Title: Verification of Wastewater GIS Utilities and Geometric Network Creation for Marine Corps Air Station Cherry Point, North Carolina

Authors: Roger K. Cottrell, Jr., PMP, GISP; Alice Mouraview; Stephen Strain, GISP

Abstract

Marine Corps Air Station (MCAS) Cherry Point is a 29,000-acre facility located in eastern North Carolina. With more than 7,500 Marines and 5,700 civilian workers, the installation is equal in size to a small city. MCAS Cherry Point's electric, water, and wastewater utilities span the facility and are critical to the installation's core mission. To meet its customers' requirements for quick outage response, efficient maintenance, and accountability of assets, the GIS Service Center at the Facilities Systems Support Office (FSSO) was tasked with combining existing geographic information systems (GIS), computer-aided drafting and design (CADD) documents, hard copy "as-built" plans, and local knowledge data into one centralized GIS database. URS Group, Inc. (URS) was contracted to integrate the existing data sources into one GIS data set and to field verify utility infrastructure using global positioning system (GPS) receivers. This two-year program yielded GIS wastewater data that MCAS Cherry Point is now using for GIS analysis and modeling, primarily with the ESRI Utility Network Analyst extension for ArcGIS.

1.0 Introduction

The geographic information system (GIS) program at Marine Corps Air Station (MCAS) Cherry Point was established in 1996. The GIS Service Center is part of the Facilities Systems Support Office (FSSO) and has been at the forefront of managing GIS data and applications since the program's inception. GIS is now integral to the operation of multiple departments across the Air Station, particularly in the generation and maintenance of facilities and infrastructure data sets for daily operations. The Facilities Maintenance Department (FMD), responsible for maintaining the water and wastewater systems on the Air Station, receives excellent support from the GIS Service Center.

Due to the size and number of on-site personnel at MCAS Cherry Point, wastewater is an important utility asset. The system serves more than 13,000 civilian and military personnel and includes over 7,000 features stretching hundreds of miles. Like any large utility infrastructure network, the system requires continuous maintenance as it expands and contracts in response to changes in the Air Station's capacity and mission. In addition to regular maintenance and construction, the system sometimes suffers breaks and stoppages caused by flooding, debris, and other natural and man-made disturbances. In an effort to support the engineering, maintenance, and other departments responsible for this system, FSSO established the Verification of Wastewater GIS Utilities and Geometric Networks project. The goals of this project were to upgrade the GIS data associated with the wastewater system to reflect the current configuration and to assemble a geometric network for modeling system outages, maintenance scheduling, tracing, asset management, and generation of "what-if" scenarios. FSSO also required attribution of sewer line capacity to be used in estimating system flow capacity throughout the year.

The U.S. Marine Corps uses the GEO*Fidelis* Data Model for management of spatial data, which is compliant with the Spatial Data Structure for Facilities, Infrastructure and Environment (SDSFIE) 2.6 developed and maintained by the Defense Installations Spatial Data Infrastructure (DISDI) group. DISDI is the formal governance group reporting to the Department of Defense's Installations & Environment Investment Review Board.

URS Group, Inc. (URS) has a longstanding relationship with the GIS Service Center at MCAS Cherry Point, particularly in the areas of GIS implementation planning, spatial data development, and custom application development. For the Verification of Wastewater GIS Utilities and Geometric Networks project, URS was contracted to provide GIS services that included the following tasks:

- Review and finalize 11 GEO*Fidelis* Data Model-compliant feature class data structures used to house existing and new wastewater data.
- Consolidate and convert existing digital and hard copy wastewater data into the 11 feature classes.
- Use global positioning systems (GPS) receivers to field verify all existing wastewater infrastructure features, including collection of x- and y- coordinates, and measure the invert elevation of each manhole.
- Incorporate all field-verified features into the 11 feature classes, complete required attribution, populate metadata, and incorporate proper topology.
- Create a geometric network of wastewater lines and junctions to be used for modeling the system.
- Populate the relevant feature classes with flow capacity of each segment of the sewer line.
- Draft a summary report that includes summary statistics, data processing methods, quality control/quality assurance (QA/QC) methods and results, and recommendations for data implementation within various departments.

The following sections summarize the problem statement, solution methodology and QA/QC procedures, results, recommendations, and lessons learned associated with this project.

2.0 Problem Statement

Although a significant amount of wastewater data existed at MCAS Cherry Point, the data was scattered across several on-site departments in various hard-copy and digital formats, including several proprietary computer-aided drafting and design (CADD) and GIS file formats. To serve all of its clients and to adhere to Marine Corps standards, FSSO needed to consolidate the data into a centrally located enterprise spatial database that could be easily accessed by multiple users with standard GIS software, including the ESRI ArcGIS suite of products.

In addition to the disparate nature of the existing wastewater data, much of the data was incomplete and outdated due to the installation's dynamic environment (e.g., ongoing construction of new developments and demolition of housing and commercial units used by enlisted and officer personnel and their families). FSSO needed to have the existing system field verified to accurately represent the current configuration and to make future maintenance of the system more efficient.

Based on past projects, FSSO recognized that GIS could be used to model the system once the data was accurately georeferenced and contained complete attribute tables and the proper topology. To enhance the usefulness of the final data set, FSSO asked URS to include the capacity data of the system in the attribute tables. This information will provide decision makers with better estimates on system capacity during modeling and system outage events, future planning, maintenance, and other system evolutions.

3.0 Solution Methodology

The U.S. Marine Corps and MCAS Cherry Point FSSO possess a mature GIS, which includes Microsoft SQL Server, ArcSDE, a distributed Citrix environment, complex infrastructure/servers, SharePoint, and a highly technical staff of information technology (IT) and GIS professionals. The obvious location for the wastewater data was the existing enterprise GIS centrally located at the East Coast Regional GEO*Fidelis* Center (GEOFIEAST) at Marine Corps Base (MCB) Camp Lejeune. This database configuration and location allows MCAS Cherry Point GIS users, and other customers throughout GEOFIEAST, to access a read-only version of the data at any time. It also allows the data steward to manage the data in a versioned and secure ArcSDE database.

