INTERN/NEW-HIRE MANUAL

Metronet Inc.

A Guide to 3-GIS and As-Builts

A brief introduction to the GIS software used at Metronet, including a thorough description on the completion and documentation of As-Builts.

Joshua Eckels
Rose-Hulman Institute of Technology

Preface

At the time of writing of these procedures, there was a backlog of over 400 as-built tasks in the OSP Design department, there were broken pieces of old designs scattered across 3-GIS, there were mislabeled, mismanaged, missing, and undocumented as-built tasks floating around in the OSP workspace in no apparent order or structure, there were no standards for the drawing of as-builts in the field nor for the completion of as-builts in the office. What procedures did exist were invented in the musk of trial and error, and passed on in the indeterminate shift of speculation. The purpose of this manual is to provide a clear and thorough standard for the completion and documentation of all tasks related to as-builts, including a beginner's reference and guide to using and understanding 3-GIS. While this manual is thorough in many sections, it is noted that not all sections or procedures are perfect. All written procedures and standards stated herein are subject to change and revision. This manual is not meant to be an infallible guide for all outlined sections; rather, it is intended to serve as a foundation from which standardization and clarity in procedures may grow, from which all interns and newcomers to Metronet, and all who take on the task of completing as-builts in the future, may benefit from.

— Joshua Eckels

August 10, 2018

Table of Contents

1. Basics of Telecommunications (Intro to 3-GIS)

1.1. General

1.1.1. Metronet

1.1.1.1. Metronet is a telecommunications company based out of Evansville, IN that services many rural and non-rural cities across Indiana, Illinois, and most recently, in Kentucky. Metronet provides Internet, telephone, and TV/cable to thousands of customers in the region, but is primarily known for its fully fiber optic network and its Internet service.

1.1.2. Software

1.1.2.1. Metronet uses 3-GIS, a Geographical Information System (GIS), to design, estimate, and track the construction of all equipment involved in its network. A brief introduction to this software and all of the equipment and data stored therein is provided in this section.

1.2. Vocabulary

1.2.1. Running Lines

1.2.1.1. Running lines refer to the medium by which telecom cables travel, or 'run'. There are two types of running lines: conduits and strands. Strands are simply thin wires that run in between poles that tie to aerial cables to provide stabilization. There are two types of strands: drop strands and non-drop strands, (see section 1.2.9). Conduits are long, plastic, tube-like, ducts through which underground cables run. There are 5 types of conduits: single-duct, dual-duct, triple-duct, quad-duct, and penta-duct. Single-duct conduit is only used for drops (see section 1.2.9). Dual-duct is primarily used for LCP cables (see section 1.2.4). Triple-duct and anything larger is normally only used for ring cables (see section 1.2.9). See the figure below for 3-GIS symbology.

