



AIR  
LAND  
SEA  
SPACE  
CYBER

# Water Use Reduction Initiative

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**Raytheon Indianapolis**

# Raytheon Company at a Glance

**Raytheon**

*Customer Success Is Our Mission*

**William H. Swanson**  
Chairman and CEO

2012 Revenues: \$24 billion  
Employees: 68,000  
Headquarters: Waltham, MA



**Raytheon Company (NYSE: RTN) is a technology and innovation leader specializing in defense, security and civil markets throughout the world.**

Business Units:

- **Integrated Defense Systems (IDS)** provides integrated naval, air and missile defense, domain awareness systems and homeland security solutions
- **Intelligence, Information and Services (IIS)** provides a full range of ISR, cybersecurity, training, space, logistics and engineering solutions for the intelligence community, government and civilian customers
- **Raytheon Missile Systems (RMS)** provides advanced missile systems and solutions for the armed forces of the U.S. and allied nations
- **Space and Airborne Systems (SAS)** provides sensors, communications, integrated systems and space solutions for defense, government and commercial customers

# Raytheon Company at a Glance (cont.)

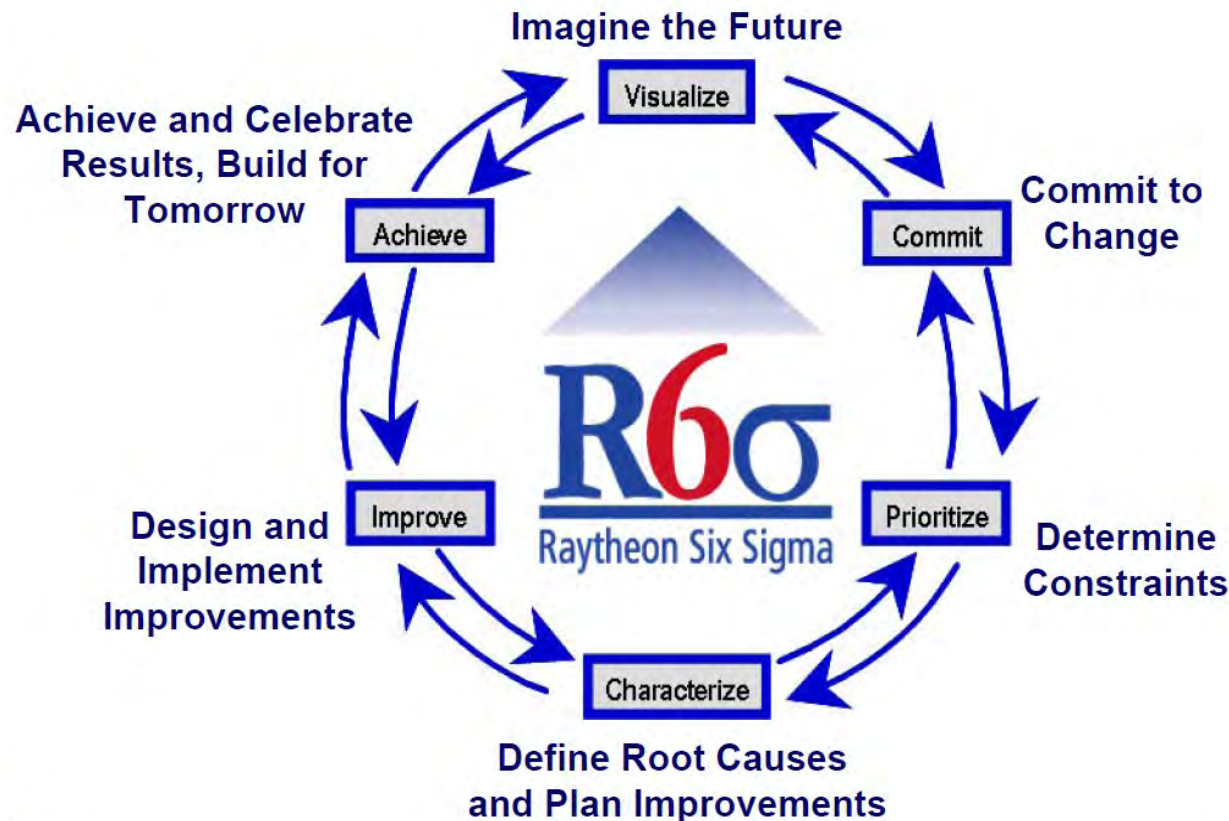
Indianapolis Campus – Systems Modernization & Sustainment – *Through research and innovation, we make systems new again or better than new.*



Former Naval Avionics facility built in 1942 to manufacture the Norden bombsight – 1 million square feet under-roof on 169 acres – approx. 1,000 employees today.

