Verification of Wastewater GIS Utilities and Geometric Networks for Marine Corps Air Station (MCAS) Cherry Point, North Carolina

Project, Process, and Product

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Presentation Outline

- Brief history and description of MCAS Cherry Point

- Brief history and description of GIS at MCAS Cherry Point

- The wastewater system data at MCAS Cherry Point

- Wastewater project goals

- Verification process and product

- Results

- Lessons learned

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History of MCAS Cherry Point

North Carolina

Atlantic Ocean

MCAS Cherry Point

- MCAS Cherry Point opened in 1941

- The Air Station encompasses 26,179 square miles and is equal in size to a small city

Mission: "To provide the highest quality aviation facilities, support, and services to promote readiness, sustainment, and quality of life for Marines, Sailors, civilian Marines, family members and others associated with MCAS Cherry Point."

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History of GIS at MCAS Cherry Point

- GIS program commissioned in 1996

- Housed under the Facilities Directorate

- Has evolved into a highly developed, mature enterprise GIS program serving multiple departments

- All spatial data is GEO*Fidelis* Model compliant based on Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE v.6)

- ESRI shop

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Wastewater Data at MCAS Cherry Point

- Wastewater is managed by FMD

- Existing wastewater data was in various formats at multiple locations

- Cherry Point FSSO was tasked with generating a complete GIS database containing all wastewater feature classes and associated attributes

- Eleven (11) feature classes were identified

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Wastewater Project Goals

- Integrate disparate datasets (CADD, hard copy, GIS) into a complete dataset

- Verify location of existing wastewater features

- Conflate existing attributes

- Establish topology

- Make final dataset SDSFIE compliant

- Enhance quality of data

- Build geometric network and calculate system capacity

- Draft executive summary report
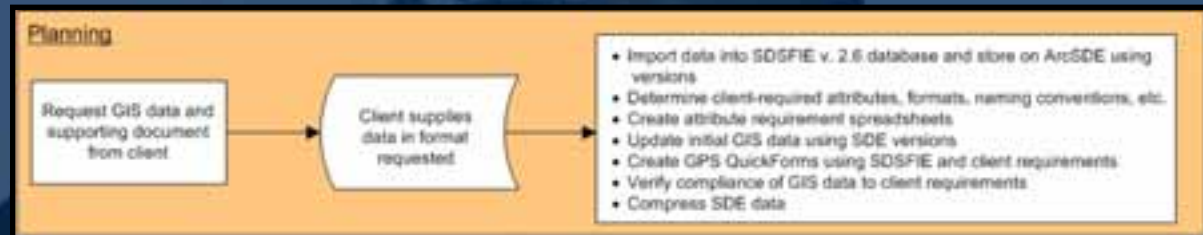
Verification Process and Product

- Research and planning

- Existing data acquisition and integration

- Feature location verification using GPS

- Spatial layer creation

- Geometric network and system capacity

- Quality assurance/quality control
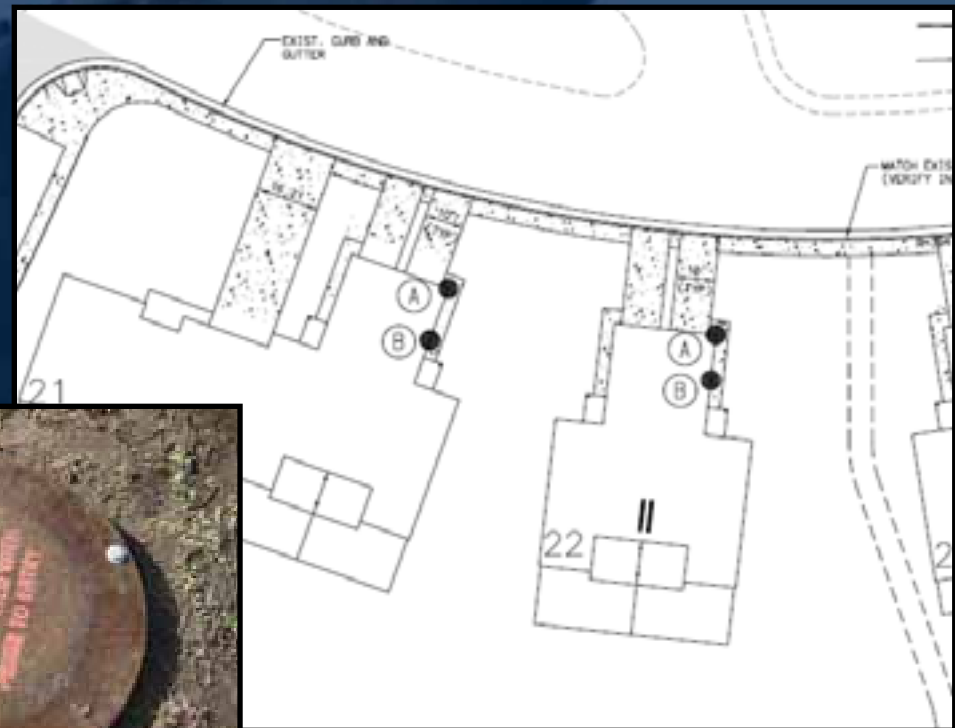
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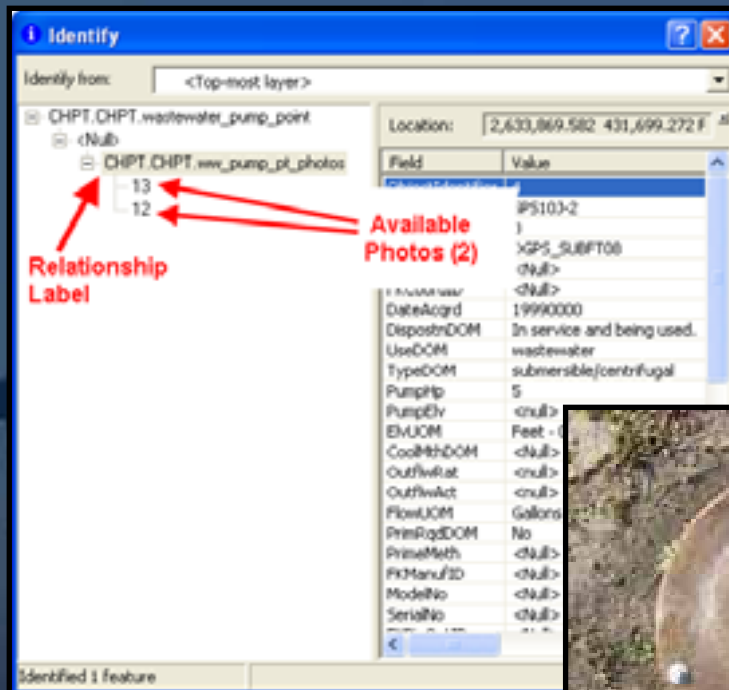
Verification Process and Product