This section describes the solution methodology used to complete this project.

3.1 Planning and Preparation

3.1.1 Work Plan

After close consultation with the GIS Service Center at MCAS Cherry Point, URS generated a comprehensive Work Plan based on the Project Management Plan (PMP), a standard document for all URS projects. Following the standards set forth by the Project Management Institute (PMI) Project Management Body of Knowledge (PMBOK), the Work Plan includes following sections:

- Scope of Work Summary
- Milestone and Deliverable Schedule (Gantt chart)
- Resource Management Plan
- Quality Management Plan
- Progress Reporting Plan
- Resource Management Plan
- Data Management Plan
- Communication Plan
- Safety Plan
- Assumptions and Constraints

The Work Plan addressed the unique needs of this project and accommodated all stakeholders, particularly the subject matter experts (SME) located in engineering and facilities management at MCAS Cherry Point. Coordination between URS field crews and the SMEs was critical, especially when immediate feedback was needed on questions related to system structure. The Communication Plan identified the formal processes and media to be used for communication, including a custom Microsoft SharePoint site used for tracking technical, managerial, and logistical issues that arose during project execution. Similarly, the Data Management Plan included instructions on transferring interim data deliverables to the client and receiving feedback via secure data channels.

3.1.2 Data Preparation

In December 2007, FSSO provided URS with wastewater GIS data in personal geodatabase (GDB) format. In addition, FSSO provided analog (paper) documents and CADD drawings that originated from a 2001 study. URS generated a new personal GDB that included all SDSFIE-compliant wastewater feature classes required to house MCAS Cherry Point's data. All data received from FSSO was imported or entered into the new SDSFIE-compliant personal GDB. To meet Marine Corps standards, all necessary GEO*Fidelis* Data Model modifications were applied to the wastewater_line, wastewater_valve, and wastewater_junction_point feature classes. The GEO*Fidelis* Data Model also required modifications to several domain tables. URS complied with these standards by modifying the SDSFIE domain table contents. URS further modified the wastewater_junction_point feature class to include a depth field, which recorded the depth of a manhole from rim to bottom (invert measurement).

Table 1 lists the 11 GEO*Fidelis* Data Model-compliant wastewater feature classes that best represent the wastewater network at MCAS Cherry Point and that were included in the new personal GDB.

Table 1. Wastewater feature classes

#	Feature Class Name	Feature Type	SDSFIE 2.6 Definition	Initial # of Features
1	wastewater_disposal_tank_point	Point	An above- or below-grade receptacle or chamber for holding wastewater on a temporary basis prior to transfer or use.	30
2	wastewater_fitting_point	Point	An item used to connect, cap, plug, or otherwise alter a pipe carrying wastewater.	917
3	wastewater_grease_trap_point	Line	A tank that separates grease from water, collects the grease for removal, and allows the water to exit.	14
4	wastewater_grit_chamber_point	Point	A chamber designed to remove sand, gravel, or other heavy solids that have subsiding velocities or specific gravities substantially greater than those of the organic solids in the wastewater system.	0
5	wastewater_inlet_point	Point	The location where wastewater is collected and received into the utility system.	8
6	wastewater_junction_point	Point	A box or small vault (usually concrete, brick, or cast iron) in wastewater systems located below-grade with above-grade access where pipes intersect. The manhole also houses associated fittings, valves, meters, etc.	1023
7	wastewater_line	Polyline	A pipe used to carry wastewater from location to location (e.g., main line, service line, force main line).	5963

#	Feature Class Name	Feature Type	SDSFIE 2.6 Definition	Initial # of Features
8	wastewater_pump_point	Point	Within a wastewater system, a mechanical device that draws material into itself through an entrance port and forces the material out through an exhaust port.	60
9	wastewater_septic_tank_point	Point	Typically, a below-grade receptacle or chamber in which solid organic waste is decomposed and purified by anaerobic bacteria.	42
10	wastewater_valve_point	Point	A fitting or device used for shutting or throttling flow through a wastewater line.	79
11	wstewat_oil_wat_separatr_point	Point	A device or structure placed in the wastewater stream to separate water from oil products.	25

SME support was critical during the entire life cycle of this project. Mr. J. J. Chadwick (Water Plant SME), Mr. Steve Simmons (Facilities Engineering Division SME), and FSSO GIS personnel provided guidance on SDSFIE attribute requirements. For QA purposes, this information provided the basis for attribute QC checklists used during project execution.

To manage the large volume of wastewater data included in this study, URS imported the final personal GDB schema into Microsoft SQL Server running ArcSDE in our Morrisville, North Carolina office. This provided the team with a secure, versioned GDB that could be accessed by the entire team during development, depending on each team member's required access level.

3.1.3 Field Verification Preparation

URS generated several custom forms using ArcPad QuickForms technology for verification of existing wastewater feature locations, collection of new feature locations, and attribution of the 11 feature classes in this project. These ArcPad forms, along with the existing GIS data, were loaded onto Trimble GeoXH GPS units for use during field verification. ArcPad software and the Trimble GPS receiver units provided the basis for verifying and updating the MCAS Cherry Point wastewater system. Using the existing data, URS generated hard copy field maps that were used for navigation, clarification, and field notes during feature verification.

3.1.4 Field Safety

Because of the inherent danger present in field operations of this nature, URS prepared a detailed Heath and Safety Plan aimed at providing guidance to all stakeholders working in the field. Items addressed included, but were not limited to, poisonous snakes and spiders, trip and fall hazards, heavy lifting (manhole covers), heat stress, driving hazards, and traffic safety. The Health and Safety Plan was reviewed by all team members prior to the start of all daily field operations.

3.1.5 Kick Off Meeting

At the conclusion of the planning phase, URS hosted a project kick off meeting and presented the formal Work Plan to FSSO and all project stakeholders. The meeting included key members of the URS team, MCAS Cherry Point SMEs, FSSO GIS personnel, and other key stakeholders. After the meeting, URS revised the Work Plan per stakeholder comments and generated a formal set of meeting minutes highlighting key decisions and discussion points that occurred during the meeting.

