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INNOVATIONS

Detecting irregular customer usage contributing to non-revenue water

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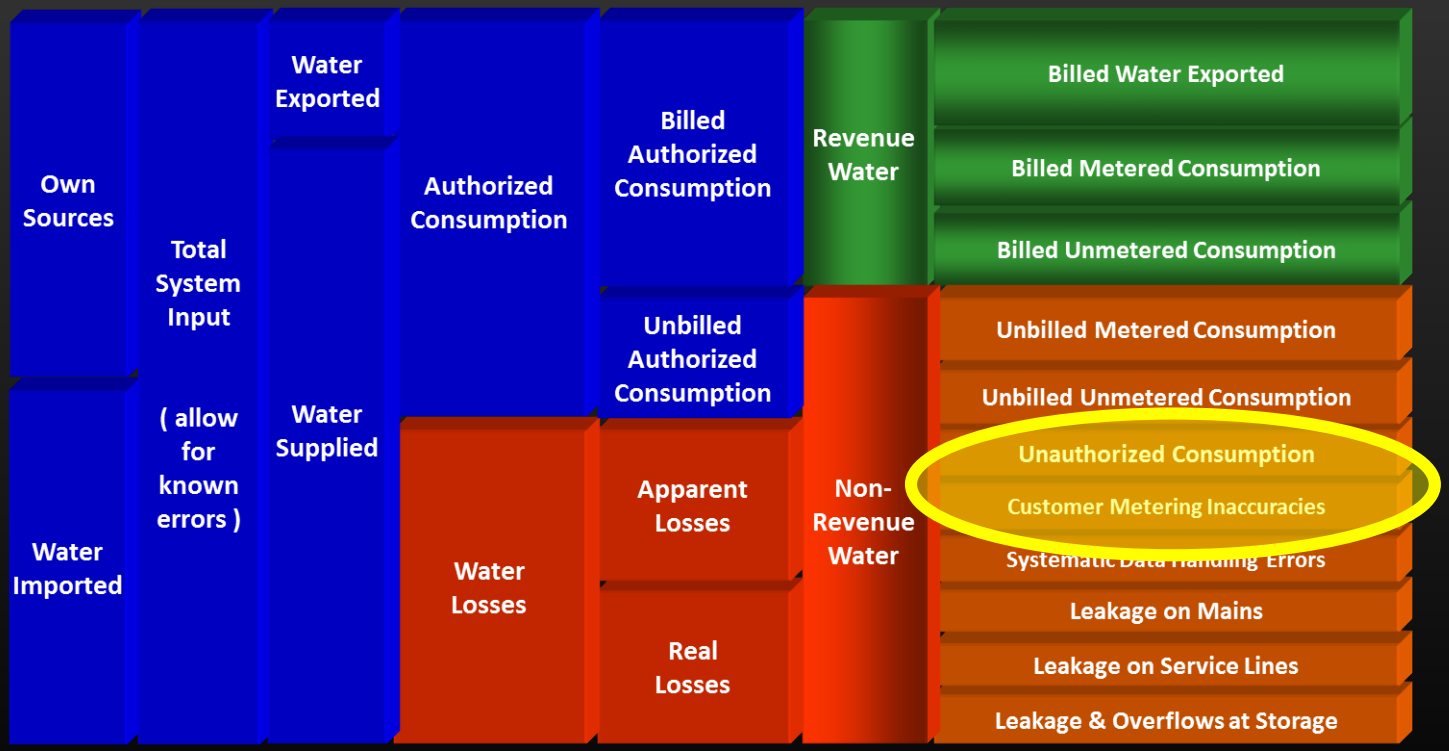
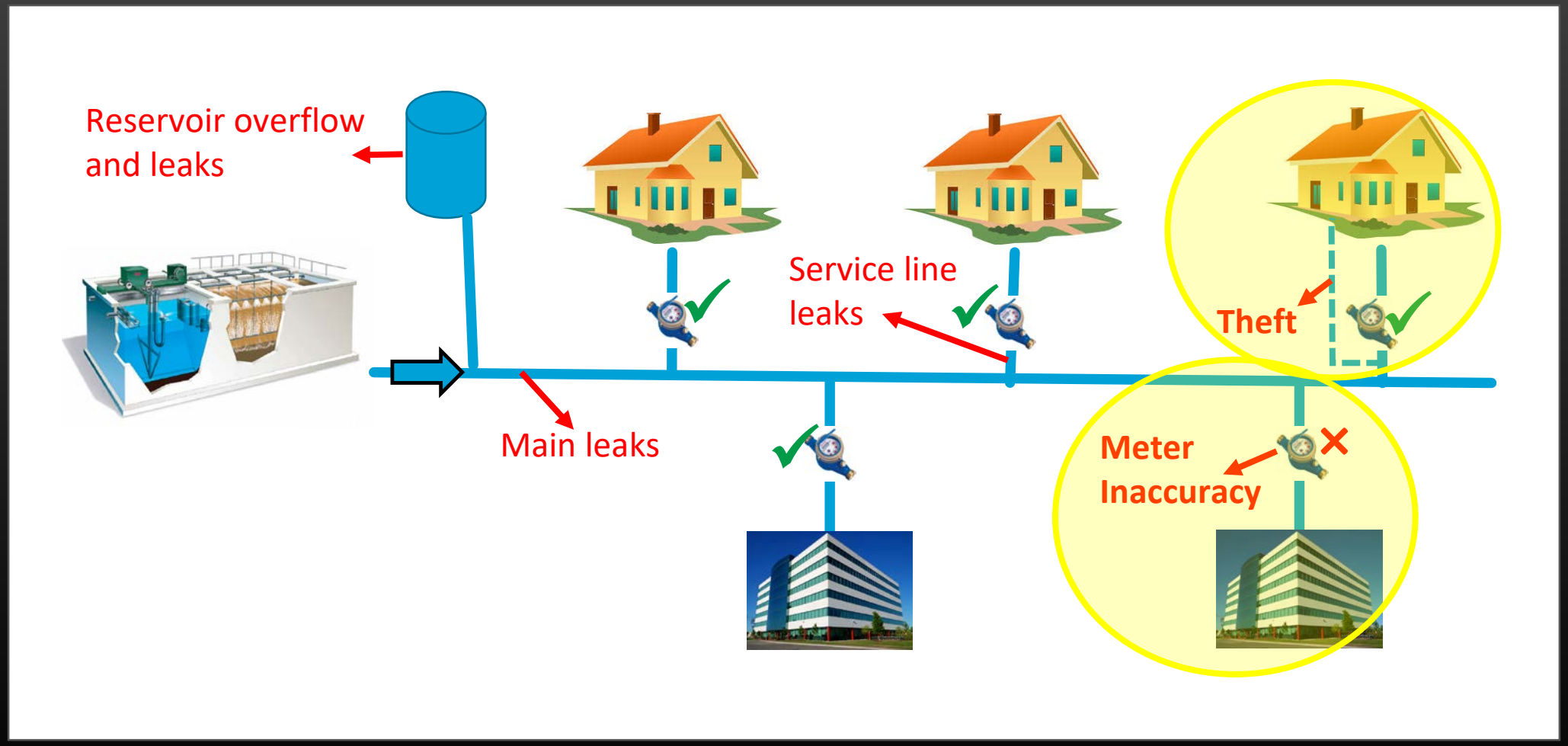
Overview – Non Revenue Water (NRW)

- Produced water that does not generate revenue for the water utility
  - increased costs
  - water conservation issues
  - potentially stricter imposed spending regulations by governing bodies.