■ **Research & Planning**

- **Meetings with subject matter experts**

- **As-built plan acquisition and review**

- **Non-spatial data**

- **Local knowledge**

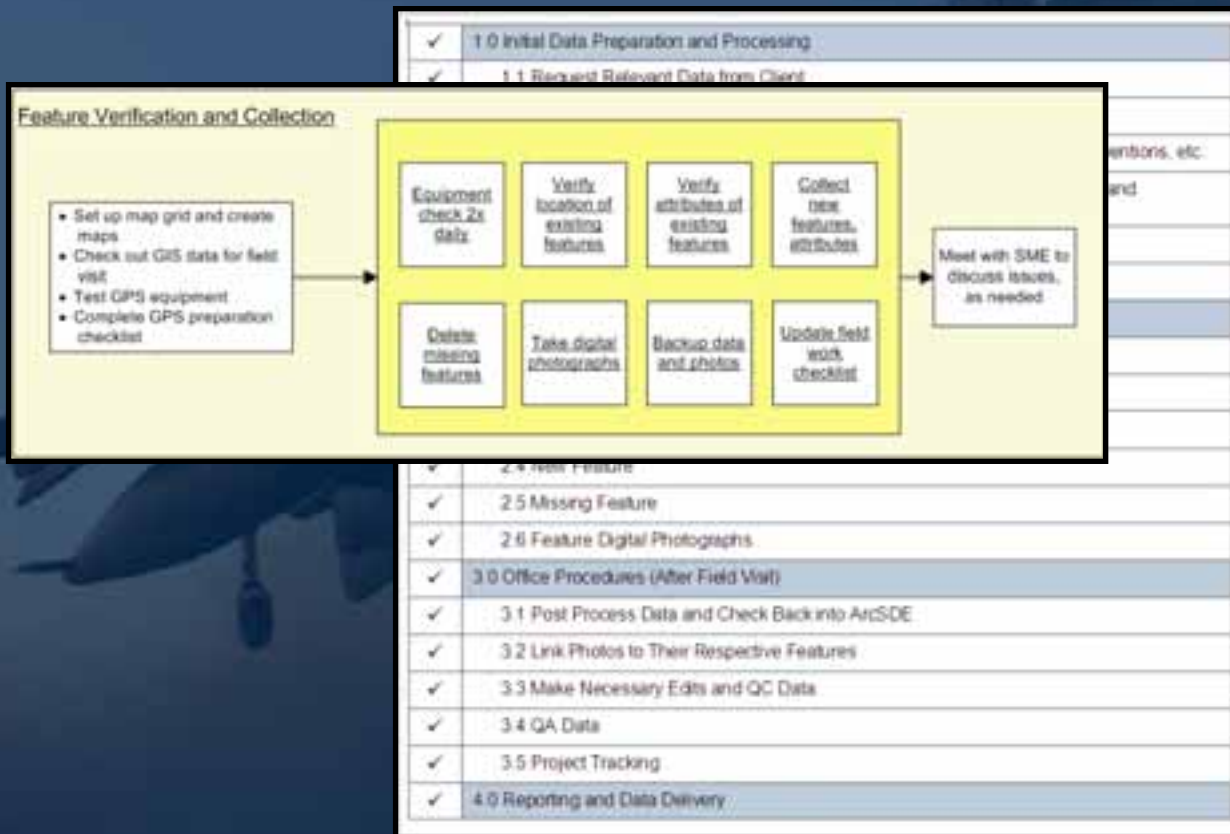## Verification Process and Product

■ **Existing data acquisition and integration**