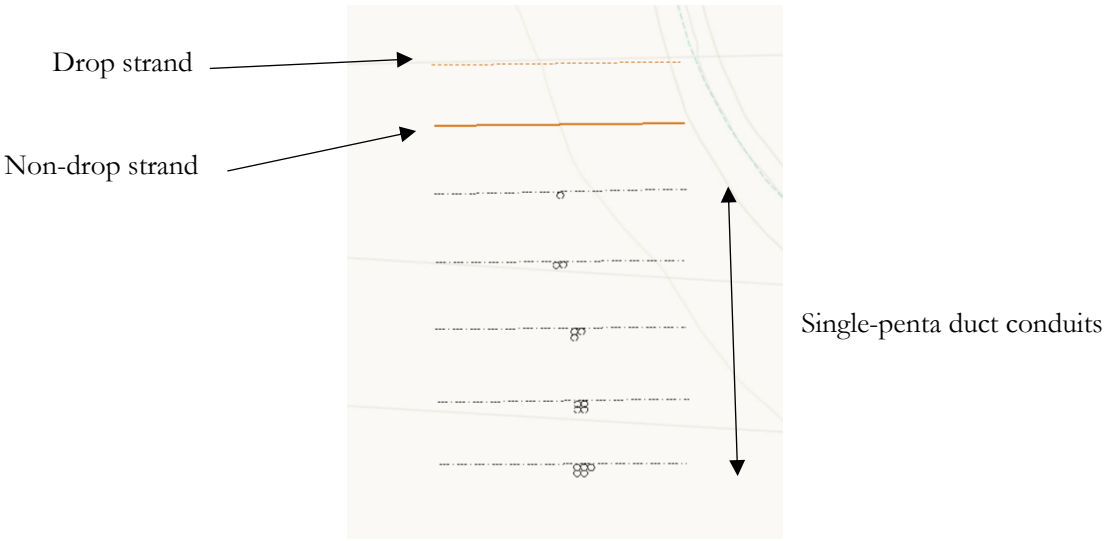


Figure 1.2.1: Running Lines

1.2.2. Poles and Risers

1.2.2.1. Strand always runs between two poles. On 3-GIS, poles are denoted by an orange circle with an X in the middle. When fiber cable goes from aerial to underground, or underground to aerial, a riser is needed. A riser is a long vertical tube attached to the side of a pole that connects underground conduit to aerial strand. A riser is denoted on 3-GIS by a white circle with an R in the middle.

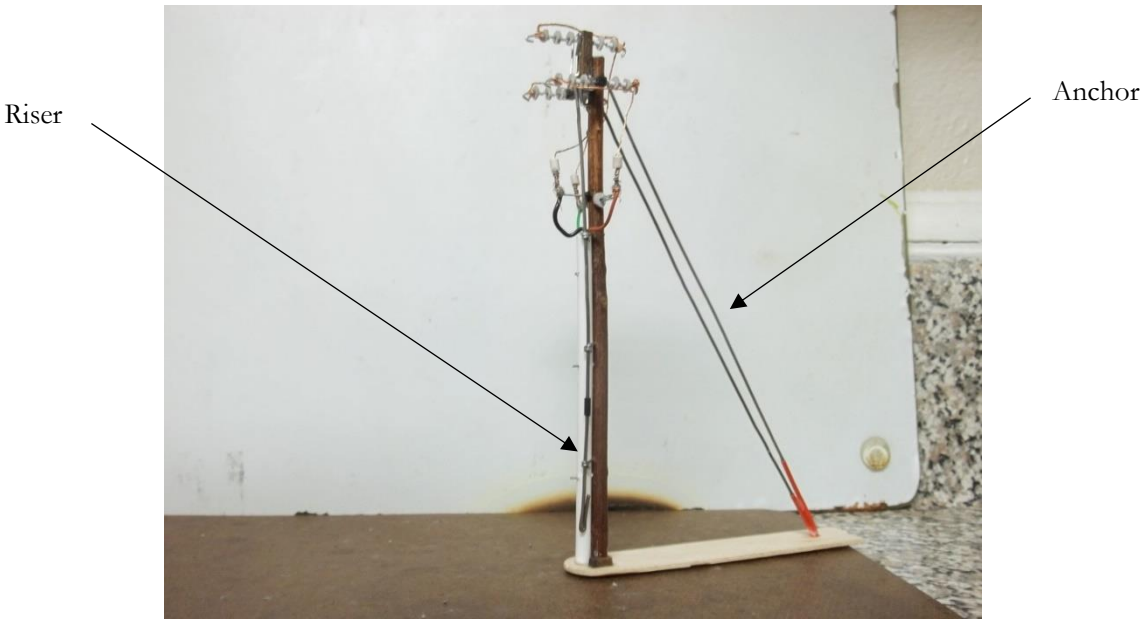


Figure 1.2.2.1: Model of pole with riser and anchor

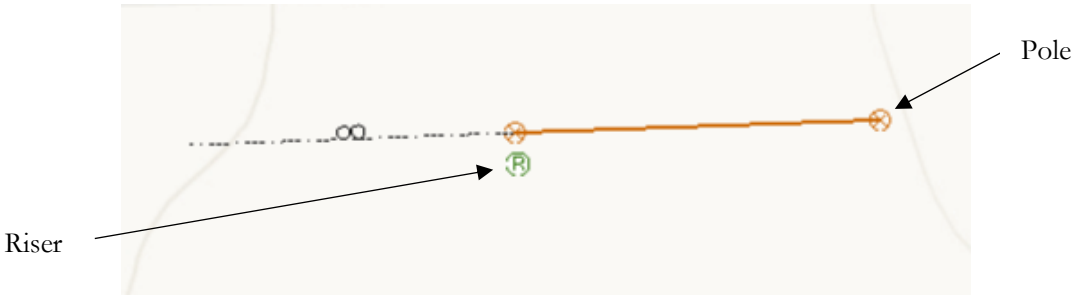
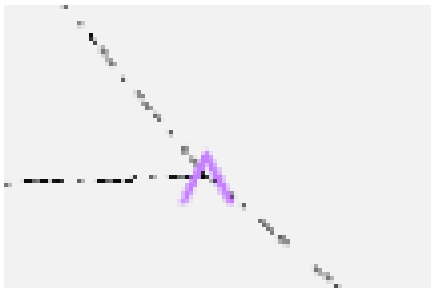


