Outlining Technology, Procedures and Research in USA

James H. Anspach, P.G.

ASCE American Society of Civil Engineers

Chair – ASCE Board Committee on Codes & Standards

Chair – ASCE 38-02, "Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data"

Chair – ASCE Construction Institute's (C.I.) Construction Standards Council

Exec Member – ASCE C.I. Education and Research Directorate

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

Principal Investigator:
"Utilities and Highway Design"

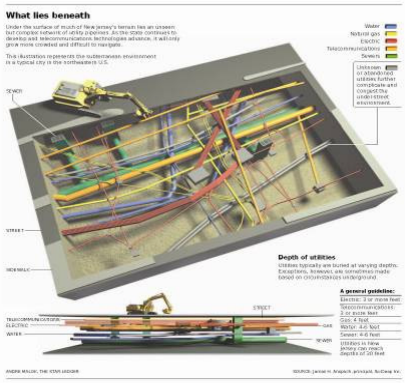
Co-Principal Investigator:
"Innovation in Technologies to Support the Storage, Retrieval, and Utilization of 3-D Utility Location Data in Highway Renewal"

"Encouraging Innovation in Locating and Characterizing Utilities"

Investigator:
"Expanding the Locatable Zone"
"Understanding Key Aspects of DOT / Utility Cooperation"
"Development of a Multi-Platform Locating Tool"

Utility Issues Getting More Attention

- 11 - 20 million miles of underground utilities exist in the U.S.
- Existing utilities are at varied depths, in varied soils, made of different materials, are varied sizes, have varied access
- More utilities are being installed daily, deeper and with less detectable materials
- No one entity in control; hodgepodge of laws, policies, attitudes (e.g. FAA & airports are both major utility owners but often do not share data; state DOTs say big problem is that municipalities do not share utility permit installation data)




How do we typically manage the risks of existing utilities on projects?
# of Projects
Do nothing
High Risk
Do everything
Low Risk
COST
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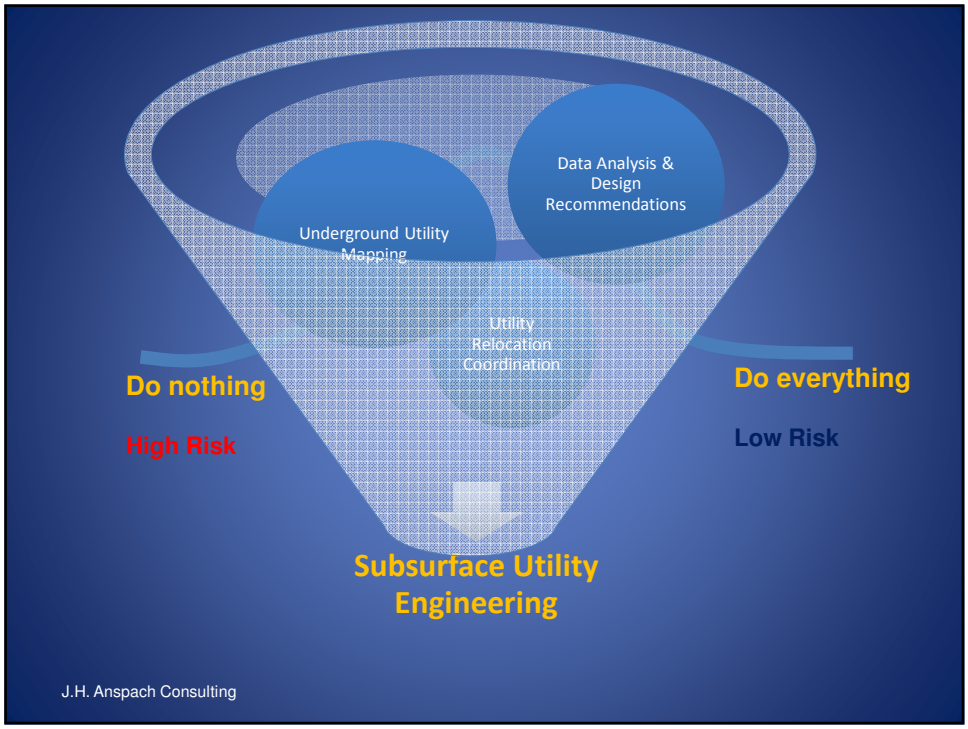
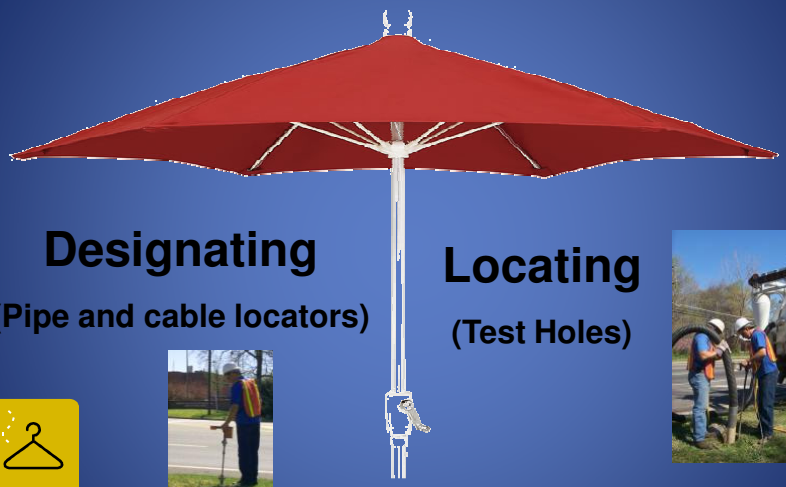