- This application helps identify ‘apparent losses’
  - unauthorized consumption
  - customer metering inaccuracies.



Overview – Non Revenue Water (NRW)



Addressing Unauthorized Consumption and Customer Meter Inaccuracies

- Driven mainly by metering infrastructure

- Typically dealt with by:
  - Meter testing
  - Visual inspections
  - Billing exception reports

- Different Approach Used here:
  - Data mining the billing history to investigate anomalies over time

The Application

- Created to identify apparent losses
- Beyond the typical standard billing system exception reports

The Application

- Processes each customer account and associated billing history
- Focused on systems with monthly / quarterly consumption data
- Requires a ‘data dump’ of the billing history for a specified time period.
- Batch processing to account for the large raw data sources.
- Flexibility of processing data in various formats.

The Application

- Applies an algorithm to detect any irregular usage potentially contributing to apparent losses.

- The resultant summary data
  - details ranking customer accounts
  - Accounts with the greatest potential impact on the utility's NRW 'apparent losses'.

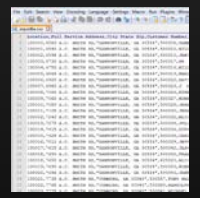
- Potential to be integrated to AMI systems for automated identification of 'apparent losses'.

The Application

Input
Billing History

SQL Server DB

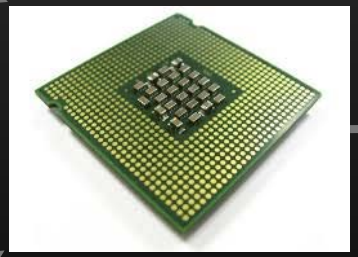
CSV File



Other

?

Process data using algorithm described in following slides



Coded in C#

Outputs - CSV

Ranked list of accounts to investigate having greatest potential impact on NRW

System trends for each meter type

Billing history trends and details of accounts to investigate

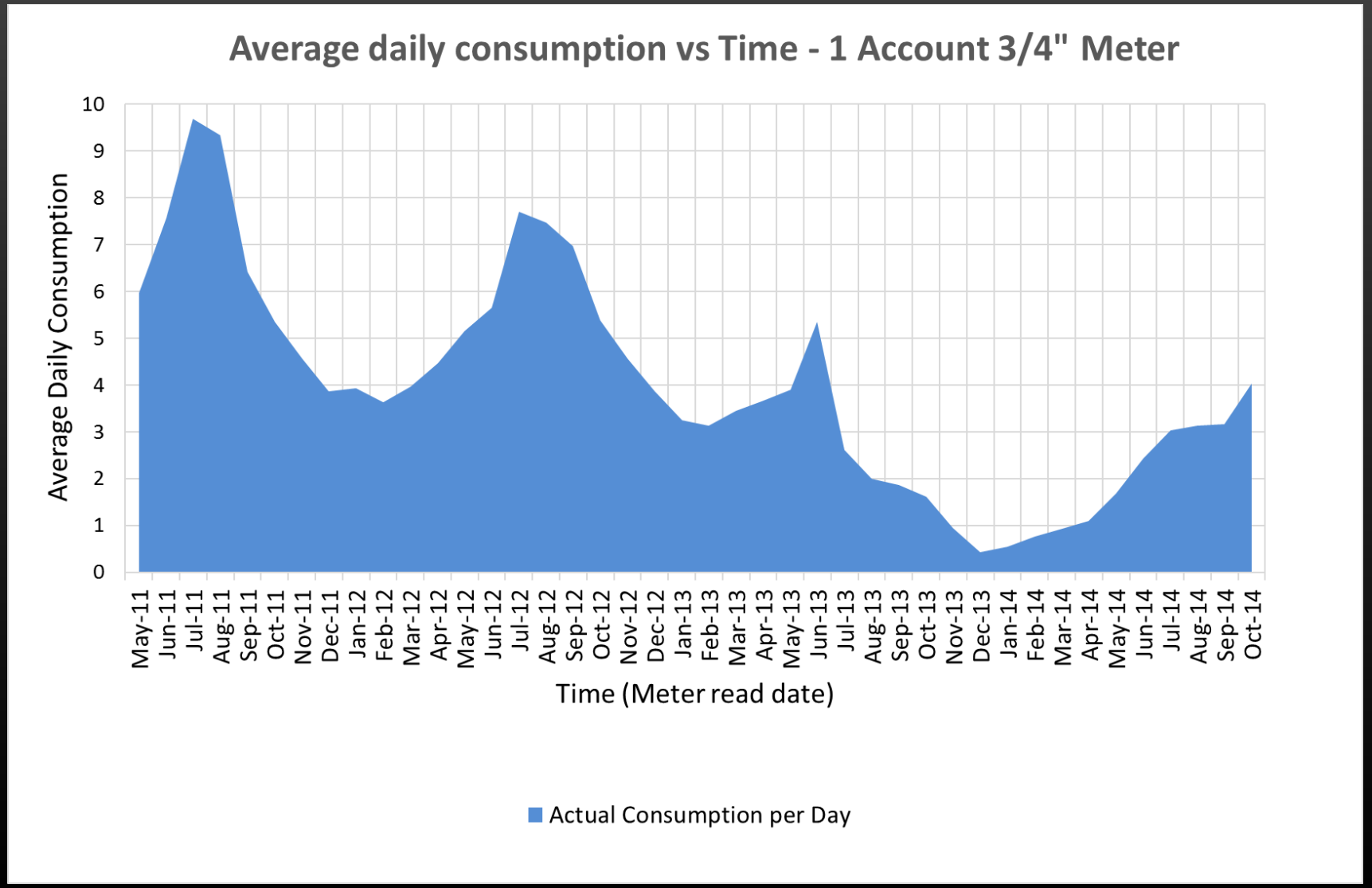
The Algorithm

- Performed on each customer's billing history trend considering:
  - changes in account ownership or location
  - varying days of service in each bill
  - the actual daily consumption
  - the expected daily consumption
  - the desensitized daily consumption to remove the effect of spikes
  - the system wide daily consumption trend for similar sized meters

The Algorithm

- Applied for any specified date range after the billing history becomes available.
- Potential to be integrated to AMI systems for automated identification of ‘apparent losses’.