# Water Use Reduction Initiative

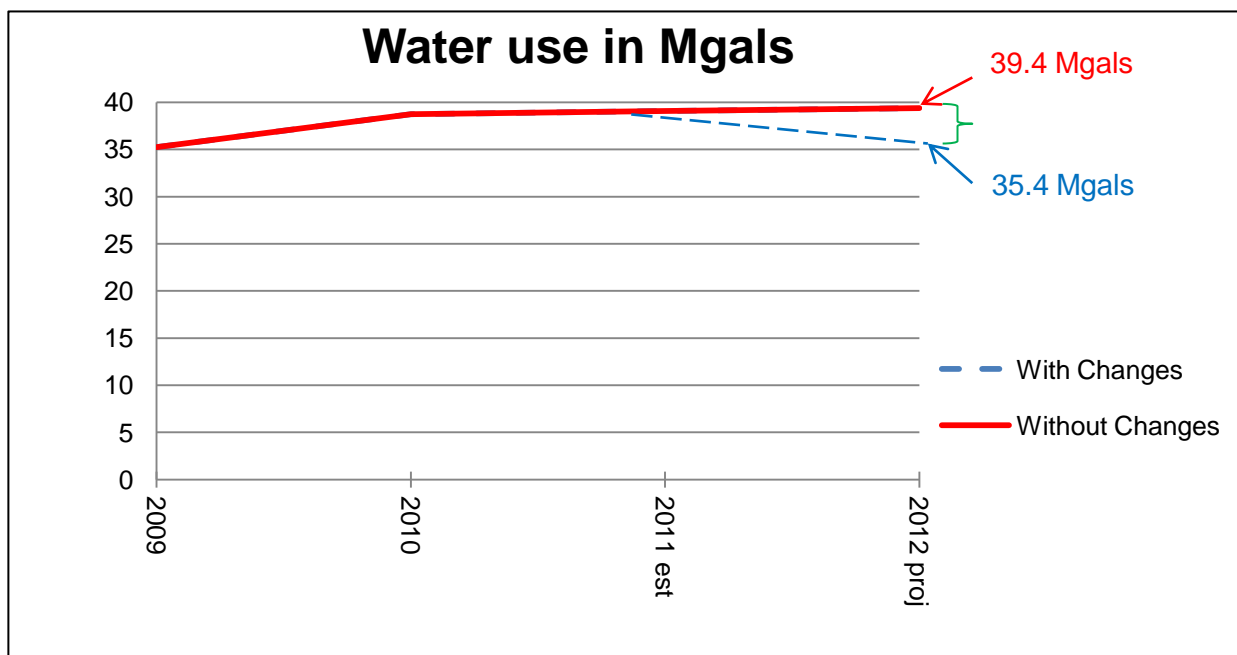
- Developed as a Raytheon Six Sigma (R6s) project



Can easily be achieved outside of the Six Sigma process.

# Background

- Raytheon's sustainability goals include reducing water usage by 25 percent from 2008 to 2015
  - Specific project target was 10 percent = 4 million gallons



# Vision

- Only Assumptions
  - Annual water use is excessive
  - Opportunities exist to reduce usage
- Not only environmentally responsible, but also financially responsible given the trend of water rate increases

Year	=	Domestic	+	sewer	=	total water cost	
2010	=	\$1.83	+	\$2.75	=	\$4.59	
2011	=	\$2.52	+	\$3.42	=	\$5.94	29% ↑
2012	=	\$2.63	+	\$3.94	=	\$6.57	11% ↑
2013	=	\$2.68	+	\$4.36	=	\$7.04	7% ↑

# Process

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- Data gathering for 12-month period
  - Heavy hitters only
  - Utility bills – water, sewer, monthly evaporative credit
  - Existing meters on main processes
    - Cooling tower – make up/blow down meters
    - Reverse osmosis system (RO) and deionized (D.I.) controllers
    - Water softening/conditioning
    - Plating
  - Building automation systems
  - Engage water-treatment vendor