3.2 Execution

3.2.1 Feature Verification and Collection Phase

Before initiating field collection, URS developed a QA/QC process specifically for this project. Procedures and metrics were developed for using GPS units to collect and verify attributes and spatial geometries in the field.

3.2.1.1 Geometry

The data that had been updated in the planning phase was loaded into the GPS receivers for verification by URS field crews. Field crews consisted of teams of URS technicians using Trimble GeoXH GPS units. URS field crews physically located the wastewater utilities in the field and verified their positions with the GPS receivers. Most features were located and verified in this manner. If a feature was discovered that was not present in the GIS layer, or if the actual location of the feature was more than 2 meters from its recorded location, the field crew captured a new point using GPS methods.

Field metrics stipulated a maximum Positional Dilution of Precision (PDOP) of 5.0 and a Predicted Post-processed Accuracy (PPA) below 30 centimeters when verifying a feature position. Additionally, when collecting new data, 90 positions were acquired and then averaged during post processing of the GPS data.

Some features were obstructed by buildings, poles, or other solid structures that obscured the GPS receiver from available satellites. URS field crews used a LaserCraft Contour XLRic laser range finder to overcome these challenges and collect otherwise obstructed wastewater utility features.

Five percent of all newly collected features were re-collected and examined for spatial precision and accuracy. Re-verification of these features reinforces the precision and accuracy of the field methodology and metrics. Features that could not be located were more problematic. In some cases, SMEs were consulted for guidance concerning missing features. In other cases, URS consulted as-builts and/or CADD drawings for information. When a determination could be made regarding the missing feature, URS took the appropriate action of retaining or removing the feature from the data layer. When a determination could not be made, URS left the features in the GIS data.

3.2.1.2 Attributes

When a feature was visited in the field, its attributes were verified and/or collected as needed. For newly collected features, attributes were also collected. In these instances, only a few attributes could be field collected in the GPS unit. The remaining attributes were populated after returning to the office. URS consulted with SMEs for guidance concerning missing or unknown attributes and referred to as-builts and/or CADD drawings for additional information. The as-builts and CADD drawings generally supplied information about the date a structure was built, pipe materials, diameters and alignment, and valve sizes. Information such as structure model, serial numbers, and manufacturer was generally not available and therefore not recorded in the GIS data.

Attribute fields not required by SMEs were populated with “<Null>”, “0”, or a required value. For example, CoordX and CoordY were calculated for each point feature class, as well as x- and y-coordinates for From and To nodes for line features. “<Null>” values were used to fill any blanks in text fields, and “0” was used to fill blanks in integer or double fields, ensuring attribute consistency with other GIS data maintained by the FSSO. Each feature in all 11 feature classes was also assigned a unique primary key.

3.2.1.3 Digital Photography

In addition to the field verification procedures outlined in sections 3.2.1.1 and 3.2.1.2, URS took digital photographs using Canon PowerShot SD1000 Digital ELPH cameras for the wastewater features that were located in the field. Photographs were taken for lift stations (wastewater_pump_point) and associated valve pits (wastewater_valve_point) and oil/water separators (wstewat_oil_wat_separatr_point). Two photographs were taken at each manhole (wastewater_junction_point). The first photograph captures the view inside the shaft of the manhole. The second, or context, photograph captures the manhole and its surroundings. Underground features were not photographed. For example, all features in the septic tank and disposal tank feature classes are below ground and could not be photographed. Caps and reducers (wastewater_fitting_point) are also located below ground and could not be photographed. Due to the large number of cleanouts that look nearly identical (wastewater_fitting_point), photographs were not taken at each of these features.

3.3 Wastewater Data Production

3.3.1 Feature Geometry

GPS-collected features were post-processed using the Trimble GPS Analyst extension. Each of the 90 positions collected for a new feature was compared to the measurable geometric satellite error recorded at nearby GPS Continuously Operating Reference Station (CORS) base stations. See Table 2 for a full list of base stations used on this project; see Figure 1 for a map of the CORS base stations. After accounting for geometric error, URS staff averaged the 90 positions to create a single point representing the new feature.

Table 2. CORS base stations

CORS Station Name	Distance from MCAS Cherry Point	Primary or Backup Station
Castle Hayne	108 km (67.1 mi)	Primary
New Bern 6	33 km (20.5 mi)	Primary
Pea Island	156 km (96.9 mi)	Primary
Washington	74 km (46 mi)	Backup

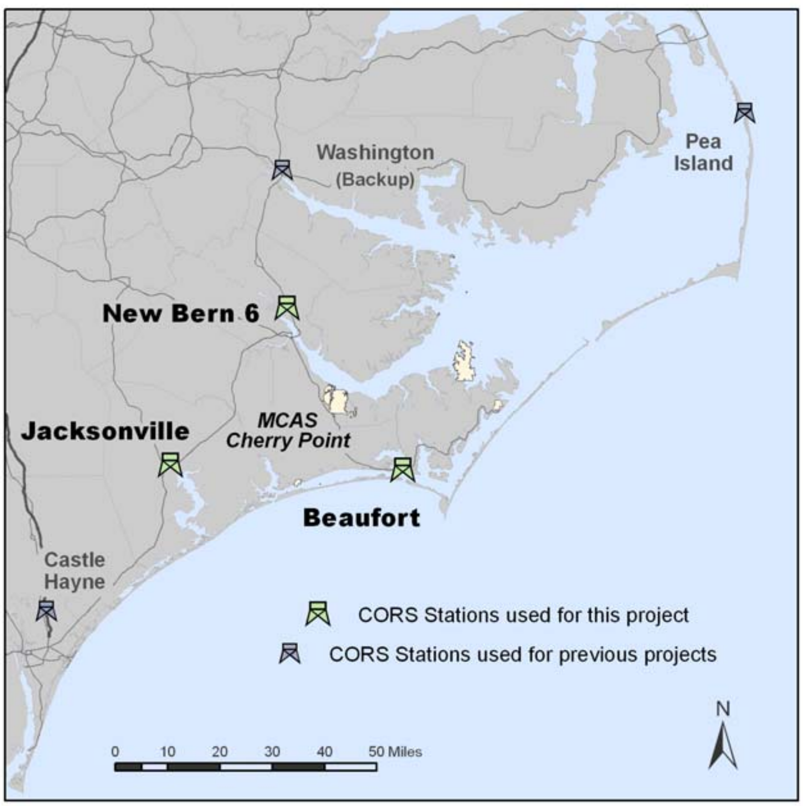

Figure 1. Map of CORS stations

When post-processing was complete, URS conducted heads-up verification and editing of related feature geometries. Each updated layer was detail checked for geometric and network accuracy prior to the next GPS field visit.

