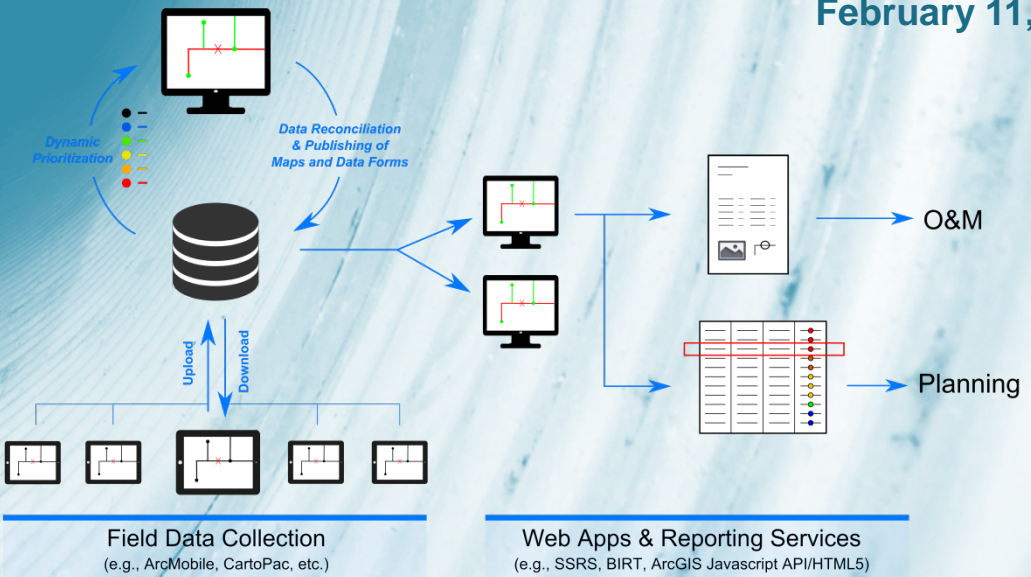


From O&M to Capital Planning

Designing a Workflow for the Utility Data Lifecycle



Database and Server Administration
(e.g., ArcGIS Desktop & Server)



Bryan Blaisdell, PE, CFM
James Garza, GISP

ESRI Water Conference
February 11, 2015

Overview

- Experience & Background
- Data Maintenance Best Practices
 - Data Evaluation
 - Geospatial Rules
 - Database Management
 - Mobile Solutions
- Risk-Based Asset Management
 - Dynamic Prioritization Model
 - Reporting for O&M and Capital Planning
- Lessons Learned



Background & Experience

FROM O&M TO CAPITAL PLANNING

Our Experience

- In the Field

- Surveys & Condition Assessments (PACP)
- Inspections by Professional Engineers
- Flow Monitoring / I&I Investigation
- Pole Camera / Remote 360° HD Panoramas
- Dye/Smoke Testing



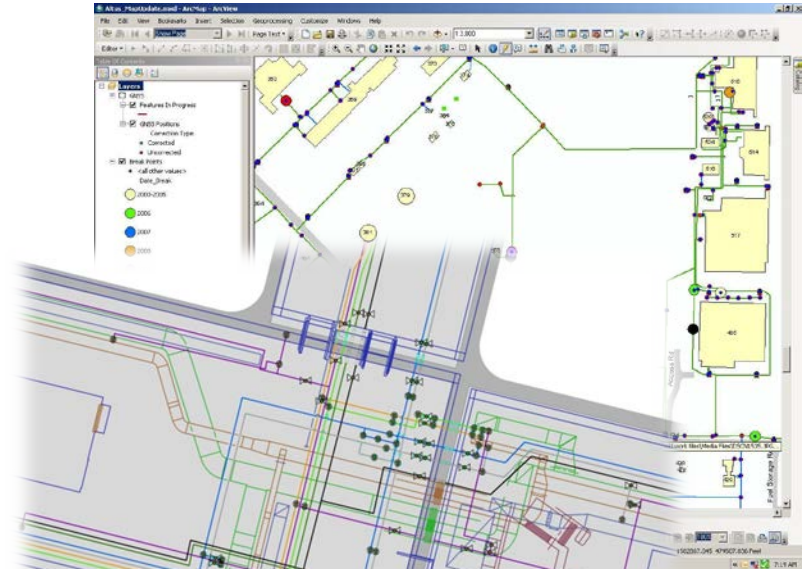
- In the Office

- ArcGIS / ArcServer Support
- SQL, ORACLE Database Administration
- Mobile Solutions & Application Development
- Water/Wastewater Design & Modeling



Recent Projects

- Drinking Water System
 - 10 Air Force Bases across multiple states (AL, CO, FL, MS, OK, TX)
- Sanitary Sewer System
 - 12 Air Force Bases across multiple states (AL, AZ, CO, IL, MS, OK, TX)
- Storm Sewer System
 - Assessment, Mapping, Hydraulic Modeling. Pacific Air Forces, Japan.
- Pilot Project 2011
 - Pacific Air Force at Joint Base Elmendorf-Richardson, Alaska
 - Water
 - Sanitary Sewer
 - Storm Sewer
 - Electrical
 - Airfield Pavements
 - Roadway Pavements



Background and Challenges

- Aging Infrastructure
- Scattered/Outdated information
- Fiscal Tightening
- Need for Improved Capital Planning
- Client-Specific Challenges
 - Mission Critical
 - Security/Functionality Risks
 - Age of Systems
 - Ownership
 - Migration



