



# MONTGOMERY

C O U N T Y

*To improve the quality of life through our environmental services*



# Wastewater Key Performance Indicators

## Proof of Efficiency

**Kevin Krejny June 24 11:00 AM**



# Why am I doing this talk?

## On Key Performance Indicators (KPIs)

- To save you time, effort and \$\$\$
- Understand ways to use your plant data as KPIs that show operational trends
- Get to measures that will help you save your rate payers money
- After 4 years of energy savings talks, changing gears to new topic. That uses energy usage as a main component.

Not because it is a fun subject, it is not, but it is very important!!



# Talking Points

- What are Key Performance Indicators (KPIs)
- KPI Faults/Troubles – one size does not fit any
- Verifying KPIs
- Setting a Benchmark with KPIs
- Using KPIs to show trends (good or bad)
- **Specific Wastewater KPIs examples**



Balanced Scorecard

Performance Measure

KPI

Critical success factor

Key Success Indicators

Key Result Indicator

Key Performance Indicator

Metric

PERFORMANCE INDICATOR

Key Business Objective

And everyone uses them differently



# Key Performance Indicators

## *WHY DO YOU NEED THEM?*

### *Book Answer*

*Once an organization has analyzed its mission, identified all its stakeholders, and defined its goals, it needs a way to measure progress toward those goals. Key Performance Indicators are those measurements.*

### *My Answer*

*Streamline operations and document using rate payers money in a responsible manner*



# BAD KPIs Examples

Where to begin?



Where to begin, where to begin...





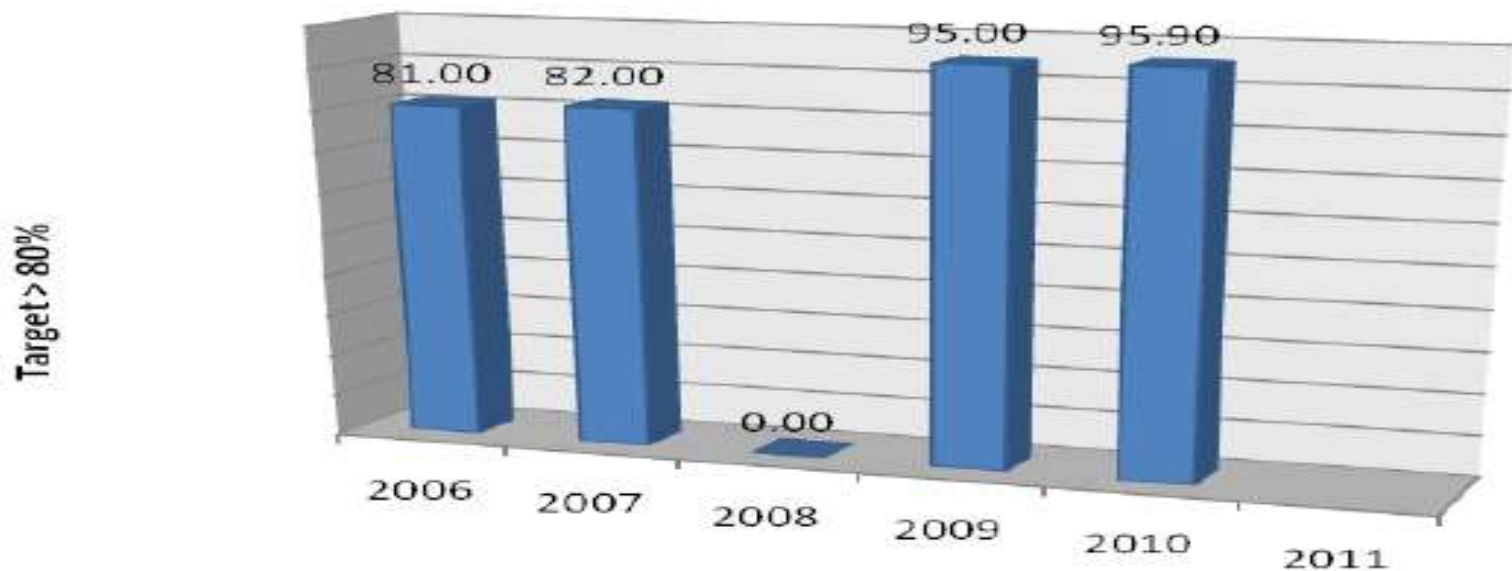
# Vague KPIs

## Customer Satisfaction

| <u>Result</u> | <u>Target</u> | <u>Calculation</u>                 |
|---------------|---------------|------------------------------------|
| 95.9%         | >80%          | Customer Surveys' and Focus Groups |

No Survey's performed in 2011

### Customer Satisfaction Rating (%)



|                       | 2006  | 2007  | 2008 | 2009  | 2010  | 2011 |
|-----------------------|-------|-------|------|-------|-------|------|
| Customer Satisfaction | 81.00 | 82.00 | 0.00 | 95.00 | 95.90 |      |