Verification Process and Product

■ **Feature location verification using GPS**
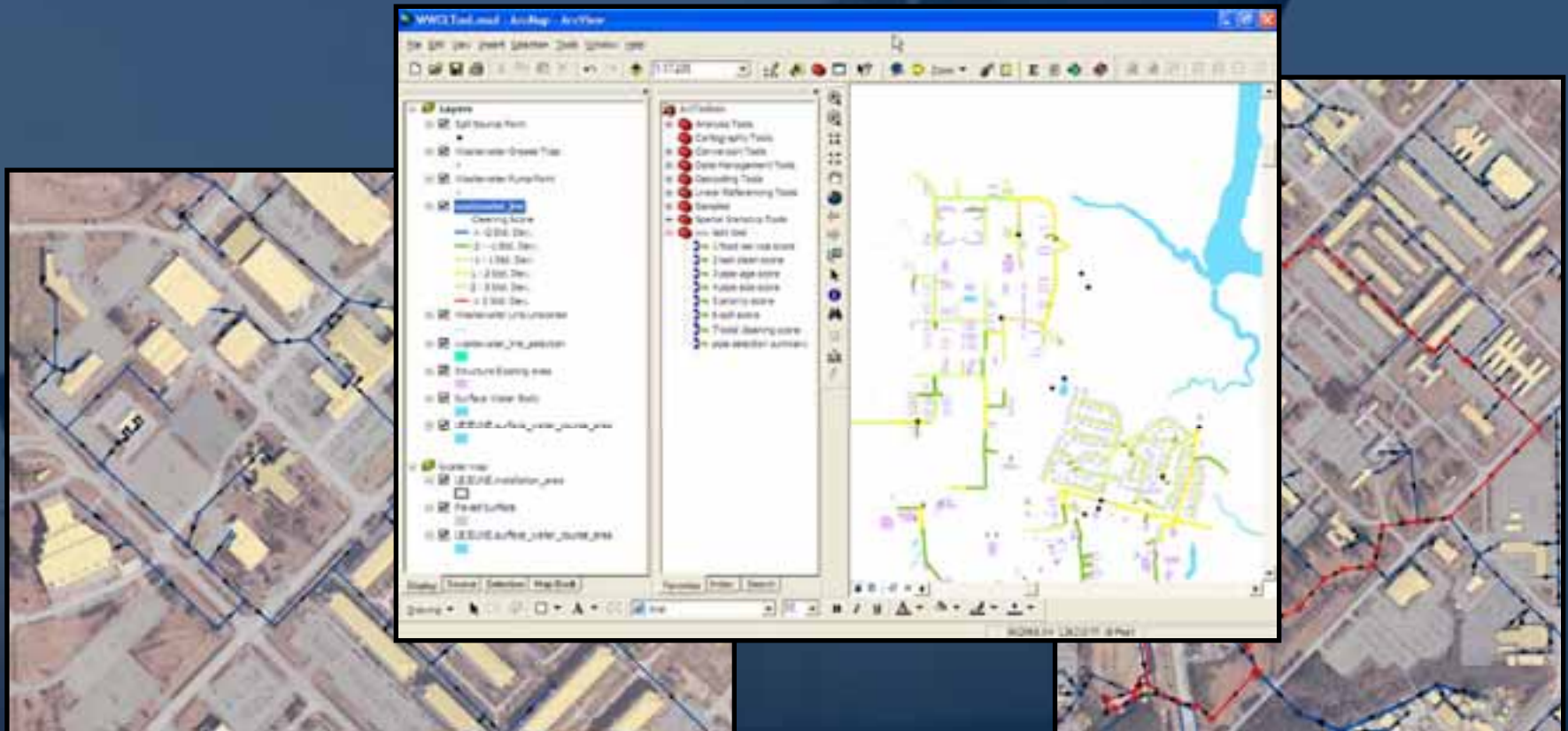
Verification Process and Product

■ Spatial layer creation

Verification Process and Product

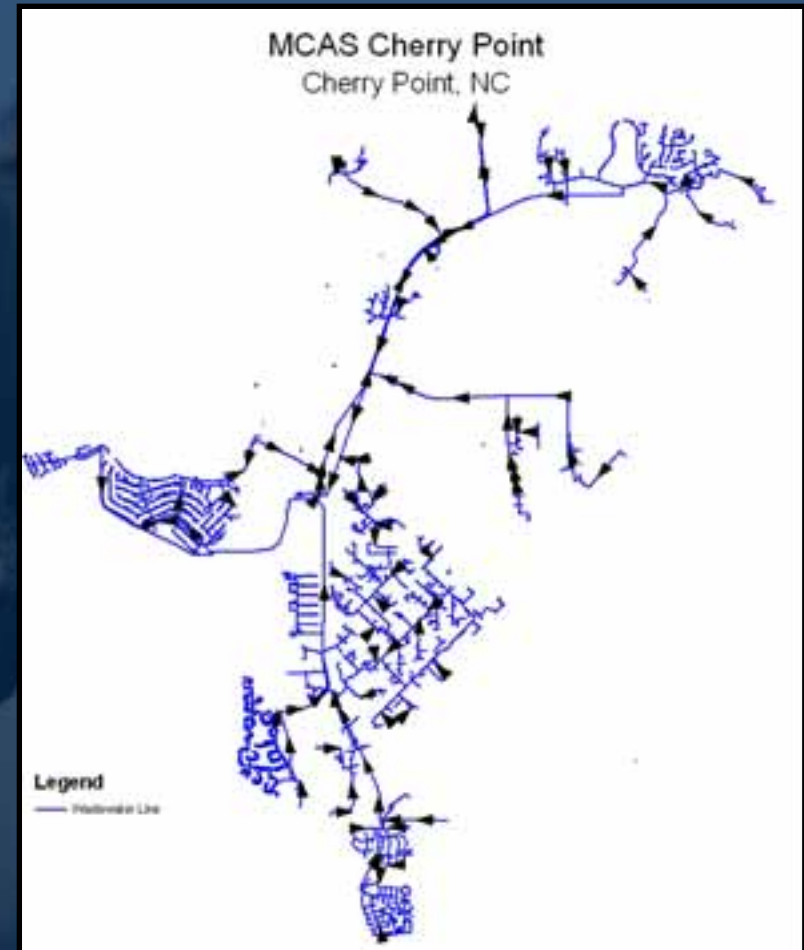■ **Geometric network and system capacity**