The Algorithm – Single Account



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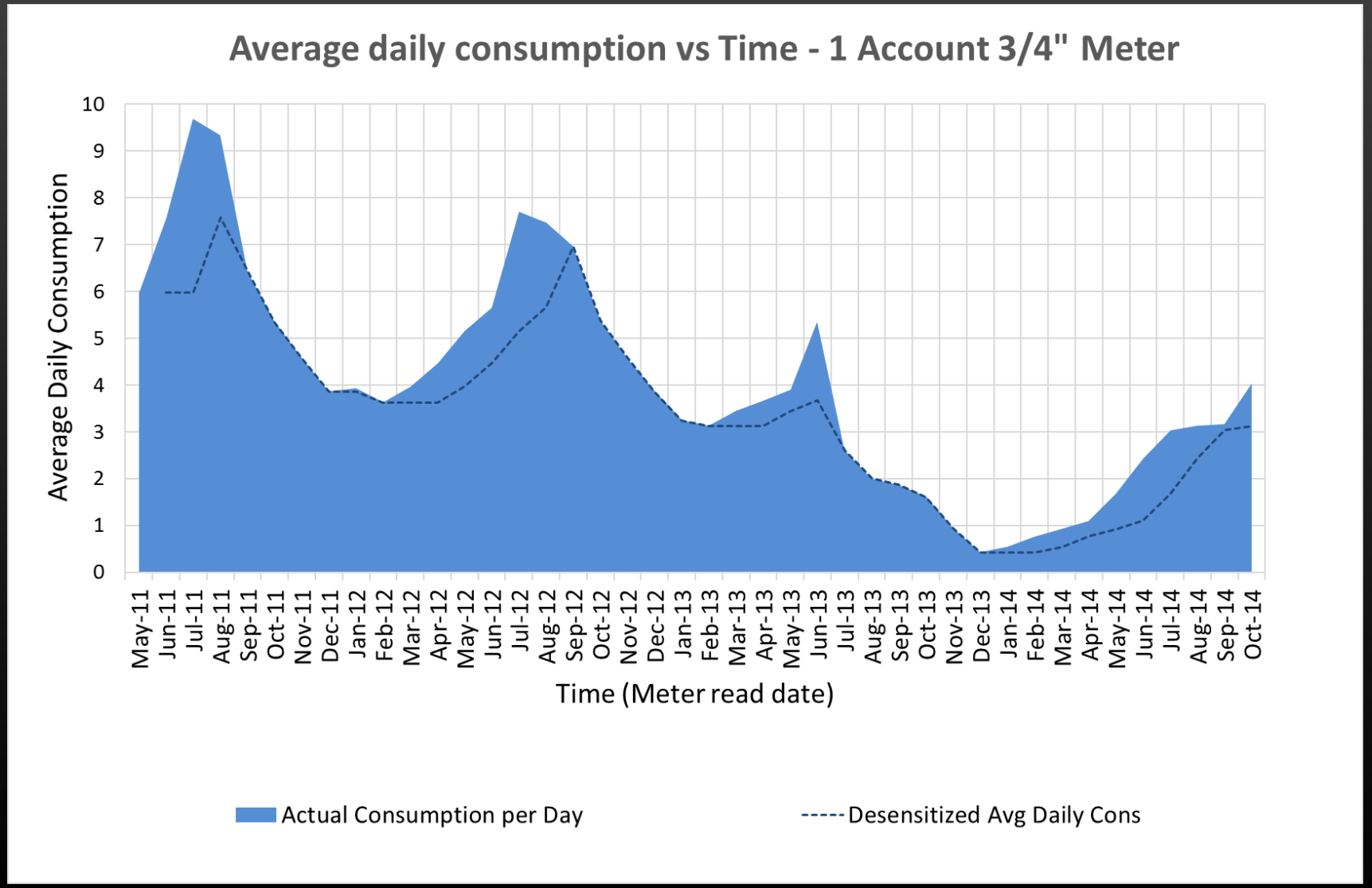

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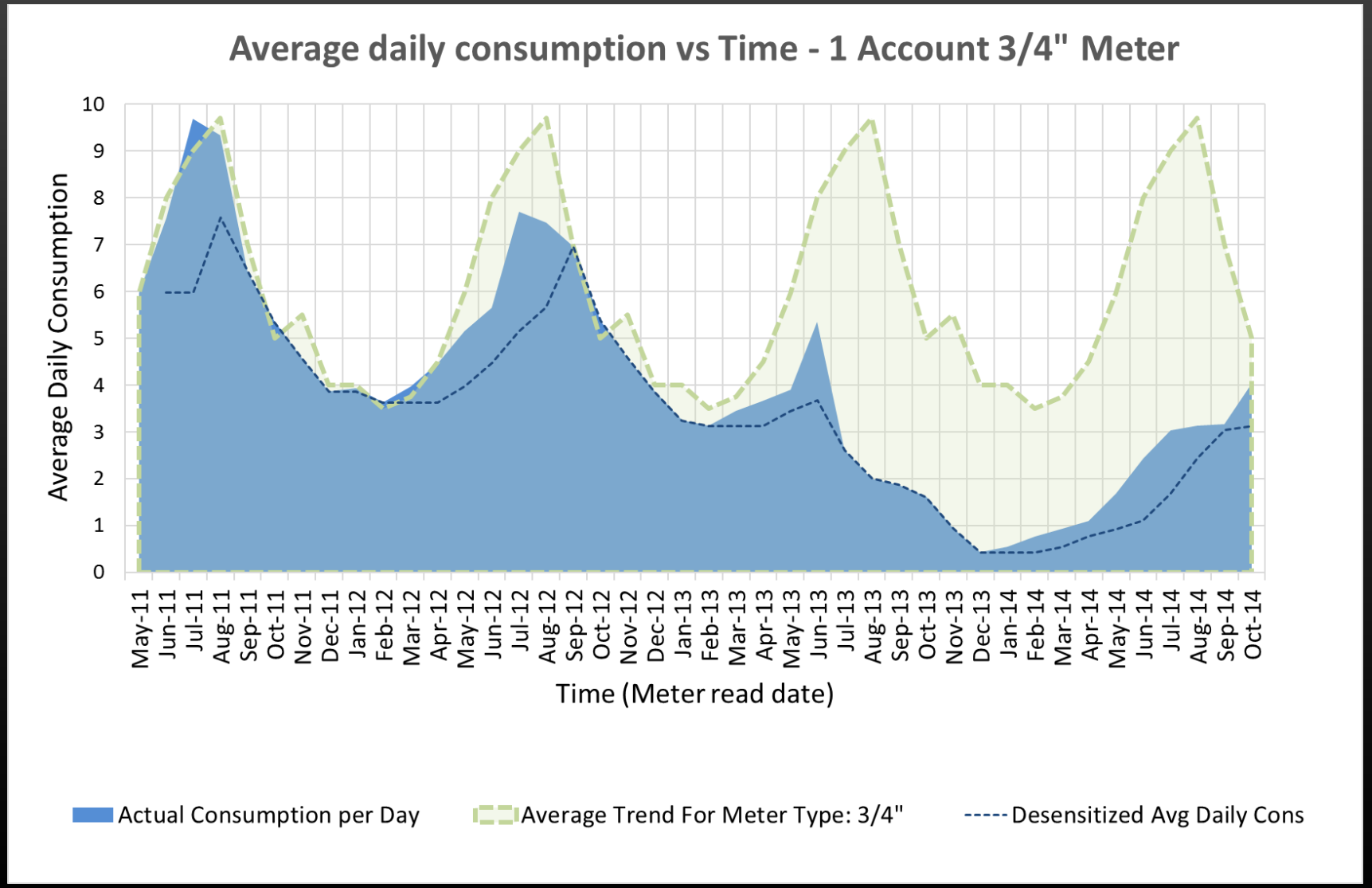