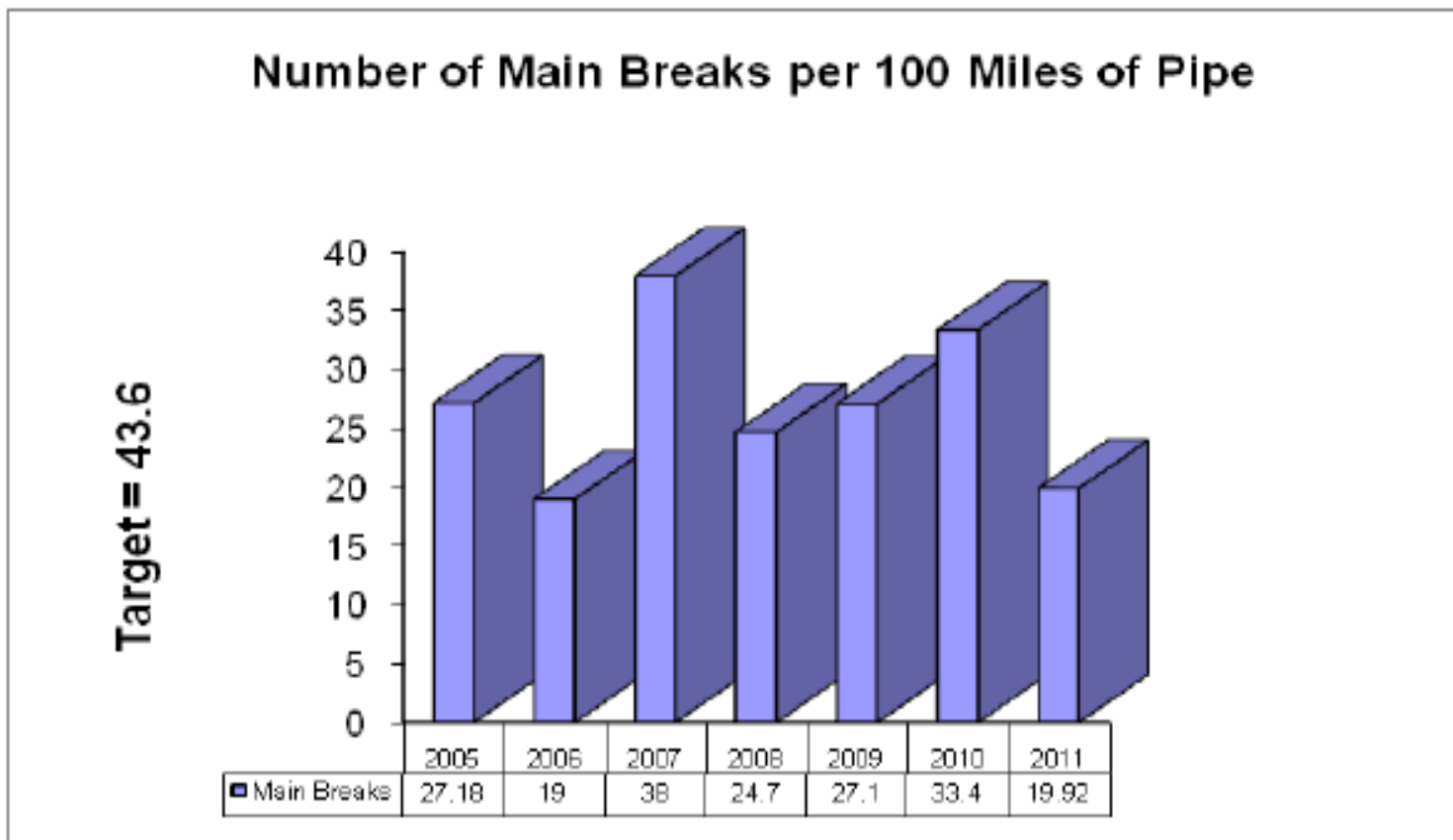
# BAD Because

- Subjective nature of “satisfaction”
- Looks like scale changed
- Missing a year or two
- Target >80% of what
- Customer satisfaction is pretty vague
- Can change with public perception and not reflect actual performance of group

# Number of Water Main Breaks per 100 Miles

| <u>Result</u> | <u>Target</u> | <u>Calculation</u>        |
|---------------|---------------|---------------------------|
| 19.9          | 43.6          | 100 x total breaks / 1300 |

A measure of the condition of the water distribution system as a total of number of breaks per 100 miles of distribution piping.



# Be Leary Because

- Weather related – You are not NOAA
- OK to use to document WMB/Infrastructure
- Target based on? - Average OH winter freeze/thaw and infrastructure condition (age)– **NO WAY**
- Also bad for weather reason
  - MGD flow to WWTP
    - Plus KPIs associated with MGD flow to WWTP
    - kWh/MGD much better
    - % I & I of WW flow – cracks in pipes – leaks in system do not change YTY or MTM
  - SSOs per mile

# Water Reclamation NPDES Violations from EPA reports

Result

24

Target

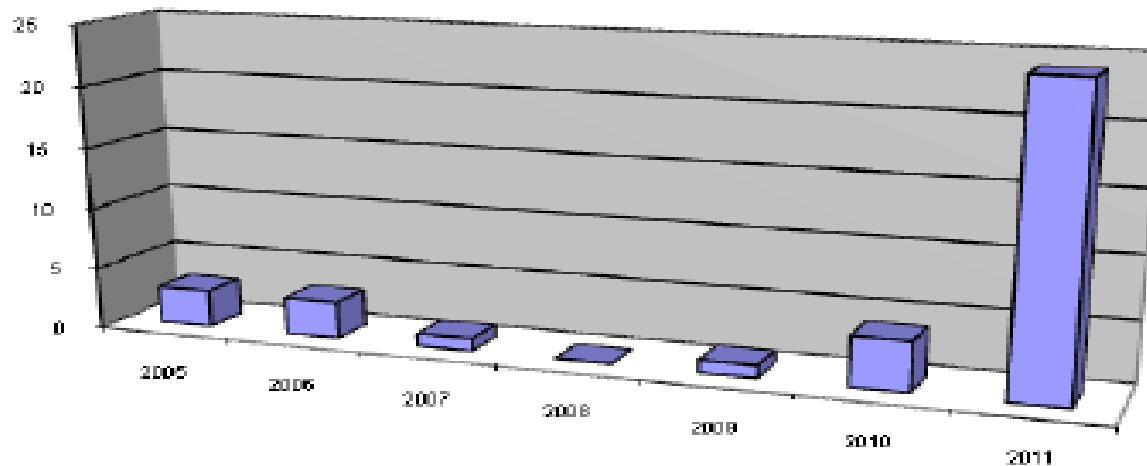
0

Calculation

total violations per year

The number of permit violations that are reported to the Ohio EPA.

## Water Reclamation Permit Violations



|                     | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---------------------|------|------|------|------|------|------|------|
| ■ Permit Violations | 3    | 3    | 1    | 0    | 1    | 4    | 24   |

# Targeting Zero

- If you are targeting zero violations, and this is your main KPI, you will never try to run your plant more efficient- Hence no need for KPIs
- Zero Target will promote robot operators and over treatment in operations that will cost \$\$\$
- Wasting electricity and chemicals is guaranteed