All field-collected data was post-processed by URS staff and posted back to the updated database. URS GIS staff verified the field-collected data and, when necessary, manually edited spatial locations and attributes of features according to redlined field maps and notes taken by the field crew during field verification.

The wastewater data set went though a series of QC checks to verify the following:

- Lines were properly snapped to point features
- Line flow direction was properly represented
- Lines were split at point features
- No features were duplicated
- No <NULL> geometries existed

QC was performed after each field visit on only the data that was collected or verified during that specific visit. Any errors in geometry were rectified before the next field visit. This resulted in a total of seven QC checks on separate portions of the data. Performing frequent, detailed checks on a specific subset of the entire data set confirmed that 100% of the geometry underwent QC.

3.3.2 Attribution

URS performed QC on attributes after each field visit using only the data that was collected or verified during that specific visit. Collected and verified attributes were compared to attribute standards outlined by SMEs. See Appendix 1 for a list of attribute standards. Primary Keys were tested to ensure that they were accurate and unique. Fields that were not required and contained no values were populated with "<Null>" and "0", as needed. Features containing attribute violations were flagged and returned to the editing team for correction.

Most attributes were easily identified and populated; however, if an attribute value was not immediately attainable, the issue was recorded in a log with a suggestion for resolution. Many attribute issues were resolved by referring to as-builts and/or CADD drawings. Issues that were difficult to resolve were communicated to the SMEs. Every attempt was made to populate all possible attributes.

3.3.3 Metadata

URS used all available resources to populate the metadata files, including the existing metadata provided by MCAS Cherry Point and additional information obtained by URS. All metadata nodes required by the Core Metadata Elements for FY08 GEO*Fidelis* Readiness Rating were populated for each layer. Existing metadata was updated to include the country and any available contact information. Dates were updated to conform to the [yyyymmdd] GEO*Fidelis* standard. Entity attribute information was updated to reflect SDSFIE v.2.6 and GEO*Fidelis* definitions. Updated thumbnails were also added. URS provided additional metadata, including a project-specific step incorporating process software and version. Attribute accuracy, positional accuracy, and completeness reports were also added.

3.3.4 Network Topology

URS built topology into the data using the topology rules available in the geodatabase. This allowed topology checks to be completed during the entire data development cycle, including proper snapping of features, elimination of overlaps, etc. The complete set of topology rules used for this project is discussed in the QC section of this document.

3.3.5 Geometric Network

ArcGIS ArcCatalog provides all of the tools needed to generate a geometric network from edges and junctions contained in a network. URS built a geometric network using the feature classes stored in the geodatabase and out-of-the-box ArcCatalog tools.

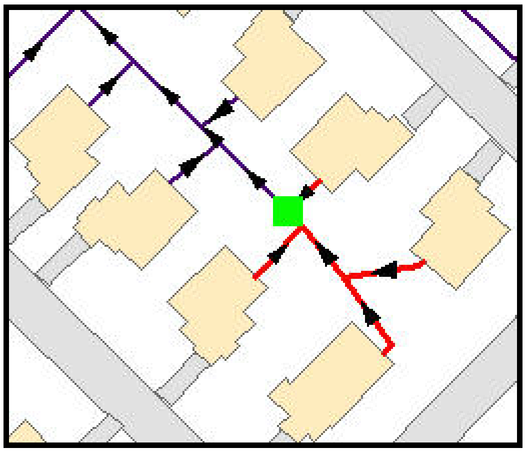

Figure 2. Sample of downstream tracing in a geometric network

3.3.6 System Capacity

URS enhanced the geometric network with volume capacity processes and estimates. Manning's Equation was used to calculate volume for wastewater lines. Operating capacities of pump stations were incorporated into the data. All calculations were based on gallons per day. Manning's Equation uses slope of the wastewater pipeline, pipe diameter, and volume of wastewater flowing out of buildings to calculate flow velocity in feet per second.

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

Figure 3. Manning's Equation

The wastewater system at MCAS Cherry Point is gravity fed. The state of North Carolina determines the minimum slope of the pipeline based on the diameter of the pipe. Because exact slope data was not available for this project, URS assumed the minimum values. Pipe diameters were gathered from existing plans and other drawings. Wastewater flow from buildings was unavailable; however, estimates of gallons per day per type of structure and total square feet of the structure were used. Using a similar study for the City of Lawndale, California, and expert advice from the URS Water Group, the URS team populated the data with industry-standard flow rates. MCAS Cherry Point SMEs provided capacity volume data for 29 pump stations. URS averaged the remaining 50 pump stations using data provided by the SMEs.

Figure 4. Wastewater pumps at MCAS Cherry Point

The resulting data set allowed SMEs and other stakeholders to visualize the wastewater volumes being generated by facilities using the wastewater network at MCAS Cherry Point. Future maintenance will include updating capacity values as they become available and change during system expansion.

3.4 Quality Assurance/Quality Control

After the data was collected, URS field technicians manually edited the data to reflect the modifications encountered in the field. For example, a manhole was GPS collected because the existing location was incorrect. Upon returning to the office, URS technicians manually edited the underlying wastewater lines to snap to the new manhole location. In addition, attributes that belonged to the geometrically incorrect manhole point were transferred to the new point location before the old point geometry was removed. Several QC methods were applied to the wastewater data layers at different points throughout the project life cycle. The geometry and attributes of data that were GPS-verified and collected during a site visit were reviewed prior to the next visit. After all field visits were completed, post-production QC methods were implemented.

3.4.1 Post-Production Quality Control

URS executed post-production QC procedures after all field visits were complete. Field-collected and verified data was loaded into a new geodatabase in accordance with SDSFIE 2.6 and the GEO*Fidelis* Data Model. The new geodatabase ensures correct domain table names and assignments to specific attribute fields.