Verification Process and Product

■ Geometric network and system capacity

- A group of features, including junctions and edges, governed by preset connectivity rules

- Allows users to model and analyze a system (water, wastewater, electric, etc.) that has a defined flow direction

MCAS Cherry Point
Cherry Point, NC

Legend
— Wastewater Line

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Verification Process and Product

■ Geometric network and system capacity

- Enhanced geometric network with volume capacity processes and estimates

- Used Manning's Equation to calculate volume for wastewater lines

- Incorporated operating capacities of pump stations

- Calculations based on gal./day

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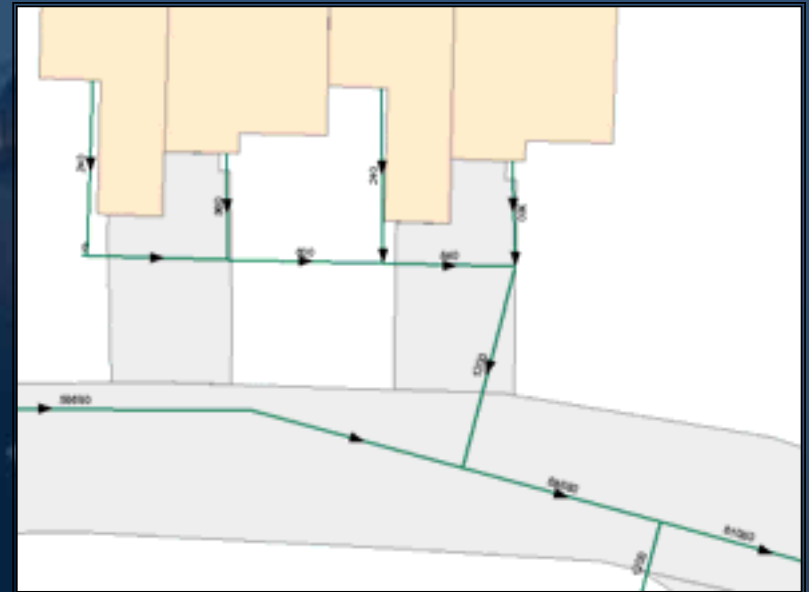
Verification Process and Product

■ **Geometric network and system capacity**

Manning's Equation:

▪ *Slope* of wastewater pipeline

▪ *Diameter* of wastewater pipeline

▪ Wastewater *volume* flowing out of buildings

$$V = \frac{k}{n} R_h^{\frac{2}{3}} \cdot S^{\frac{1}{2}}$$

V = Velocity in feet/second
k = 1.49 for unit conversion
n = Coefficient of roughness of pipe material
S = Slope of wastewater line
R$_h$ = Hydraulic radius

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Slope of pipe:

- Values to the right are the minimum slope that gravity-fed wastewater lines are permitted to have in North Carolina

- Due to the lack of data available for slope, the minimum required slope was assumed for each pipe diameter

Diameter of Pipe	Minimum Slope
(Inches)	(Feet per 100 Feet)
6 or less	0.60
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06
36	0.05

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Diameter of pipe:

- Using plans, URS updated many wastewater lines that were previously missing pipe diameters

- URS exhausted plans from Facilities and Engineering to populate these missing attributes

