

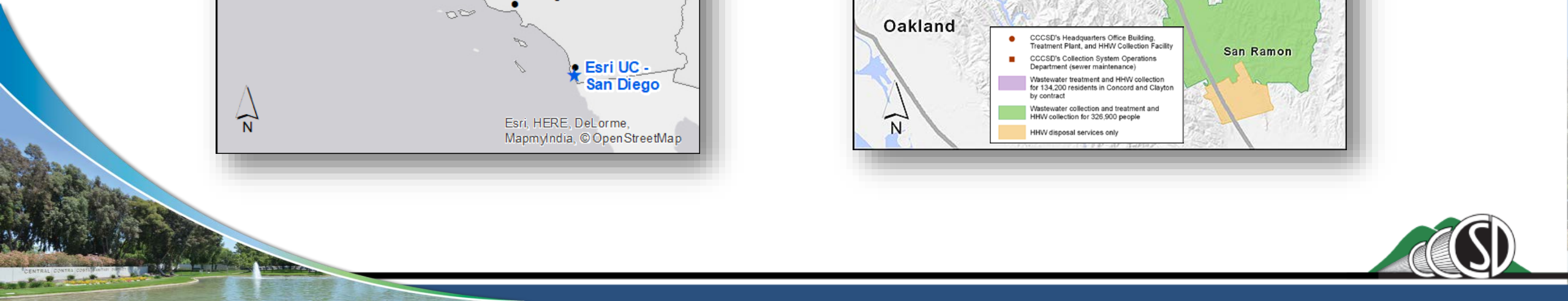
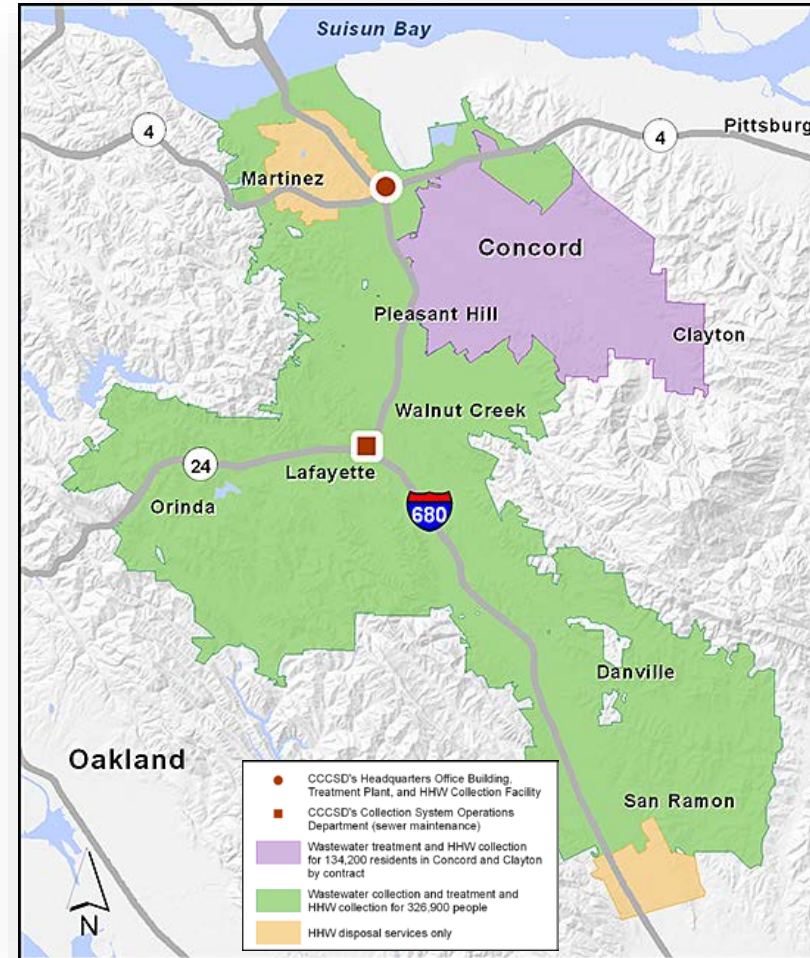
How Central San Became A GIS-Centric Water Resources Agency

Carl Von Stetten
GIS Analyst, Central San

Esri User Conference Water Meeting
July 9, 2017



Where is Central San?



Protecting Public Health and the Environment

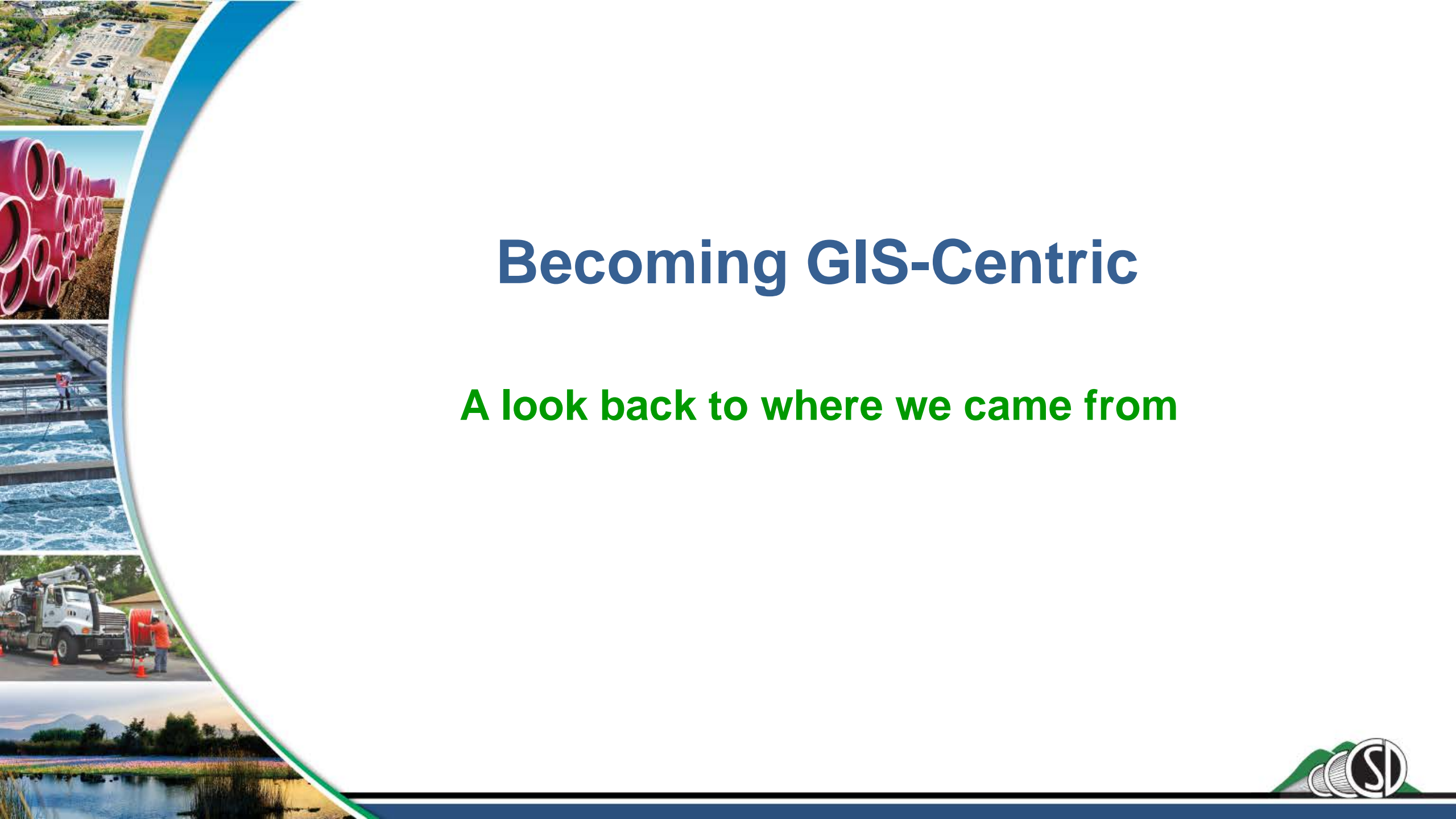
- Wastewater collection and treatment for 327,000 residents and business customers
- Wastewater treatment for 134,000 residents of the cities of Concord and Clayton
- Produce recycled water for irrigation and industrial use
- Household hazardous waste collection
- Contribute to environmental stewardship of the Sacramento/San Joaquin River Delta and San Francisco Bay
- Operation Statistics:
 - Treat average of 32 MGD (up to 53 MGD max permitted dry weather capacity)
 - 1,500 miles of gravity sewer pipelines
 - 22 miles of pressurized force main sewer pipelines
 - 19 pumping/lifting stations
 - Produce 550 million gallons per year of recycled water
 - Collect 2.1 million pounds per year of household hazardous waste