The post-production QC process involved a check of 100% of the attributes and metadata. Additionally, 100% of the geometry was checked using ESRI topology rules. After all known issues were resolved, a final QA check was performed by an independent technical reviewer.

3.4.1.1 Feature Geometry

URS verified geometric integrity by applying a series of ESRI topology rules at the feature data set level and testing them using ArcCatalog. Topology rules help guarantee geometric correctness within and between different GIS layers and allow for a complete check of all geometric features in the network. The rules also ensure the geometric correctness of the data set, which provides the basis for geometric networking.

URS included all 11 feature classes when testing the accuracy and precision of the wastewater network. The following rules were tested:

- *Must not intersect or touch interior* (polylines)
- *Must not have dangles* (polylines)
- *Must be covered by endpoint of* (points and polylines)

Must Not Intersect or Touch Interior

The *Must not intersect or touch interior* topology rule applies to polyline layers. Individual lines can touch only the ends of other lines and cannot overlap.

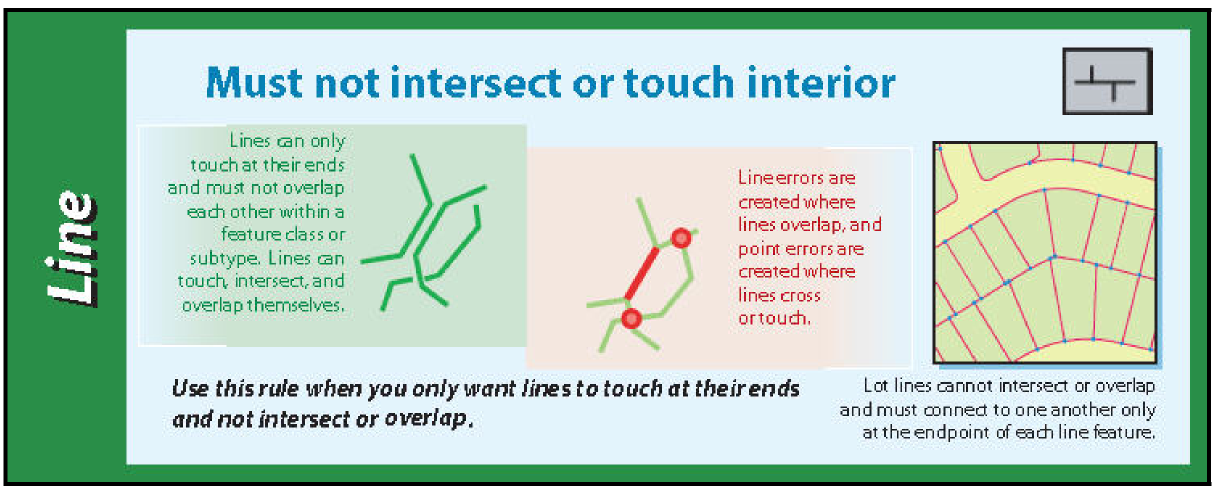

Figure 5. ESRI topology rule: *Must not intersect or touch interior* (Source: (ESRI)

This rule flags polyline features – in this case, features from wastewater_line – that are not properly snapped to one another. The rule also flags lines that intersect other lines and lack endpoints at the intersection. Additionally, the rule identifies lines that overlap.

Lines that intersect and do not have proper nodes and vertices were a common problem in the wastewater_line feature class. In Figure 6, a topology error, indicated with the black square, was generated at the intersection of two wastewater lines. In this instance, the red line should be split where the blue line intersects it. The error was corrected by splitting the red line at the intersection of the blue line.

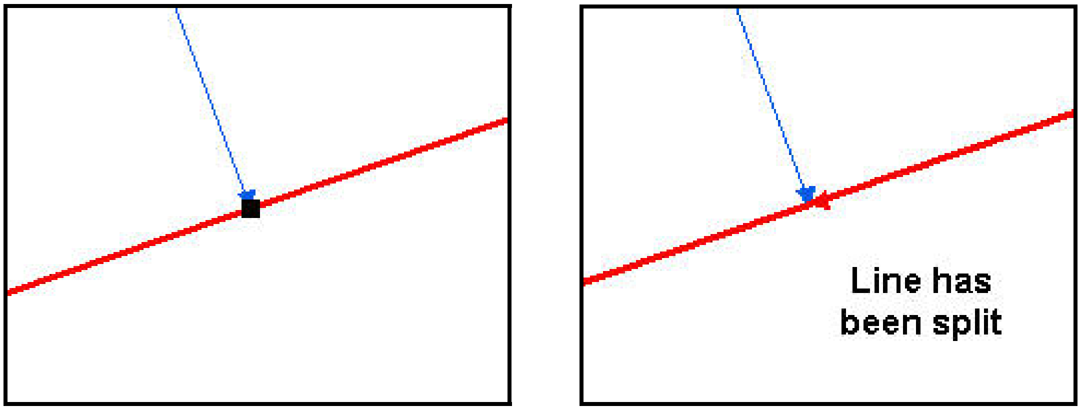

Figure 6. Topology error: Intersecting lines

Some *Must not intersect or touch interior* rule violations identified areas in the data with generally poor geometry. The wastewater lines in the left image in Figure 7 had been copied directly from an MCAS Cherry Point CADD drawing. Any errors in the CADD drawing, including unsnapped lines, were transferred to GIS. In this and similar instances, URS edited the lines for a more accurate representation of the line network. The image on the right depicts the same area after topology violations were resolved.