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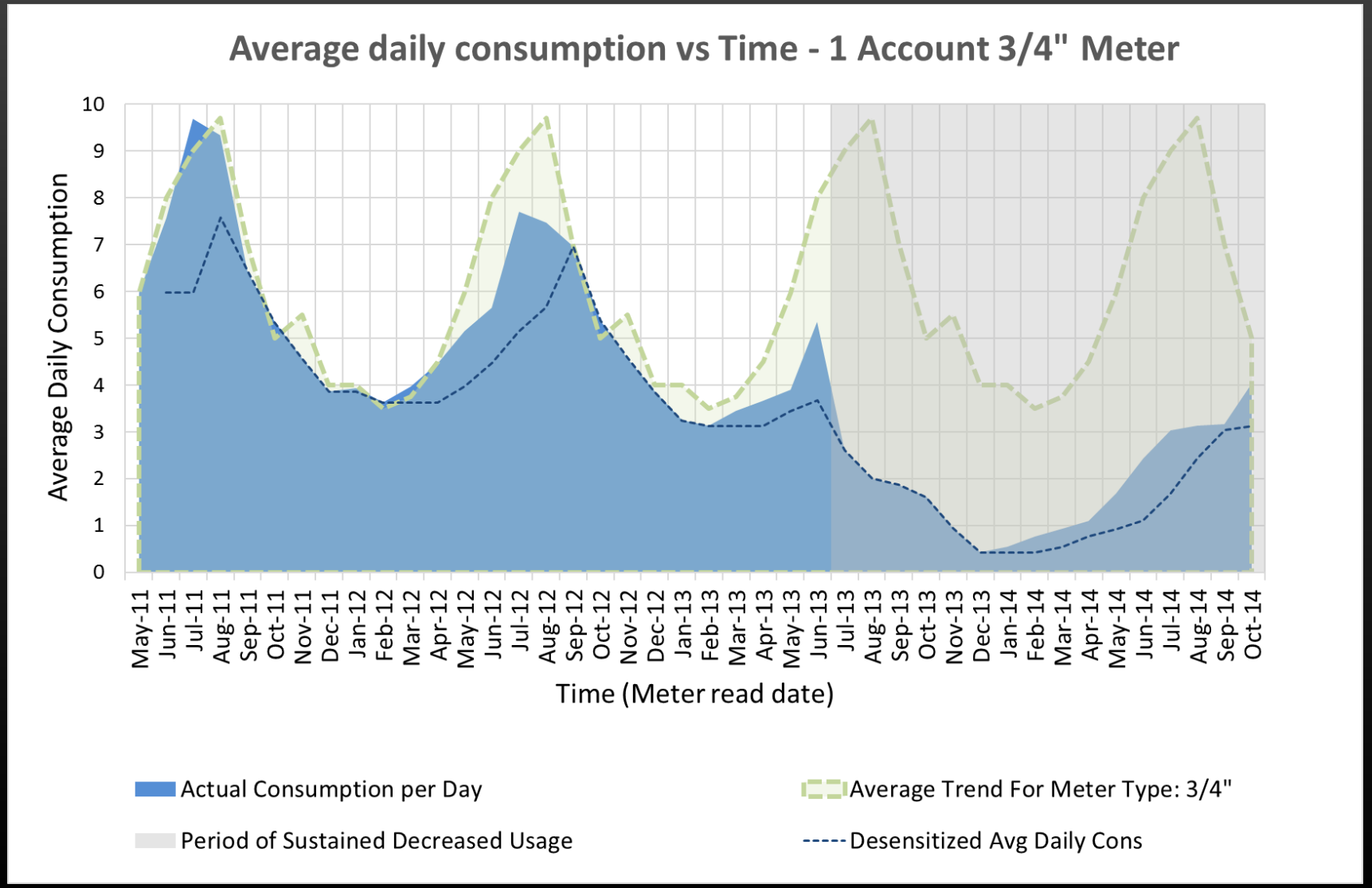

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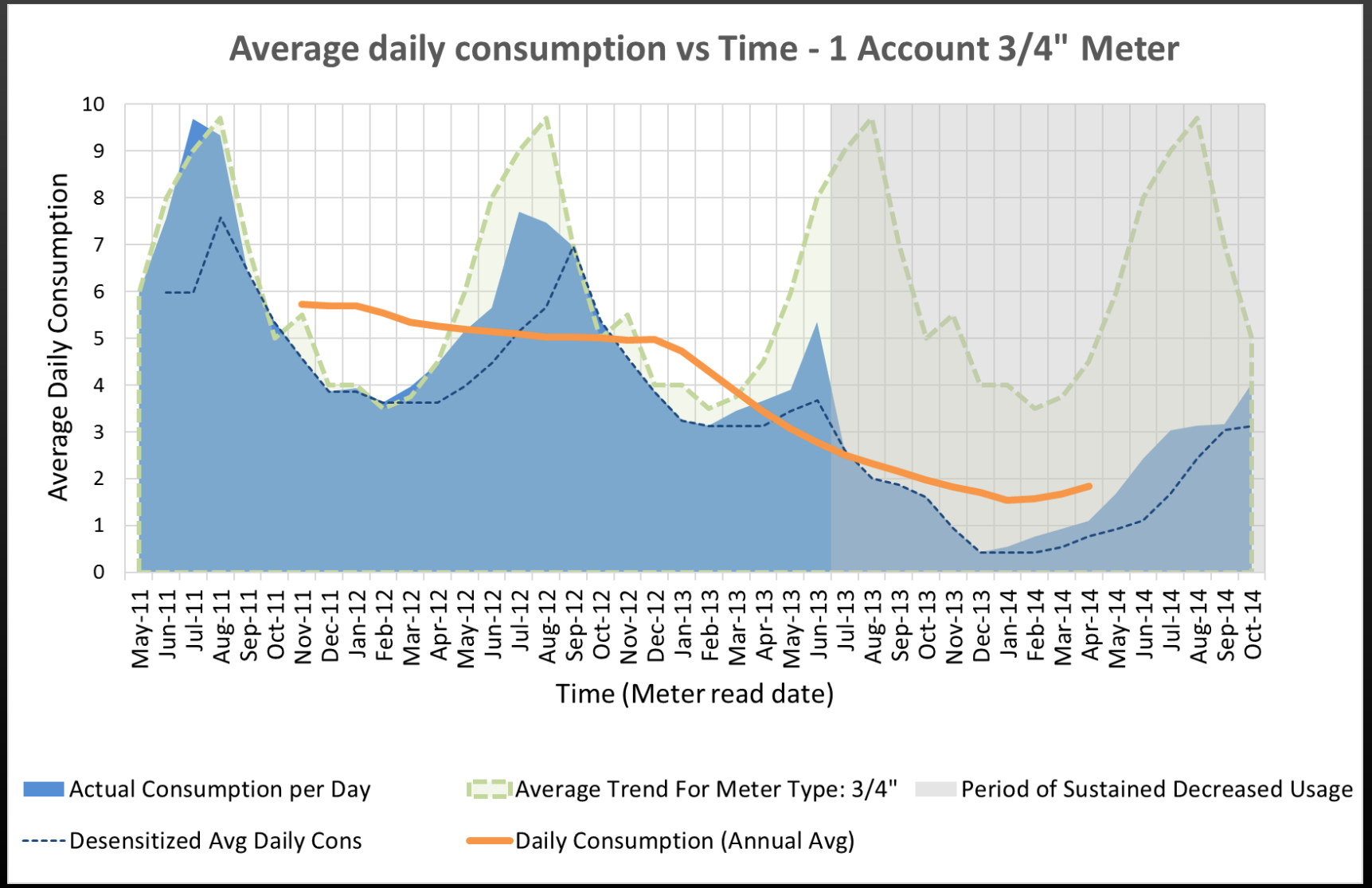