Agenda

- Asset Management and GIS – Past and Present
- Rebuilding the GIS
- Rebuilding the Asset Management System
- Adding Supporting Systems
- Enabling Risk-Based Asset Management





Becoming GIS-Centric

A look back to where we came from



Asset Management Evolution

Prior to
2002

- Not condition-based
- Some preventative/prescriptive maintenance planning
- Sewer cleaning schedules set up based on past history and limited CCTV
- Minimal GIS support

2002-2016

- Condition-based
- District-wide CCTV inspection/assessment contracts
- Identify and replace/rehabilitate most critical defective pipes, fine-tune cleaning schedules
- GIS tools used to visualize high CCTV scores and high-frequency cleaning

2016
Onward

- Risk-based and long-term planning (20 year master plan, 100 year forecast)
- Plan asset replacements before end of lifecycle
- Requires lots of data: (GIS, maintenance history, CCTV and other condition assessments, hydraulic capacity model)



Asset Management Systems Over the Years



Collection System
"SMMS" (custom Dbase III+)

Treatment Plant/Pumping Stations/Facilities
Mainsaver CMMS

Collection System
Sussex (Accela) CMMS

Cityworks

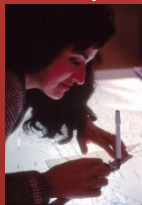


History of Mapping and GIS at Central San



'70s thru mid-'90s

- Pen and ink drafting on mylar film
- 669 maps



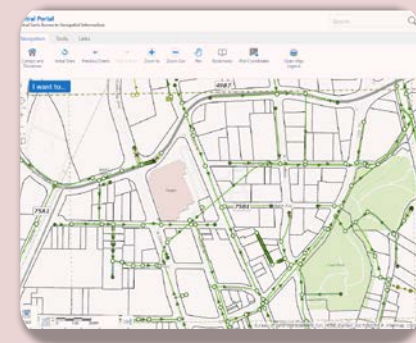
Mid-'90s thru 2005

- MicroStation + MGE
- 739 maps



2005 thru 2016

- Intergraph GeoMedia
- AutoDesk MapGuide web maps
- 766 maps



2016 Onward

- Esri ArcGIS
- Geocortex
- No printed map books!



What Should Our GIS-Centric Operation Look Like?

- GIS will be the single authoritative asset repository
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- Custom programming will be reduced or eliminated
- Web GIS will run on any platform/browser
- Asset Management System (AMS) will integrate directly with GIS platform
- Maintenance crews will access AMS on mobile devices
- Enable risk-based long-term asset management





Becoming GIS-Centric

Rebuilding the GIS



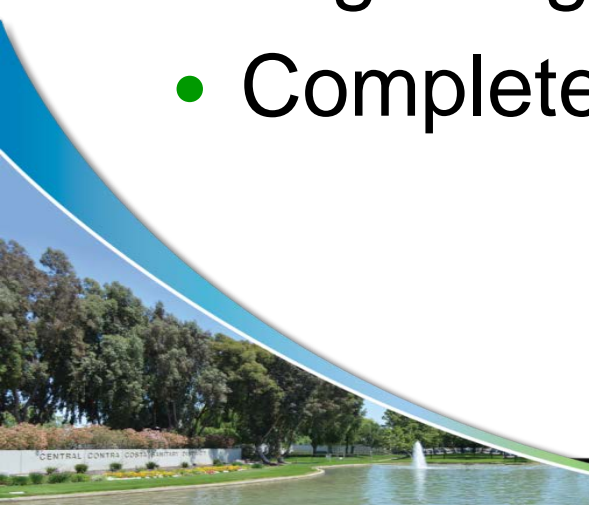
Esri ArcGIS Platform Selected

- One unified industry-standard platform for desktop, web, and mobile applications
- Previous custom solutions could be replaced with already built-in functionality
- Large selection of industry partners for various applications related to asset management
- Latitude Geographics[®] Geocortex selected to simplify web application development



Migration to Esri ArcGIS Platform

- Local Government Information Model (LGIM)
 - Customized to meet our needs
 - Also added numerous fields to support Cityworks
- Safe Software FME to massage/move most of the data
- Esri assisted with some FME process designs and migrating parcel data into LGIM Parcel Fabric
- Completed migration in June 2016



Local Government Information Model (LGIM)

- Standard framework for data model consistency
- Improves data interoperability/sharing
- Pre-built maps and applications for desktop and web
- Attribute Assistant automates many tasks
- Support for parcel fabrics (topology) and geometric networks
- Updated regularly by Esri



Attribute Assistant

Improves Accuracy and Efficiency

- Automated rule-based data input (71 rule methods available)
- Configure when the rules run (on create, attribute change, geometry change, or manual) and in what order (weight)
- Rules stored in attribute tables inside your geodatabase
- No programming required!!!



Attribute Assistant

Central San Examples

- Assign globally unique “assetid” numbers (shared sequence) to assets
- Concatenate multiple fields into descriptive “FACILITYID” field for sewer/water point features
- Populate “FROMMH” and “TOMH” fields on sewer mains from FACILITYID of connected structures



Data Reviewer for Quality Control

- Extension for ArcGIS Server/Desktop
- Rule-based data quality checking
 - Geometry
 - Geometric network/topology
 - Attribute values
 - Validate domains
- Esri provides “starter” rules for many of the LGIM feature data sets



GIS Data Management

- Editing Environment
- Versioned
- Access limited to GIS staff

Production SDE
Geodatabase

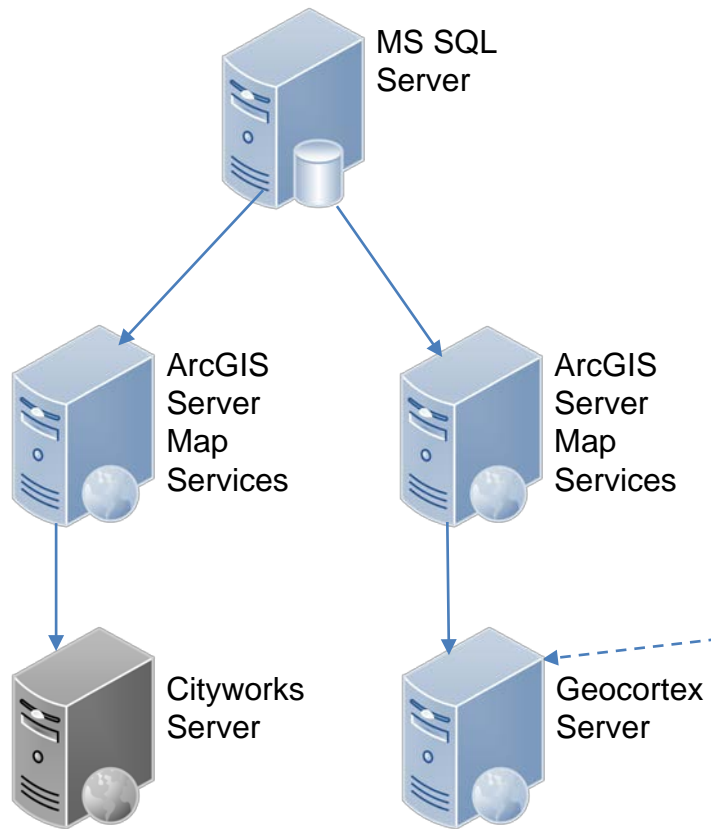
Published SDE
Geodatabase

- For web maps and cartographic products
- Not versioned
- Sewer/Water/Parcel data refreshed on weeknights (FME Server processes)
- Read access for everyone