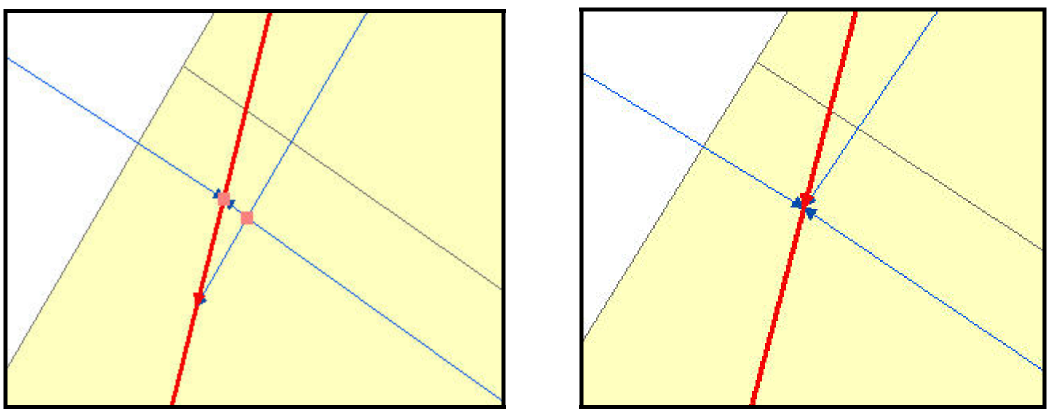

Figure 7. Topology error due to poor geometry

Must Not Have Dangles

The *Must not have dangles* topology rule applies to polyline layers and checks the connectivity of the line network. For each line feature, the To Node must be snapped to the From Node for the next line feature downstream. This ensures precise network connectivity and is especially important when modeling unidirectional networks like wastewater systems.

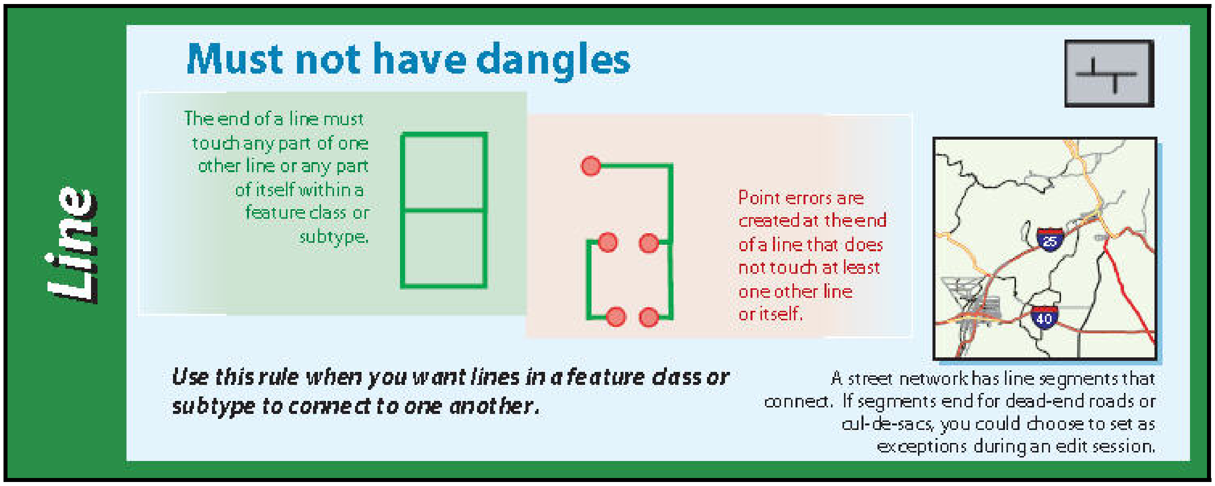

Figure 8. ESRI topology rule: *Must not have dangles* (Source: ESRI)

The *Must not have dangles* rule was applied to all wastewater lines. Lines with endpoints that were not snapped to the endpoints of other lines were flagged. In the example shown in Figure 9, the blue service line should be snapped to the red gravity main. In the right image, the violation has been corrected by snapping the blue line to the red line.

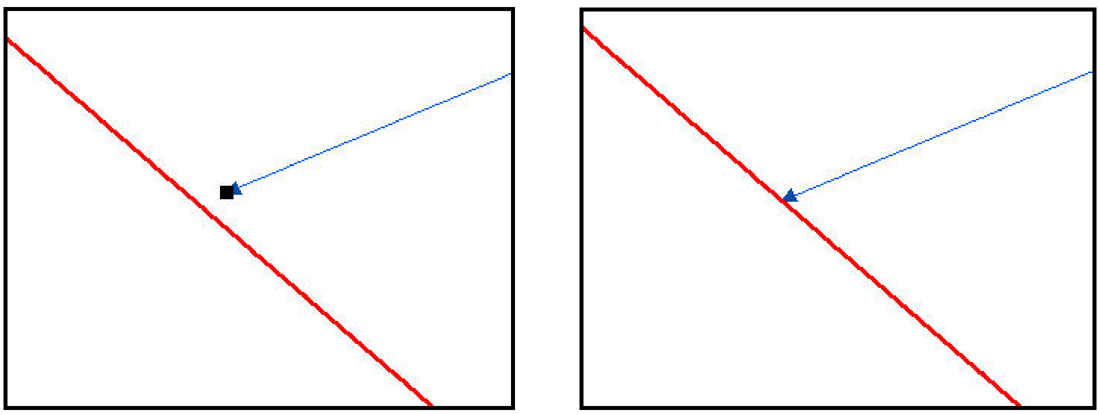

Figure 9. Topology error: Dangles

The *Must not have dangles* test initially returned a few topology violations, but a detailed inspection revealed that most of these violations were not actually errors within the data set. In Figure 10, lines that start at the edge of a building are not covered by a node from another line feature. The service lines in blue are connected correctly to buildings instead of other lines. This is flagged as a violation by the topology editor when, in fact, it is not an error. URS examined each violation individually and rectified errors, as needed, to preserve the geometric integrity of the line network.