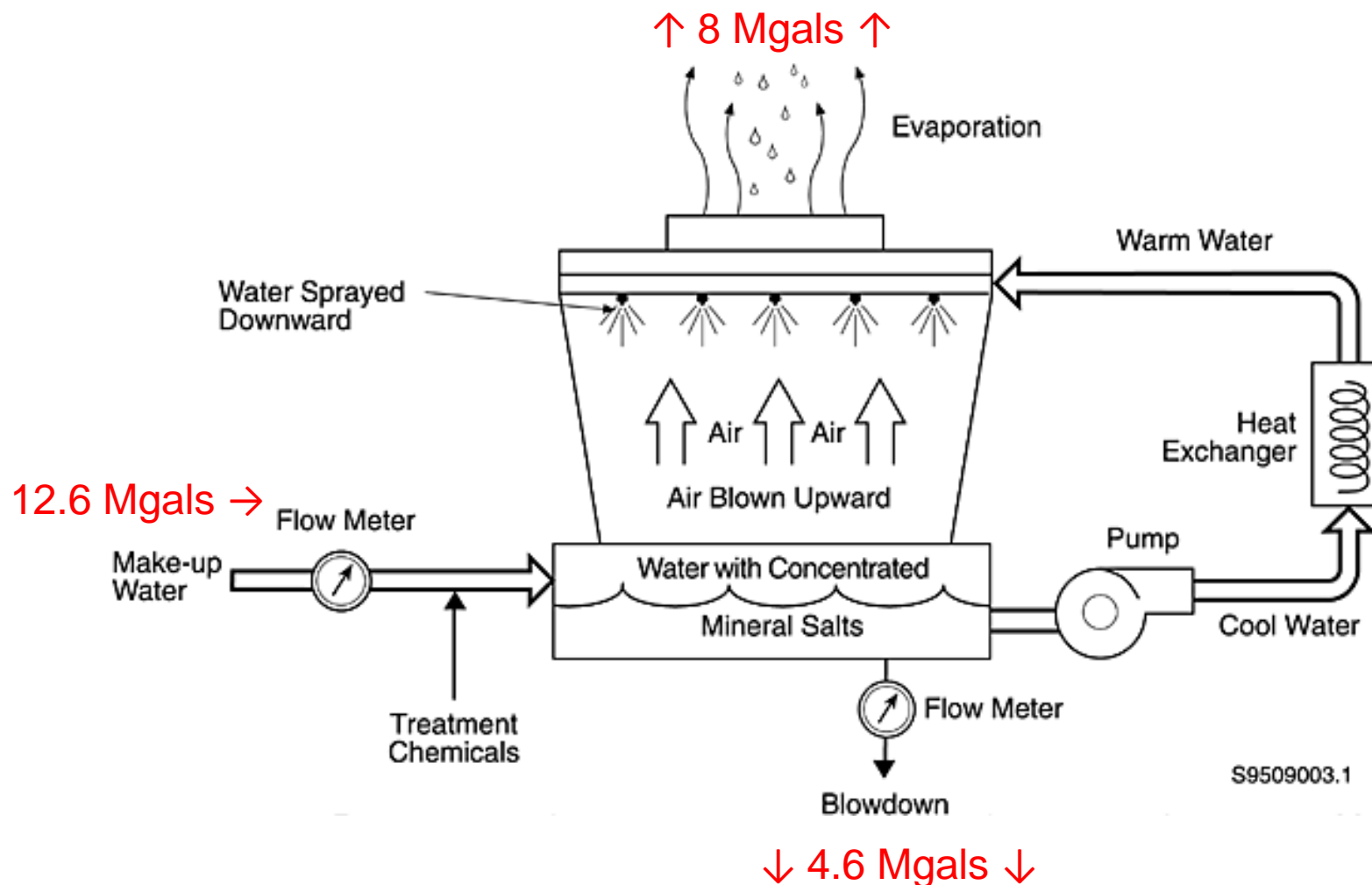
# Review Data

## Total consumption – 38.8M gallons

Cooling Tower Makeup	12.6 Mgals	32%
R/O System - Boilers	6.7 Mgals	17%
R/O System - Plating	4.1 Mgals	11%
R/O System for one process	1.1 Mgals	3%
	24.5 Mgals	63%