- Pipes with empty values still participate in the network but do not have a Percent_Capacity value in the flow accumulation field
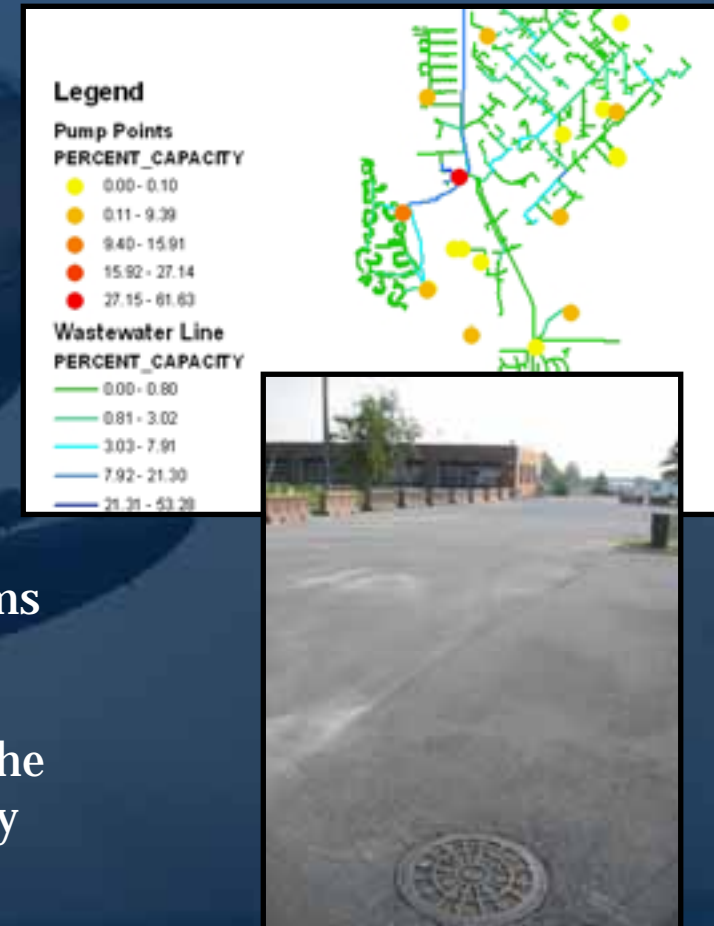
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Flow from buildings:

■ Flow data unavailable

■ Estimates of gallons per day per type of structure and total square feet of structure

■ Estimate sources:

• North Carolina's minimum design standards for sanitary sewer systems

• City of Lawndale, CA study

• URS professional experience to estimate the sewage flow for the remaining buildings by square foot

Legend
Pump Points
PERCENT_CAPACITY
○ 0.00 - 0.10
○ 0.11 - 9.39
○ 9.40 - 15.91
○ 15.92 - 27.14
○ 27.15 - 61.63
Wastewater Line
PERCENT_CAPACITY
─── 0.00 - 0.80
─── 0.81 - 3.02
─── 3.03 - 7.91
─── 7.92 - 21.30
─── 21.31 - 53.20

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Verification Process and Product
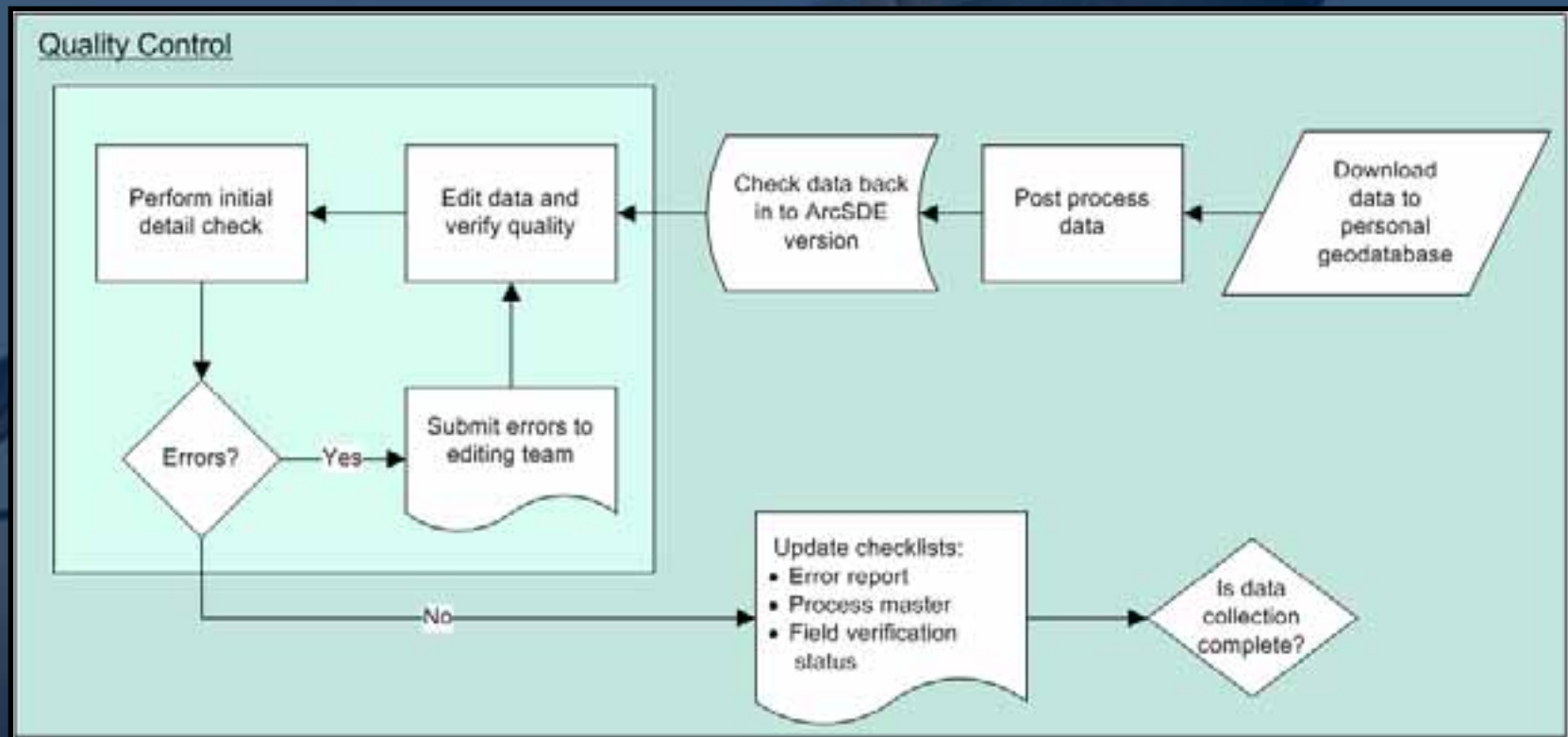
Pump station capacity volume:

- 79 pump stations currently in the GIS on Cherry Point's main base

- Attributed capacities for 29 pump stations using values provided by SMEs

- Applied average rated capacity of the 29 pump stations to the remaining 50 pump stations
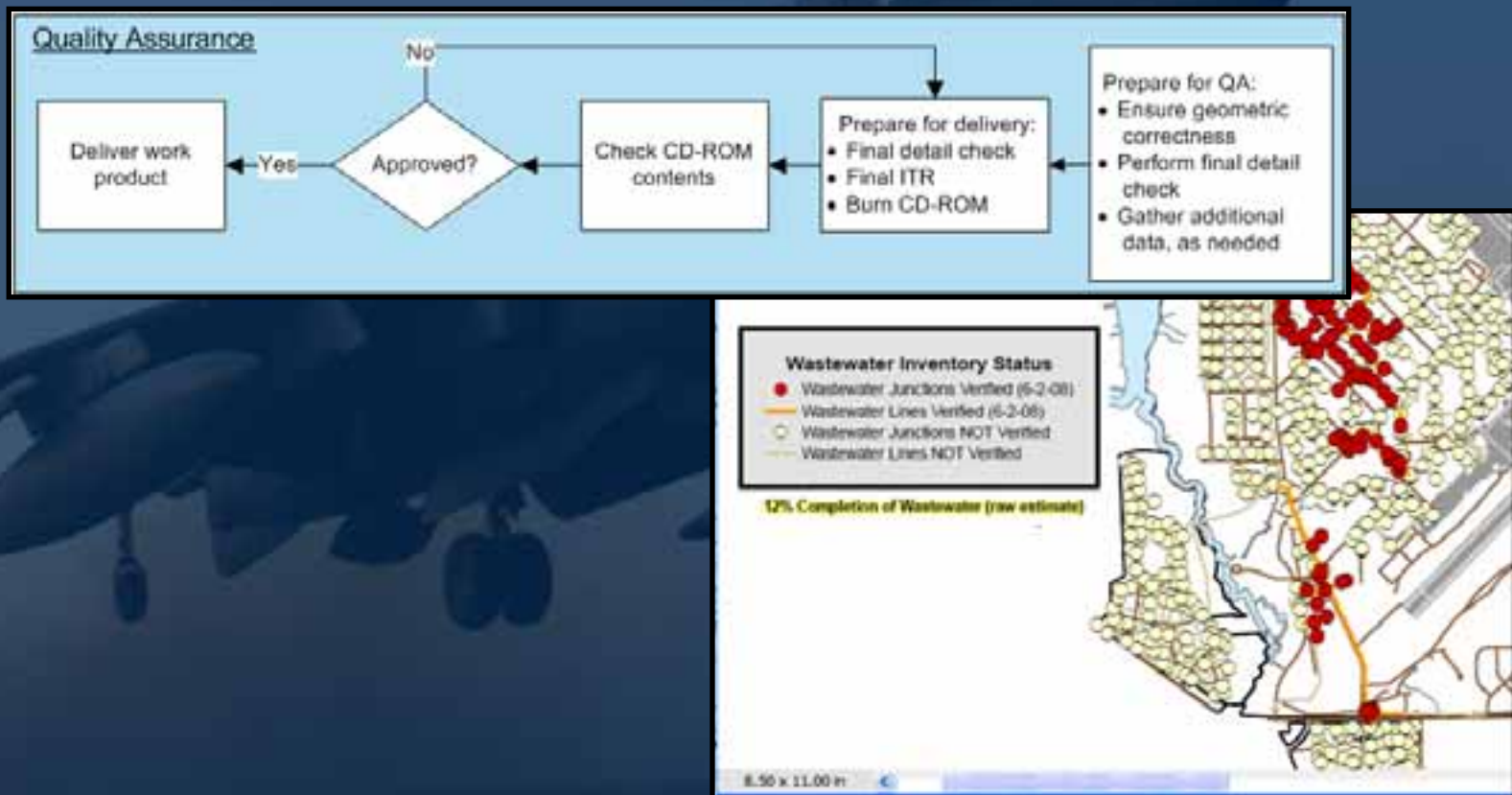

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Verification Process and Product