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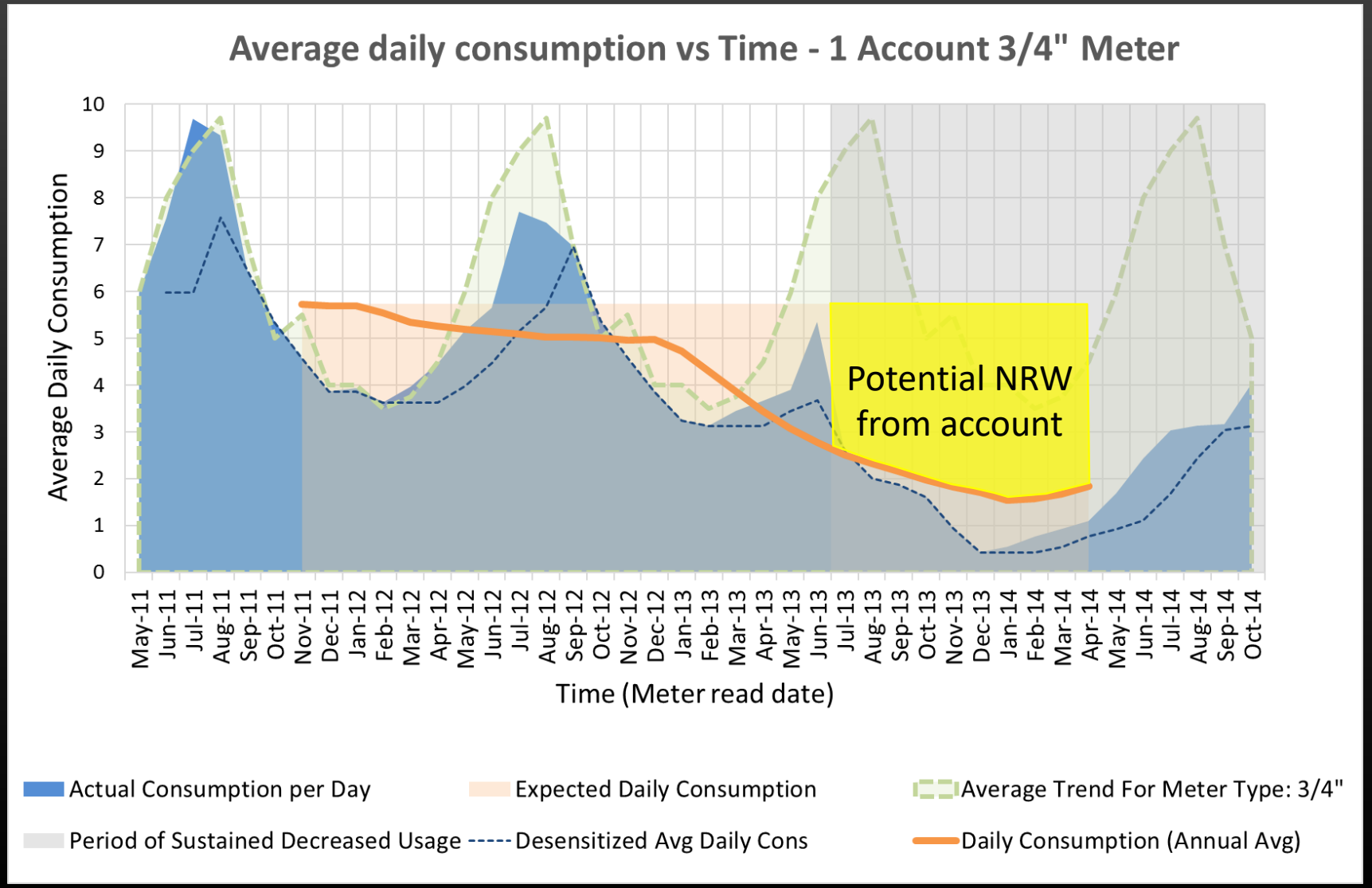
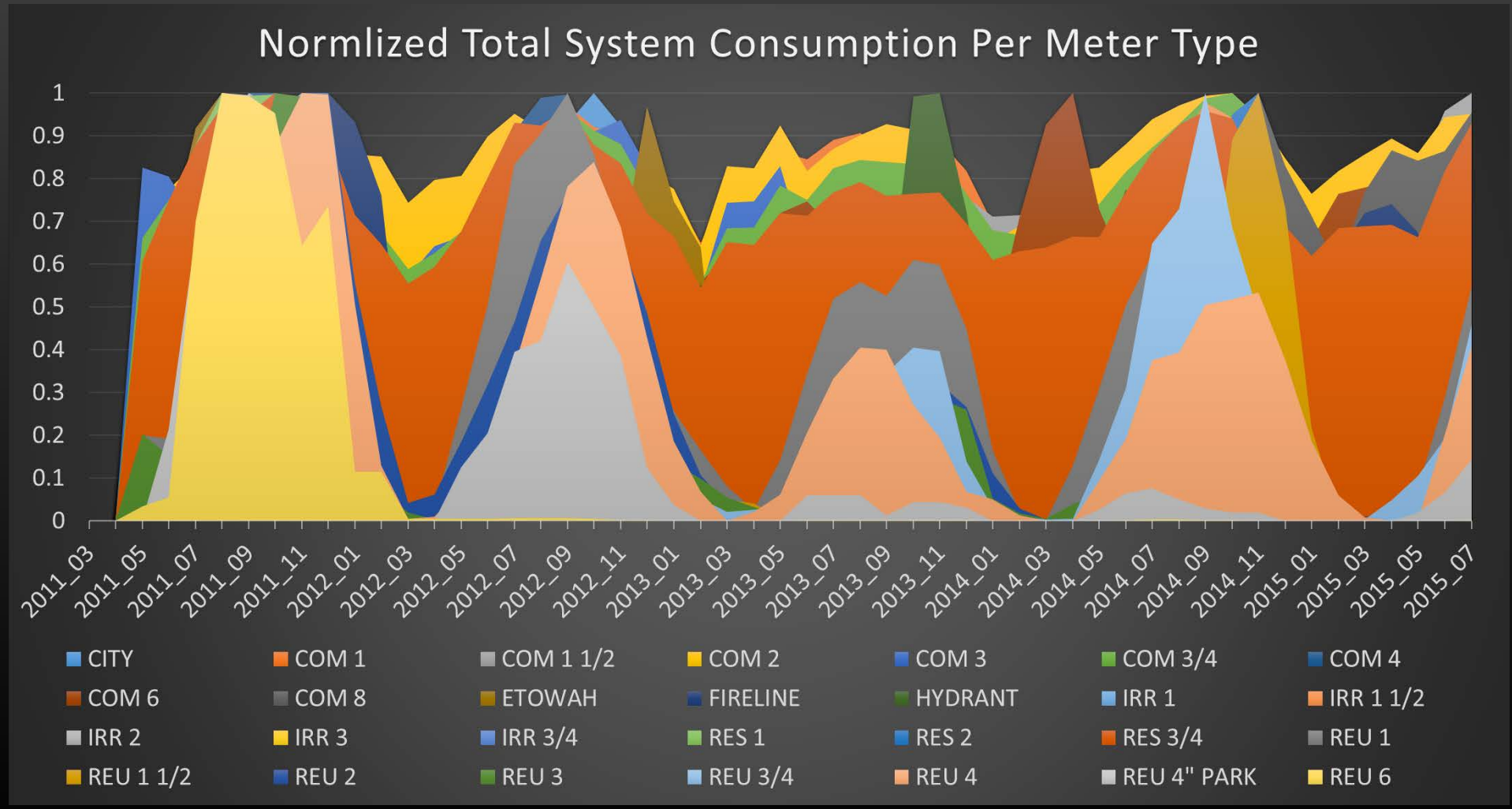