# North & South Planned Maintenance Ratio (hours)

Result

Target

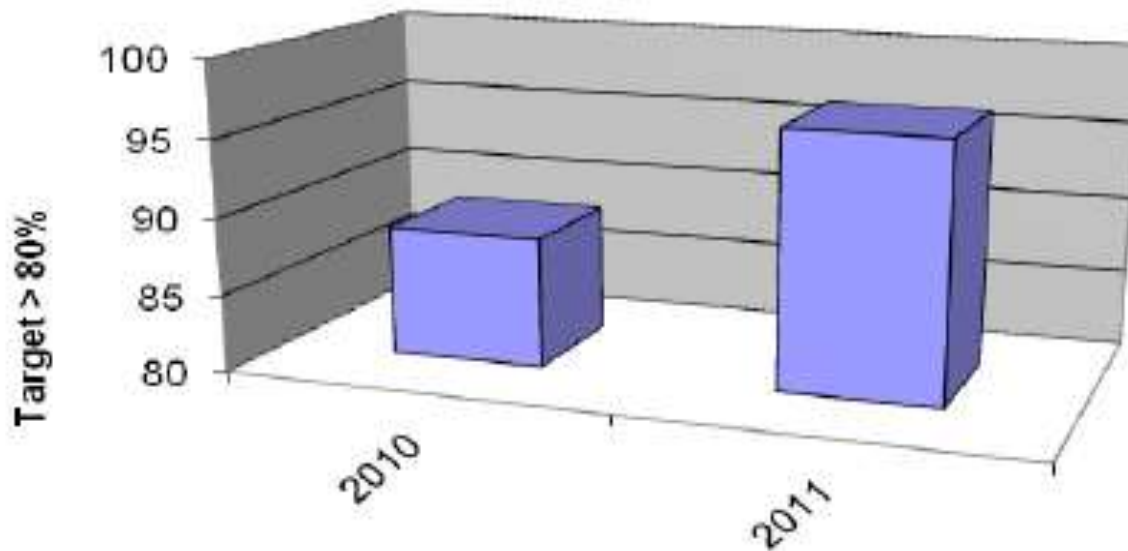
Calculation

97%

80%

100 X (hours of planned maintenance / total hours planned & emergency maintenance)

**North & South Planned Maintenance Ratio**



|                             | 2010 | 2011 |
|-----------------------------|------|------|
| ■ Planned Maintenance Ratio | 88.4 | 96.5 |

# NYSERDA Wastewater Benchmarks

| Size Category    | Activated Sludge<br>(kWh/MG) | Fixed Film<br>(kWh/MG) | Lagoons<br>(kWh/MG) |
|------------------|------------------------------|------------------------|---------------------|
| < 1 mgd          | 4,100                        | 3,600                  |                     |
| 1 mgd to 5 mgd   | 1,340                        | 1,380                  |                     |
| 5 mgd to 20 mgd  | 1,570                        | 1,140                  |                     |
| 20 mgd to 75 mgd | 1,630                        | 1,060                  |                     |
| >75 mgd          | 1,070                        | -                      |                     |

| Size Category    | Activated Sludge<br>(kWh/lb BOD) | Fixed Film<br>(kWh/lb BOD) |   |
|------------------|----------------------------------|----------------------------|---|
| < 1 mgd          | 4.1                              | 3.3                        |   |
| 1 mgd to 5 mgd   | 2.2                              | 1.1                        |   |
| 5 mgd to 20 mgd  | 1.7                              | 1.0                        |   |
| 20 mgd to 75 mgd | 1.3                              | 1.2                        |   |
| >75 mgd          | 2.0                              | -                          | - |







## Montgomery County Environmental Services

### Participant Overview

#### Operational Summary

|                     |     |
|---------------------|-----|
| Water Only          | 33  |
| Wastewater Only     | 11  |
| Combined Operations | 80  |
| Total Participants  | 124 |

#### Regional Summary

##### Region 1 - US Northeast

|            |   |
|------------|---|
| Water      | 3 |
| Wastewater | 2 |
| Combined   | 4 |
|            | 9 |

##### Region 2 - US Midwest

|            |    |
|------------|----|
| Water      | 8  |
| Wastewater | 3  |
| Combined   | 14 |
|            | 25 |

##### Region 3 - South

|            |    |
|------------|----|
| Water      | 9  |
| Wastewater | 2  |
| Combined   | 44 |
|            | 55 |

##### Region 4 - US West

|            |    |
|------------|----|
| Water      | 13 |
| Wastewater | 4  |
| Combined   | 15 |
|            | 32 |

##### TOTAL

|     |
|-----|
| 121 |
|-----|

#### Population Summary

##### 0 - 10,000

|            |    |
|------------|----|
| Water      | 7  |
| Wastewater | 2  |
| Combined   | 2  |
|            | 11 |

##### 10,001 - 50,000

|            |    |
|------------|----|
| Water      | 5  |
| Wastewater | 0  |
| Combined   | 15 |
|            | 20 |

##### 50,001 - 100,000

|            |    |
|------------|----|
| Water      | 1  |
| Wastewater | 0  |
| Combined   | 10 |
|            | 11 |

##### 100,001 - 500,000

|            |    |
|------------|----|
| Water      | 14 |
| Wastewater | 5  |
| Combined   | 39 |
|            | 58 |

##### More than 500,000

|            |    |
|------------|----|
| Water      | 14 |
| Wastewater | 5  |
| Combined   | 39 |
|            | 58 |

##### TOTAL

|     |
|-----|
| 123 |
|-----|

Lunch starts in

00:30:00

Hours

Minutes

Seconds

# Problems with External Benchmarking

There are lots of factors that make your utility unique. ***Do not*** waste your time comparing yourself to others that might be similar. They are not.

**Here are a few of the many reasons why?**



# Regional Weather

- Many different climates in the US
- Wet areas, dry areas, harsh winters, mountains, depth to water, storm events (inflow and infiltration),  
Combined sewer systems



# Population Density

- Various population settings
- Urban, suburban, rural, size of watershed, growing cities, dying cities, manufacturing bases



# Socioeconomically

- This is a financial based comparison
- Cost of living
- Price of energy, chemicals, labor
- Union vs. non-union labor
- Employee retirement systems
- Age of the workforce
- New infrastructure vs. old infrastructure



# Permit Limits

- Nitrogen limits
- Phosphorus limits
- Seasonal Limits
- Discharge locations and discharge bodies of water



# Benchmarking

- Compare yourself to your **old** self, your **current** self and your **future** self!!!
- Find historical trends of operations, set yearly goals, and keep improving each year until your trend lines plateau
- Trend before and after known changes to verify changes are for the better

Excel and charting are how you show trends



# What do Good KPIs need?

- Need to be **quantifiable** - numbers
- Need to be in units that **do not change**
- If using dollar amounts need to be **consistent over time** (commodity swings not representative)
- Need to use Consumer Price Index (CPI) to **standardize dollar amounts** over time
- Need to be in units that are easy and consistent to measure over time
- Hopefully data you have **historically**



# SMART

**S** – Specific purpose for the organization

**M- Measureable**

**A**- Achievable – *what does this mean?*

**R**- Relevant to success of organization

**T**- Time for a predefined and relevant period

**Cited in numerous sources**



# Time Period

- At least a month (average daily results) to show noticeable trends
  - Electric bills monthly
  - eDMR monthly (permit)
  - Bacteria take 2-3 weeks to grow (see changes)
  - Financial reports monthly
- Quarter or yearly too long to wait to see changes or comparisons

**So I recommend monthly KPIs**



# Pounds Matter

- Pounds formula a must
- Concentrations change daily, need to convert to pounds
- Ohio high flow vs. low flow cannot be compared in concentration
- Diurnal swings cannot be compared in concentrations

**See example**



Lunch starts in

00:15:00

Hours

Minutes

Seconds



## Example #1

Proof of Technology Upgrade Performance  
Possible Future KPI to chart aeration basin operations