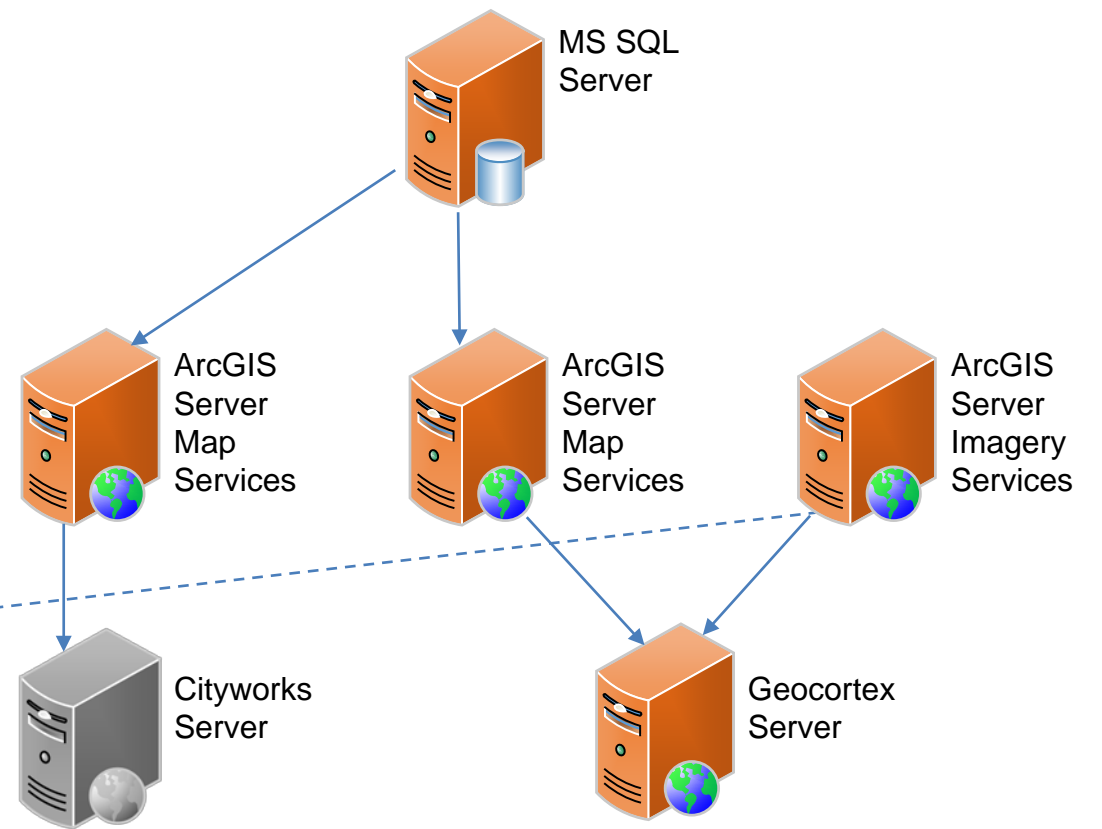


Web GIS Architecture

Testing

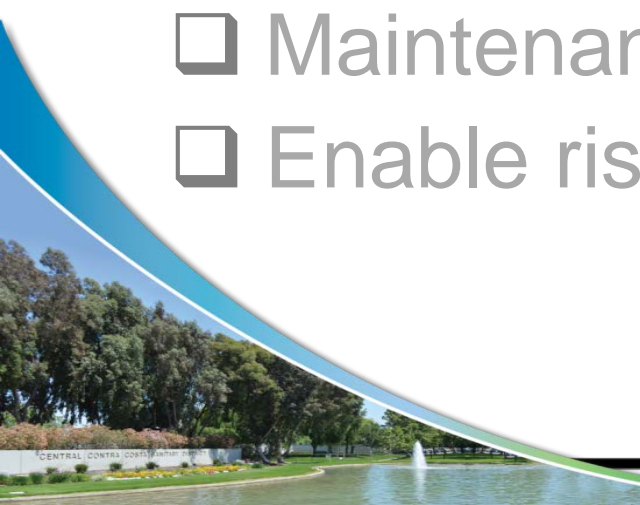


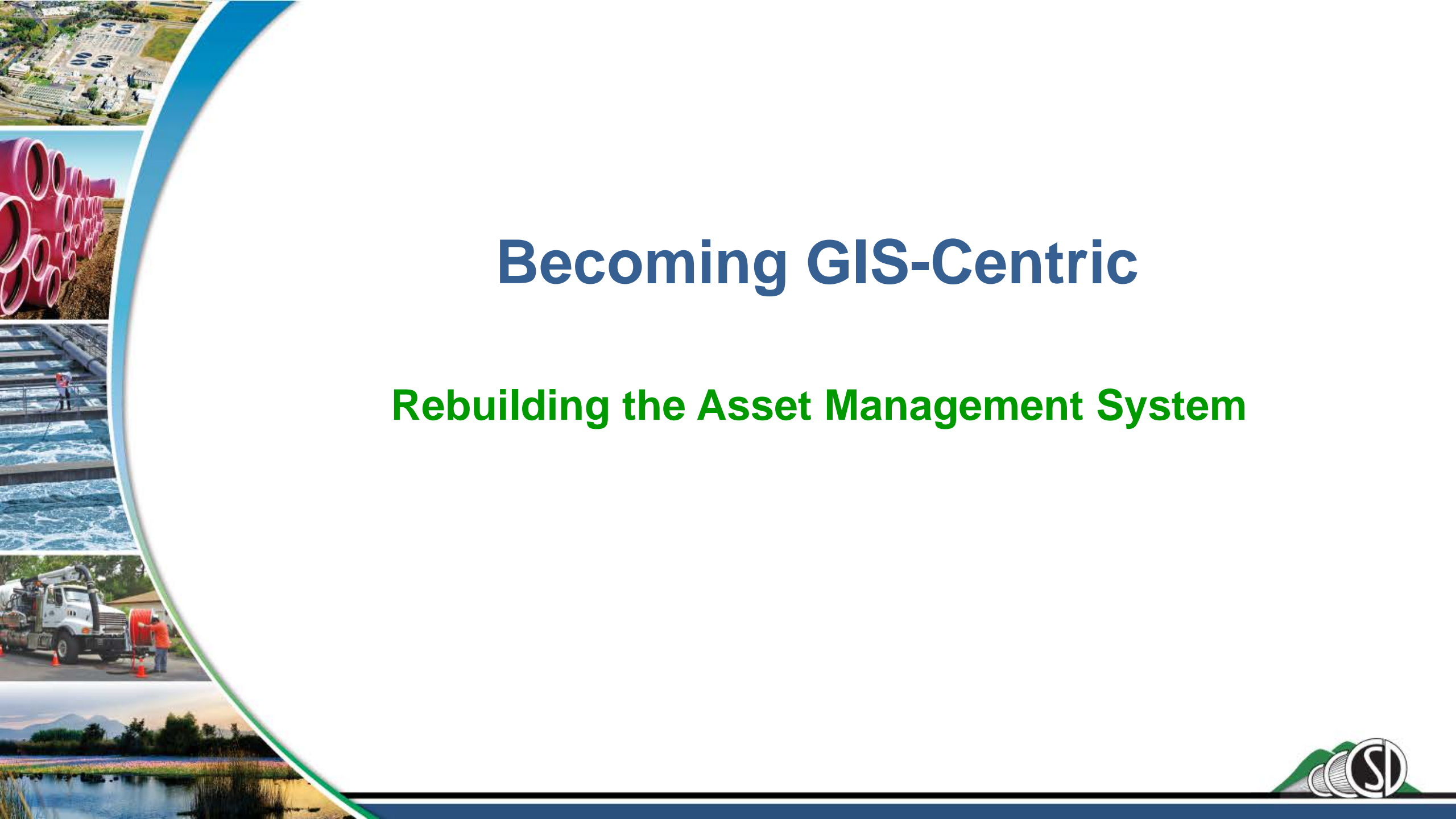
Production



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Becoming GIS-Centric

Rebuilding the Asset Management System



Asset Management System Replacement

- Central San chose to implement Cityworks by Azteca Systems
 - Leverages GIS map services for asset repository
 - Supports both horizontal assets (sewer collection/water distribution) and vertical assets (treatment plants, pumping stations, general facilities)
 - Web interface
 - Mobile apps (iOS, Android)



Cityworks Implementation

- Hired Woolpert to assist with the implementation
- Met with stakeholders to configure Cityworks to our needs
- Facilitated LGIM schema changes to support Cityworks
- Designed geodatabase for treatment plant, pumping stations, general facilities assets