Data Maintenance Best Practices

FROM O&M TO CAPITAL PLANNING

Issues and Project Scope

- Environmental Compliance
- Prioritization of Investment

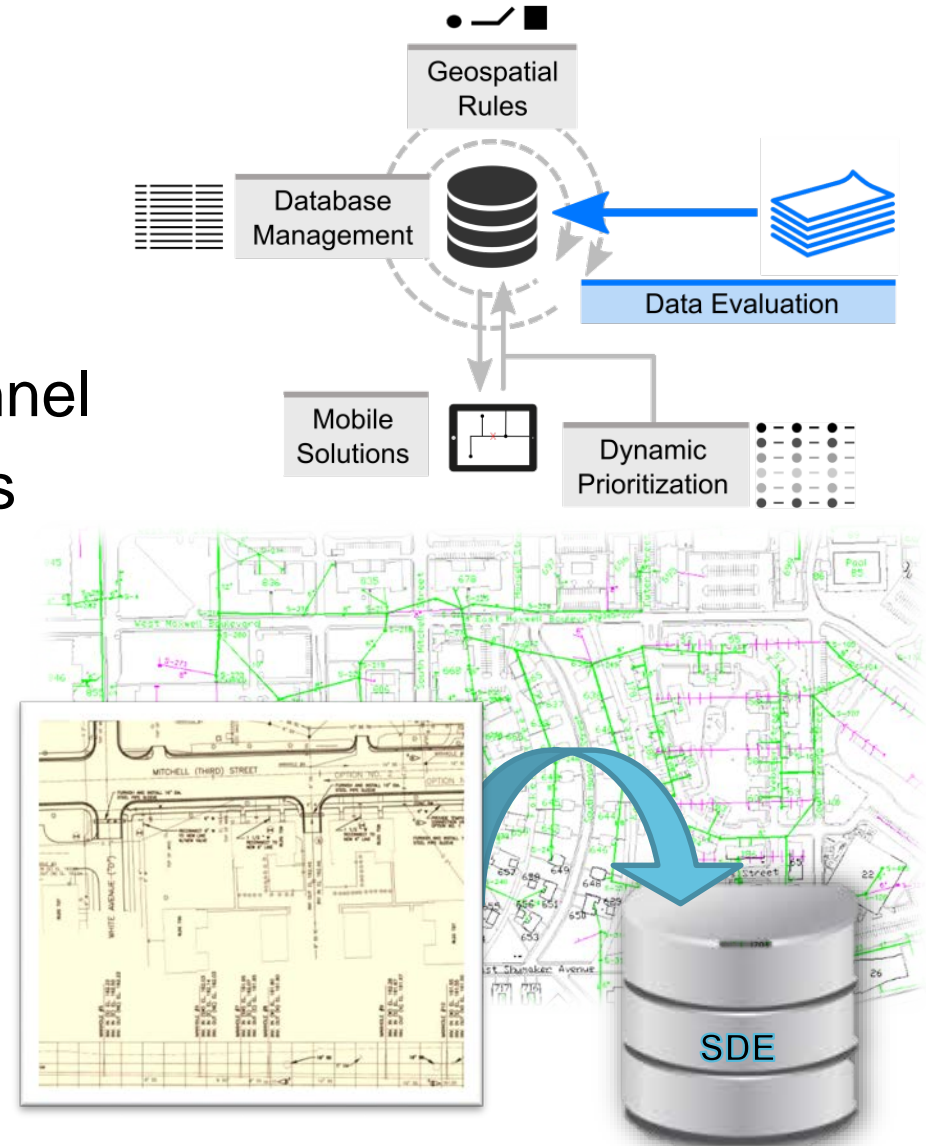


-
- Centralize / Standardize Database
 - Accurate Assessment
 - Data Collection
 - Asset Validation / Connectivity
 - Data Gap Analysis / Update Attribution
 - Asset Management Tools



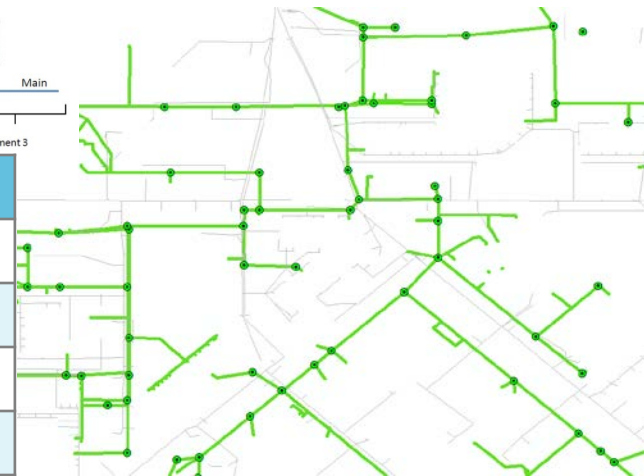
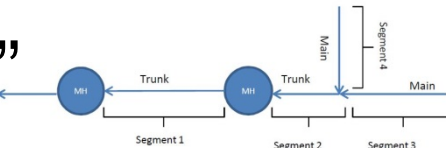
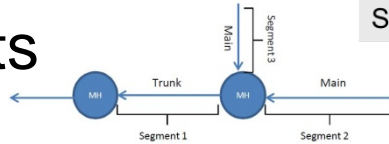
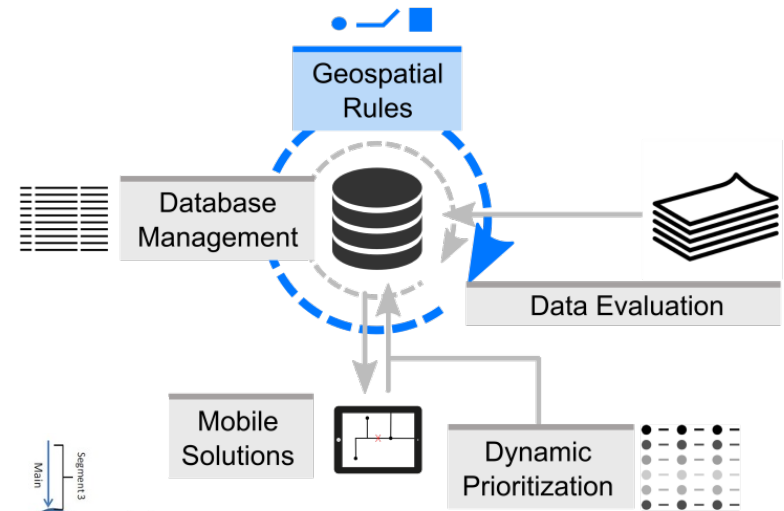
Data Evaluation

- Working Inventory
 - Existing “Data Health”
 - Reports / Logs
 - Interviews with Personnel
 - CAD / Transformations
 - Employ Spatial/Table Tools
 - Duplicates
 - Delete Vertices / Polylines
 - Flatten Z-Data
 - Domain checks
 - Script Conversions