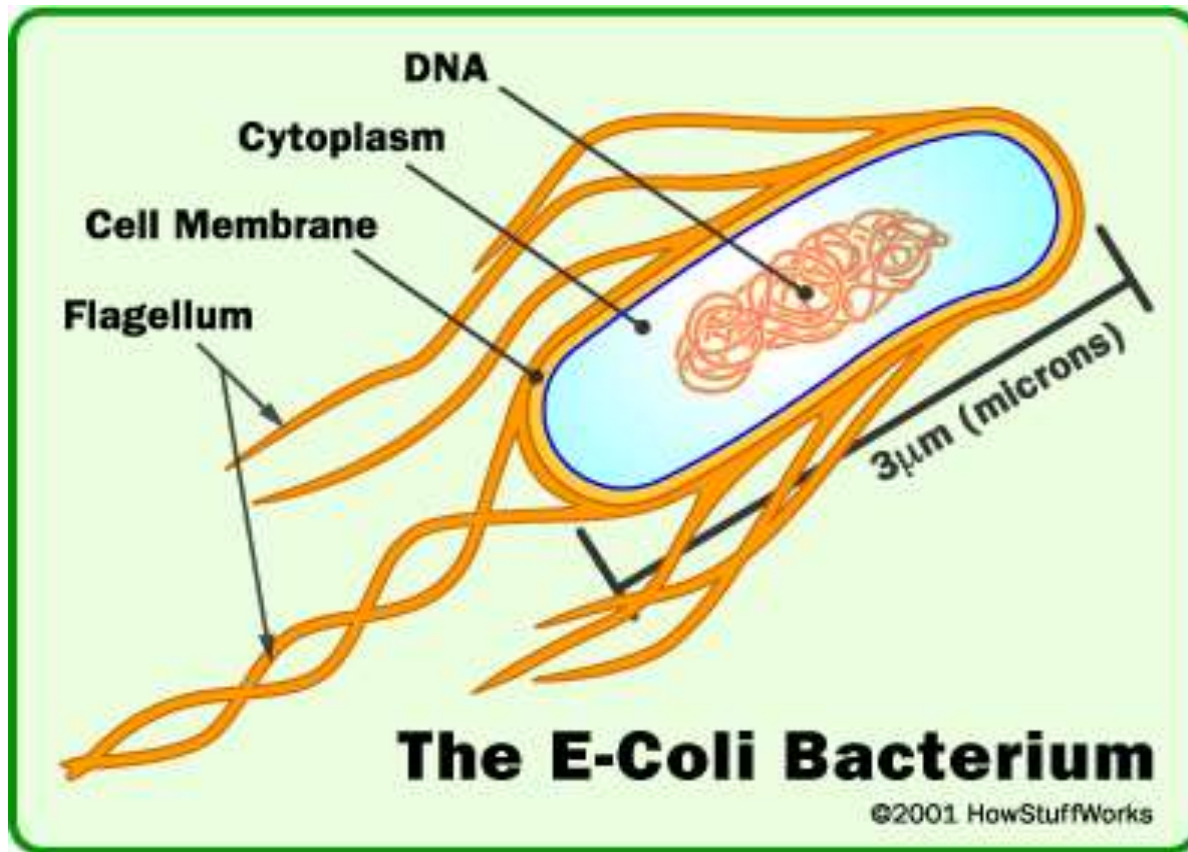
# Aeration Basin Upgrade Proof

10 month side-by-side comparison

| MLSS | lbs solids in aeration | Aeration Flow MGD | Jet Aeration Tanks |               |                |     | Fine Bubble Tanks |               |                |
|------|------------------------|-------------------|--------------------|---------------|----------------|-----|-------------------|---------------|----------------|
|      |                        |                   | average cfm        | 30 min Settle | ammonia (mg/l) | SVI | Average cfm       | 30 min Settle | ammonia (mg/l) |
| 3206 | 89127                  | 16.2              | 3048               | 281           | 2.65           | 88  | 2026              | 270           | 1.70           |

|        |       |      |       |
|--------|-------|------|-------|
| % less | 33.5% | 3.9% | 36.0% |
|--------|-------|------|-------|