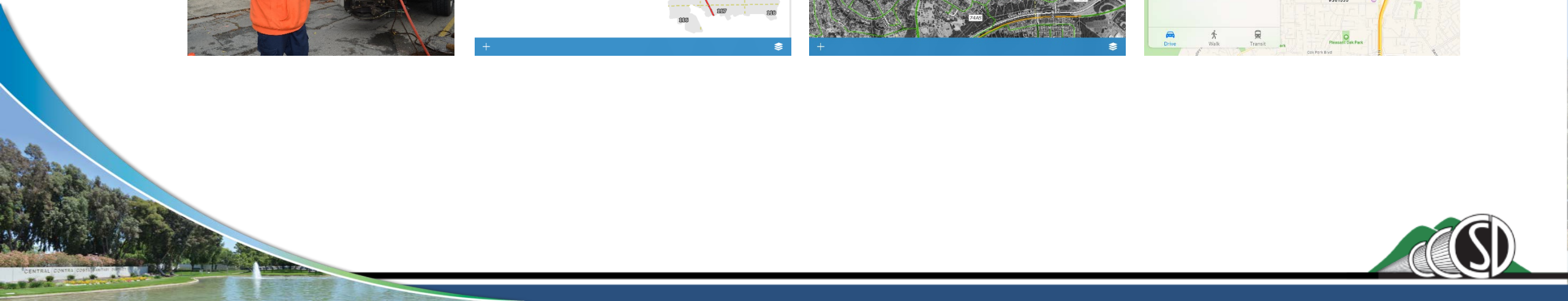
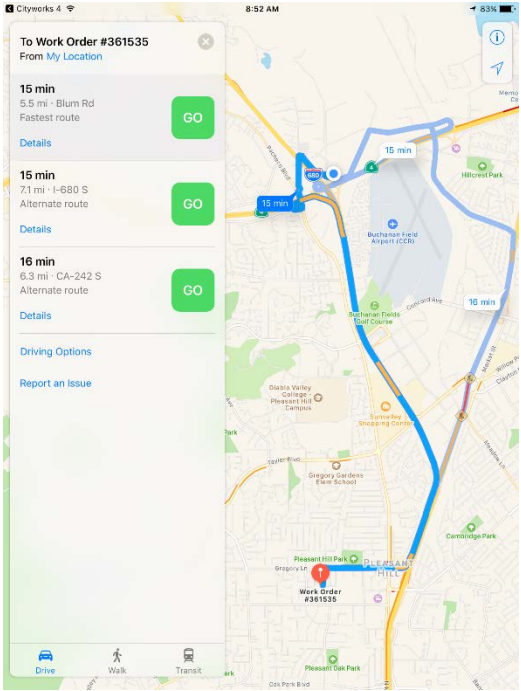
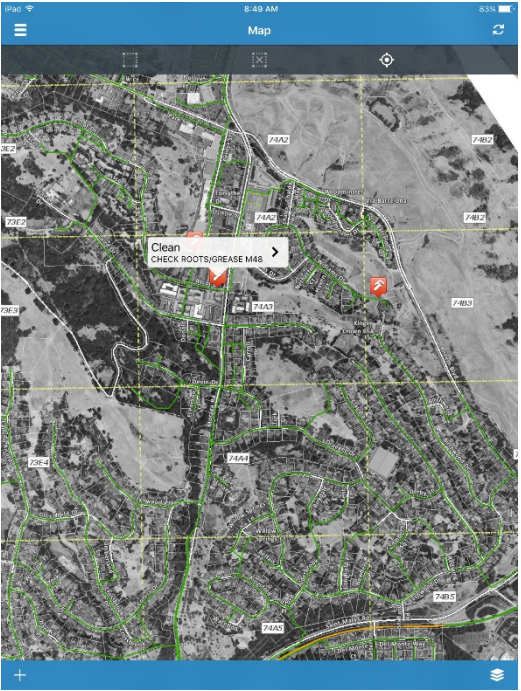
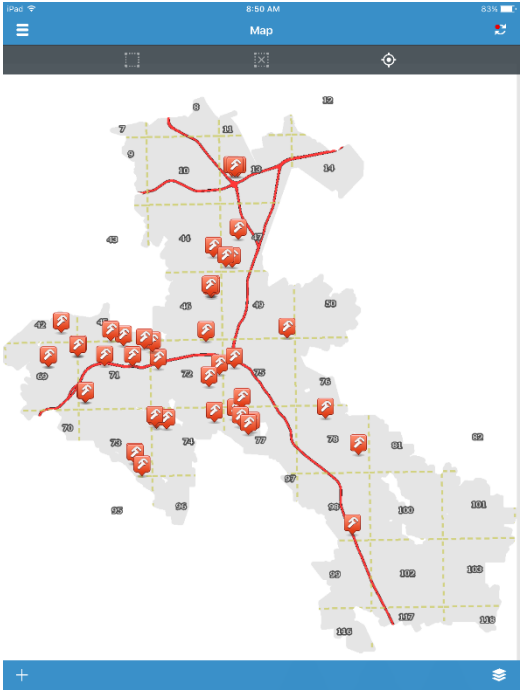


Collection System Implementation Completion

- Collection System “go live” – late September 2016
 - Data migration of historic sewer and fleet work orders
 - PM schedules “seeded” and triggered
 - Printed paper schedules/maps for October work orders
 - 100% mobile since November



Cityworks in the Field - Collection Systems



Treatment Plant Implementation Ongoing

- Treatment Plant “soft start” – late January 2017
 - Implementation ongoing
 - Maintenance shops use mixture of iPads and desktops to access Cityworks



Woolpert Cityworks Enhancements

- Woolpert built automated “integrations” to pull data from:
 - Dynac SCADA – equipment runtimes
 - SunGard – parts and materials fulfilled by our Material Services warehouse



Cityworks for Treatment Plant

Cityworks Inbox Designer Service Request Work Order Asset Search Search

Work Order Open Selected Open In ELM Calendar Map View WO Frequency Data Map Refresh

Drag a column header and drop it here to group by that column

WorkOrderId	Entity Type	Description	Status	Submit To	Proj Start Date	Actual Start	Shd
369872	TPPUMP	PDM Influent Pump 500 Hour	CANCEL	Botelli, Don	3/20/2017 7:58 AM		MEI
371128	TPPUMP	Troubleshoot/Repair	CLOSED	Ford, Thomas	2/7/2017 5:32 AM	2/8/2017 7:00 AM	MEI
371234	TPPUMP	Troubleshoot/Repair	CANCEL		8/2/2016 1:01 PM		MEI
371250	TPPUMP	PM SCB OCU Scrubber Circulation Pump 6 Month	INITIATED		6/24/2017 12:00 PM		MEI
373733	TPPUMP	PDM Clarifier Sump Pump 1000 Hour	CANCEL		2/11/2017 11:55 PM		MR
374277	TPPUMP	PM Clarifier Sump Pump 1 Year	CLOSED	Nicolaus, Jon	10/23/2016 12:00 PM	2/18/2017 12:00 PM	MEI
374807	TPPUMP	PDM Clarifier Sump Pump 1000 Hour	CANCEL		2/17/2017 11:55 PM		MEI
374819	TPPUMP	Troubleshoot/Repair	CLOSED	Sullivan, Sean	2/20/2017 9:37 PM	2/20/2017 12:00 PM	ELB
375234	TPPUMP	PDM Utility Water Pump 1 Year	INITIATED		11/28/2017 12:00 AM		MR
375247	TPPUMP	PM UV Chemical Room and Equip 1 Year	INITIATED		12/9/2017 12:00 AM		MR
375253	TPPUMP	PM Aer Condenser Hogger Pump 1 Year	INITIATED		12/11/2017 12:00 AM		MR
375261	TPPUMP	PM Tamaround Wet Scrubber Spray Pump	INITIATED		12/12/2017 12:00 AM		MR
375269	TPPUMP	PM Tamaround Wet Scrubber Spray Pump	INITIATED		12/27/2017 12:00 AM		MEI
375274	TPPUMP	PM Tamaround Wet Scrubber Spray Pump	INITIATED		12/27/2017 12:00 AM		MEI
375291	TPPUMP	PM FE Sample Booster Pump 1 Week	CLOSED	Serrato, Paul	2/23/2017 12:00 AM	3/2/2017 12:00 PM	MEI
375298	TPPUMP	Troubleshoot/Repair	CLOSED	Ford, Thomas	2/27/2017 5:48 AM	3/2/2017 12:00 PM	MEI
377608	TPPUMP	PDM South West RAS Pump 1 Year	INITIATED		3/13/2018 12:00 PM		MR
377626	TPPUMP	Troubleshoot/Repair	CLOSED	Martinez, Bernard	3/2/2017 5:57 AM	3/2/2017 12:00 PM	MR
378112	TPPUMP	Troubleshoot/Repair	CLOSED	Serrato, Paul	3/6/2017 9:04 AM	3/6/2017 12:00 PM	MEI
378658	TPPUMP	Centrifugal Pump Condition Inspection	CLOSED	Botelli, Don	3/22/2017 12:00 AM	4/8/2017 9:30 AM	MEI
378996	TPPUMP	PM Recycle Press Pumps Inst 1 Year	CLOSED	Jaschek, Chad	5/3/2017 12:00 AM	6/20/2017 2:09 PM	INS
379099	TPPUMP	Troubleshoot/Repair	ON HOLD	Ford, Thomas	3/31/2017 11:09 AM	3/31/2017 7:00 AM	MEI
380611	TPPUMP	PDM WAS Pump 1 Year	INITIATED		1/25/2018 10:22 AM		MEI
388726	TPPUMP	PDM Influent Pump 500 Hour	CLOSED	Derrick, Dewayne	1/30/2017 12:57 PM	3/3/2017 7:00 AM	MR
388780	TPPUMP	PDM Influent Pump 500 Hour	CLOSED	Martinez, Bernard	1/30/2017 12:57 PM	4/18/2017 12:30 PM	MEI
389480	TPPUMP	PM Infl Pump 5 Function Test 1 Month	CLOSED		1/24/2017 8:00 PM	4/17/2017 12:00 PM	OPE
389511	TPPUMP	PM Waste Oil Pump 1 Month	CLOSED	Botelli, Don	1/26/2017 12:00 PM	2/10/2017 12:00 PM	MEI
389524	TPPUMP	PDM Clarifier Sump Pump 1000 Hour	CANCEL		1/30/2017 11:55 PM		MEI
370440	TPPUMP	Paint	CLOSED	Griffis, Jimmy	1/31/2017 1:00 PM	1/27/2017 6:00 AM	MA
370447	TPPUMP	Paint	CLOSED	Griffis, Jimmy	1/31/2017 1:39 PM	2/2/2017 6:00 AM	MA
371274	TPPUMP	Install	ON HOLD		2/17/2017 3:25 PM	2/14/2017 9:00 AM	ELB
371297	TPPUMP	Centrifugal Pump Condition Inspection	CLOSED	Ford, Thomas	2/8/2017 7:42 AM	2/8/2017 9:00 AM	MEI

Page 1 of 1, Items 1 to 515 of 515.