Geospatial Rules

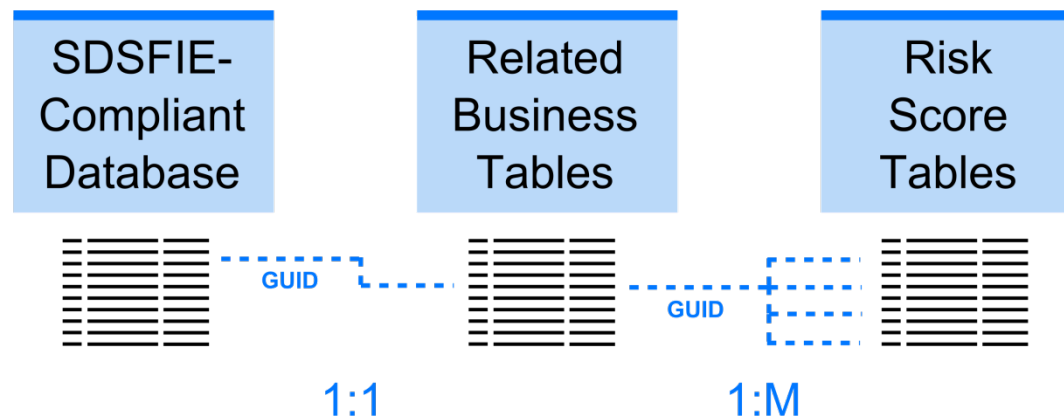
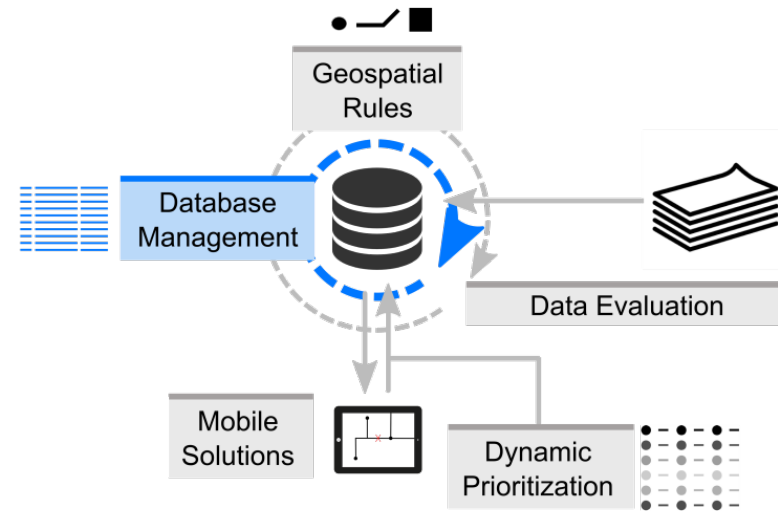
- Linear segmentation
 - Manual Inspection
 - Business Rules
- Geometric Networking
 - Connectivity / Weights
 - Model Refinement
- “Super-Segmentation”



Domain Display Value	SSID	Score
No noticeable defects	PK05236	0
Minor deterioration	PK05498	4
Severe deterioration	PK04236	10
Severe deterioration	PK04237	10

Database Management

- SDSFIE compatibility
- Relationships, domains
- Business tables
 - Criteria
 - Survey Components
- Version control

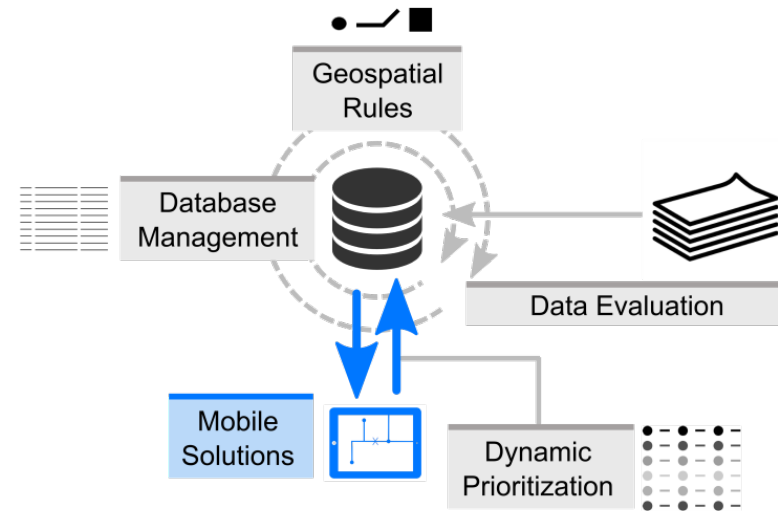


Mobile Solutions

• CartoPac Mobile



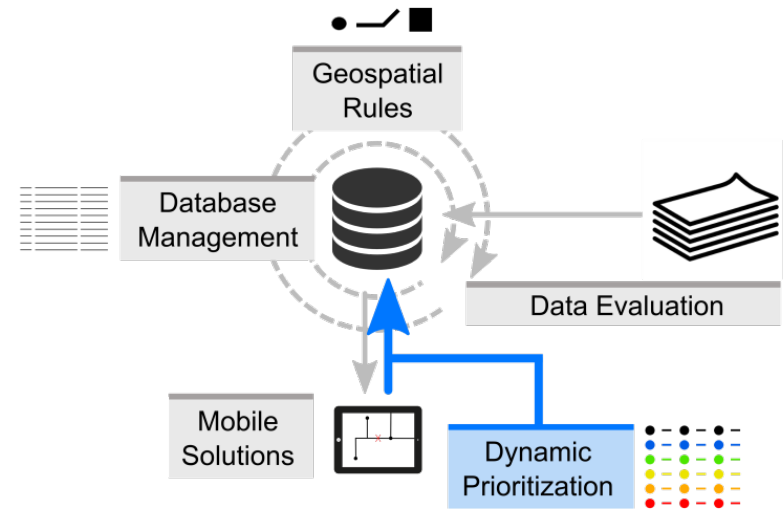
- Minimal learning curve
- Dynamic forms
- Data validation
- Direct connection to SDE



• CartoPac Server and Studio

The screenshot shows the CartoPac Studio interface. On the left is the 'Forms Explorer' tree view showing a hierarchy of forms: Water > Structure > QVGA - Portrait > Devices > Facility Inspection > Facility Inspection. The main area is 'Form Preview' for 'CartoPacCE', showing a 'Facility Inspection' form with a table containing columns 'BldgNum', 'SurveyDate', and 'SurveyorID'. On the right is the 'Properties' panel with sections for Behavior, Data, Display, and Forms.