Figure 1.2.2.2: 3-GIS poles and risers

1.2.3. Structures

1.2.3.1. Just as strands run in between poles, conduits run in between 'structures' underground. There are four main types of structures: pedestals, utility boxes, large hand-holes, and small hand-holes.

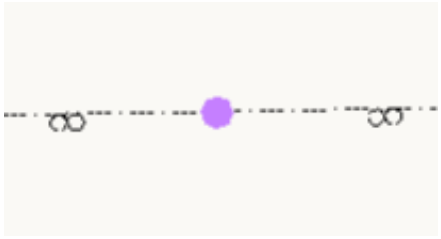
=



=

Pedestal: Used anywhere there is an underground terminal (see section 1.2.6).

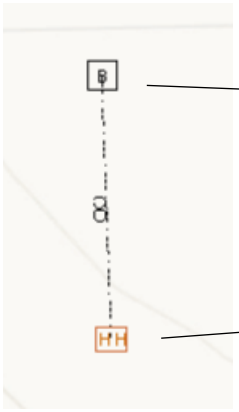
=



=

Utility box: Used as an access point to conduit. Placed adjacent to parcels. Drop fiber is run from each house directly to a utility box to connect them to the network. Also known as flower pots, (or FP).

=



Small Hand-hole: Used when conduit takes a sharp turn. Also seen as SHH.

Large Hand-hole: Used anywhere there is an underground 2x8 splitter or Large Splice Case, (see section 1.2.6). Also seen as LHH.

Figure 1.2.3: Underground Structures

1.2.4. Fiber Cable

1.2.4.1. If conduit and strand are the skeleton of the network, then fiber cable is the nervous system. A single optic fiber services exactly one address, or 'pass' (applies mainly to residential houses and small businesses). Several fibers bundled together make up a fiber

cable. There are three main types of fiber cable: Ring cables, trunk cables, and LCP cables. See section 1.2.9 for more detail. Fiber cables can be underground (UG) or aerial (AE), and run through conduit or on strand, respectively. Every cable has a specific fiber count associated with it. Large fiber counts (144 or 288 ct) belong to ring cables; smaller fiber counts (24 and 48 ct) belong to LCP and trunk cables. UG cables are colored red on 3-GIS; AE cables are colored blue on 3-GIS.

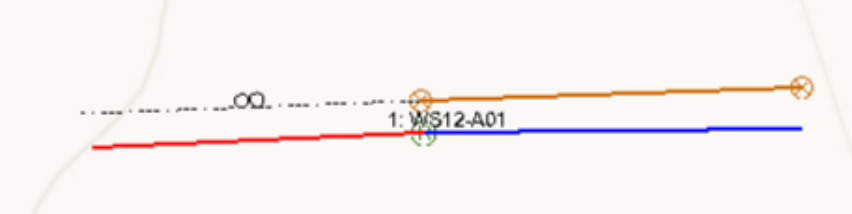


Figure 1.2.4: AE and UG fiber cables

1.2.5. Fiber Equipment

1.2.5.1. There are two main types of fiber equipment that are discussed in this manual: 1x4 splitters and 2x8 splitters. 1x4 splitters take one fiber and split it into 4 fibers. Terminals contain up to three 1x4 splitters, (see section 1.2.6). 2x8 splitters act in a similar fashion, providing eight outgoing fibers. Fiber equipment should always be located underneath a splice closure on 3-GIS.

Figure 1.2.5: Fiber Equipment

1.2.6. Terminals

1.2.6.1. Terminals are fiber endings located inside pedestals (UG) or on poles (AE). Terminals contain either one, two, or three 1x4 splitters. In the three splitter case, terminals take three fibers from a cable and split them into 12 fibers that run directly to customers. Essentially, one terminal provides for up to 12 passes at max. Green 1x4 'terminal' boundaries are drawn around the 12 passes that belong to one individual terminal.