Cityworks Inbox Designer Service Request Work Order Asset Search Search

Work Order Email Print Save Close Delete

Quality Assurance

Tasks Complete: 9 / 10

Inspections Closed: 3

Required Fields Filled In: 1

Assets Attached: 1

Labor Hours Entered: 1

Equipment Unit-Hours Entered: 1

Material Units Entered: 1

Work Order

Description: PM Condensate Pump 1 Month

Number: 375900

Entity Type: TPPUMP

Category: Preventive

Initiated By: Mahoney, Matt Date: 03/24/2017 2:39 PM

Status: Closed Priority: Medium

On Hold Reason: Shop

Requested By: Supervisor: Mahoney, Matt

Submitted By: Derrick, Dewayne Date: 03/16/2017 2:53 PM

Projected Start: 03/15/2017 12:00 PM Projected Finish: 03/16/2017 12:00 PM

Compliance WDI: No Completed By: Derrick, Dewayne

GIS Updated: No Planner Update: No

Closed By: Mahoney, Matt Date: 3/29/2017 8:28:30 AM

Actual Start: 03/16/2017 10:00 AM Actual Finish: 03/16/2017 11:00 AM

Expense Type: Maintenance

Instructions: Grease both pumps with GRE#2 (PH ID # 374)

Add Comments

Created By: Derrick, Dewayne 3/15/2017 11:37:43 AM

Comments: Postioned job as per procedure.

Location Information

Legacy Id: 52121 Cond Pump 2

Location Details: P8B-O Condenser Rim 5103

X Location: 6.109.906.99 V Location: 2.189.390.82

Assets

Asset	Complete?	Legacy Id	Location
TPPUMP		52120 Cond Pump 1	P8B BSMIT
TPPUMP		52121 Cond Pump 2	P8B-O Conde
TPBUILDING		52000 Pump and Blower Building	SEC Area

Related Work Activities

Service Requests

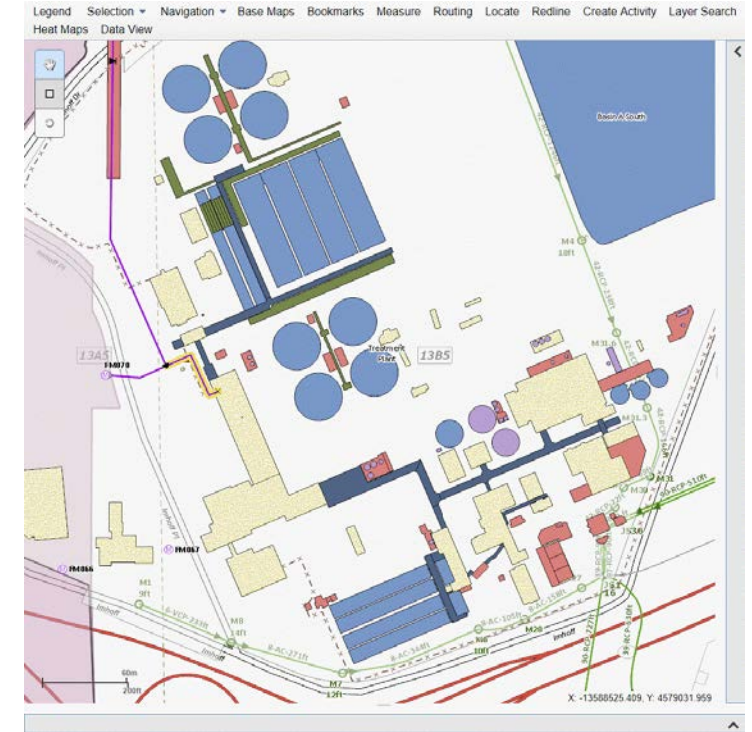
Inspections

Work Orders

Attachments

Work Cycle

Custom Fields



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- ✓ **Maintenance crews will access AMS on mobile devices**
- ☐ Enable risk-based long-term asset management





Becoming GIS-Centric

Adding Supporting Systems



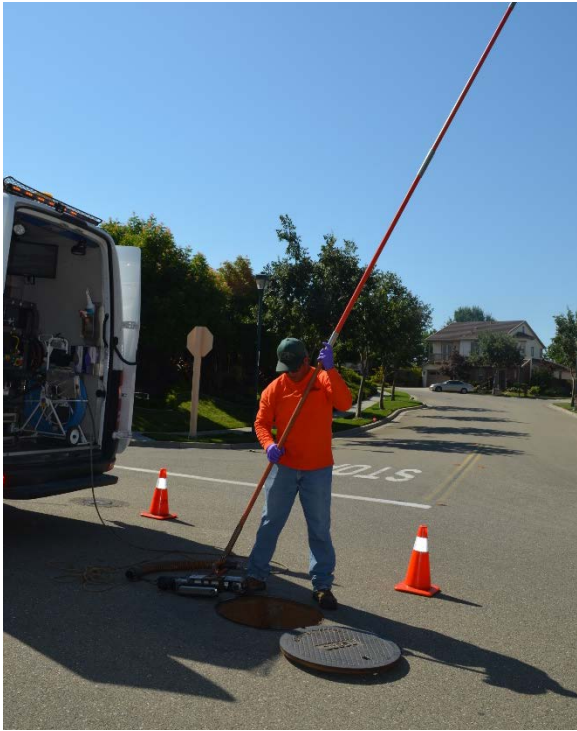
Sewer Collection System

CCTV Inspection/Condition Assessment

- Had mixture of WinCan and GraniteXP systems
- Central San chose to replace both with ITpipes
 - Configurable/customizable user interface
 - Syncing with centralized ITpipes databases, GIS, and Cityworks
 - Web access to inspection information, photos and videos
- Migrating all Wincan & GraniteXP data into new ITpipes system



ITpipes in Action



Sewer Collection System Hydraulic Capacity Modeling

- Sewer Network Analysis Program (SNAP)
 - Custom-built VBA application running inside ArcMap
 - Stored each model in Microsoft Access databases
- Needed a dynamic model
 - Simulate changes in flow rates throughout a 24-hour period
 - Account for travel time of water through collection system
 - Evaluate how and when operational activities might trigger an SSO
 - Plugging a pipe to perform maintenance/repair/replacement
 - Simulate pumping station operation under various conditions
 - Evaluate proposed new property development and increased inputs