■ **Quality control**

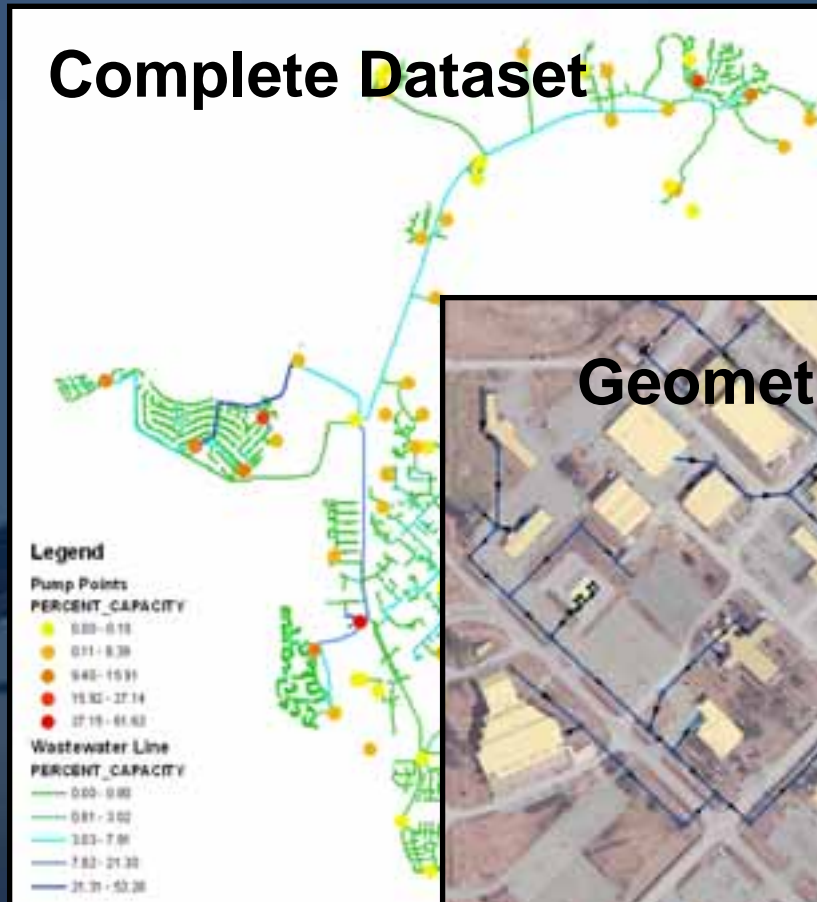# Verification Process and Product

■ **Quality assurance**

Quality Assurance

Deliver work product ←Yes— Approved? ← Check CD-ROM contents ← Prepare for delivery:
- Final detail check
- Final ITR
- Burn CD-ROM

← Prepare for QA:
- Ensure geometric correctness
- Perform final detail check
- Gather additional data, as needed

No →

Wastewater Inventory Status
- Wastewater Junctions Verified (6-2-08)
- Wastewater Lines Verified (6-2-08)
- Wastewater Junctions NOT Verified
- Wastewater Lines NOT Verified

12% Completion of Wastewater (raw estimate)

8.50 x 11.00 in

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Results

Complete Dataset

Photo Linking

Geometric Network

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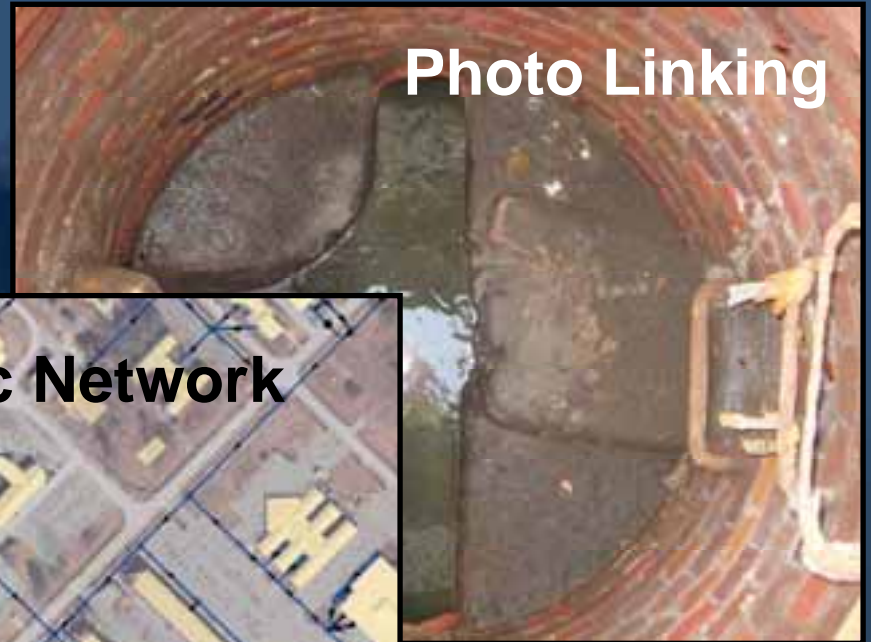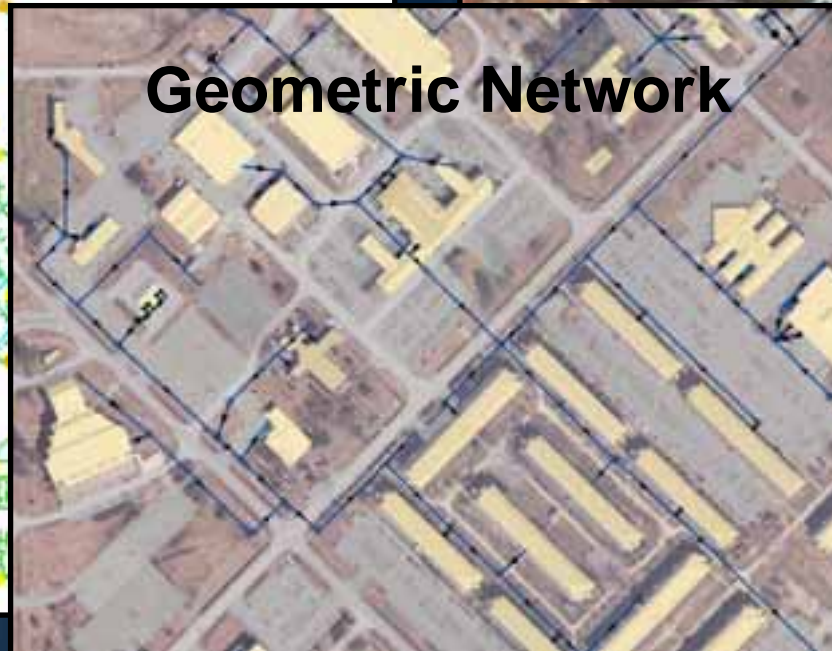
Results

