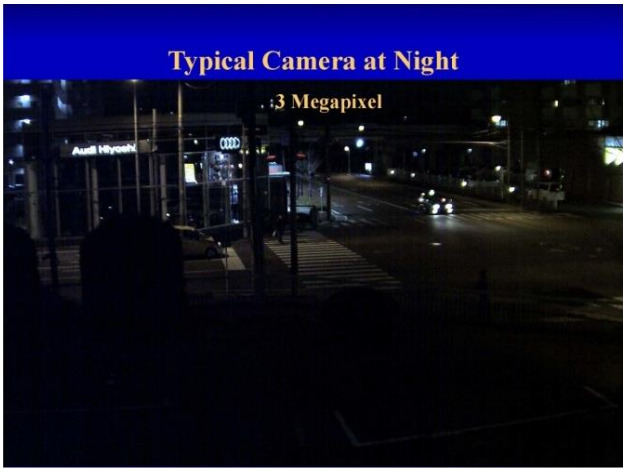
Non-Megapixel Camera View

To put this into practical terms, the photo shown above is that from a standard camera with a VGA of 480 by 640 pixels. The photo shown below, is the same view, but using a 1.3 Megapixel camera in place of the standard camera. The difference in both clarity and coverage is quite significant. The author has specified and implemented this type of camera into several diverse security applications, particularly perimeter security situations with considerable success.

It is now possible to design and implement perimeter security systems using a smaller number of cameras, but with greater efficiency, and less cost.

Megapixel Camera View

2) **Low Light Capability**



Standard Megapixel Camera at Night

A major issue with perimeter security systems, and especially true with surveillance systems has been the issue of lighting and how well camera surveillance systems work in remote areas where lighting is limited, or non-existent. Remote pump stations, main intakes, water storage tanks, and particularly reservoir areas are notorious for having little or no electric lighting.

From experience, some water treatment facilities, where there is lighting, switch it off to reduce operating cost. However, it is in the area of Low Light and Low Power that there has been significant developments with both camera and associated equipment technology, that allow the latest cameras to return reasonable video under low light conditions.

To demonstrate the low light developments, Slide 17 above shows a standard 3 Megapixel camera view at night time utilizing existing street lights covering an intersection. The coverage from an area point of view is excellent, but the overall detail is less than perfect.

1.3 Megapixel Camera at Night with Technology Improvements"

In the view above of the same intersection at night, but using a lesser cost 1.3 Megapixel camera with Digital Noise Reduction and minimum illumination of 1.5 lux, the difference is very substantial.

It should be stressed however, that where there is no light at all such as at reservoirs or remote pump stations, etc., and the area is in pitch darkness, even the best typical Megapixel camera is not going to operate in such conditions. The answer for that environment is to use IR (Infra-Red) illumination, either separately, or built-in to the camera itself.

This will be discussed in more detail on Page 15.

All Megapixel Cameras Are Not Alike:

As with many technologies, Megapixel cameras vary significantly in terms of cost and performance.

Reasonable Megapixel Camera View

Camera Technology (Continued):

The view above dramatically illustrates the Megapixel technology from a camera manufactured by Company A, and is considered a more than reasonable example of the difference between Megapixel cameras and analog cameras. However, please note the greater coverage provided by a different camera from Company B, as shown in the photo below (Slide 20), which also utilizes a more efficient DNR mechanism than Company A.

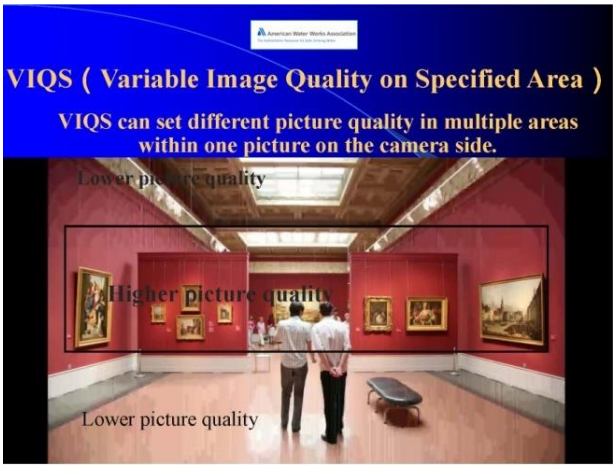
Of even more interest, the Company A camera is more costly than Company B and the warranty provided by Company B is three times that of Company A. It pays to have a qualified third party review your bids in terms of value and performance.

Another Company Megapixel Camera View – Same Location

3) **Functional Intelligence**

The latest camera technology includes features that can be referred to as Functional Intelligence, in the sense that these features can be turned on and off to provide greater performance for particular applications.