New Hydraulic Capacity Model

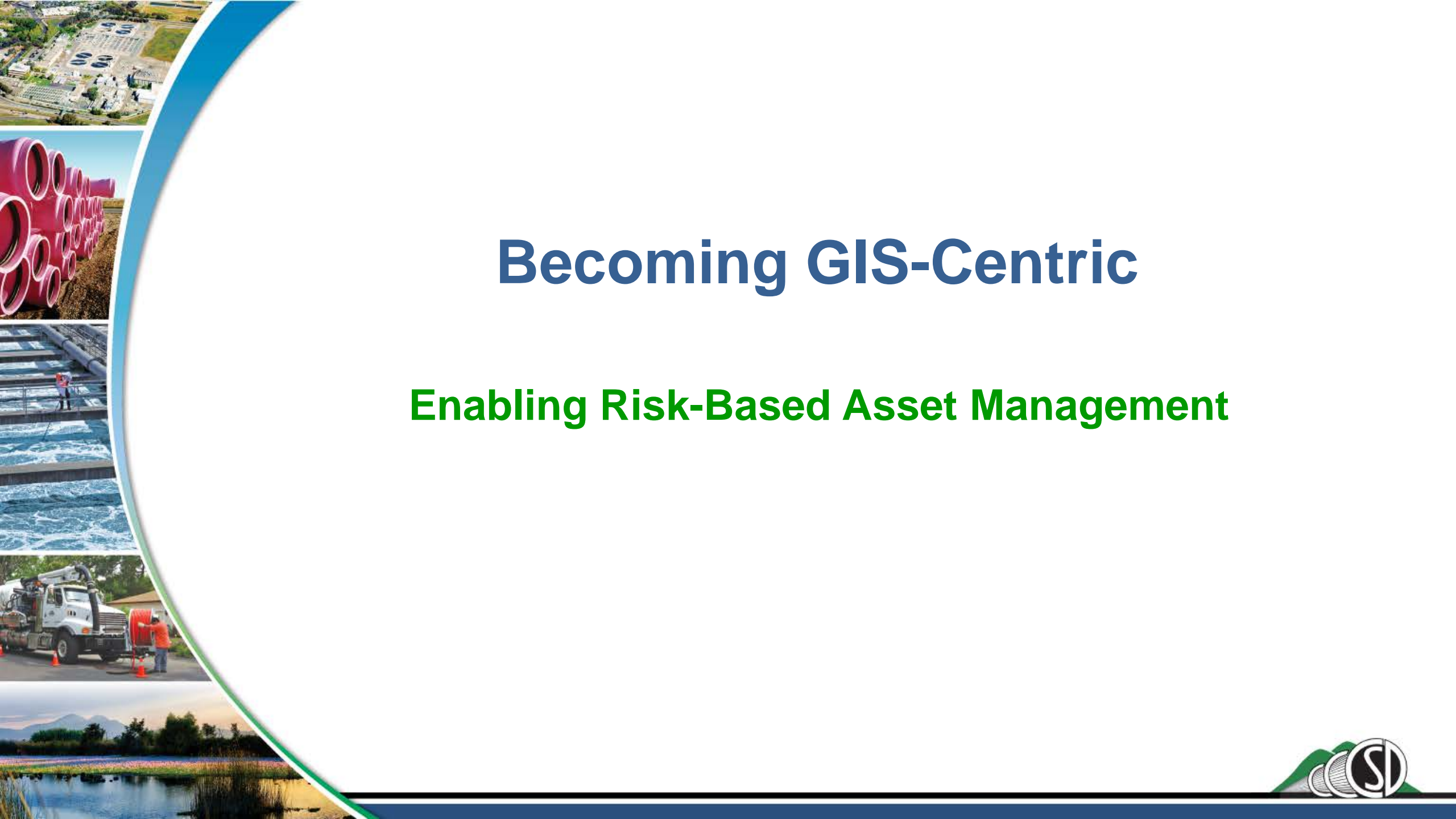
- Selected InfoWorks ICM[®] SE by Innovyze[®]
- Hired RMC Water and Environment to model and evaluate capacity of backbone trunk sewers (10" and larger)
 - Identified 20 potential wet weather capacity issues
 - No capacity improvements required to accommodate estimated 20-year population growth



Additional Asset Management Components

- Currently evaluating options for:
 - Underground Service Alert request management
 - Integration with Cityworks to initiate service requests/work orders
 - Automatic Vehicle Location (AVL)
 - Integration with Cityworks to retrieve vehicle diagnostic telemetry and trigger PM and troubleshooting work orders





Becoming GIS-Centric

Enabling Risk-Based Asset Management



Risk Assessment and Capital Planning

- 20-Year Comprehensive Wastewater Master Plan (CWMP)
- Selected InfoMaster[®] by Innovyze[®] for risk modeling and capital improvement project planning
- Hired Carollo Engineers, Inc. to prepare CWMP and help set up risk model



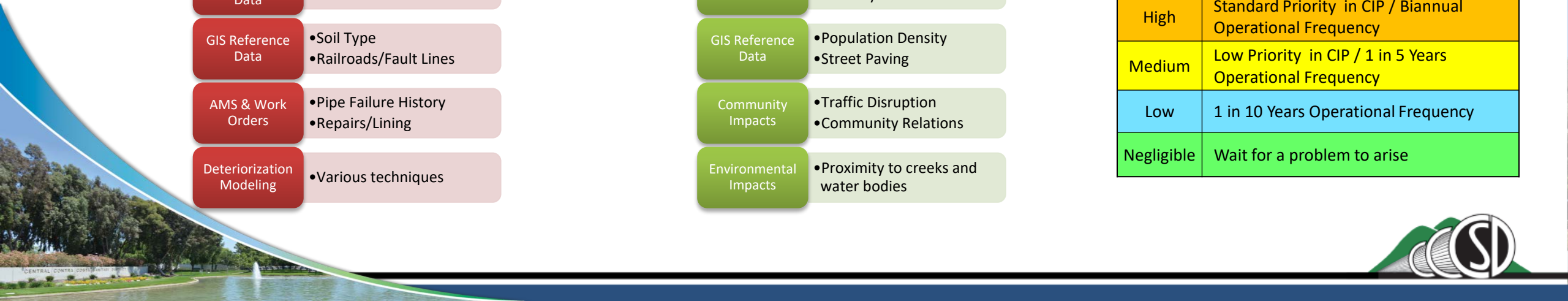
Calculating Risk for Collection System Assets



- Hydraulic Model**
 - High Velocities
 - Bottlenecks
- GIS Infrastructure Data**
 - Age
 - Material
- GIS Reference Data**
 - Soil Type
 - Railroads/Fault Lines
- AMS & Work Orders**
 - Pipe Failure History
 - Repairs/Lining
- Deterioration Modeling**
 - Various techniques