Wastewater System Capacity

Legend
Pump Points
PERCENT_CAPACITY
- 0.00-0.10
- 0.11 - 9.39
- 9.40 - 15.91
- 15.92 - 27.14
- 27.15 - 61.63

Wastewater Lines
PERCENT_CAPACITY
- 0.00 - 0.80
- 0.81 - 3.02
- 3.03 - 7.91
- 7.92 - 21.30
- 21.31 - 53.28
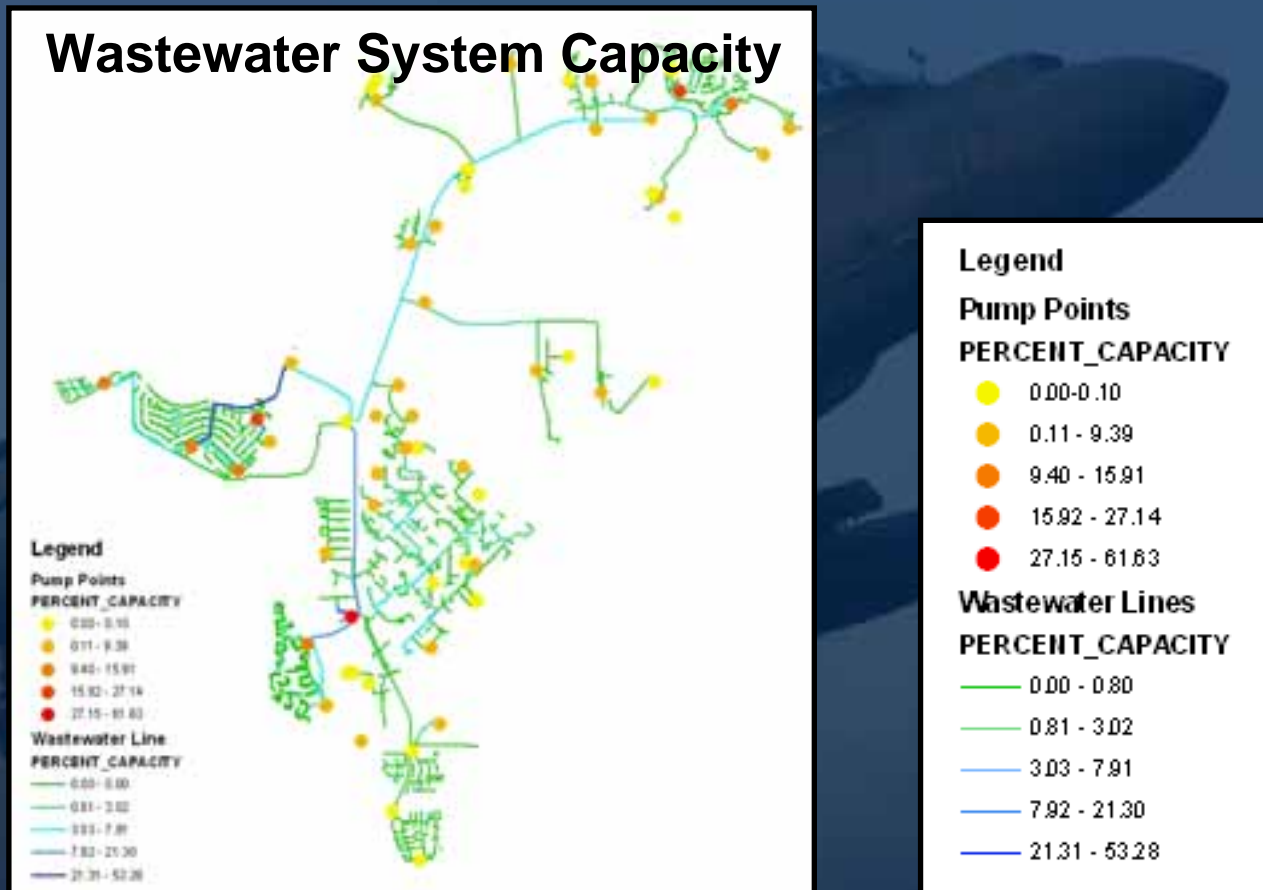
Lessons Learned

- Local knowledge (SME) is key to a successful wastewater inventory

- GEO*Fidelis*/SDSFIE Data Model can be cryptic and requires a steep learning curve early in the planning process

- Photo-linking proved to be a great asset to the client

- QA/QC process must start during the initiation and planning phase of the project to be most effective

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