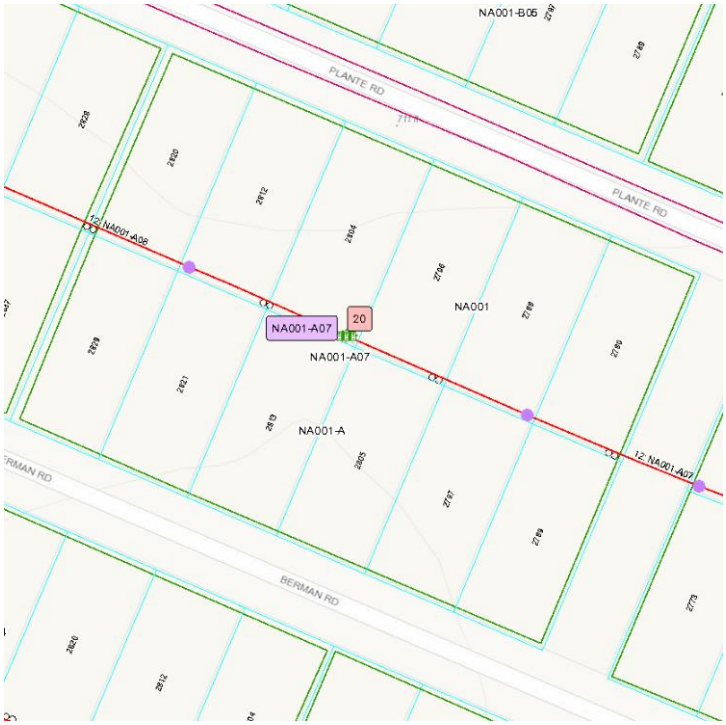


Figure 1.2.6: NA001-A07 terminal inside its terminal boundary

1.2.7. Splice Closures

1.2.7.1. A splice in telecommunications is essentially a junction of fiber cable. At splice points on cables, splice closures are placed in the field. There are three types of splice closures: terminal splice closures (green), 2x8 splice closures (red), and Large Splice Closures (LSC), (pink). 1x4 splitters will always have a green terminal closure placed over it on 3-GIS, and 2x8 splitters will always have a red 2x8 closure placed over it. The pink LSC's are usually placed at junctions involving ring and trunk cables. The general flow of cables starts at LSC's to 2x8's to terminals, (see section 1.2.9). Terminal splice closures are denoted on 3-GIS in one of three ways, depending on if it has one, two, or three 1x4 splitters underneath it.

Figure 1.2.7: (from left to right) 01 – 1x4 Terminal, 02 – 1x4 Terminal, 03 – 1x4 Terminal, 2x8 Splice Closure, LSC

1.2.8. Market Layout

1.2.8.1. New cities where Metronet plans on building are known as new 'markets.' Each market is broken into several smaller pieces, known as LCP's (Local Control Points). Each LCP is serviced by multiple 2x8 splitters. In a similar way to how a terminal boundary is drawn around the 12 passes serviced by a given terminal, red 2x8 boundaries are drawn around the eight terminals serviced by any given 2x8 splitter, (see section 1.2.9). Within each 2x8 boundary is up to eight individual terminal boundaries. Within each terminal boundary is up to 12 individual passes, which is the smallest unit of 'service', so to speak. Each pass resides within a parcel, denoted by light blue lines on 3-GIS, (see section 1.2.10). In general, serviced areas are broken down as so: Market → LCP → 2x8 boundary → 1x4 (terminal) boundary → Parcel → Pass.

1.2.8.2. Naming conventions for these items follow a logical path along this line. Markets are abbreviated with two letters, (Ex: Davenport is abbreviated as DV). LCP's contain the markets abbreviation and a number, (Ex: DV004). 2x8's in a given LCP are then lettered; DV004-A, DV004-B, etc. Terminals belonging to a given 2x8 are then numbered; DV004-A01, DV004-A02, DV004-A03, etc. Naming conventions for fiber cables, fiber equipment, splice closures, and structures fall directly out of this pattern.