Data Analysis & Design Recommendations
Underground Utility Mapping
Utility Relocation Coordination
Do nothing
High Risk
Do everything
Low Risk
Subsurface Utility Engineering
J.H. Anspach Consulting

Subsurface Utility Engineering



Designating

(Pipe and cable locators)

Locating

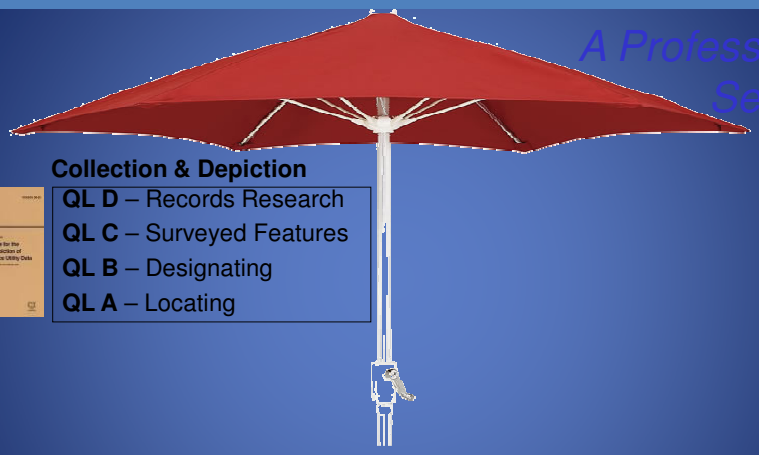
(Test Holes)

Graphics Courtesy of TBE
Pictures Courtesy of So-Deep

THEN (1985)