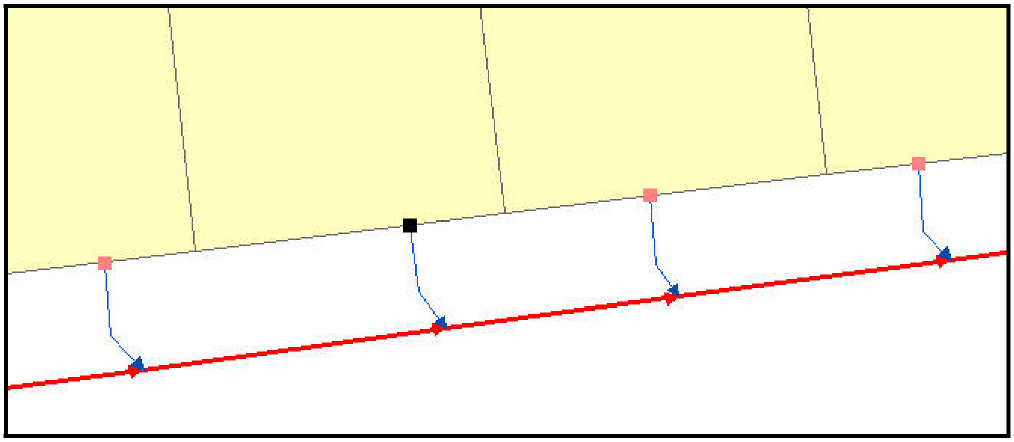

Figure 10. The *Must not have dangles* topology rule flags lines not connected to other lines

Must Be Covered By Endpoint Of

The *Must be covered by endpoint of* topology rule identifies point features not covered by the endpoint of line features. This rule can identify point features, such as manholes, cleanouts, and oil/water separators that are not properly connected to the wastewater line network.

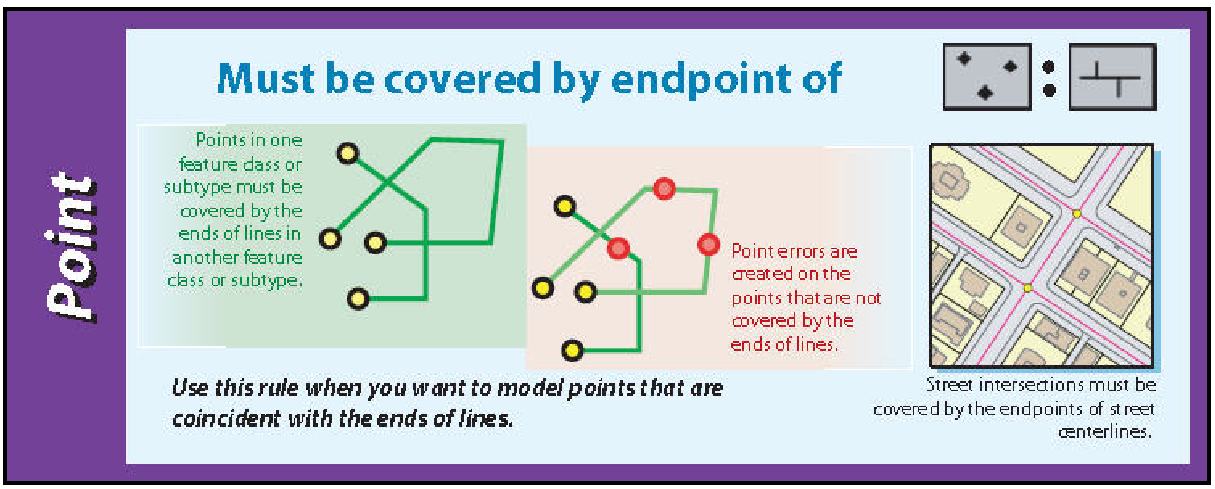

Figure 11. ESRI topology rule: *Must be covered by endpoint of* (Source: ESRI)

3.4.1.2 Attribution

To ensure the compliance of all attributes, the attribute requirements identified in the GEO*Fidelis* Data Model data dictionary were manually compared to the wastewater attribute tables. All attributes in the tables were checked, and problems were resolved on an as-needed basis.

When attribute testing was complete, URS used a model to populate the attribute BUILDING_ID with the facility number from the nearest feature within the structure_existing_area feature class. Actual attribute tables were compared to the required attribute table spreadsheets in the data dictionary to ensure that all required attributes are properly populated and that only the SME-identified allowable values were used. Primary Keys were checked to ensure they are unique and properly assigned. Other attributes were checked to ensure they were properly filled with “<Null>” or “0”, as appropriate. Any issues were flagged and resolved by the editing team.

3.4.1.3 Metadata

The Core Metadata Elements for the FY08 GEO*Fidelis* Readiness Rating guidelines provide explicit instructions on populating metadata for each feature class. The post-production metadata QC process included a manual comparison of metadata for each wastewater feature class to these guidelines.

URS added a project-specific process step outlining the methods and software used to complete the data. URS also reformatted dates and added contact information, where necessary, to ensure compliance with GEO*Fidelis* metadata guidelines.

3.4.2 Post-Production Independent Technical Review

When the data edits were complete and the final QC had been performed, the data was examined by the independent technical reviewer. The reviewer checked the draft data set’s geometry, attribution, and metadata. All errors indentified by the reviewer were resolved before delivery of the data.

As a result of the QA/QC procedures described in this section, URS is confident that the feature locations were collected within acceptable industry standards for collecting mapping grade data. In addition, URS is confident that the attributes are accurate and represent the best information available concerning the wastewater system at MCAS Cherry Point.

3.5 Monitoring

Project milestone and deliverable status were relayed to MCAS Cherry Point via the project SharePoint site on a monthly basis. Status reports included a map highlighting completed feature verification and a textual description of project progress, major milestones, meetings attended, ad hoc requests, and milestones and deliverables due the next period.

3.6 Closing

URS hosted a data review meeting at the conclusion of the project to review the data geometry, attributes, and metadata. This meeting included a lessons learned session where the project team provided valuable input concerning the entire project life cycle.

4.0 Results

This project resulted in a GEO*Fidelis*/SDSFIE-compliant wastewater data set. URS delivered the data set to MCAS Cherry Point for importation into their existing enterprise GIS database. The data set delivery included a geometric network for use with ESRI’s Utility Network Analyst Extension. To help MCAS Cherry Point understand the limitations of the data, URS generated a detailed summary report highlighting the methods and procedures used to create the wastewater data set.