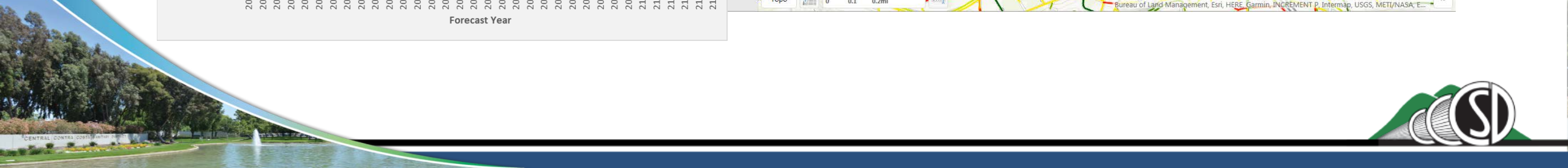
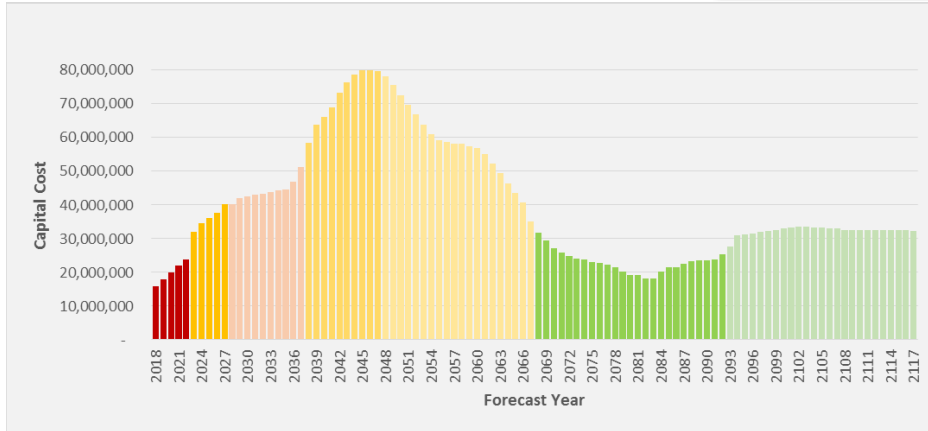
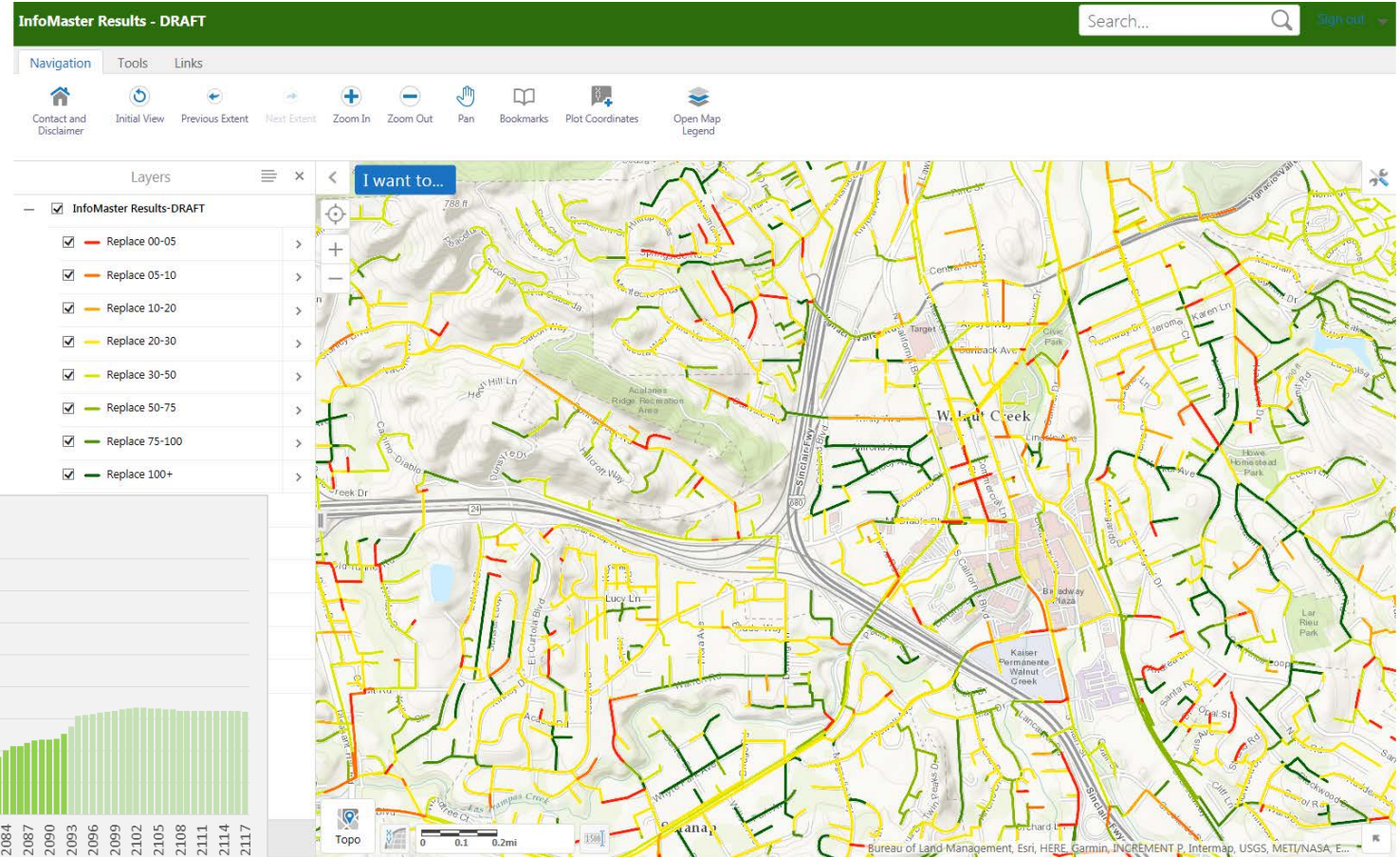
- Hydraulic Model**
 - Capacity
 - Blockages/Overflows
- Critical Facilities**
 - Hospitals, Schools, Etc.
 - Industry
- GIS Reference Data**
 - Population Density
 - Street Paving
- Community Impacts**
 - Traffic Disruption
 - Community Relations
- Environmental Impacts**
 - Proximity to creeks and water bodies

Risk Class	Example Capital Action
Extreme	High Priority in CIP / Yearly Operational Frequency
High	Standard Priority in CIP / Biannual Operational Frequency
Medium	Low Priority in CIP / 1 in 5 Years Operational Frequency
Low	1 in 10 Years Operational Frequency
Negligible	Wait for a problem to arise

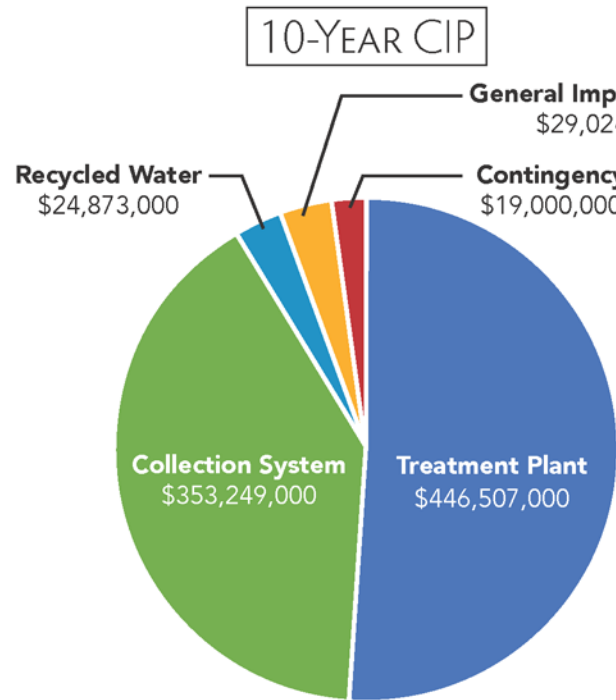


Risk-Based, Long-Term Collection System Capital Improvement Prioritization

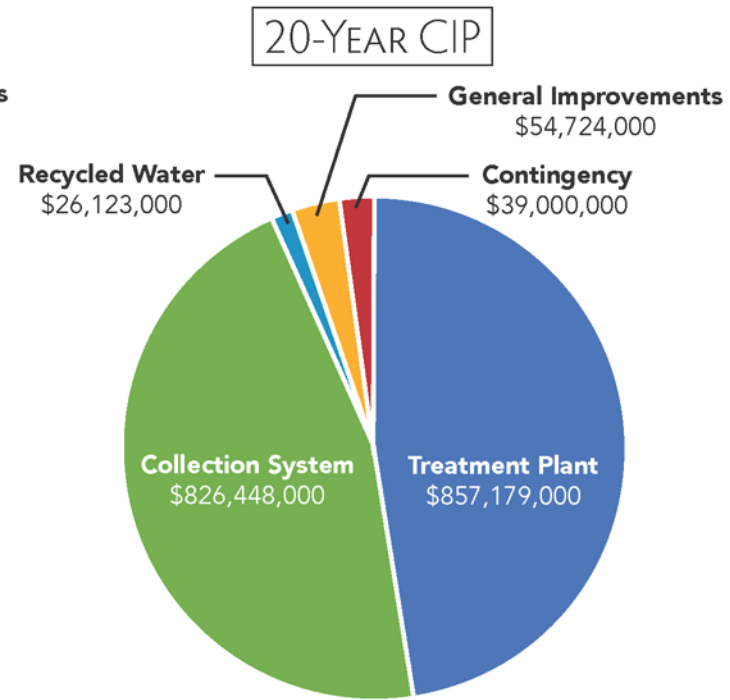
Period	Cost (\$M)	Mileage
0-5 Years	\$99	38
5-10 Years	\$180	42
10-20 Years	\$441	184
20-30 Years	\$724	281
30-50 Years	\$1,156	403
50-75 Years	\$575	206
75-100 Years	\$808	276