Subsurface Utility Engineering

A Professional Service



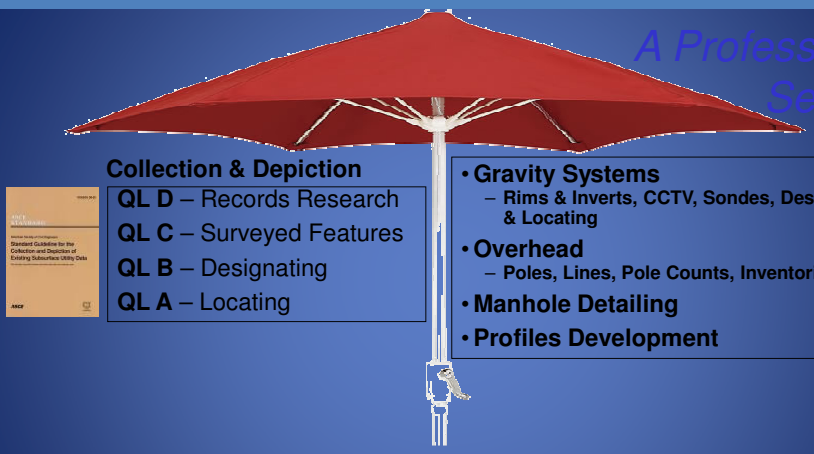
Collection & Depiction

QL D – Records Research
QL C – Surveyed Features
QL B – Designating
QL A – Locating

Today

Subsurface Utility Engineering

A Professional Service



Collection & Depiction

- **QL D** – Records Research
- **QL C** – Surveyed Features
- **QL B** – Designating
- **QL A** – Locating

- **Gravity Systems**
  - Rims & Inverts, CCTV, Sondes, Designating & Locating
- **Overhead**
  - Poles, Lines, Pole Counts, Inventories
- **Manhole Detailing**
- **Profiles Development**

Today

Subsurface Utility Engineering

A Professional Service

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- **Utility Coordination**
  - Conflict Analysis
  - Conflict Resolution
- **Utility Relocation Design**
- **Corridor Planning**
- **Authoring Utility Policies**

Today

Subsurface Utility Engineering

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Collection & Depiction

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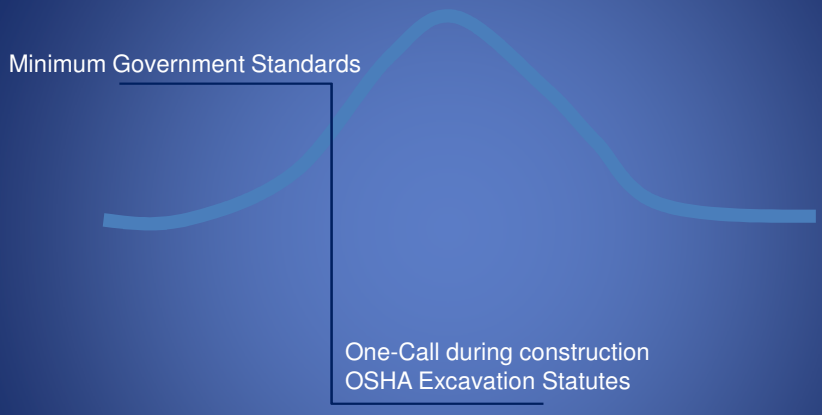
- **Manhole Detailing**
- **Profiles Development**
- **Modern mapping tools**
  - GPR, "3D" Imaging, other new tools
- **Construction Observation & Certified Record Drawings**
- **GIS Database Population**
- **Damage prevention**

Today

Projects with no perceived risk



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Projects thought to have some risk

Sketchy design plans

Utilities, if shown on plans,
plotted from minimal office effort

Contractor calls One-call

Contractor potholes utilities
marked by utility owners

Contractor modifies design in field
Based upon one-call marks and pothole results

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Projects with minimal design may not meet "The Standard Of Care"

- Standard of care is the degree of prudence and caution required of an individual who is under a duty of care
- Engineers and surveyors are under a higher duty of care than an average person
- Measured by peers practices, national industry standards, protecting the public safety

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"Median" practice

Utilities plotted from available records

Utilities in conflict potholed, Design modified if necessary

Contractor calls One-call

Contractor potholes utilities marked by utility owners

Contractor modifies design in field Based upon one-call marks and pothole results

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Increasing levels of risk management for Projects thought to have more risk

Utilities plotted from available records

Designer calls One-Call or Contract Locator

Locator marks surveyed and plotted by designer

Design advanced to 60% or so

Utilities in conflict potholed, Design modified if necessary

Contractor calls One-call

Contractor potholes utilities marked by utility owners

Contractor modifies design in field, based upon one-call marks and pothole results