The Algorithm – Normalized Consumption



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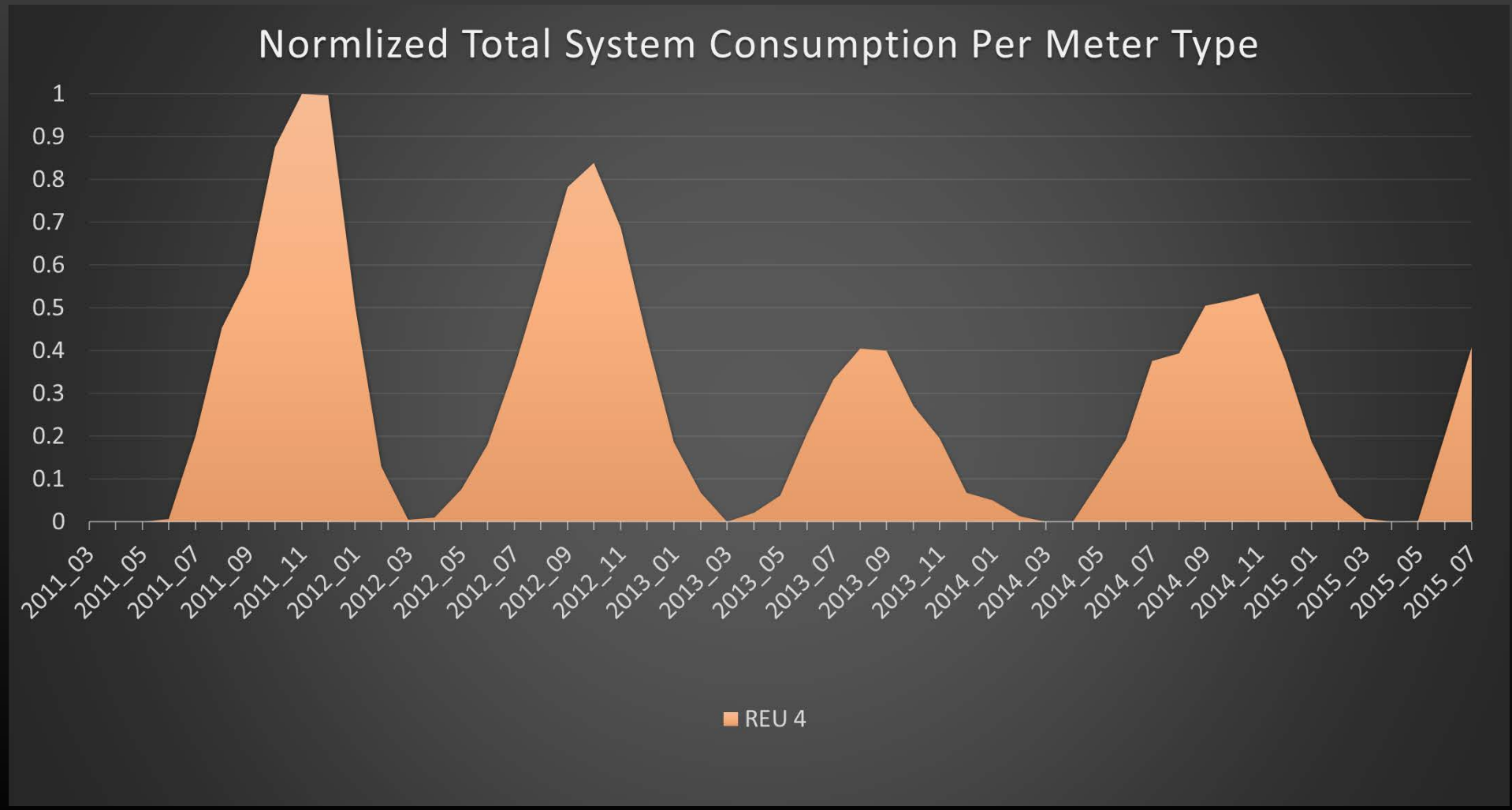