Examples include the following:



Megapixel Camera Demonstrating VIQS

VIQS (Variable Image Quality on Specified Area)

With certain cameras, it is possible to not only "mask" a section of the view, but it is also possible to apply high quality definition to one part of the view, and lesser quality definition to the rest of the view. As can be seen above, the area of concentration is the opening between the two rooms and people passing through the open area.

There is lesser interest in the roof and floor where there are no valuable exhibits.

LDC (Lens Distortion Compensation)

Compensation for Wide Angle Lens

There are occasions when it is necessary to cover as much area as possible with a single camera, and thus cameras are fitted with wide angle lenses, also known as "Fish Eye" lenses. The problem with this type of coverage is the distortion induced by the Fish Eye lens.

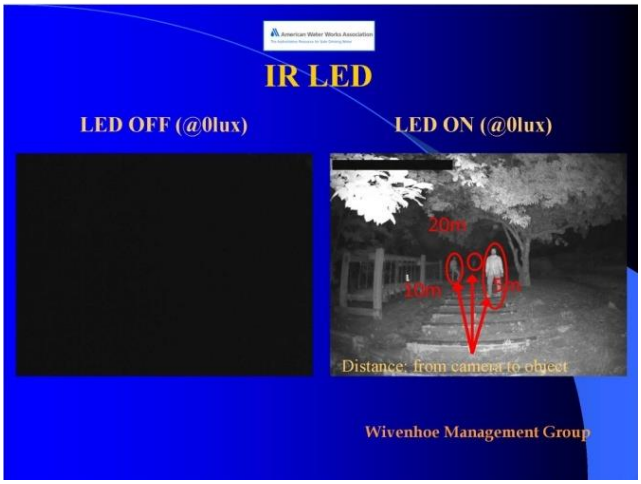
Utilizing LDC, it is now possible to significantly reduce that distortion as shown in the photo above.

4) **Low Power Requirements**

On Page xx, Slide #10 illustrated the dramatic reductions in power achieved in the area of cameras, but it is not just in the field of cameras that this has taken place. As already mentioned, where there is little or no light, it is necessary to consider infrared illuminators, either built-in to the camera system, or as free standing devices. The power consumption of such equipment has also seen low power development, such that sustainable power sources of which solar is one of the better examples is now able to power both the camera and associated equipment, including IR illuminators without too much trouble and at reasonable cost.

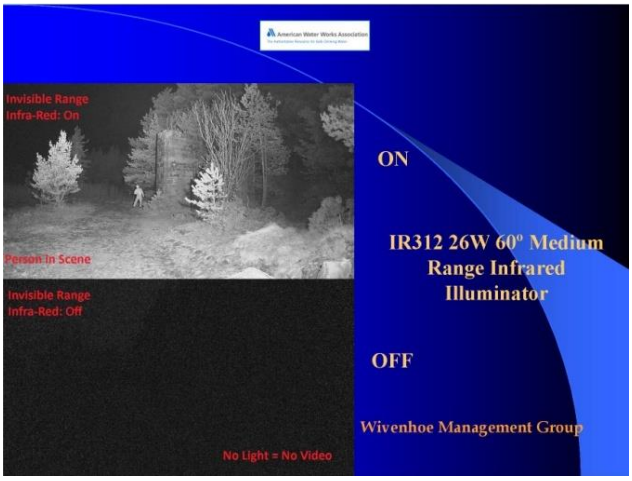
Low Sensitivity.

IP Megapixel cameras operate in conditions of low light, but they cannot see in pitch darkness. To compensate for such conditions of no light, as found at many remote water and wastewater facilities, it is possible to deploy IR (infrared) illuminators. This can be built-in to the camera or installed as a separate device.



IP Megapixel Camera with Built-In IR

The photo shows a Megapixel camera operating in pitch darkness, and as can be seen, there is no image. However this camera also has built-in IR, and when the IR feature is switched on, figures can be seen up to 60 feet away, and quite clearly at distances of 15 to 30 feet or so.



IP Megapixel Camera & Separate Medium IR Illuminator

In the next slide above, a Megapixel camera is first shown operating in pitch darkness, and as with the situation before, the camera generates no image in such lighting conditions. However, when a medium and separate IR Illuminator is switched on, it can be seen that the degree of IR generated light is greater than the camera with the built-in IR feature and the figure can be seen at greater range.

A further example, as illustrated below of using a separate medium IR Illuminator is shown in a warehouse environment. In pitch darkness the camera is unable to generate an image, other than that coming from outside distant lighting via a small panel in the overhead door. When the IR Illuminator is switched on, it is a very different situation and there is no question that an intruder is using a small flashlight to check cartons of equipment.