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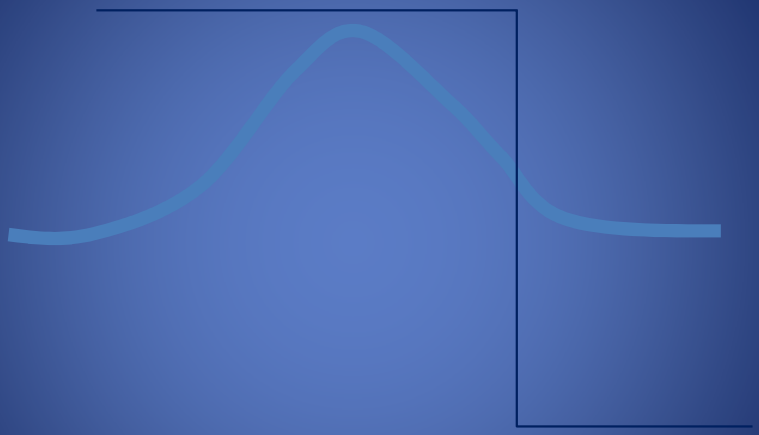
National engineering standard CI/ASCE 38-02



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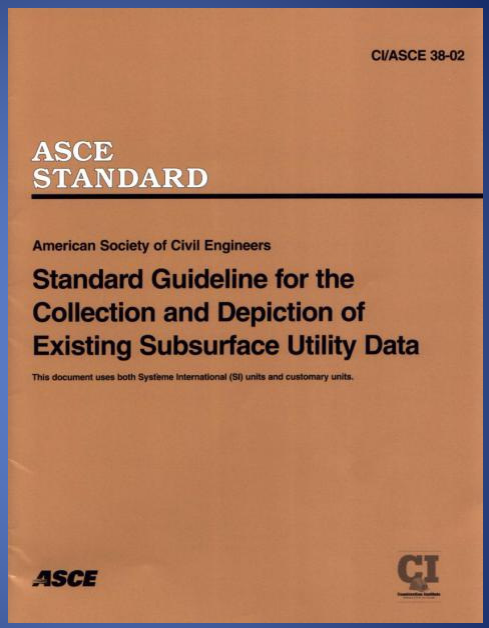
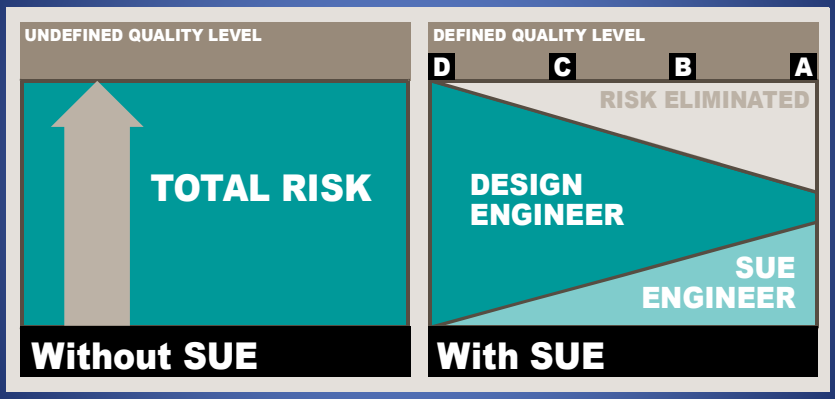
- Outlines specific steps for the engineer / surveyor to take that result in increasingly better utility mapping.
- Utilities as mapped are shown according to their "Utility Quality Level" which allows all parties to make better risk decisions.
- Use of Utility Quality Levels protects engineers and surveyors
- Requires all utility mapping to be performed under the direct responsible charge of a registered professional, experienced in utility issues, surface geophysics, survey, and CAD
- Increasing usage across the country is increasing its importance in cases where standard of care is an issue.



The total risk for the engineering pool decreases
as quality level increases,
While within the engineering pool,
The risks shift towards the subsurface utility engineer
as quality levels trend towards QLA data



TOTAL ENGINEERING RISK POOL

ALLOCATION OF RISK
WITHIN ENGINEERING POOL

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What's Missing?