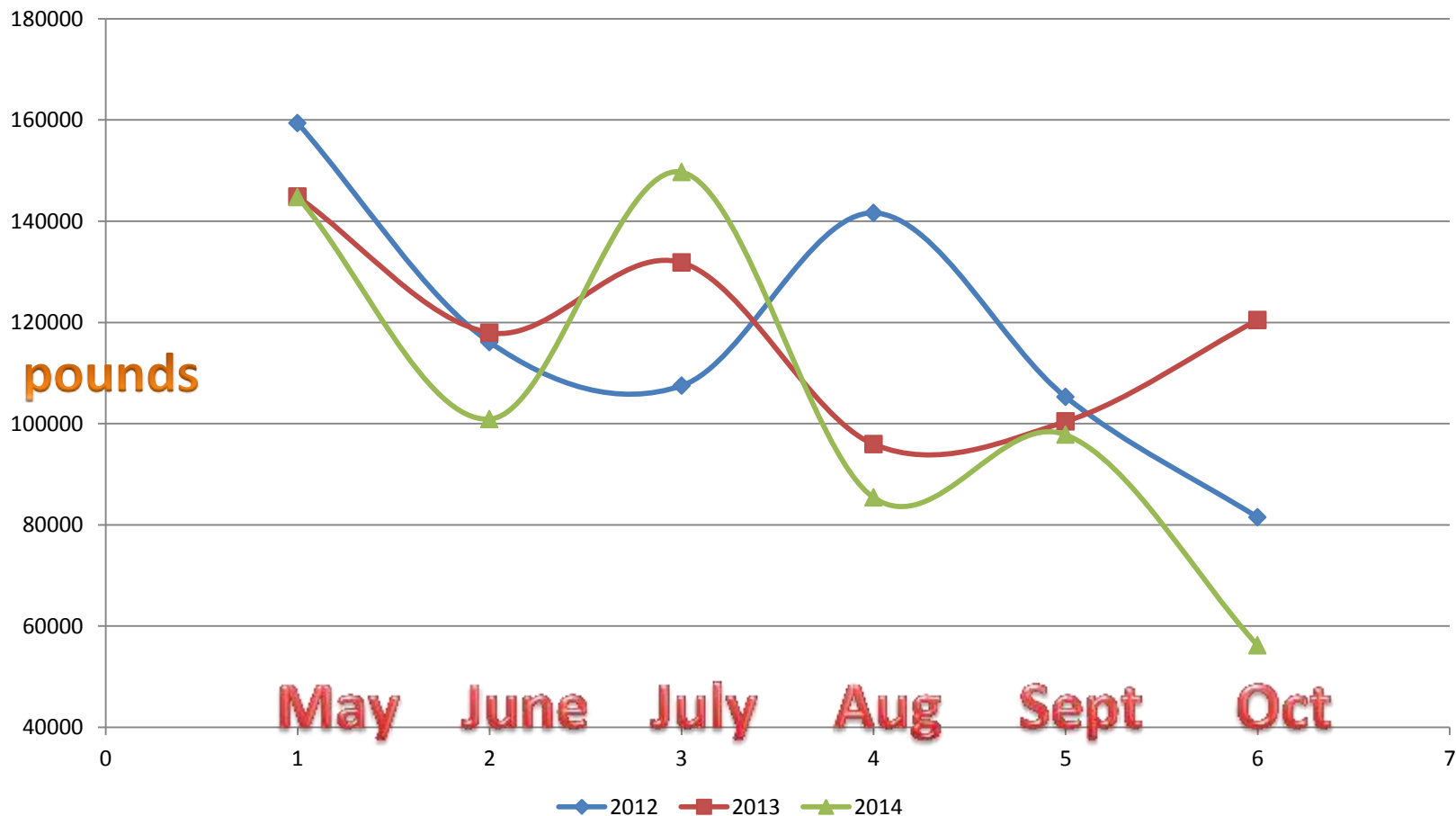




## Example #2

Minimize disinfection chemicals and meet *e coli* permit limits  
189 weekly/ 126 monthly #/100 ml