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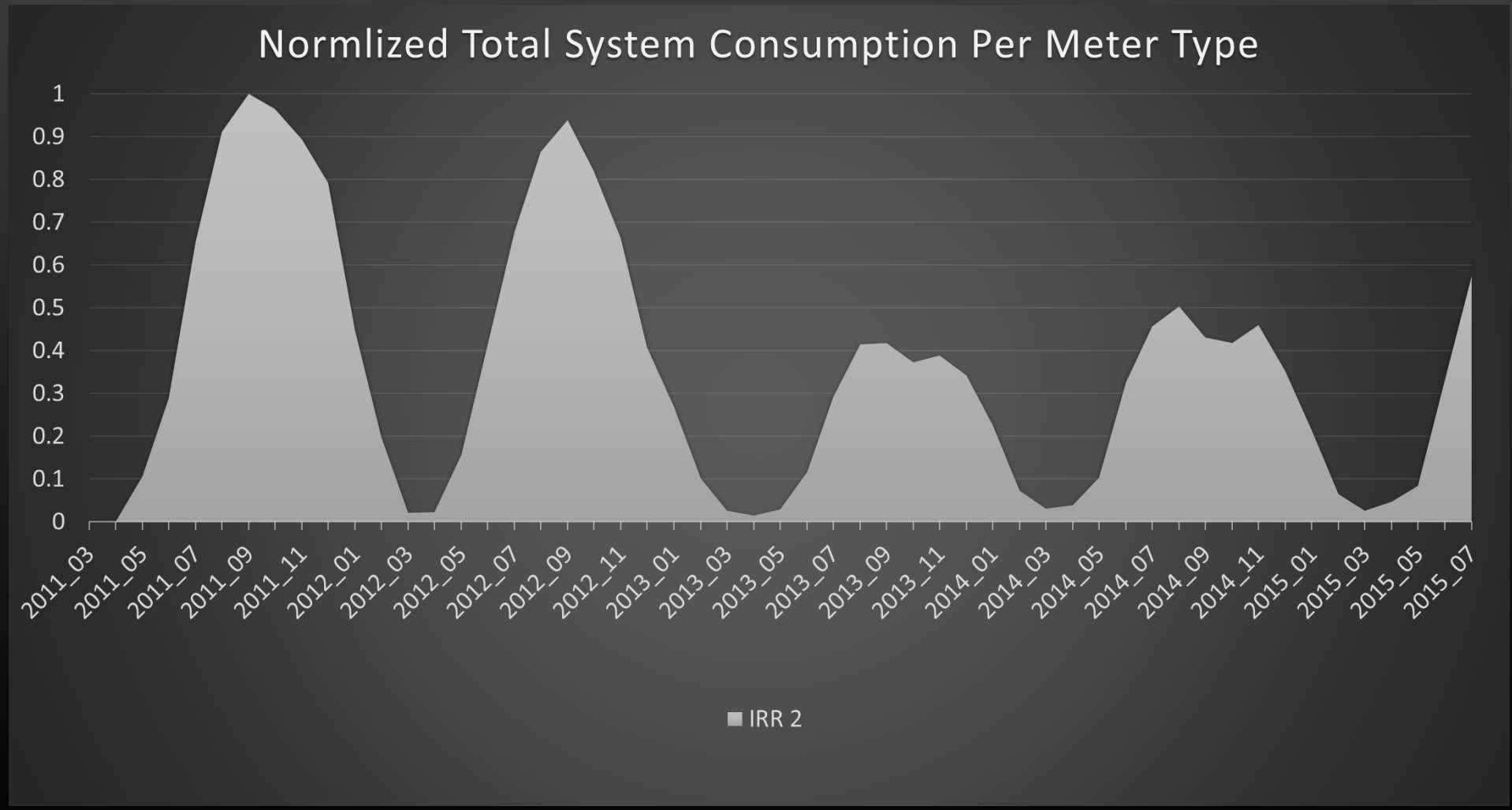


Case Studies

- Applied to 4 utilities
  - 2 utilities have followed up with field investigation that were provided as an output of the application.
  - 1 utility used the results to prioritize meter replacement
  - 1 utility is still in the process of field investigation

Case Study 1 – Athens-Clarke County, GA

Athens Clarke County, GA	
ASSESSED	~80,000 accounts
APPLICATION RETURNED	72 accounts (up to 15 in each size category)
FIELD INVESTIGATION	7 requiring corrective action, 31 warranting a field investigation
LOST REVENUE RECOVERED ANNUALLY	$238,000

Case Study 1 – Athens-Clarke County, GA

Athens Clarke County							
		Successfully Identified Accounts			Explanations and Improvements		
Meter Size	**# of Accounts Provided**	**# scheduled for change out from analysis**	**Potential annual loss retrieved (MG)**	**~$11.64 / 1000 gal**	**0 readings but account is still active**	**Change out not represented by a meterID change**	**Anomaly provided some insight**
75	13	1	0.615	$ 7,159	1	0	1
1	15	1	1.343	$ 15,633	6	0	0
150	15	0	0	$ -	4	2	3
2	15	1	11.501	$ 133,872	2	2	5
3	9	3	5.615	$ 65,359	0	1	2
4	3	1	1.409	$ 16,401	0	1	0
6	2	0	0	$ -	0	1	0
Totals	**72**	**7 (10%)**	**20.483**	**$ 238,422**	**13 (18%)**	**7 (10%)**	**11 (15%)**

Case Study 2 – Aqua America SEPA, PA

Aqua America SEPA, PA - PART 1	
ASSESSED	741 large accounts (>= 2” meters)
APPLICATION RETURNED	30 accounts
FIELD INVESTIGATION	5 requiring corrective action
LOST REVENUE RECOVERED ANNUALLY	$30,000