Section	Property	Value
Behavior	Optional	False
	Save value even when disabled	False
	Allow Create	True
	Allow Offset Create	False
	Allow Delete	True
	Enable RFID Reader Mode	False
	Enable Barcode Reader Mode	False
Data	Record Source	CurrentRecord
	Source Table Key Field	BUILDINGNUMBER
	Enable Cable Locator Mode	False
Display	Mode	OneToMany
	Label	Facility Inspection:
	Use attribute alias as label	False
Forms	Label Buttons	False
	Multiline Label	False
	Label Buttons	False



Risk-Based Asset Management

FROM O&M TO CAPITAL PLANNING

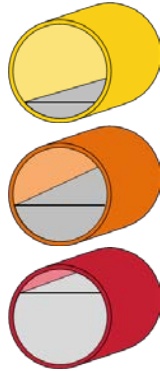
Types of Risk

- Two modes of failure

Operational

Example Criteria

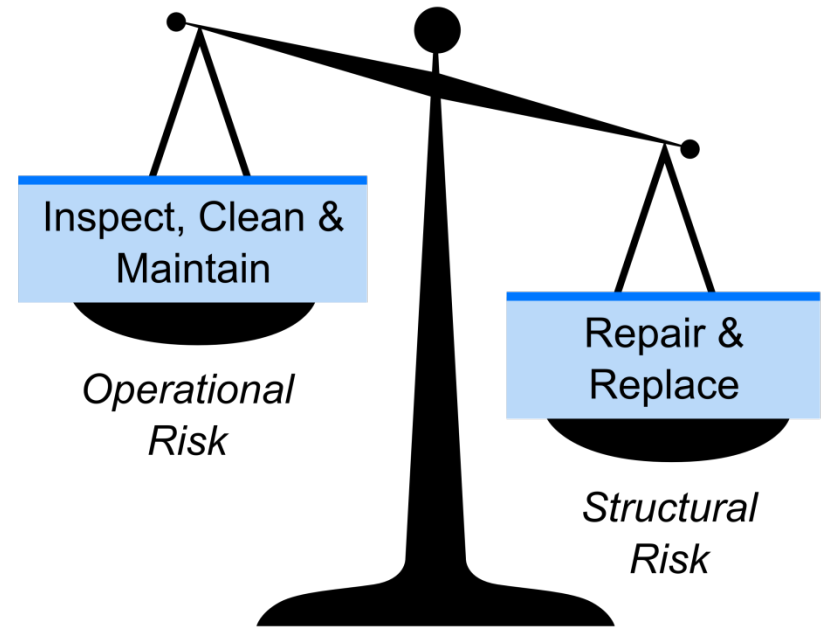
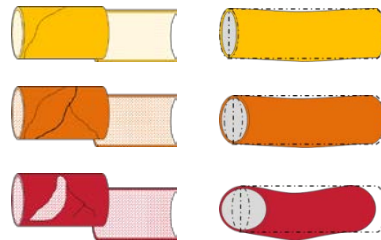
Sediment build-up
SSO history
Level of inflow/infiltration
Evidence of surcharge
Fats, oils, & grease



Structural

Example Criteria

Breaks & cracks
Deformation & sag
Remaining service life
Condition of
mechanical and/or
electrical parts (if any)



Prioritization Model

Risk is a function of

Condition & Context



Likelihood of Failure
(Probability)



Consequence of Failure
(Criticality)



Risk
Score

- Systematic
- Logical
- Data Driven
- Repeatable

Probability of Failure	Consequence of Failure				
	Low	→	Medium	→	High
Low	Negligible	Negligible	Low	Low	Moderate
↓	Negligible	Low	Low	Moderate	Moderate
Medium	Low	Low	Moderate	Moderate	High
↓	Low	Moderate	Moderate	High	Extreme
High	Moderate	Moderate	High	Extreme	Extreme

Prioritization Model Criteria

Likelihood of Failure (Probability) \times Consequence of Failure (Criticality) $=$ Risk Score

	Likelihood of Failure (Probability)	Consequence of Failure (Criticality)
Determination	Field observations Asset / Work order history	Utility network analysis
Criteria	Age of asset Prior failures Observed condition Capacity limitations Local environment	Critical facilities served Size of service area Load on infrastructure
Benchmarks	Industry standards Environmental regulations	Contingency plans Federal & state law

Weighted Scoring Values

Manhole Probability Criteria

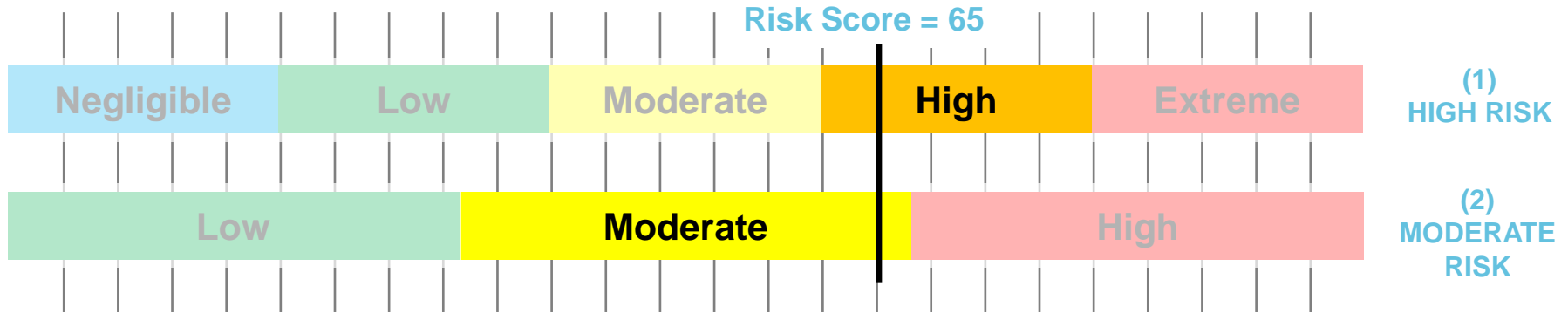
Probability Criteria	Weighting
Chimney Condition	15%
Barrel Condition	15%
Bench Condition	15%
Evidence of Infiltration	15%
Frame/Cover Condition	10%
Remaining Life Expectancy	10%
Evidence of Surcharge	5%

Chimney Condition Attribute Scoring

Domain Display Value	Stored Value	Score
No noticeable defects	NO_DEFECTS	0
Minor deterioration	MINOR_DET	4
Moderate deterioration	MOD_DET	7
Severe deterioration	SEV_DET	10
No chimney	NO_CHIMNEY	-
No cone	NO_CONE	-
Not Applicable/AIP/NA	NA	-

Risk Classification

Different inputs yield different results!