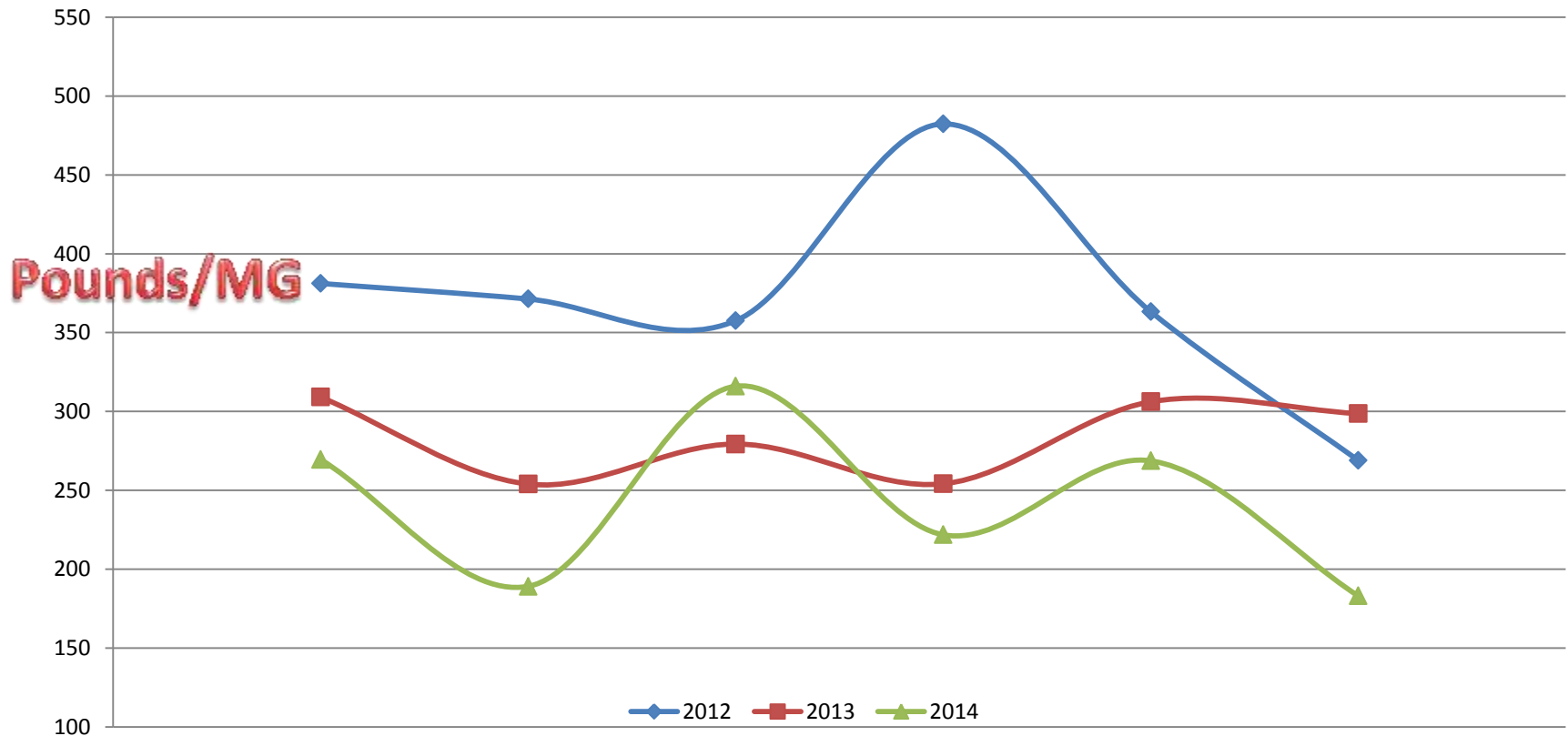
# Pounds of Chemical per Month



Does not show much improvement



# Let's use KPI: lbs chemicals/MG flow

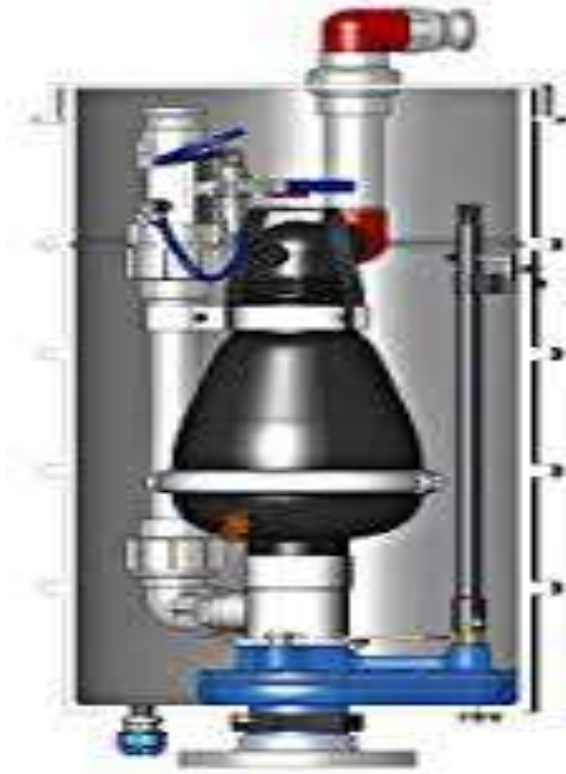


**2012→2013 24% reduction**

**2013→2014 another 15% reduction = 35% reduction in 2 years**

years



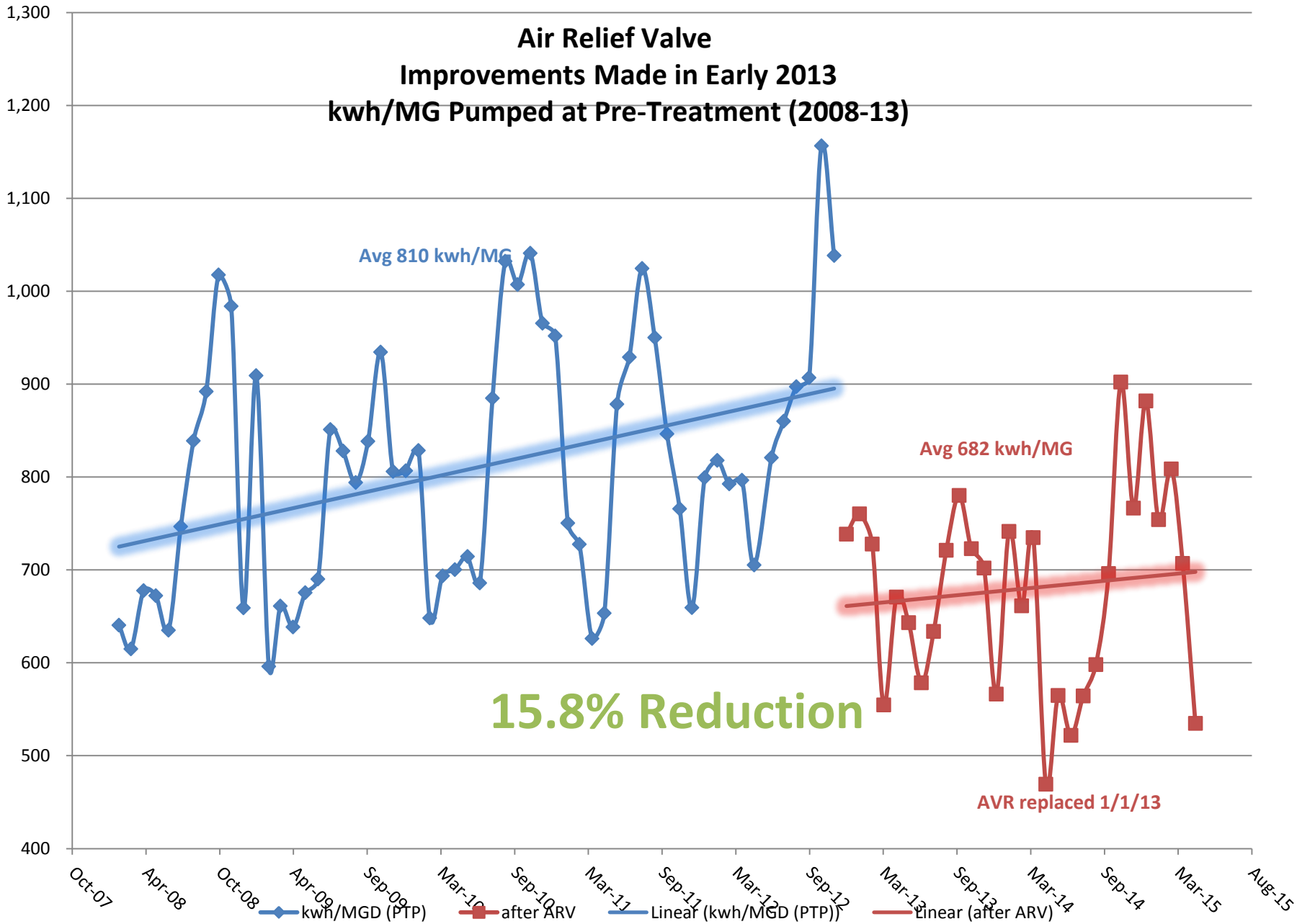