IP Megapixel Camera with Separate Medium IR in Warehouse Environment"

Yet another example of the use of separate IR Illuminators is that shown below where a van is parked outside an entry point to a building and individuals are moving equipment into the van from the building. In pitch darkness the camera generates a limited image based on the light coming from the interior of the vehicle. However, when the IR Illuminator is switched on, the van and its contents is clearly shown, as will be the individuals moving (stealing) the equipment.

IP Megapixel Camera with Separate Medium IR in White Light Situation

Again, from a water industry environment, it is now possible to install sustainable perimeter systems that will operate in a wireless or IP network environment at moderate cost, with limited installation in terms of excavation and trenching, and yet provide very effective deterrent, or stealth protection.

Network Video Recorder & Controller Developments

In almost every video surveillance situation, it is important to be able to record events as they unfold for later use in Court, or as an investigation tool. With IP camera systems there has been a corresponding technology advance similar to that of the cameras themselves. Again, from a water industry point of view, an issue with perimeter security, especially at remote locations, is being able to record video events, and communicate same together with accessing and controlling any camera surveillance system from a central location.

The technology has now evolved to where it is possible to transmit from a remote location via a network digital recorder with a separate IP address to a central control location with all cameras being monitored 24/7 either in a passive mode, or in event mode.

In many cases, it is less expensive to have the surveillance system monitored on a passive 24/7 basis than via events.

Many security integrators also provide a Virtual Watch Tour arrangement whereby a central location can conduct brief monitoring of all cameras at a location for 10-15 minutes or longer, every few hours acting in a way similar to security officers walking around the perimeter.

Network Recorders have also developed in enhancement performance and capability. The Network Video Recorder and Controller shown below is able to handle up to 64 cameras and can be equipped with a total memory of 18 terabytes per unit with the ability of three units being used together for a combined memory of 54 terabytes. This particular device also has certain "analytic" features allowing management to enhance any video recording by a host of functions that include:

Various Recording Modes
200 Mbps throughput
Full Pan/Tilt, Zoom, Focus, Brightness Controls
Audio from Cameras
Group Browsing
Filtered Search
2X 4X Digital Zoom
SD Memory Card
Disk Partitioning

Network Digital Recorder & Controller

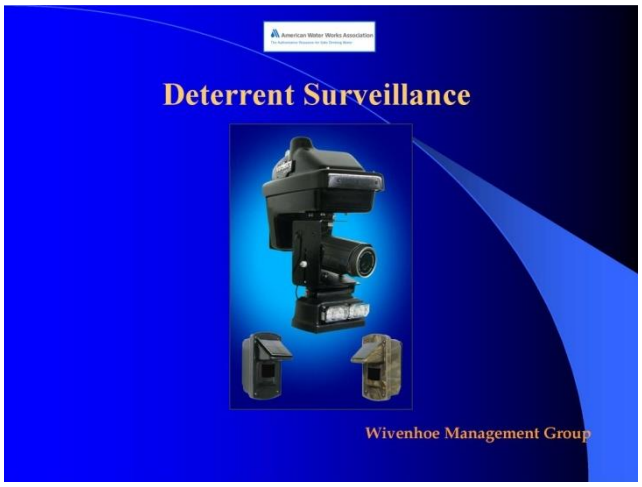
Deterrent Surveillance

Another technology development that has taken place is that of Deterrent Surveillance. The platform assembly shown below is a very unique development where in essence, the platform which can include virtually any IP or Analog camera type, automatically reacts to any adversary intrusion (triggered by PIR wireless, sustainable sensors positioned along and throughout a perimeter area), by tracking and making the intruder very aware of their having been detected and now being video recorded.

The method of operation is that an intruder sets-off a sensor somewhere along or within the perimeter which then causes the platform to flash two sets of high intensity LED light units and then remain on as the platform tracks to the sensor area, the lights and camera pointing directly at the intruder.

The tracking system operates in a way designed to monitor a typical security guard manually controlling a camera and following the intruder's path. The system operation in effect tells the intruder that he or she has been detected, is now being identified and recorded by a camera, and that in all likelihood, a call has already gone out to local law enforcement and security to respond to the security breach.