# Review Data (cont.)

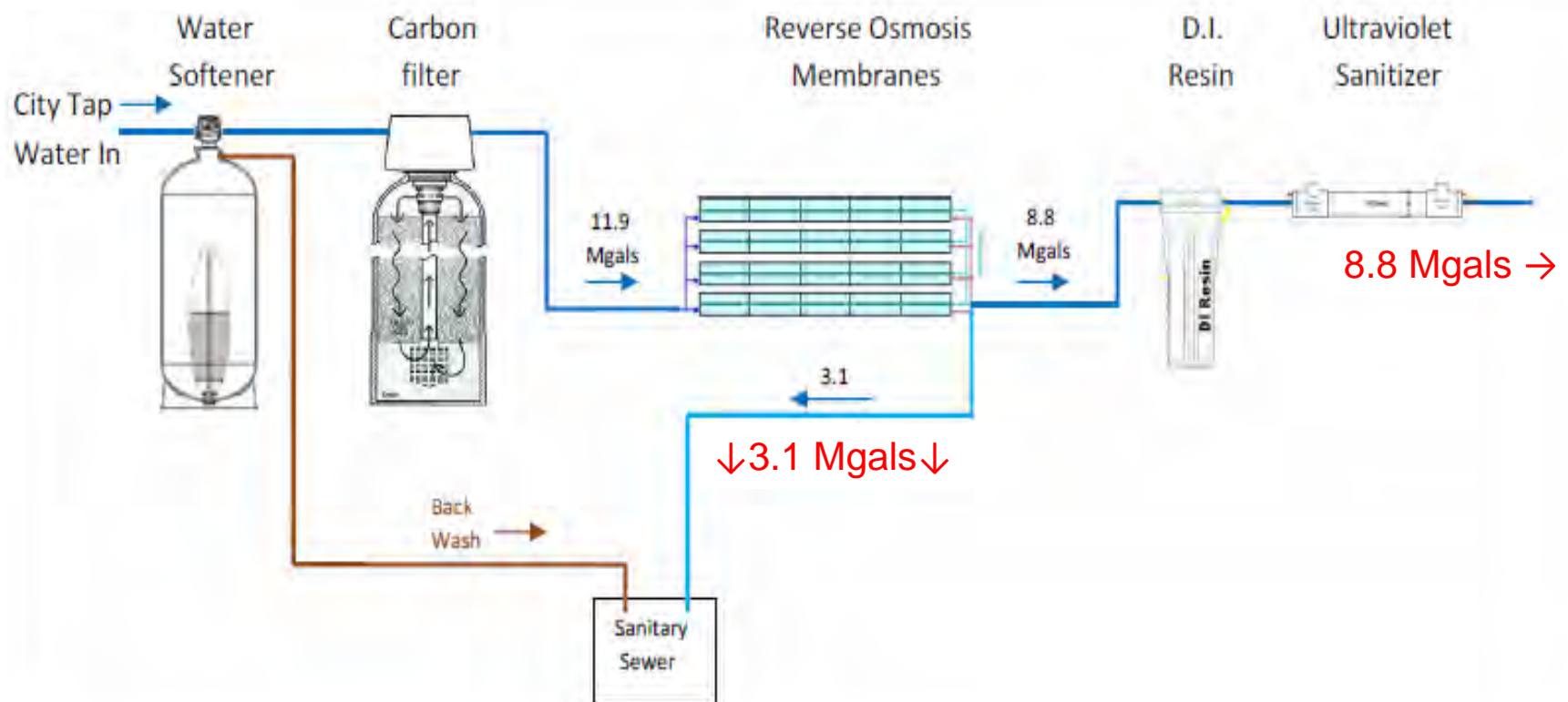
## ■ Cooling Tower



# Review Data (cont.)

## ■ RO/DI Systems

11.9 Mgals →



# Analyze High-Use Processes

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- Validate Current Need
  - Does the original need still exist?
  - Can it be replaced?
- Evaluate Process
  - Can the process be improved to reduce water consumption?
  - Is there a means to capture or reclaim waste water?
- Envision Change
  - Entertain all “what if” scenarios
- Consider additional Opportunities
  - Rainwater harvesting
  - Re-commission two existing water reservoirs

*No pre-conceived ideas ... entertain all options*

# Constraints

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- Minimize impact on plant operations – involve department managers
- Prevent cross-contamination – use backflow preventers
- Cooling tower uses evaporative cooling – ~~geothermal~~
- Tower water must be chemically balanced– sample reclaimed

# Design, Cost Estimates, RoI & Recommendations

- Weighed each idea - “green”, cost and return on investment

R6s Water Conservation Project	Annual Savings		Initial Investment			
	Mgals	\$\$\$	Material	Labor	Total	Returned in
<u>A. B1200 RO Reclamation</u>	1.161	\$6,896				
Cost Estimate			\$1,298	\$1,004	\$2,303	4 months
<u>B. B1300 RO Decommission</u>	1.054	\$6,261				
Cost Estimate			\$500	\$1,000	\$1,500	3 months
<u>C. B6000 RO Reclamation</u>	1.629	\$9,676				
Cost Estimate			\$5,465	\$6,121	\$11,587	14 months
<u>D. B6000 Rainwater Harvesting (Roof Drains)</u>	0.164	\$425				see note
Cost Estimate			\$2,214	\$3,158	\$5,372	13 years
<u>E. B6210 Rainwater Harvesting (Roof Drains)</u>	0.092	\$218				see note
Cost Estimate			\$2,147	\$2,352	\$4,499	19 years
<u>F. B1000 - B1200 (HALF) rainwater Harvesting</u>	8.700	\$22,446				
Cost Estimate			\$23,370	\$23,332	\$46,702	2 years
Total Water Saved=>	12.800	\$45,942				
Notes:						
Projects D and E show a long ROI, but require a small investment and save 1/4 million gallons a year.						
Detailed cost estimates, savings and return on investment were compiled for each project.						