### **Example #3**

Dramatic increase in pumping efficiency  
Air Relief Valve Replacement

# Air Relief Valve Improvements Made in Early 2013

## kwh/MG Pumped at Pre-Treatment (2008-13)



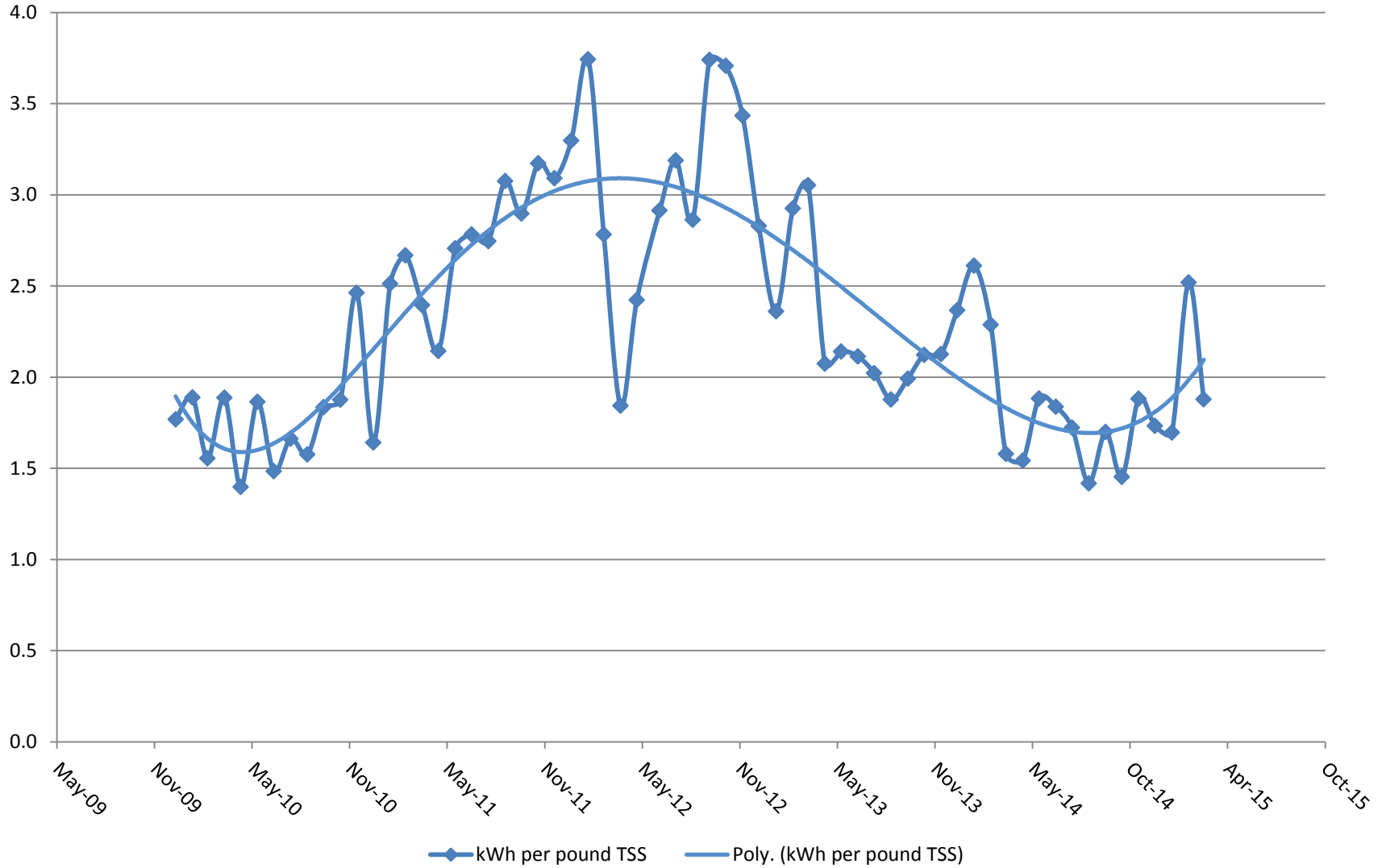


## **Example #4**

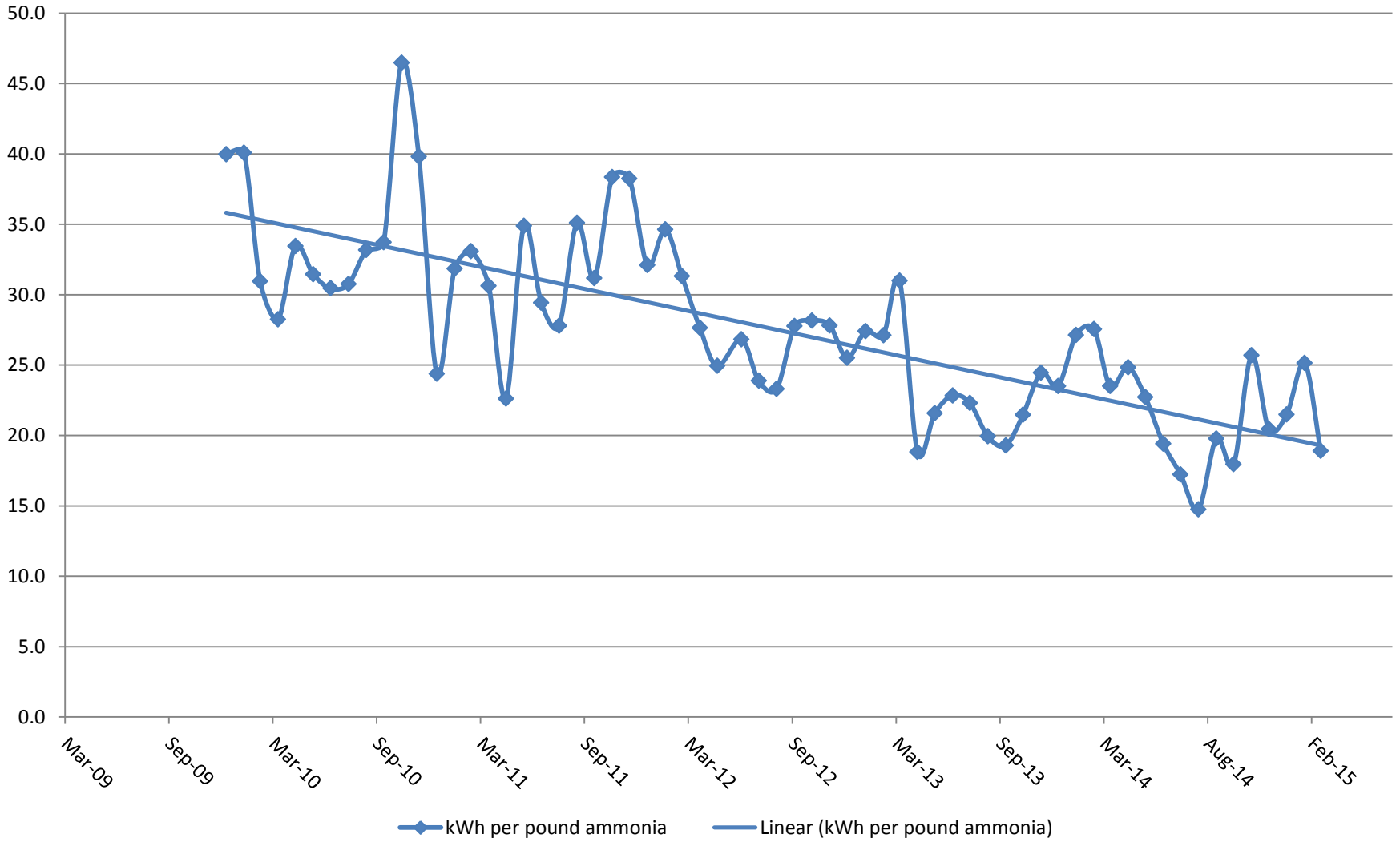
Minimize aeration needed to treat pollutants to permit limits  
Ammonia, TSS, cBOD