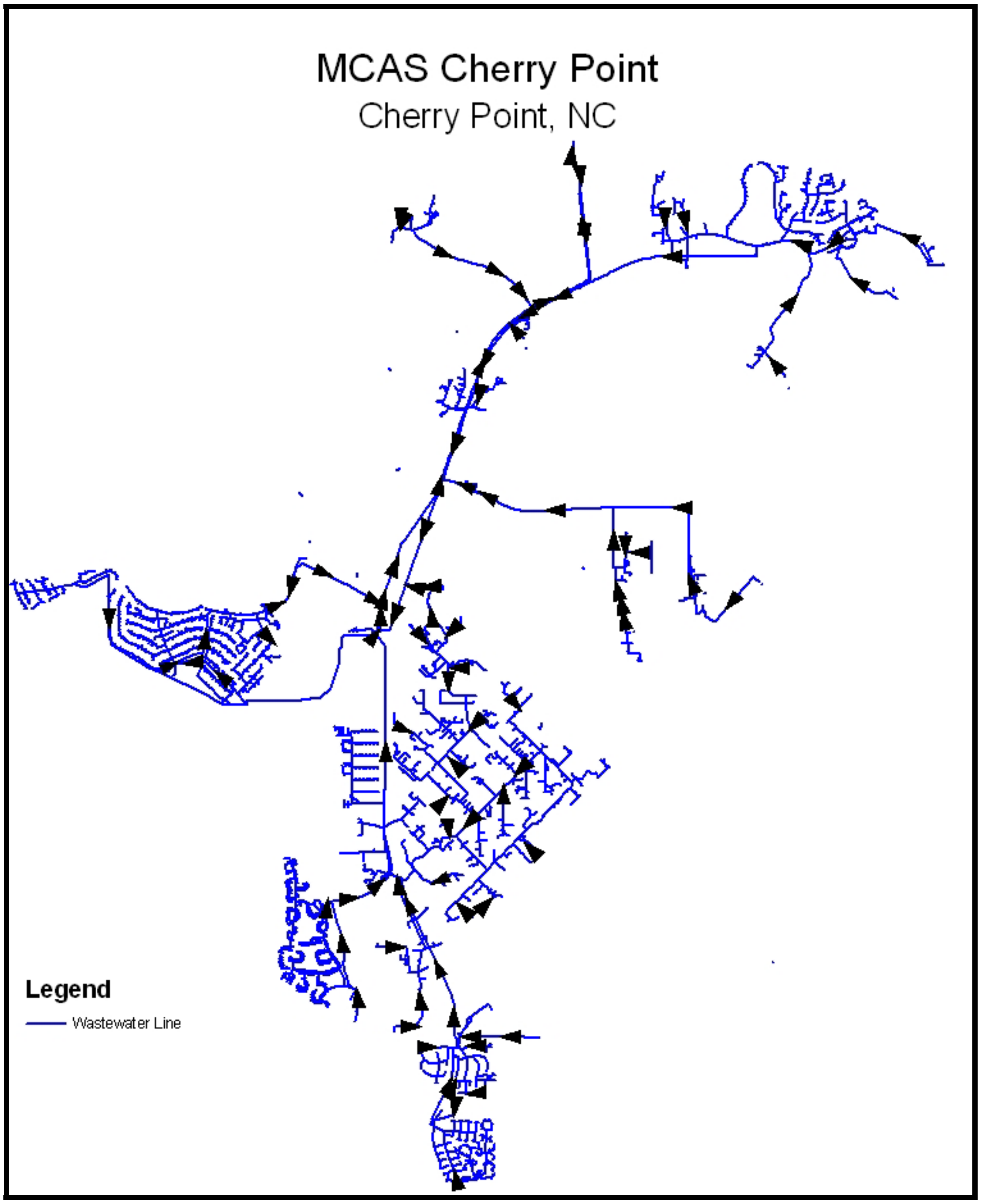

Figure 12. MCAS Cherry Point wastewater utility system

5.0 Recommendations for Maximizing Benefits

MCAS Cherry Point invested significant resources in creating and updating wastewater utility data. To capitalize on this investment, URS believes that MCAS Cherry Point should maximize the application of this data to increase the efficiency and effectiveness of the installation's wastewater utility operations. URS recommended that MCAS Cherry Point utilize the new wastewater data set for modeling, asset management, and value-added process improvement to achieve maximum return on investment.

6.0 Lessons Learned

Although this project was not the first of its kind, the project yielded valuable lessons learned for this type of GIS work. URS and FSSO discovered that local knowledge provided by the SMEs was critical to project success. Decades of hands-on experience provided insight into the unique aspects of the wastewater network that could not be pulled from any database, drawing, or other historical documents.

Although the SDSFIE data model provides a good framework for structuring spatial data, the project team discovered that the naming conventions, domains, and other schema items in the model require a steep learning curve for project team members. This challenge was solved by involving stakeholders early in the planning stage to allow them to gain maximum benefit from the model.

The linking of digital photographs to GIS features in the database proved to be a valuable asset to the project team, particularly the MCAS Cherry Point clients. The addition of photos not only allowed for quick review of a particular wastewater feature, but also allowed the SMEs to identify current maintenance issues that needed to be addressed.

The project team confirmed that QA must start during the initiation and planning phases of a project to obtain maximum benefit. Integrating quality into the project early on paid high dividends to all stakeholders, from the execution of the project to the closing phases.

7.0 References

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8.0 Key Contacts and Acknowledgements

Roger K. Cottrell, Jr., PMP, GISP
Senior Project Manager
URS Corporation – North Carolina
1600 Perimeter Park Drive, Suite 400
Morrisville, NC 27560
roger_cottrell@urscorp.com
336.225.9930

Alice Mouraview
Director, FACSSO
MCAS Cherry Point
alice.mouraview@usmc.mil
252.466.4776

Stephen Strain, GISP
Senior GIS Specialist
URS Corporation – North Carolina
1600 Perimeter Park Drive, Suite 400
Morrisville, NC 27560
stephen_strain@urscorp.com
919.461.1479

The following individuals worked hard to ensure this project yielded the desired results.

Denise Smith, GISP

Darlene Kisner

J. J. Chadwick

Sallie Vaughn

Laura Barrick

Kelsey Novacek

Mark P. Smith

Cara Stackpoole

Matthew Railey