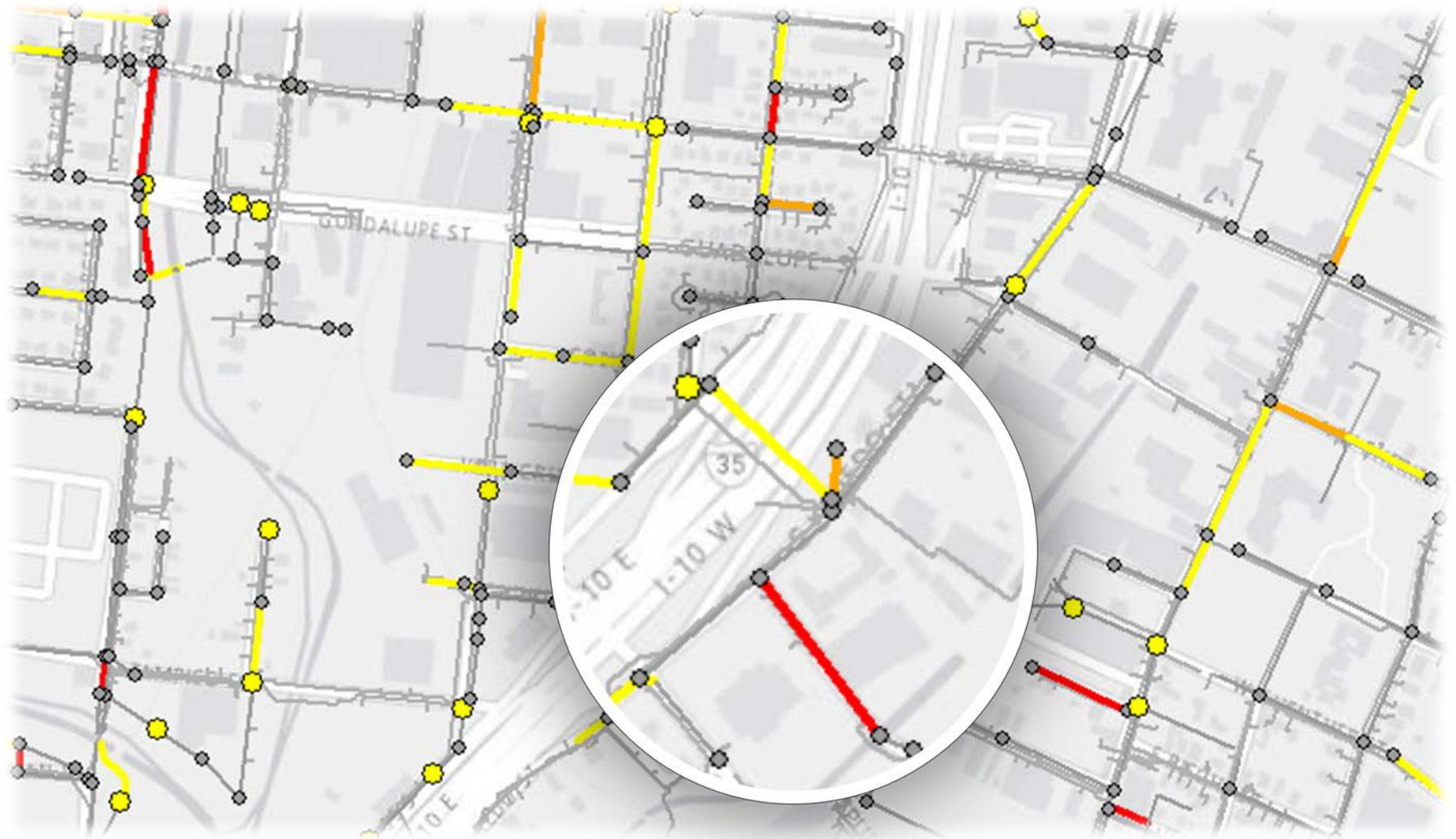


- Encourages objective assessment
- Calibrated using field and engineering judgment
- Fully customizable based on client needs

Risk Score Actions

	Risk Category	Complete Data	Incomplete Data
Reactive	Extreme	Immediately repair/replace	Immediately perform necessary inspections to determine true condition and potential for failure
	High	Repair/replace within 2 to 5 years	Immediately perform necessary inspections to determine true condition and potential for failure
Proactive	Moderate	Schedule detailed inspection & evaluation at minimum 5 year intervals.	Schedule detailed inspection & evaluation at minimum 5 year intervals.
	Low	Normal inspection schedule.	Normal inspection schedule
Minimal	Negligible	Normal inspection schedule.	Normal inspection schedule