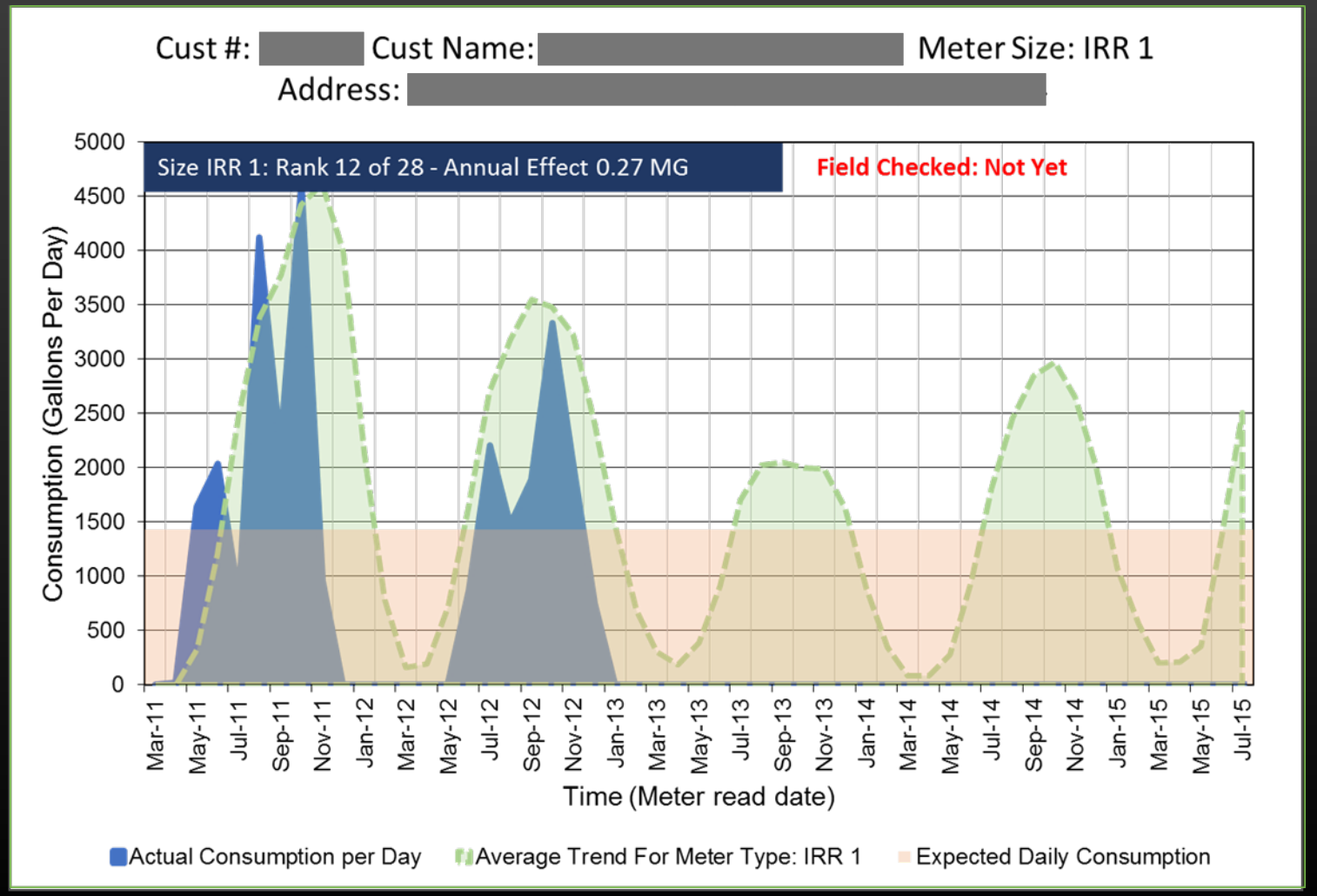
Case Study 2 – Aqua America SEPA, PA

Aqua America SEPA, PA - PART 2	
ASSESSED	All accounts < 2” meters ~330,000 accounts
APPLICATION RETURNED	80 accounts
FIELD INVESTIGATION	In process of being completed
LOST REVENUE RECOVERED ANNUALLY	-

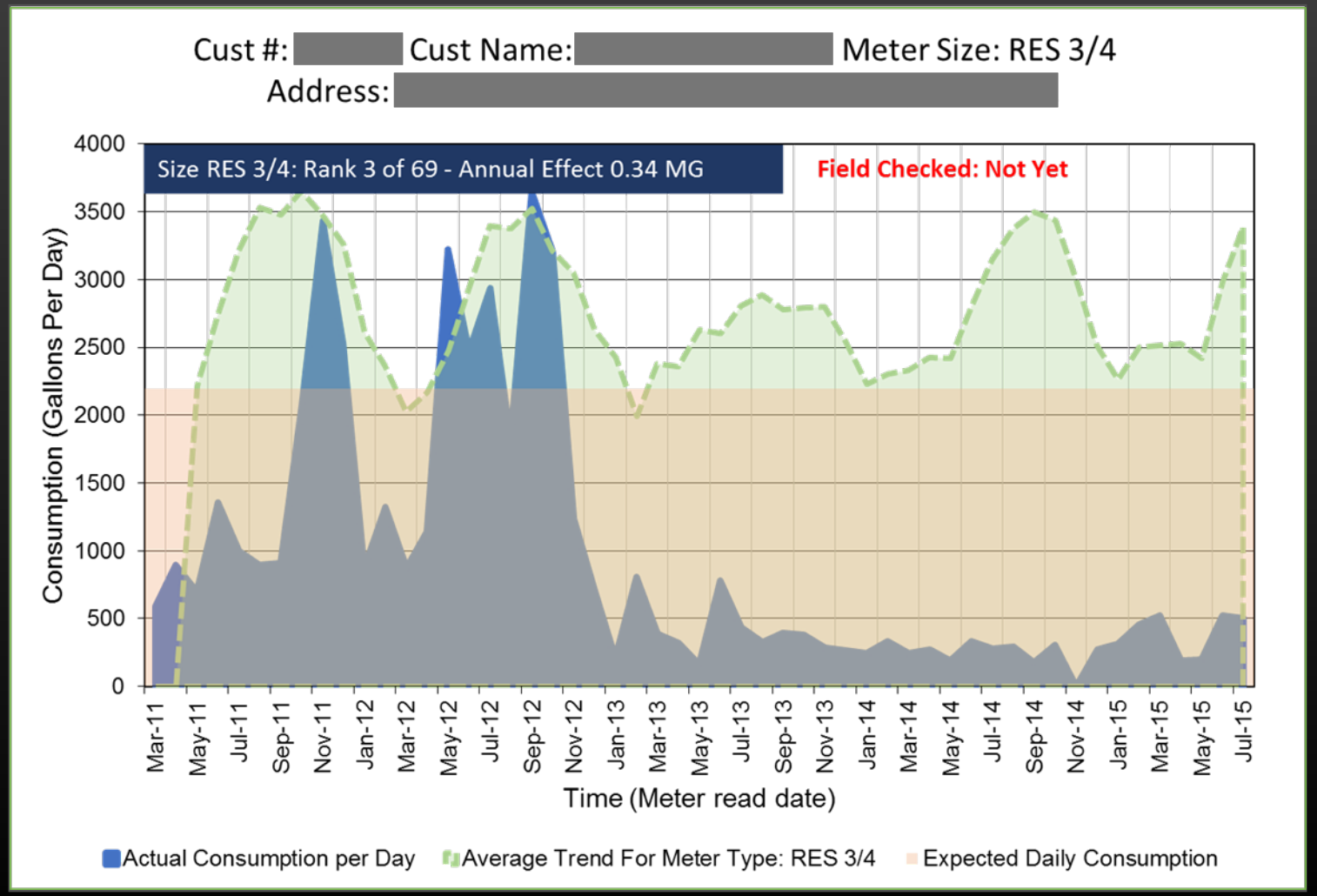
Case Study 3 – Medium Sized Utility

Medium Sized Utility	
ASSESSED	Complete system ~50,000 accounts
APPLICATION RETURNED	200 accounts
FIELD INVESTIGATION	In process of being completed.
LOST REVENUE RECOVERED ANNUALLY	-

Case Study 3 – Medium Sized Utility



Case Study 3 – Medium Sized Utility



Case Study 4 - Cleveland Water, OH

- completing their AMI system upgrade across 425,000 accounts
- Pilot performed to assist with
  - prioritizing stuck meter repairs
  - determining which remaining non-AMI accounts should be upgraded first due

Cleveland Water, OH	
ASSESSED	Pilot study on 3,000 accounts with large meters which had been upgraded to AMI
APPLICATION RETURNED	List of top accounts displaying irregular usage
FIELD INVESTIGATION	Highlighted several accounts warranting a field investigation.

Conclusions

- Provides a report identifying the largest potential contributors to NRW apparent losses
- Requires the utility to have resources to field investigate and act on
- Success rate
  - subsequent case studies have been reducing false positives.
  - 50% success rate with latest case study

Future Applications

- Assessment of current approach to detecting apparent losses
- Application intended to run on regular 6-month basis using rolling 2-4 years of billing history
- Integrate into billing history system to automate reports
- AMI Integration

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thank you

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