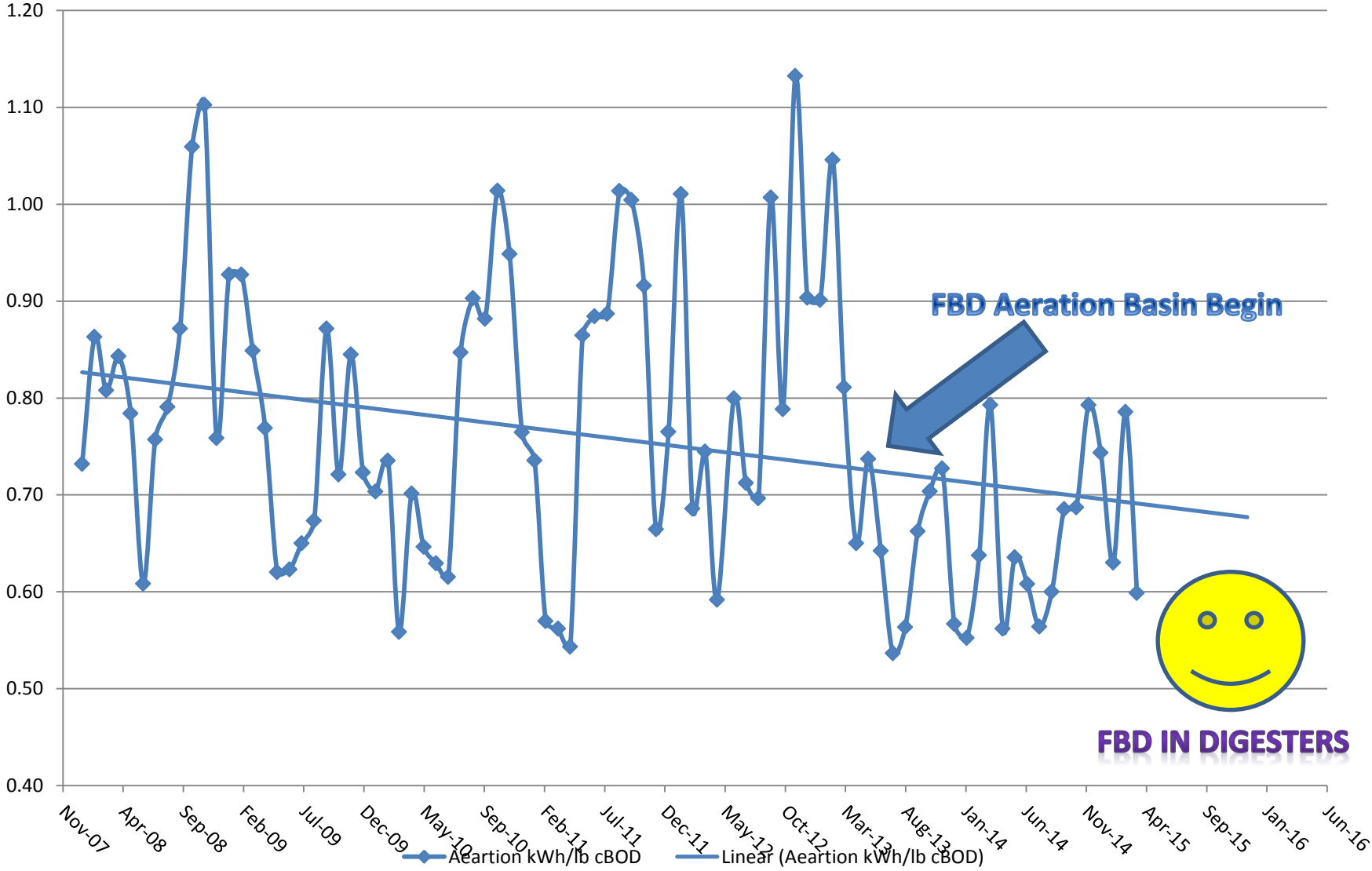
# kWh per pound TSS



# kWh per pound ammonia



# Aeartion kWh/lb cBOD



**FBD IN DIGESTERS**



# Wastewater KPIs

- *O & M Expense per month*
- *Aeration kWh per pound of cBOD treated per month (WR)*
- *kWh per pound of cBOD treated per month*
- *% Emergency Maintenance work per month*
- *Pounds of disinfection chemicals per MG per month*
- *kWh per MG pumped at Pre-Treatment (PTP)*
- *pounds of ferric chloride per pounds of Total Phosphorus removed per month*
- *Biosolids costs per month (pressing +disposal)*
- *kWh per pound of ammonia treated per month*
- *kWh per pound of TSS treated per month*

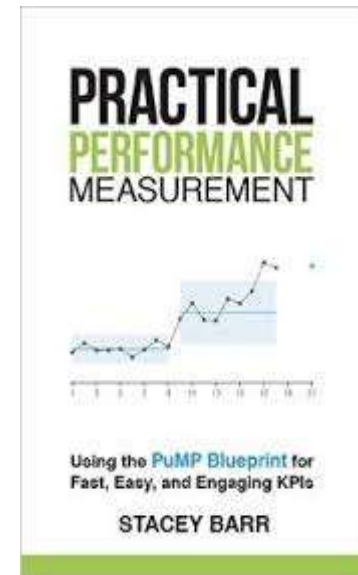
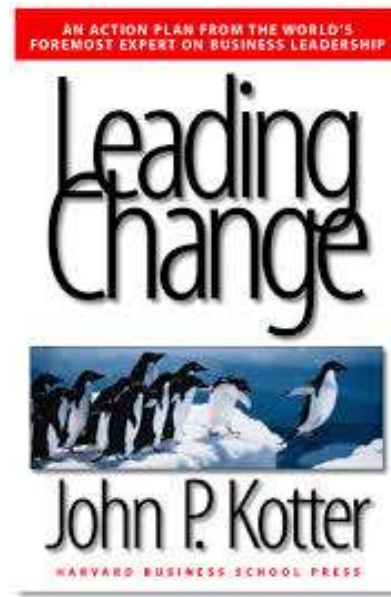
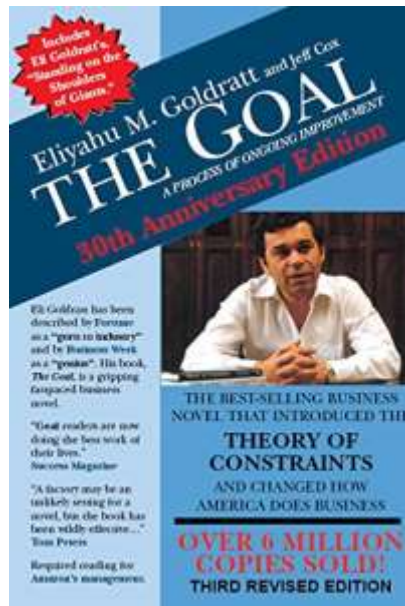
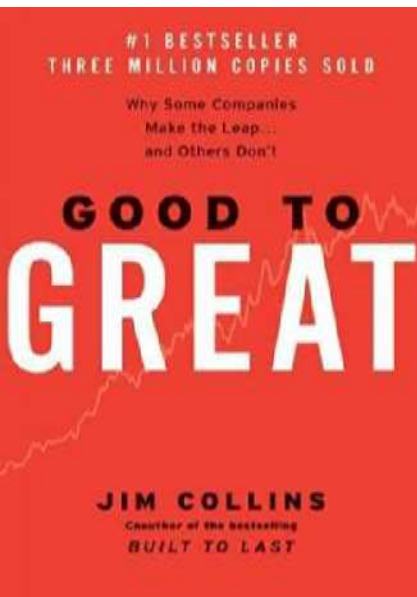
## Sources of Information and Ideas

- [http://en.wikipedia.org/wiki/Performance\\_indicator](http://en.wikipedia.org/wiki/Performance_indicator)
- [http://www.pwc.com/gx/en/audit-services/corporate-reporting/assets/pdfs/UK\\_KPI\\_guide.pdf](http://www.pwc.com/gx/en/audit-services/corporate-reporting/assets/pdfs/UK_KPI_guide.pdf)



ESSENTIAL STRATEGIC KEY PERFORMANCE INDICATORS

UTILITIES



# Questions Now

## Or Later

**Kevin Krejny**

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