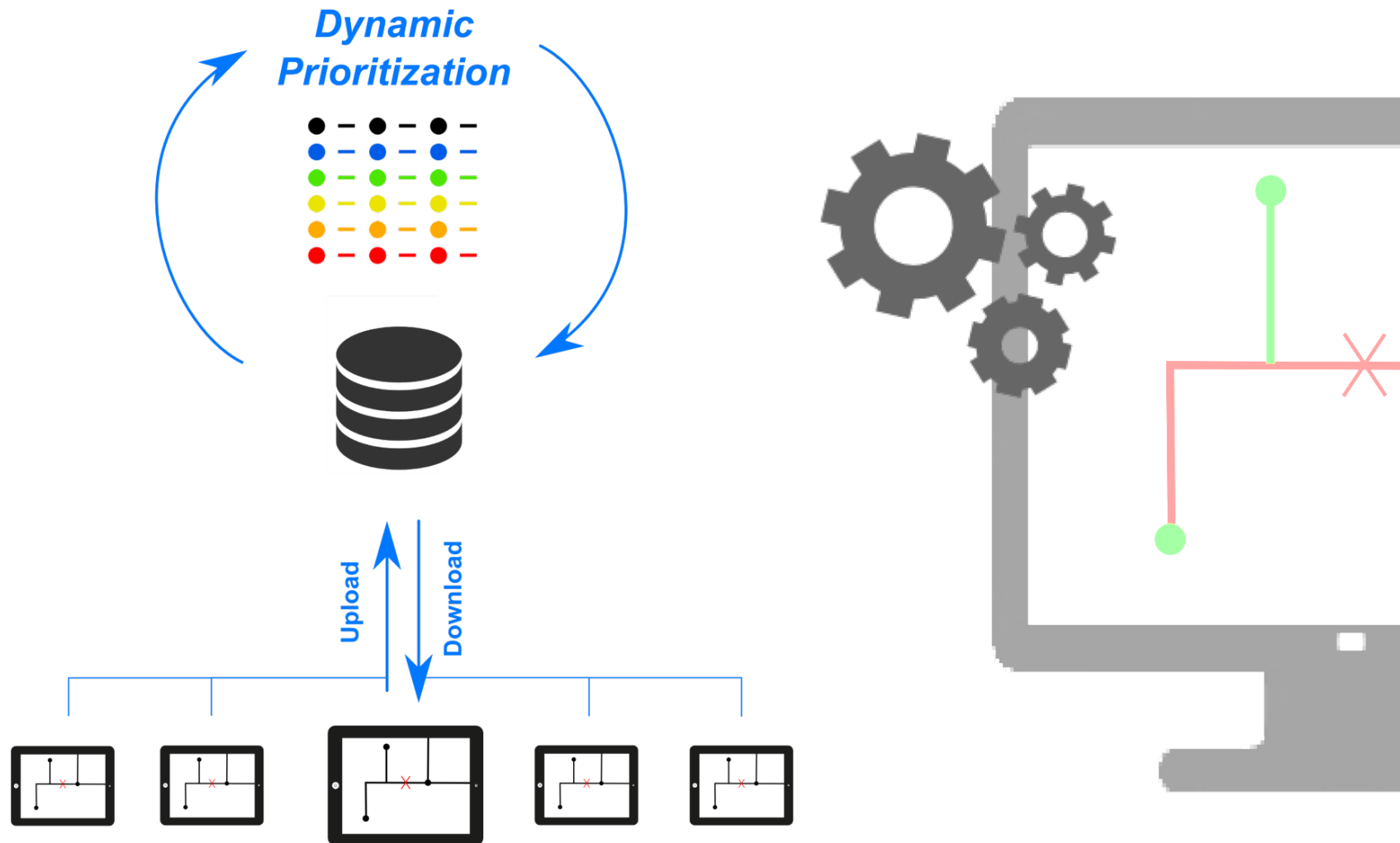
Risk Mapping



“Priority”-Based Scoring

- Which factors are the most important to overall utility system operations?
- Evaluating priorities
 - Purpose and usefulness of data
 - Ease and cost of data collection
 - Critical areas and facilities
 - Regulatory requirements
 - Opportunities to combine future projects

Prioritization as a Dynamic Tool



Asset Condition Indicators

Manholes

(R&R) Structural Assessment

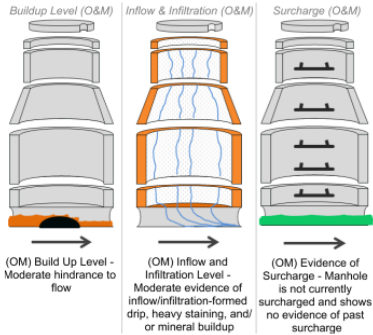


(RR) Chimney Condition - Minor deterioration -isolated hairline cracks
(RR) Cone Condition - Severe deterioration-loose aggregate or breakthrough(s)

(RR) Barrel Condition - No noticeable defects



(RR) Bench Condition - Moderate deterioration-multiple cracks >1/16th inch



(OM) Build Up Level - Moderate hindrance to flow

(OM) Inflow and Infiltration Level - Moderate evidence of inflow/infiltration-formed drip, heavy staining, and/or mineral buildup

(OM) Evidence of Surcharging - Manhole is not currently surcharged and shows no evidence of past surcharge

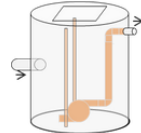
Lift Stations

Electrical (R&R)



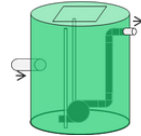
Fair - Rare to occasional power outages or breaker trips; minimal panel corrosion; alarm(s) can't be heard/seen from street

Mechanical (R&R)



Fair - Pumps, guiderails, valves, piping, and supports have little deterioration; minimal noise, heat or vibration; fair maintenance history; minimal piping leaks

Structural (R&R)



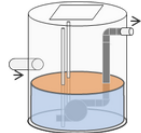
Good - Structure FRP, steel, or concrete protected with corrosion resistant coating; little to no deterioration

Chain Corrosion (O&M)



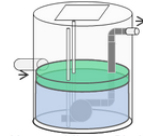
Minor/moderate rust or other corrosion

F.O.G. (O&M)



Moderate-Water Surface Less than 50% Visible

Build-Up (O&M)



None to Minor - Sludge buildup <5% depth of final compartment

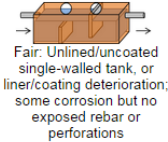
Pretreatment Devices

Electrical (R&R)



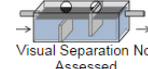
No electrical or mechanical components

Structural (R&R)



Fair: Unlined/uncoated single-walled tank, or liner/coating deterioration; some corrosion but no exposed rebar or perforations

Separation (R&R)



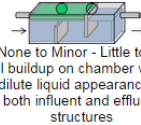
Visual Separation Not Assessed

Permit Exceedence (O&M)



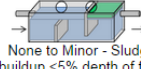
Permits Exceedences Not Assessed

Excess Oil (O&M)



None to Minor - Little to no oil buildup on chamber walls, dilute liquid appearance in both influent and effluent structures