“What if’s” became six tangible projects

Projected savings 12.6 Mgallons

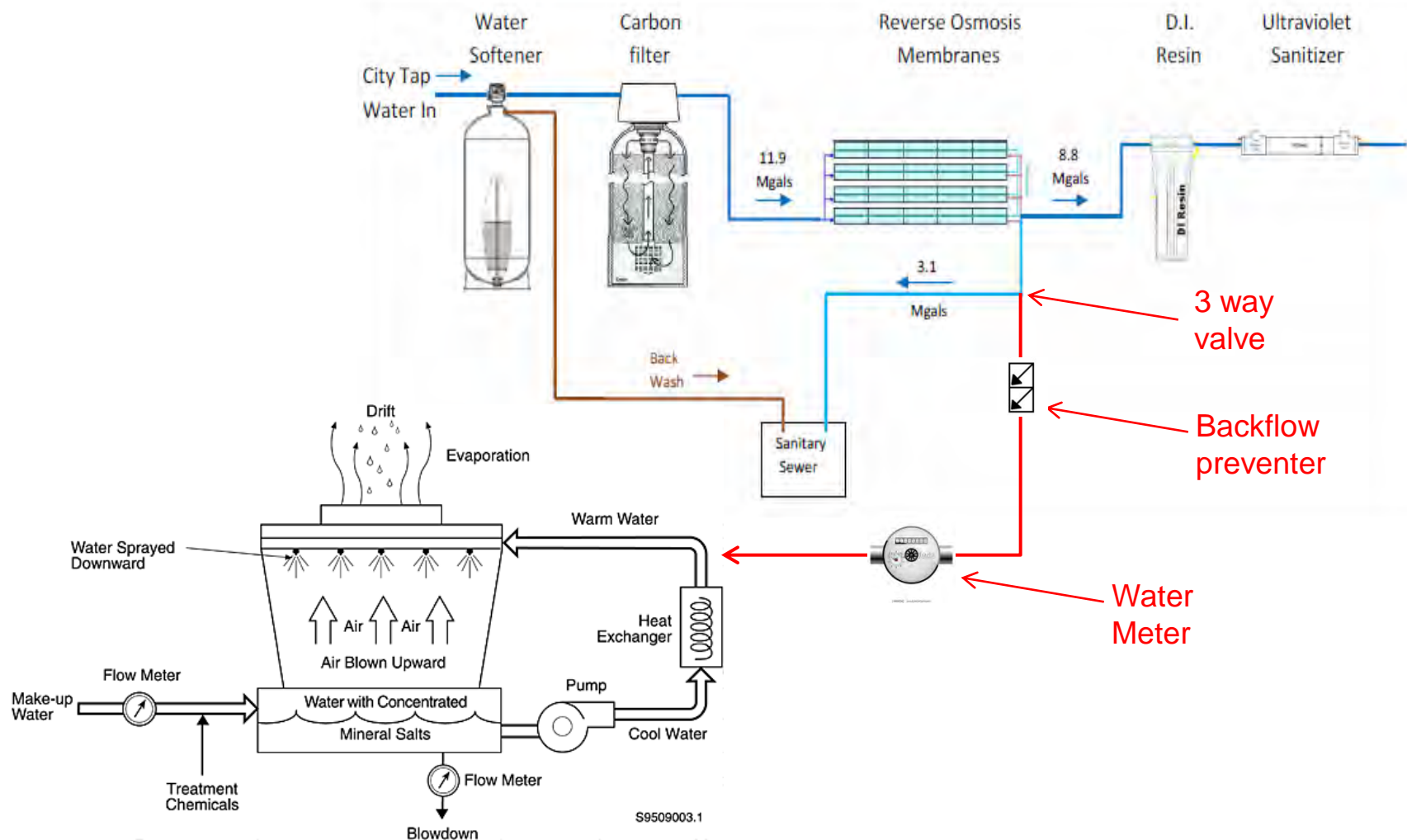
## Project 1 - Replace Circuit Board Cleaner

- Eliminates one R/O system
- Lower machine operating cost
- R/O contractor placed system in storage condition for possible future use.
- Saves 1.05 Mgals    \$7,392 w/s
- ROI <2 years

### **Additional benefits:**

- Cleaner boards
- Improved efficiency
- Improved insurance risk score

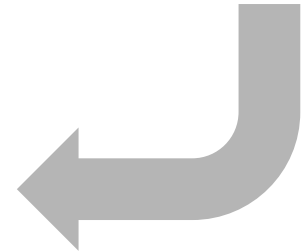
# Projects 2 & 3 – Send ‘Reject’ Water from Two R/O Systems to the cooling tower



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Backflow Preventer  
& water meter



Tower Water  
Return



# Projects 2 & 3 – Send ‘Reject’ Water from Two R/O Systems to the cooling tower

- Short connection runs
- Passive equipment
- Saves 2.79 Mgals      \$19,641 w/s
- ROI <14 months