- Improved Geophysics to see utilities in the ground
- Better Data Management
  - Improved access to authorized parties
  - More timely data
  - Better ways to display and make data useful
- National Utility Data Standards
- Keeping Data Current
  - Better Installation Records
  - Comprehensive Permit management

Imminent Updates to ASCE 38

- GIS deliverables formatting
- Depth data for other than QLA
- Value Studies
- 3-D imaging geophysics

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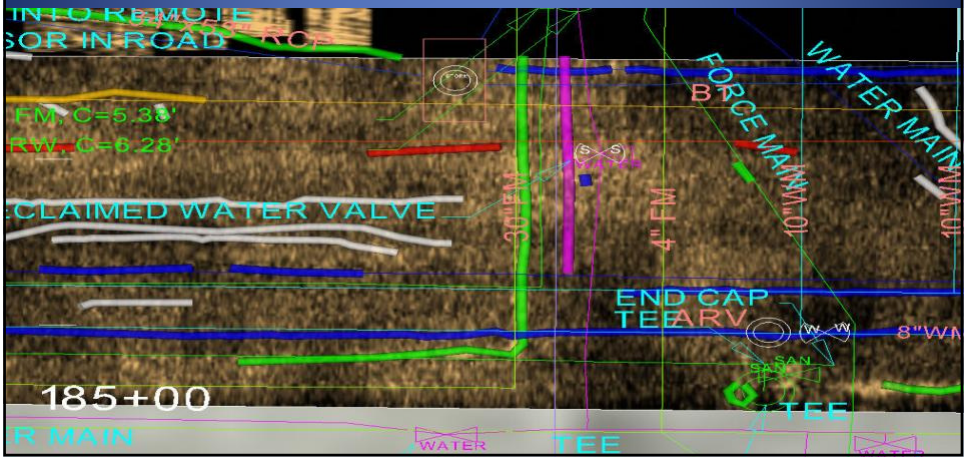
Future Updates to ASCE 38

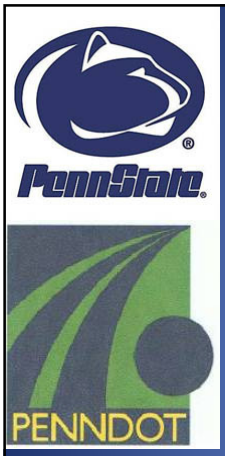
- Attribute and Metadata specifics
- Certified Record Drawing requirements
- 3-D deliverable examples
- Merging of Sensor data to utility databases



ASCE Standards

- Committee of 12 to 50 members
- Must be balanced between "Users," "Producers," and "General Interest – Regulatory"
- Consensus vs. Mandatory
- Committee Balloting / Public Balloting Procedures
- Updates every 5 years
- Can be "licensed" to other countries for their individual modifications (Australia has done this with ASCE 38-02, Canada interested)
- Dr. Nicole Metje added to 38-02 committee as GB Liaison
- 38-02 was the result of approx 10 years of outreach efforts before committee formed

MOST RECENT COST STUDY



2007 Penn State Study for PENNDOT

10 randomly selected projects
Looked at:

- Utility relocation costs
- Utility damage costs
- Emergency restoration costs
- Traffic delay costs
- Business impact costs
- User service costs
- Environmental impact costs
- Information gathering costs (i.e. not using QLs)
- Legal & Litigation Costs
- Efficient design costs

Savings of $22.21 for every $1 spent in upgrading to QL B and QL A as opposed to projects using only QL D or QL C.

Total cost of obtaining QL A / QL B was 0.6 % of project costs.