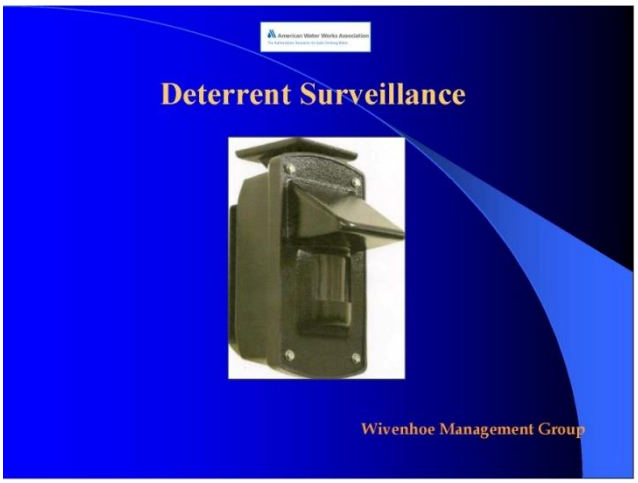
Criminals, terrorists, trespassers and other intruders share a common goal. They do not intentionally wish to be caught, they do not want to be identified and later apprehended, and basic human instinct, when spotted by a camera/light automatic tracking system is to immediately leave the area. The platform also has its own IP address allowing for a variety of communication functions.



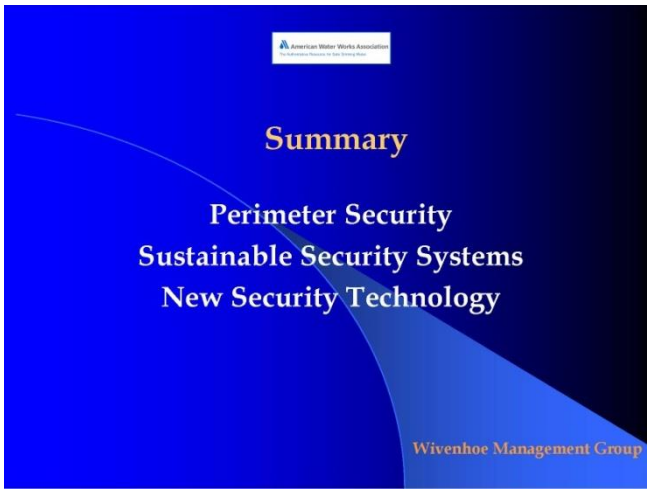
Deterrent Surveillance Automatic Tracking Platform

The illustration below is a close-up of the System Sensor which is totally wireless, (there are hard-wired versions available) can be up to 500 feet away from the platform, and is powered by a solar panel built-in to the top of the sensor. It is understood that if the sensor has six (6) hours of sunlight exposure charging its battery, it can then operate for approximately eighty (80) days.

The author can confirm from having specified this system into a project that it works exceptionally well and in most cases where installed, the system will deter, or cause a "would be" trespasser or intruder to go elsewhere.



Deterrent Surveillance Automatic Tracking Platform Wireless Sensor



SUMMARY

In summary, this paper/presentation was in three parts, being:

Perimeter Security

Perimeter represents the first line of defense in any security system.
Layered security starts with the outer perimeter.
The perimeter is the earliest point to detect intrusion and respond.
The DHS place significant importance on good perimeter security in their Standards of Performance.

Perimeter security has been a problem to the Water industry for remote Locations, due to the need for power and communication for perimeter security systems and an ability to respond.

SUMMARY (Continued)

Sustainable Security Systems

To counter the issues of providing power to remote locations necessary for security surveillance and detection equipment, and the corresponding high cost, as well as providing an effective communication system, it has been necessary to introduce an alternative arrangement to installing and power remote perimeter security systems. There have been two important developments on this front, namely Wireless Networks and stand-alone Sustainable Power Sources, particularly Solar.

This paper/presentation identified Wireless Networks and security equipment that is IP addressable, and as such provides POE (Power over Ethernet). As a result, it is possible to set-up appropriate wireless and local IP surveillance networks utilizing sustainable power and thus not only reducing very significantly the cost of installation, but also making it a practical solution for Water Perimeter Security Systems.

New Security Technology

The third part of this paper/presentation dealt with new security technology, concentrating on IP Camera Surveillance and Detection systems, including specific camera developments such as HD, Megapixel performance, Low Power, DNR, H.264 Multiple Streams, ABF, Progressive Scan, Face Detection, Wide Dynamic Range, Auto Dehumidification, and Low Sensitivity (Light) developments, LDC, and others.

Also discussed were developments in Video Motion, Video Analytics and Digital Video Recording, Deterrent Surveillance systems, IR Illumination, and Remote Monitoring Management.

All of these developments combine to allow Water facilities to acquire and install Perimeter Security systems, particularly at remote locations without the high cost of excavation and trenching to run cables for power and communication, utilizing camera surveillance as the most practical and least costly method of perimeter security, and able to be monitored from a third party central point at low to moderate cost.

The end result also leads to Environmental Friendly security that may well qualify for specific grant funding as a result.

For questions and further information, please see below:


Questions
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