## **Additional benefits:**

- better make-up water
- cleaner strainers
- reduced service and down time

## Projects 4 – 6 - Rainwater Harvesting

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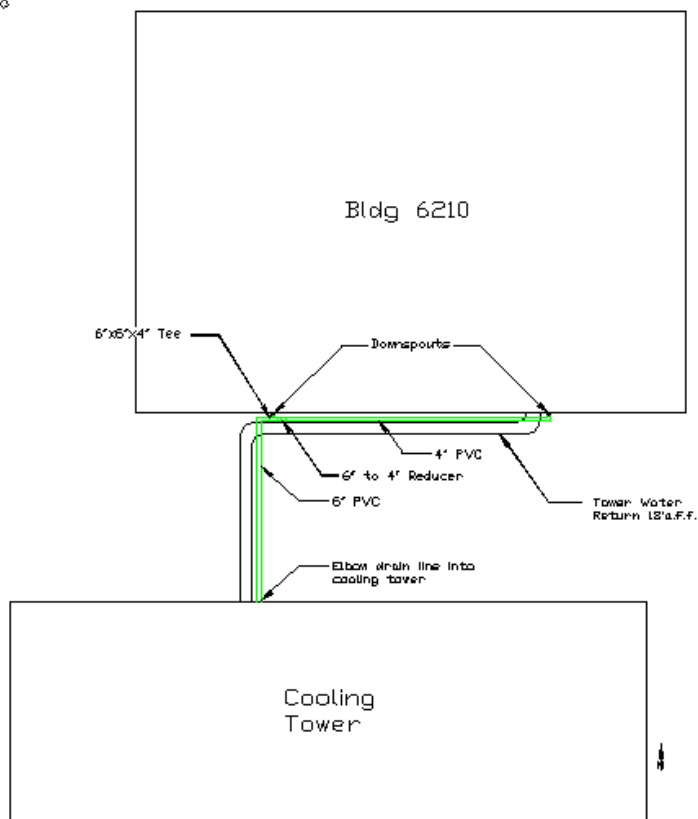
- Based on Indianapolis data:
  - Annual rainfall is 43 inches
  - Each square foot of surface can produce 27 gallons annually.
  
- Each building was given a quick assessment
  - Roof Square footage
  - Ease of harvest and transport
  - Estimated implementation cost
  
- Three buildings rose to the top
  - Chiller Building
  - Power House
  - Main building

# Project 4 - Chiller Building

30' from cooling tower

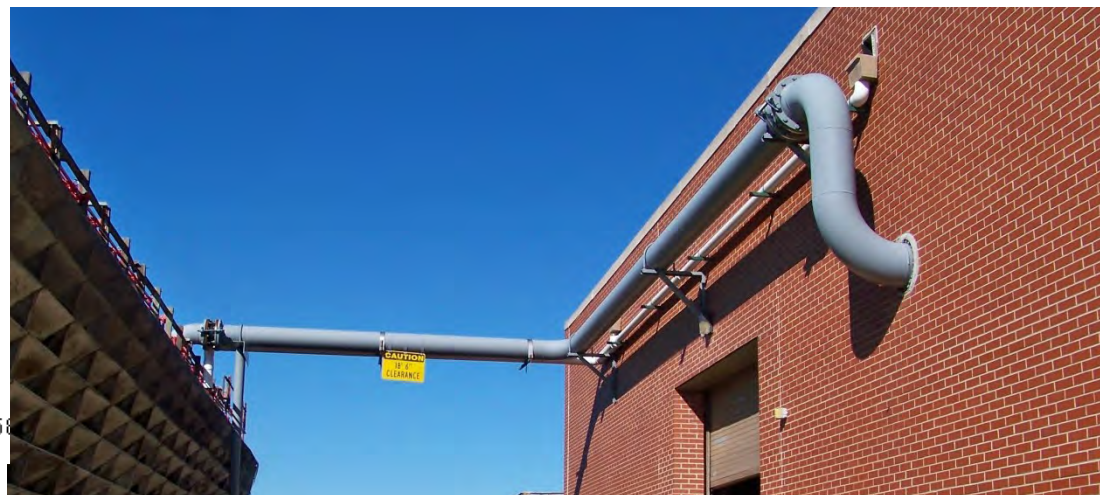
Roof sloped towards the tower

Existing supports between buildings



Notes  
1. Remove the existing 3' downspouts. Cap the drain pipes at ground level.  
2. Install Schedule 40 PVC pipe, fittings, associated unistrut and hangers to divert the rain water run off from the roof to the cooling tower.