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DAMAGE PREVENTION RESEARCH

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Phase I Electronic White Line

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Phase I Electronic White Line

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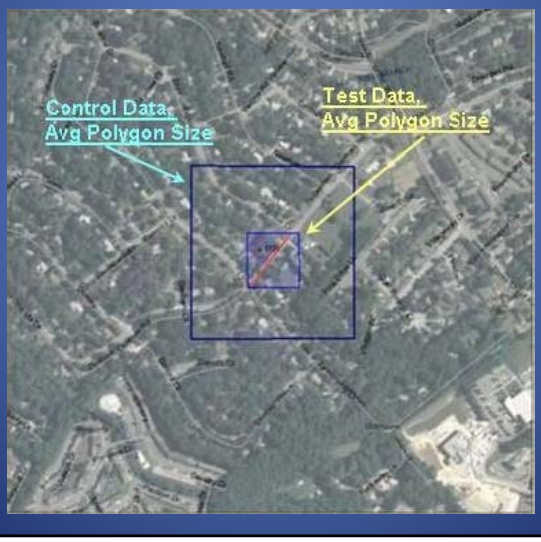
Phase I Metrics – Polygon Size



Phase II Electronic Manifest

- Collection of GPS points of the field locate through the use of a GPS enabled locating instrument
- Overlay the GPS points on VUPS' ortho-photography / land-base. (produced through Sentinel USA)
- Archive the electronic manifest within VUPS' ticket history

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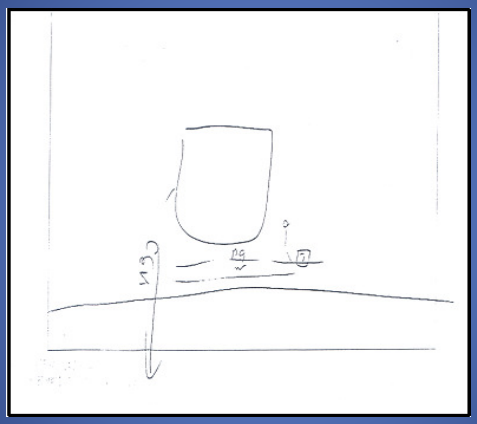
Phase II Electronic Manifest



Current manifest record

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Phase 3

> Objective

– Develop and demonstrate a GPS-based excavation monitoring system

– Phase 3A - Protect against excavators that do not utilize the one-call center or accidently leave the valid ticket area

– Phase 3B - Protect against excavator encroachment

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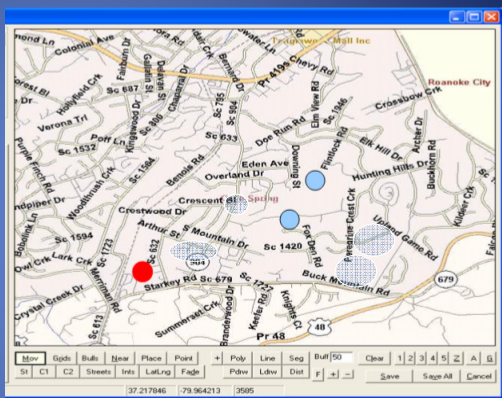
Phase 3A

- GPS Excavation Monitoring
  - Low cost, low accuracy
  - Commercially available
  - Additional benefits



- Portal
  - Central data repository
  - Monitoring software to detect excavation activity that is occurring outside of a valid one-call ticket

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Phase 3A

- Digging Trigger
  - How does the system know when digging is occurring?
  - Retrofit Sensors
    - Motion or pressure sensors
    - Diagnostics
  - Next Generation Equipment

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Phase 3A

- Pilot Project
  - Fall 2009
  - Soliciting participation from excavators
  - Selecting equipment types

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Phase 3B

- GPS grade control system
  - High accuracy, high cost
  - Commercially available
  - Additional benefits
- Real-Time Portal
  - Monitoring software to warn excavator of imminent encroachment
  - Low and high cost options
- GPS-Enabled Locator
  - High accuracy GPS

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Other Research

- See-ahead GPR on Directional Drilling equipment
- Utility Conflict Matrix
- Multi-Sensor Locating Unit
- GPS / GIS data repositories
- Elastic wave plastic pipe detection
- Keyhole technology
- RFID