Solid Build-Up (O&M)



None to Minor - Sludge buildup <5% depth of final compartment

Pipes

Breaks, Cracks, Corrosion (R&R)



Breaks / Corrosion Moderate - Multiple Cracks, Wall Displacement, and/or Some Corrosion

Deformation (R&R)



Deformation Moderate - Moderate deflection and/or deformed cross-section

Build-Up Level (O&M)



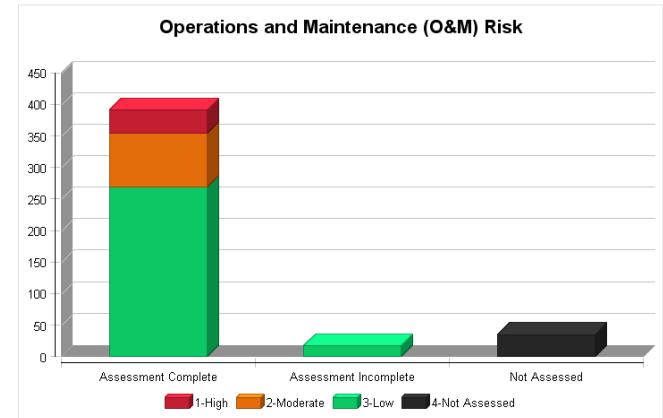
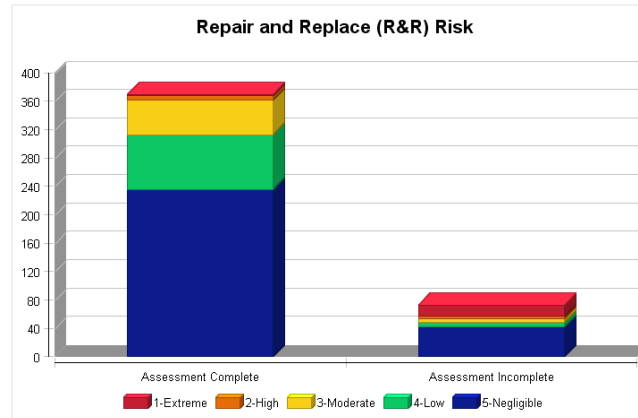
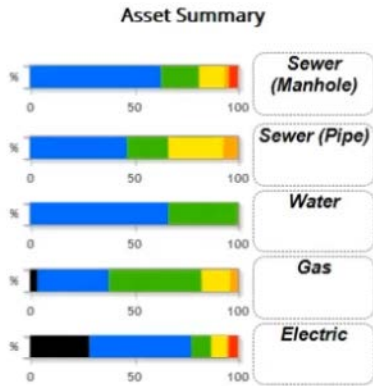
Build-up Level Minor - Little to no buildup, no hindrance to flow

Root Intrusion



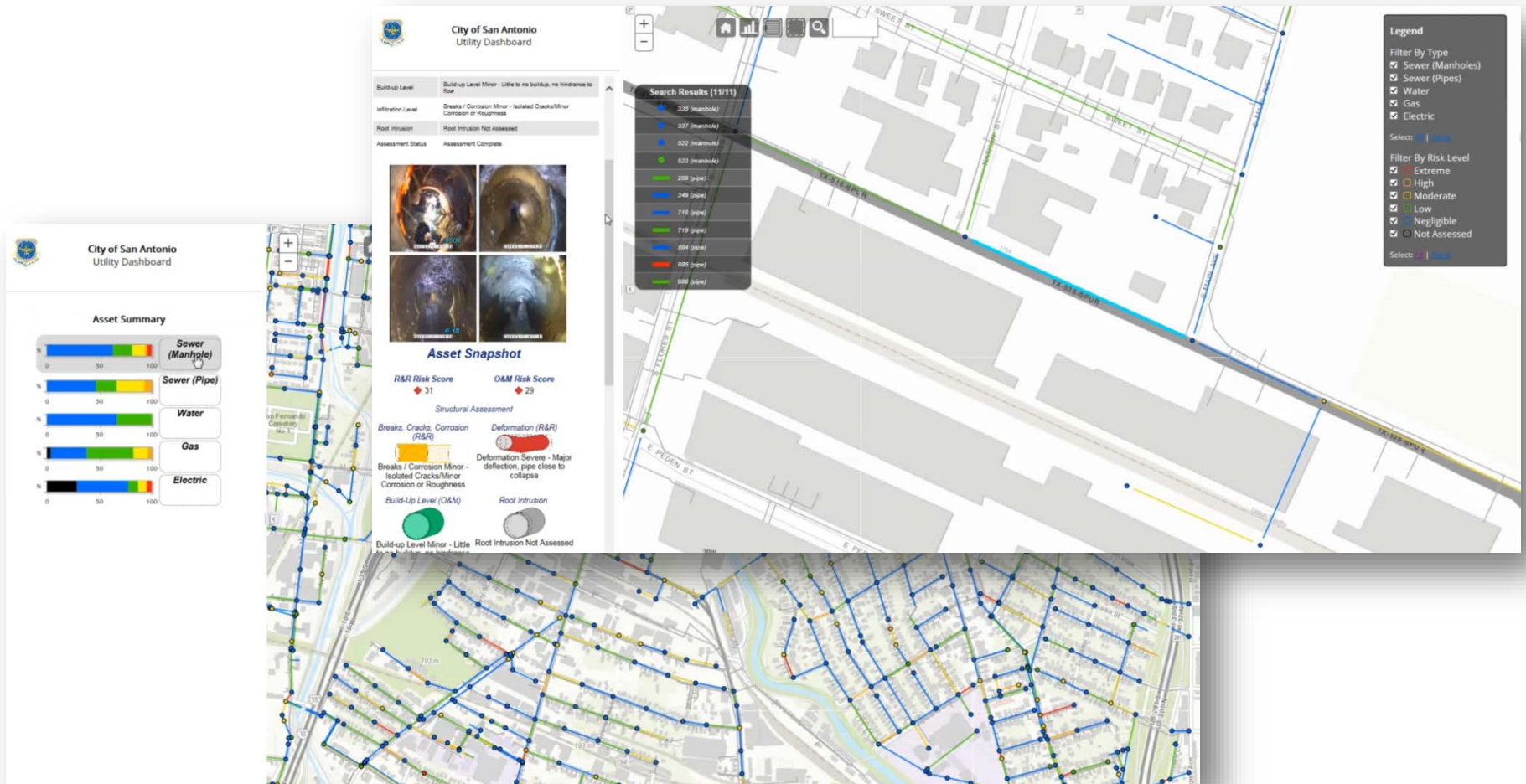
Root Intrusion None - No root intrusion observed NONE