WR 595



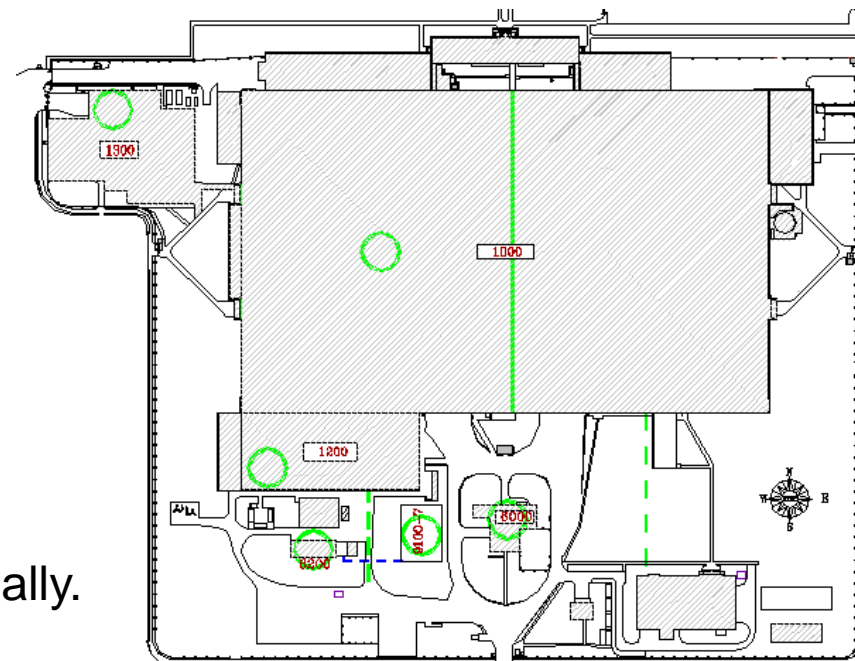
# Project 5 - Power House - Pending

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Two interior roof drains

Tie into existing piping carrying  
boiler R/O reject to cooling tower.

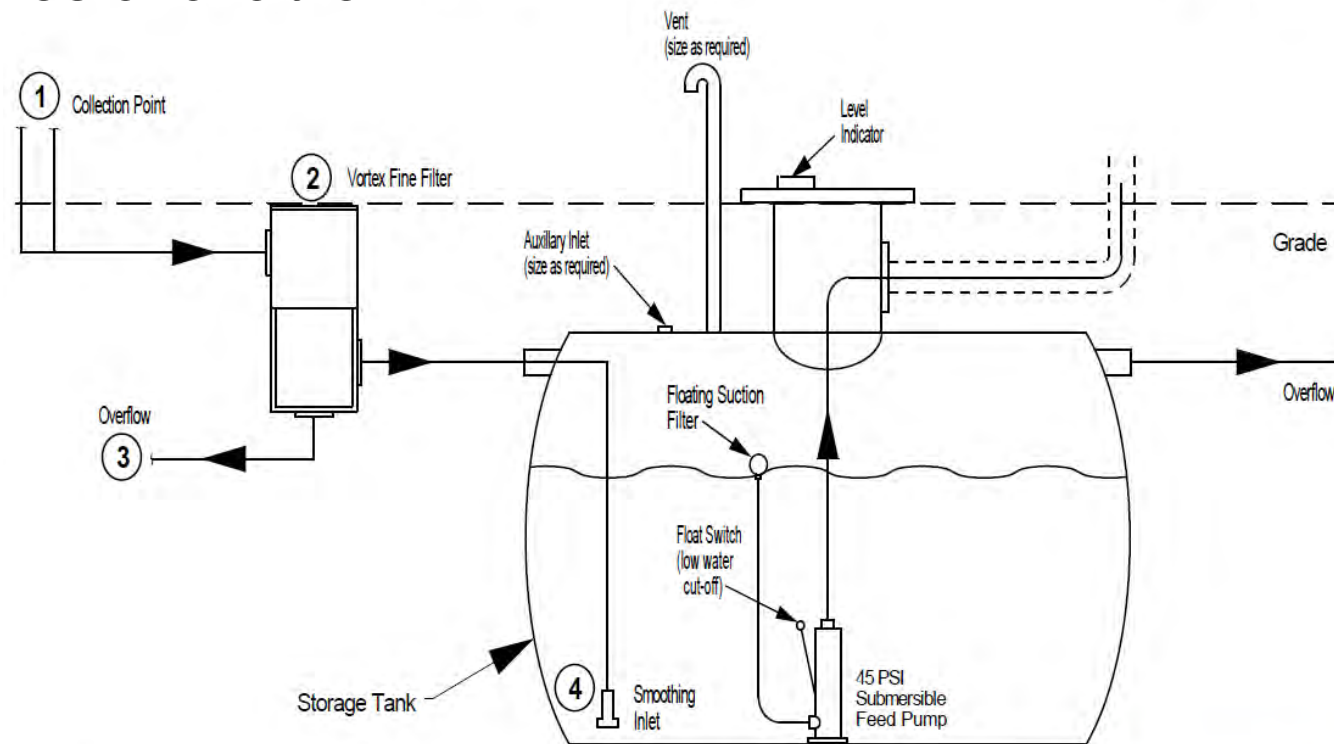
# Project 6 - Main Building - pending



- Main building
  - 621 ksf
  - drains through two 24" pipes
  - One pipe lies within 60' of a decommissioned ½ Mgal reservoir
- Redirecting one pipe yields 9 Mgals annually.
- save \$21,420 in water fees
- storm water credit for the watershed area of \$1,841/yr.
- ROI = 3 years
- Connecting the second B1000 roof drain would double the rainwater harvested, but at a higher expense due to its location.