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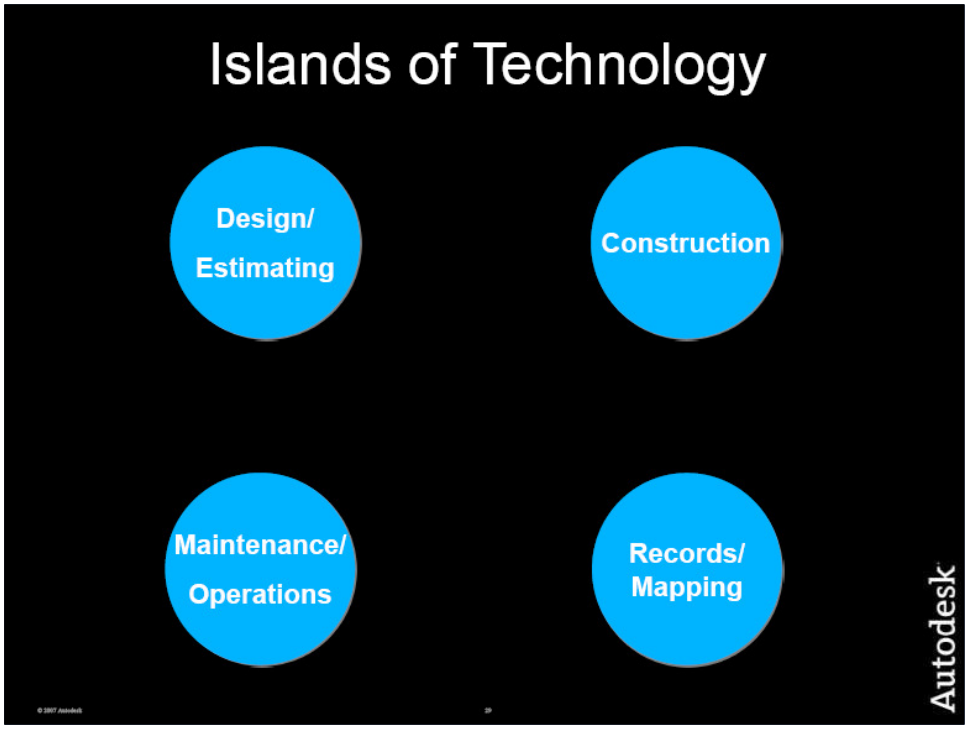
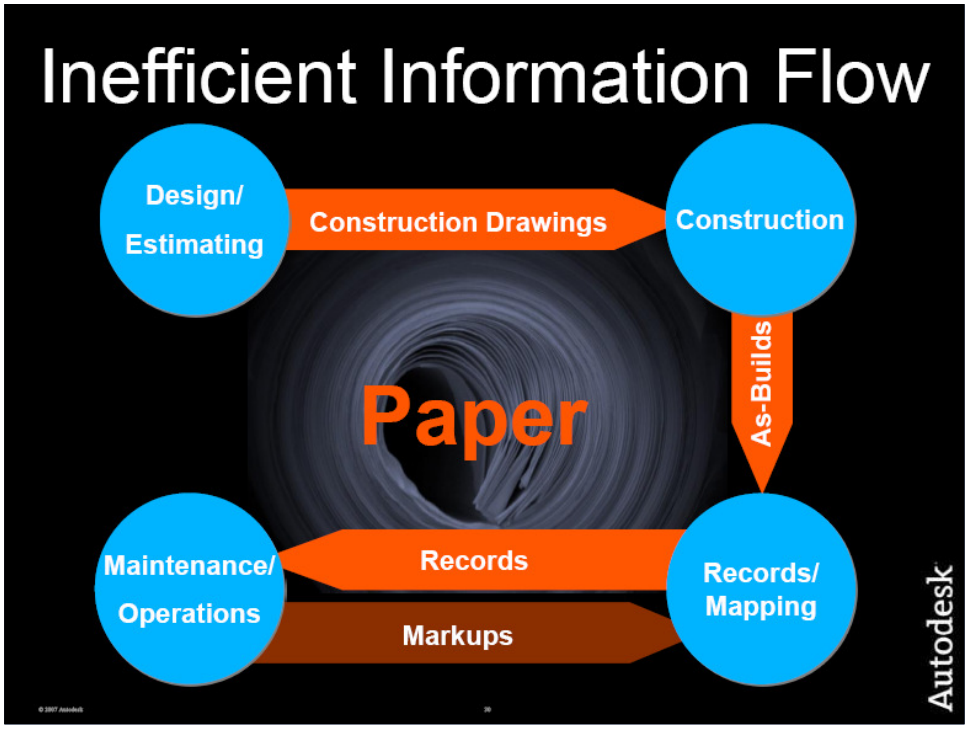
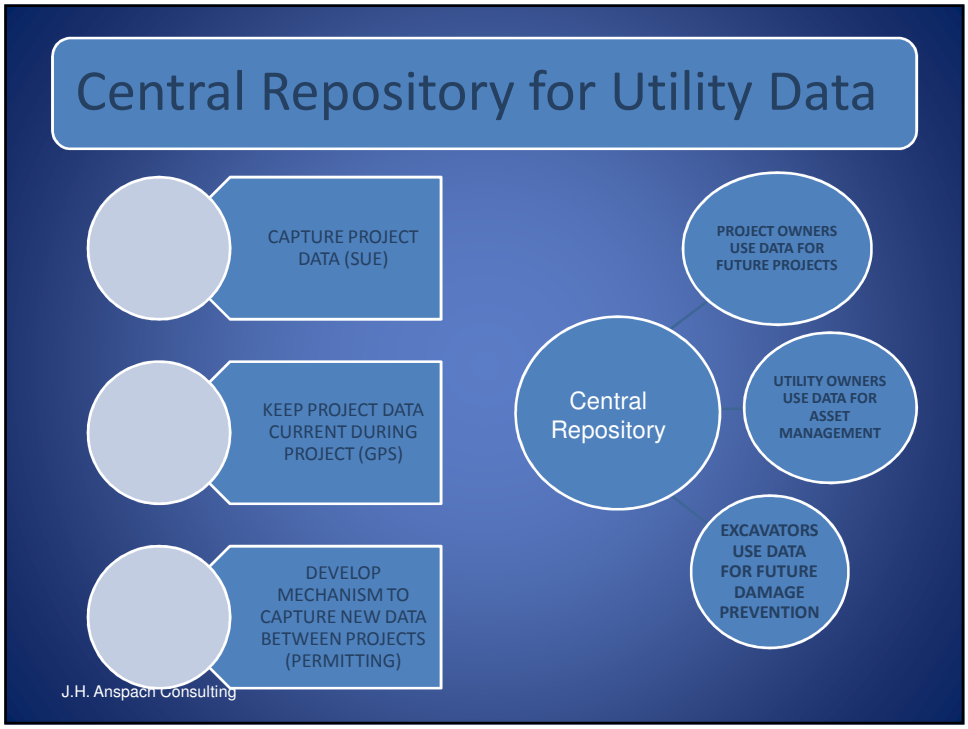
What Does the Future Hold?


Islands of Technology
Design/ Estimating
Construction
Maintenance/ Operations
Records/ Mapping
Autodesk


Inefficient Information Flow
Design/ Estimating
Construction Drawings
Construction
As-Builds
Paper
Maintenance/ Operations
Records
Markups
Records/ Mapping
Autodesk


Central Repository for Utility Data
CAPTURE PROJECT DATA (SUE)
KEEP PROJECT DATA CURRENT DURING PROJECT (GPS)
DEVELOP MECHANISM TO CAPTURE NEW DATA BETWEEN PROJECTS (PERMITTING)
Central Repository
PROJECT OWNERS USE DATA FOR FUTURE PROJECTS
UTILITY OWNERS USE DATA FOR ASSET MANAGEMENT
EXCAVATORS USE DATA FOR FUTURE DAMAGE PREVENTION
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