Comprehensive Wastewater Master Plan



Total 10-year CIP \$872,653,000



Total 20-year CIP \$1,803,474,000

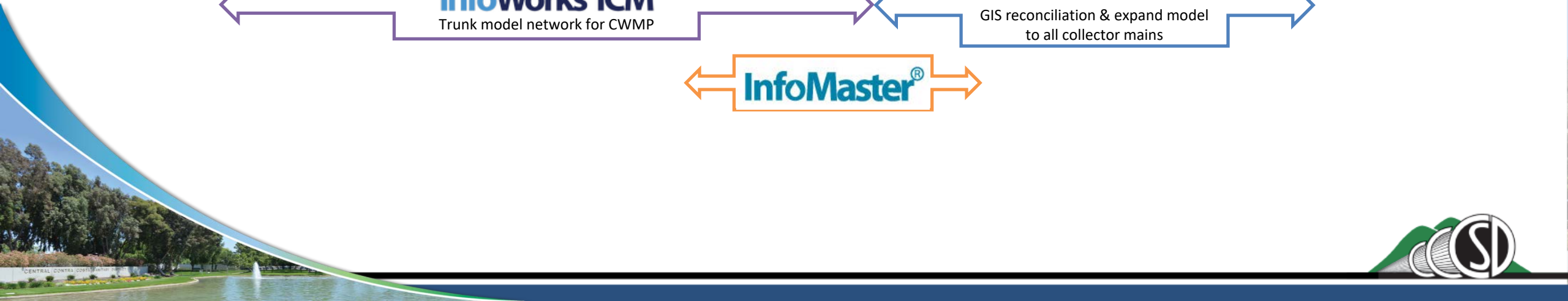
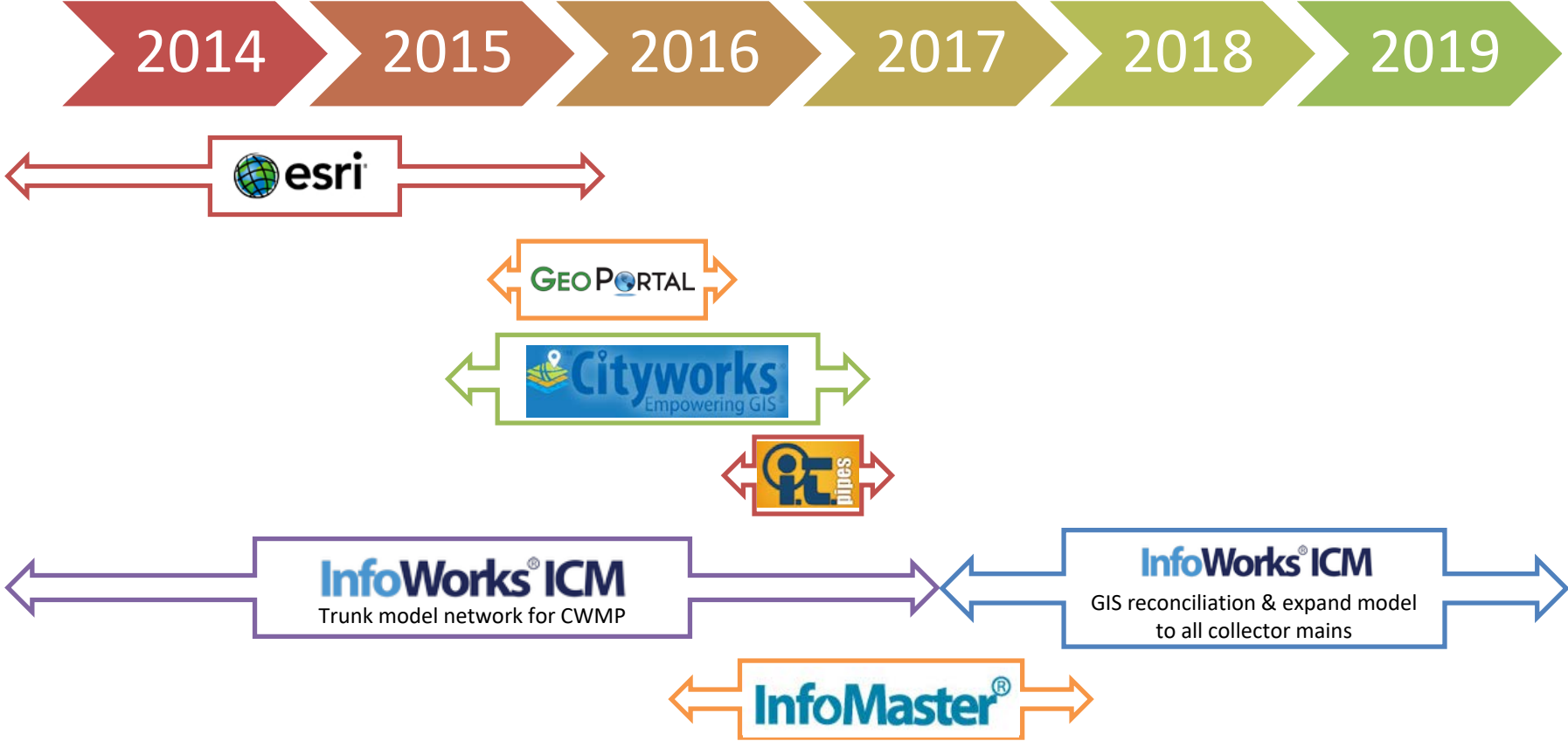


What Should Our GIS-Centric Operation Look Like?

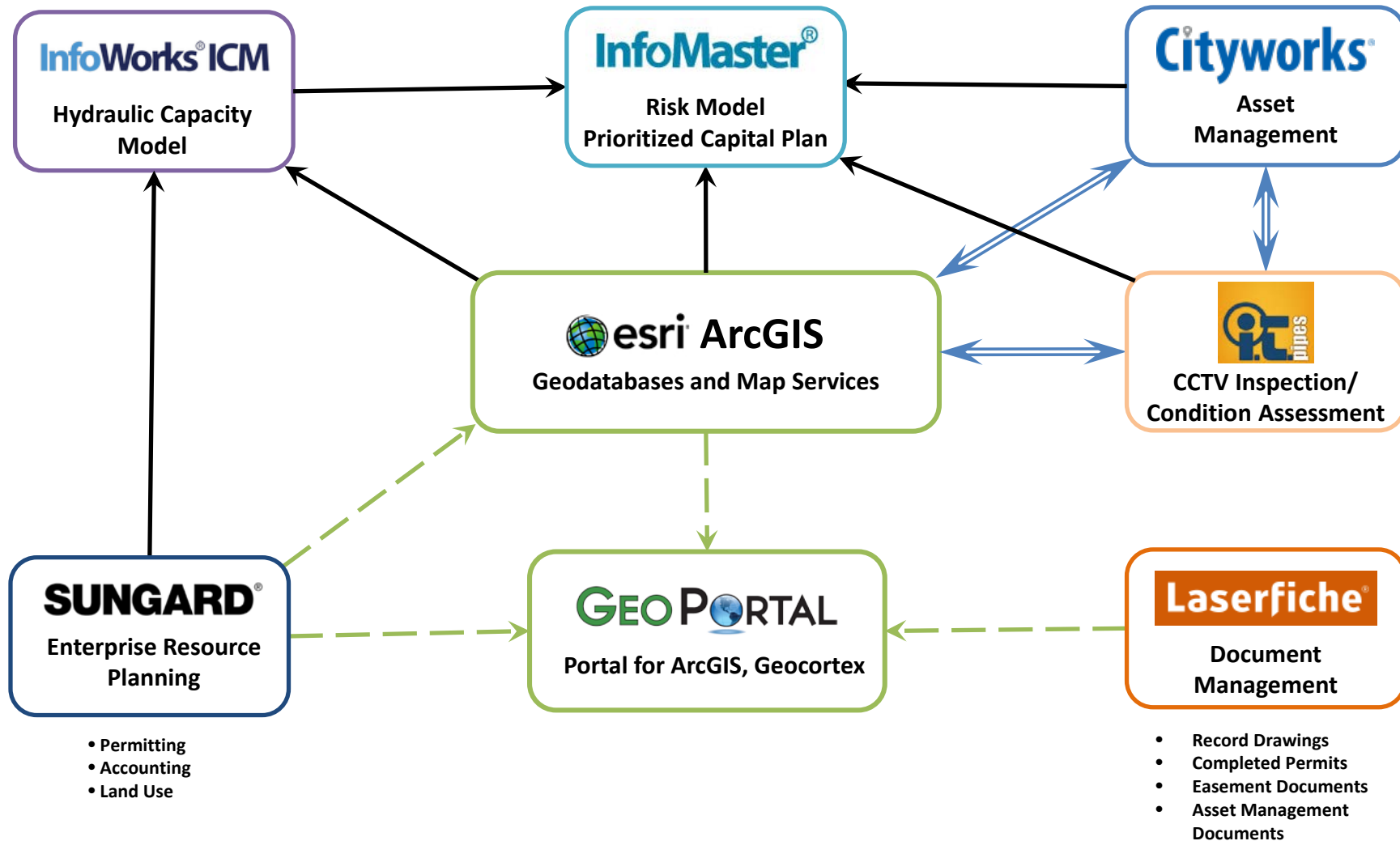
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- ✓ **Enable risk-based long-term asset management**



Implementation Timeline



GIS-Centric Asset Management



Summary

- Central San has become more effective and resilient by implementing
 - A modern, robust GIS leveraging the Esri ArcGIS platform,
 - A highly available and accessible GIS-centric AMS combining Cityworks, ITpipes, and other work management systems
 - A dynamic hydraulic capacity model using InfoWorks ICM[®]
 - A risk-based long-term capital improvement planning system using InfoMaster[®]
- All of which helped in developing our 20-year CWMP and continuing to responsibly manage our assets



Thank you!



- Contact Information:
Carl Von Stetten
Email: cvonstetten@centralsan.org
Web: <http://www.centralsan.org>
Twitter: [@cfvonner](https://twitter.com/cfvonner)
Spatial Community Slack Team:
[https://thespatialcommunity.slack.com/](https://thespatialcommunity.slack.com/signup)
signup: <http://thespatialcommunity.org/>
- More information on our 20-Year CWMP:
 - <http://bit.ly/CentralSanCWMP>