# Conservation & Rainwater Harvesting

- Entire industry
- Innovative products
- Design companies available



① Rainwater collection point (roof drains, gutters, etc.)

② Rainwater enters the vortex filter and is processed. (Possible 90% diverted to storage tank.)

③ Remaining water from vortex filter to overflow.

④ Smoothing Inlet - stainless steel "flow-calming" device to eliminate turbulence of the incoming water as it enters the tank.



# Validate

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- Meters on reclaimed water

NOTE: Add these values to monthly evaporative credit

- Existing meters on make-up and blow down
- Water invoices prior to and after conversions

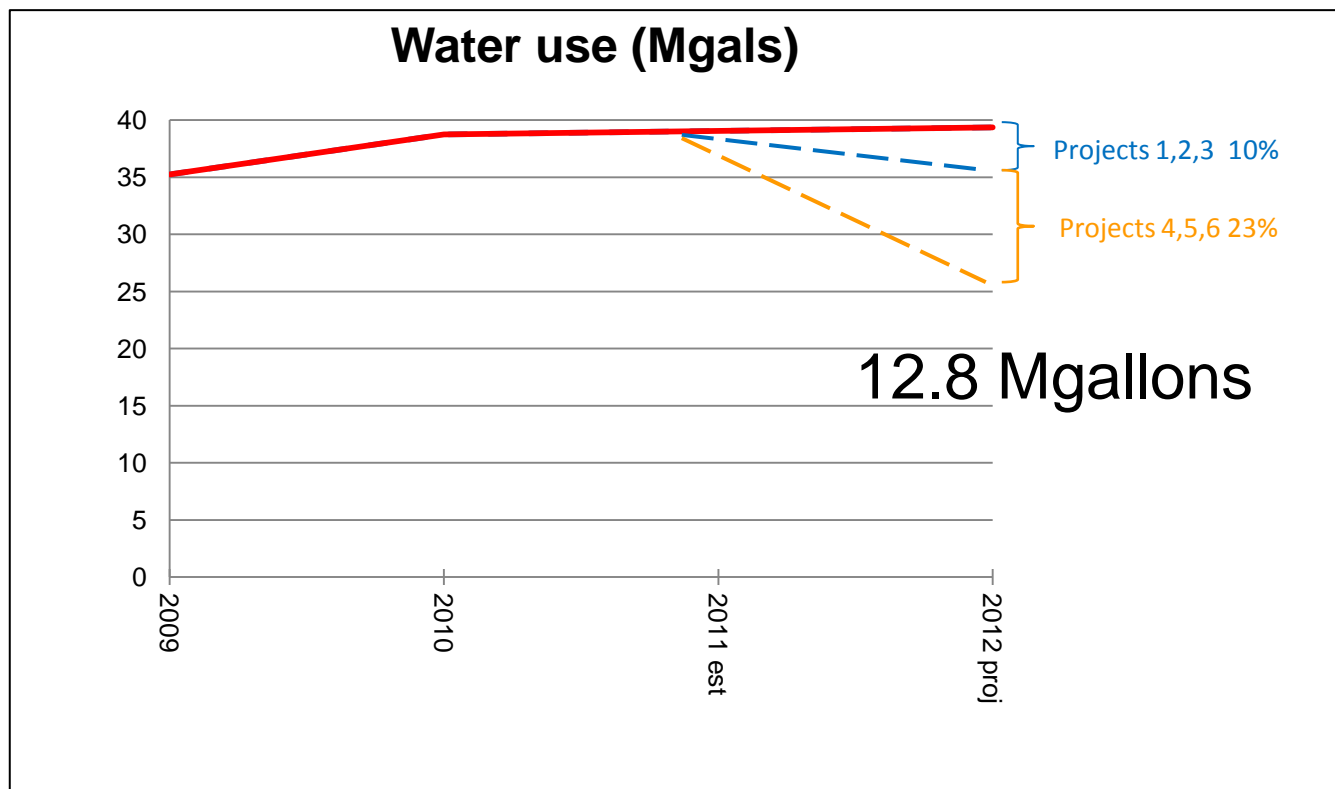
***Measured results***

## Achievements after 4 of 6 projects

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- Reduced water purchased by 5.3 Mgals.
- Reduced sanitary discharge by 4.1 Mgals.
- Reduced storm water discharge by 1.2 Mgals.
- Exceeds our initial goal.

# Projected savings after all 6 projects



# Approach

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- Look for opportunities everywhere water is used
- Keep an open mind
- What if?
- Explore all options before dismissing them

# Conservation

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- Demand and cost for clean water continues to increase
  - Growing populations
  - Climate change
  - Industry
  
- Evaluate Options
  - Innovative technologies
  - Review all waste streams for reduction
  - Alternative water supplies

# Outcome

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*Raytheon became a better steward of the natural resources used in our local plant.*