Reporting Tools



Repair and Replace (R&R) PAN Score	R&R Data Completion	Operations and Maintenance (O&M) PAN Score	O&M Data Completion	Criticality Component (CC) Score	R&R Failure Probability Score	O&M Failure Probability Score
65	Assessment Incomplete	7	Assessment Incomplete	65	100	10
53	Assessment Incomplete	0	Not Assessed	53	100	0
41	Assessment Complete	13	Assessment Complete	45	91	28
37	Assessment Incomplete	0	Not Assessed	37	100	0
35	Assessment Incomplete	4	Assessment Incomplete	35	100	10
35	Assessment Incomplete	0	Not Assessed	35	100	0
35	Assessment Incomplete	0	Not Assessed	35	100	0
35	Assessment Incomplete	4	Assessment Incomplete	35	100	10
16	Assessment Complete	33	Assessment Complete	40	40	82
24	Assessment Incomplete	32	Assessment Complete	53	46	61
12	Assessment Incomplete	32	Assessment Complete	47	25	69
11	Assessment Complete	30	Assessment Complete	35	32	86
18	Assessment Incomplete	30	Assessment Complete	52	35	57
28	Assessment Complete	8	Assessment Complete	55	51	14
28	Assessment Incomplete	0	Not Assessed	28	100	0
5	Assessment Complete	27	Assessment Complete	45	10	61
5	Assessment Incomplete	26	Assessment Complete	45	10	57

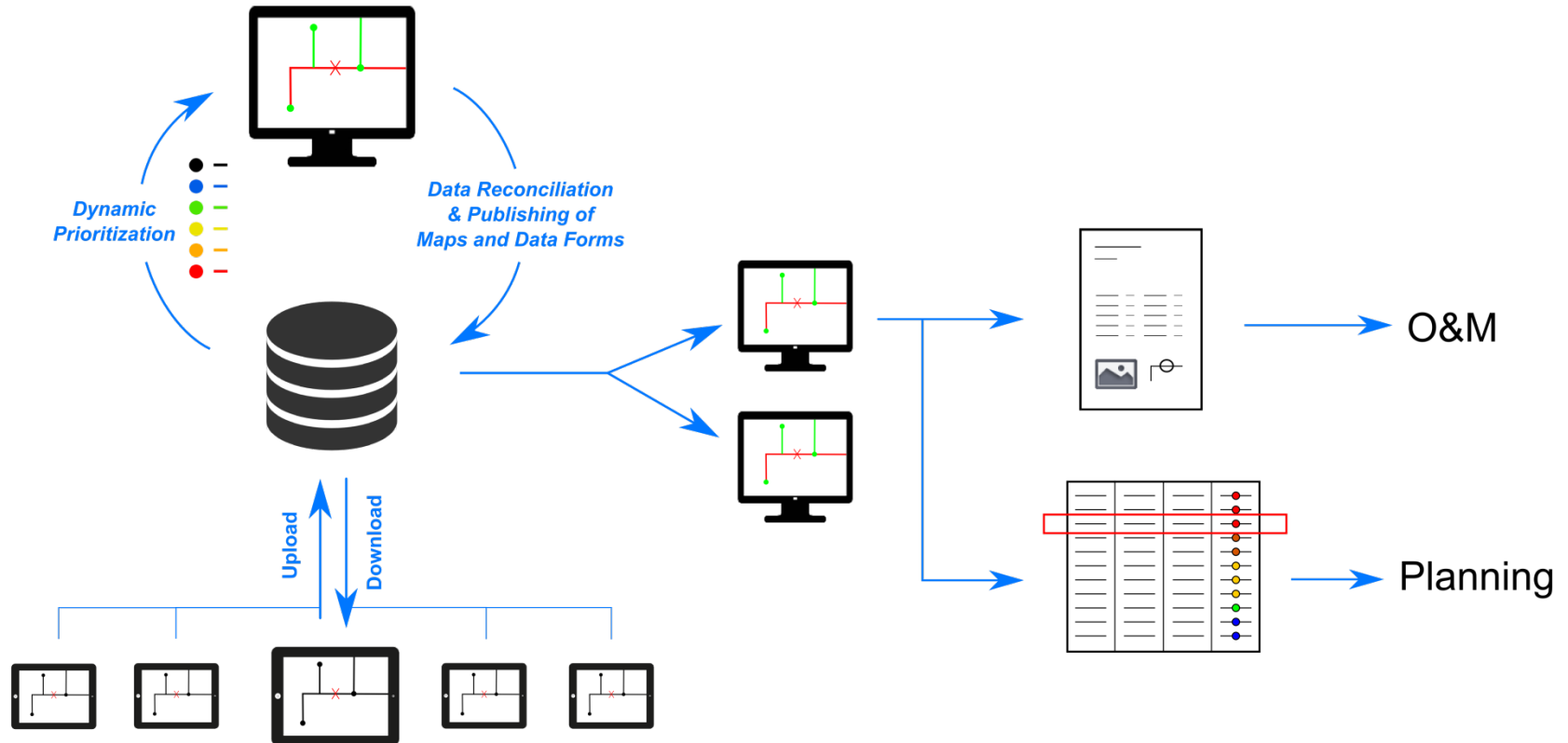
Customized Web Tools



Data Maintenance Lifecycle

Database and Server Administration

(e.g., ArcGIS Desktop & Server)



Field Data Collection

(e.g., ArcMobile, CartoPac, etc.)

Web Apps & Reporting Services

(e.g., SSRS, BIRT, ArcGIS Javascript API/HTML5)

Lessons Learned

- Flexibility and Accessibility
- Maximize use of existing tools
- Efficient reconciliation of field data
- Simplified Scoring Criteria (Usefulness vs. Cost)
- Use of Open-Source Tools and APIs (ArcServer)



Q&A

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