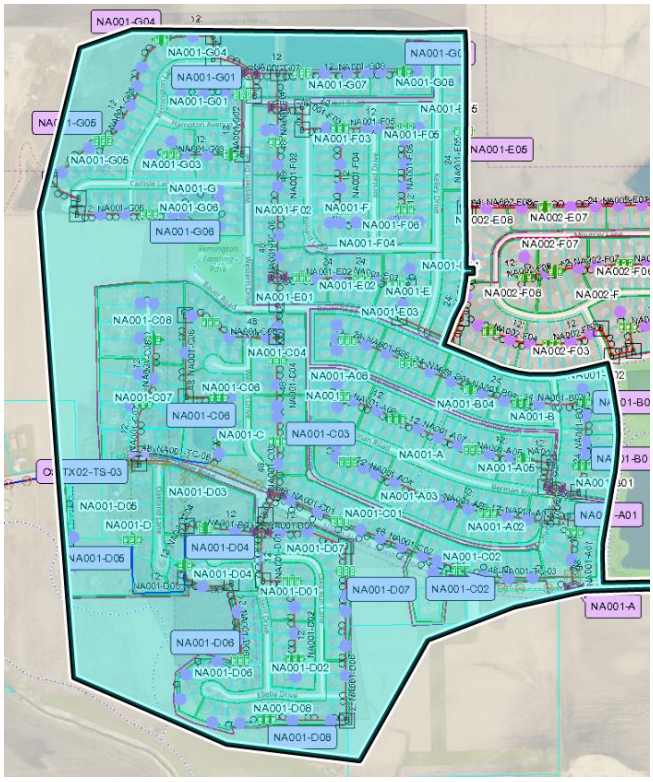


Figure 1.2.8.1: NA001 LCP (North Aurora, IL market)

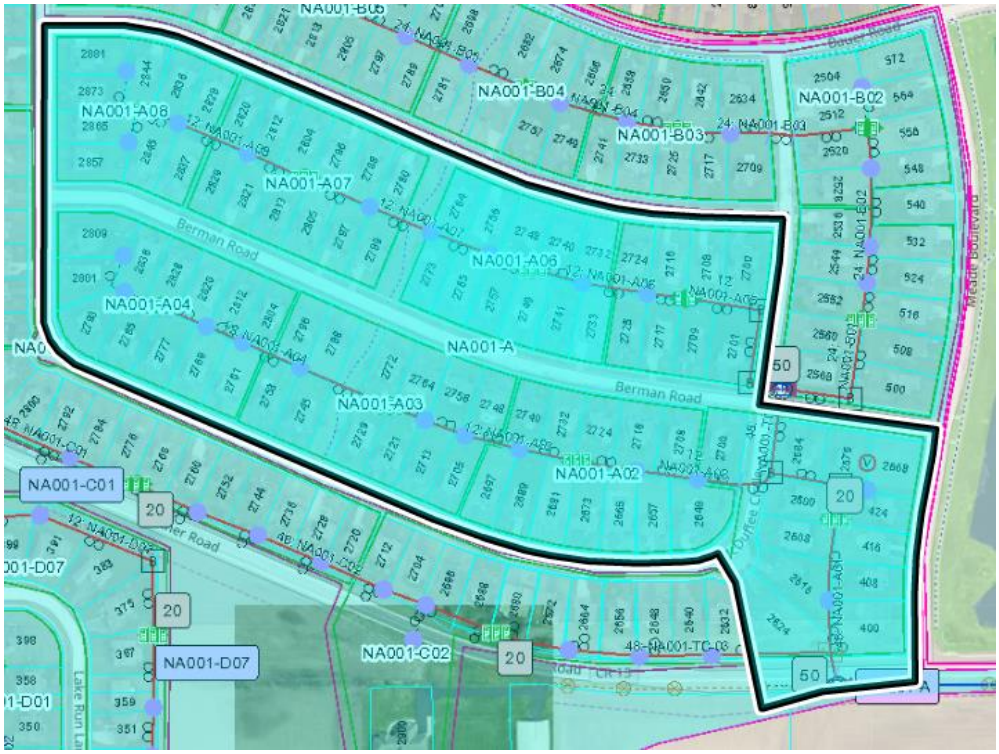


Figure 1.2.8.2: NA001-A 2x8 boundary

Figure 1.2.8.3: NA001-A07 1x4 boundary

1.2.9. Network Distribution

1.2.9.1. In most markets, the light signals that travel down optic fibers to consumers originates from one central location, known as the "Hut" for that market. Connected to the hut are large ring cables that loop around the entire market. These are the backbone cables of the network in any given market. Ring cables can typically be identified by the presence of "FR" in their name, meaning "feeder ring", although ring cables in older markets follow different naming conventions. The figure below shows a map of the Westfield market with its hut and ring cables:

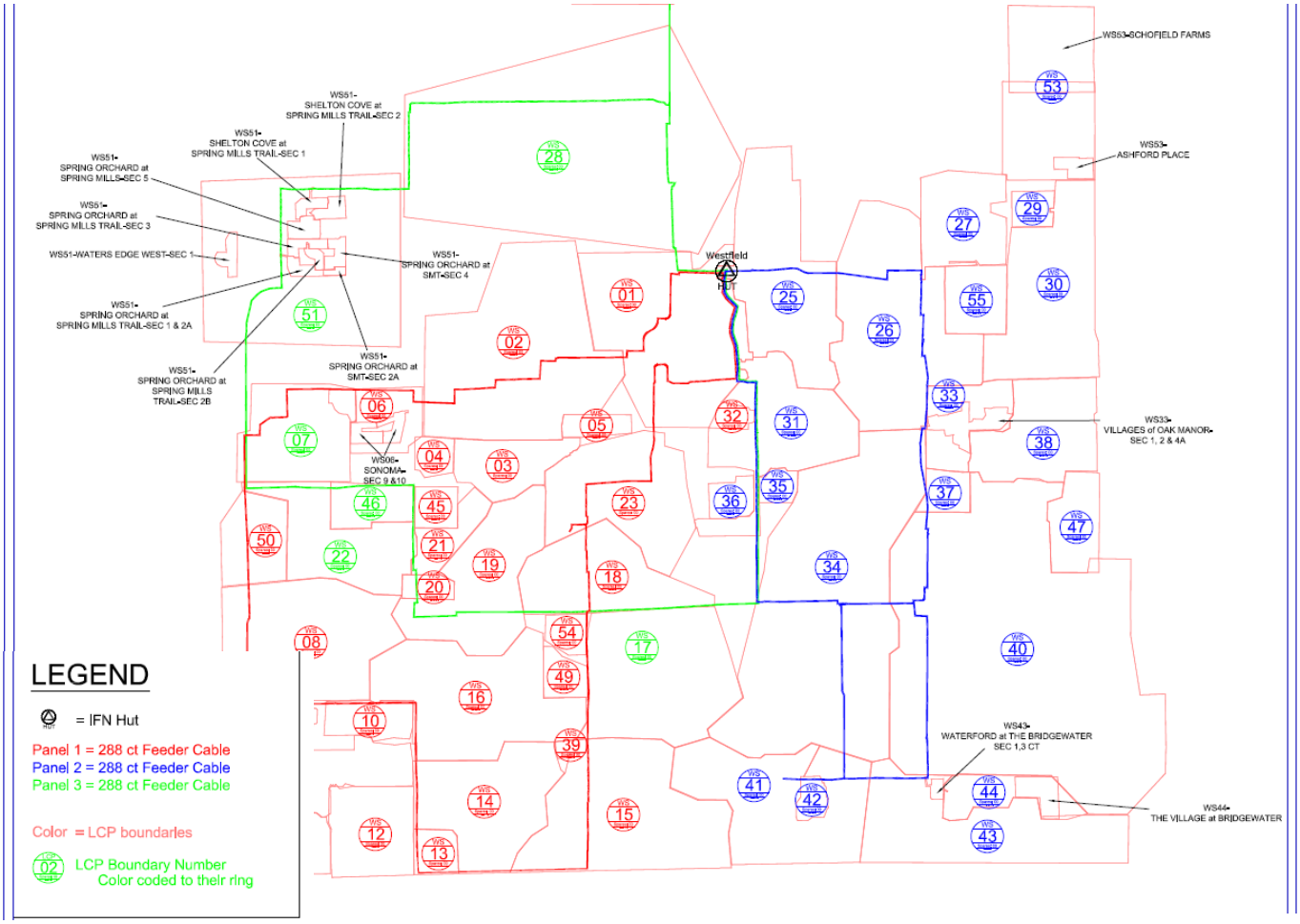


Figure 1.2.9.1: Westfield market Rings

1.2.9.1. Every LCP in a market is connected to a Ring in one or a few locations, typically at LSC junctions. Any fiber cable that branches directly off a Ring, or is somehow involved in connecting an LCP to a Ring, is classified as a "trunk cable", (or "TC"). Fiber cables that run within an LCP and handle network distribution from the 2x8 on down to each terminal

are known as "LCP cables". When any given address signs up with Metronet, a "drop fiber" is run from their address into drop conduit or onto drop strand and eventually reaches the terminal associated with that specific address. Drop fibers are not represented on 3-GIS. In general, the network proceeds as follows: Market Hut → Ring Cables → Trunk Cables → LCP cables → Drop fibers. Any cable that does not fall into one of the categories described above is generally classified as a "TC" cable. The figure below demonstrates this flow:

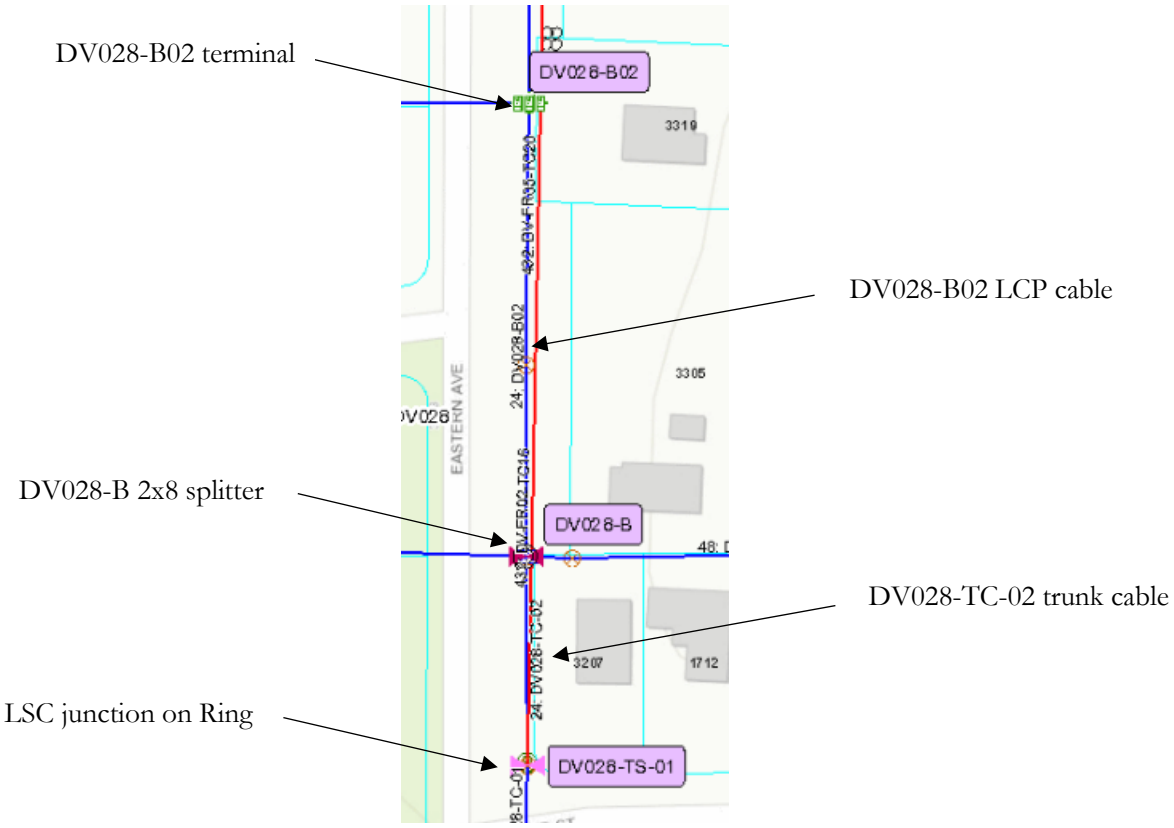


Figure 1.2.9.2: Network distribution DV028

1.2.10. Addresses

1.2.10.1. There are four main types of addresses loaded into 3-GIS during design: Business, Residential, Multiple Dwelling Unit (MDU), and Vacant Lot (V/L). MDU's are not typically serviced by Metronet unless in a special project. Some typical examples of MDU's are apartments, quadplexes, and large residential homes. For the scope of this manual, MDU's are grouped in with residential addresses, even though this distinction is important in other phases of design. Residential addresses are represented on 3-GIS as simple black lettering; businesses are represented as black lettering inside a box; vacant lots are represented by a V inside a red circle. Most residential addresses and small businesses, as well as vacant lots, are

counted as one pass, (or one opportunity for customer sign-up). MDU's and some businesses will have more than one pass per address.

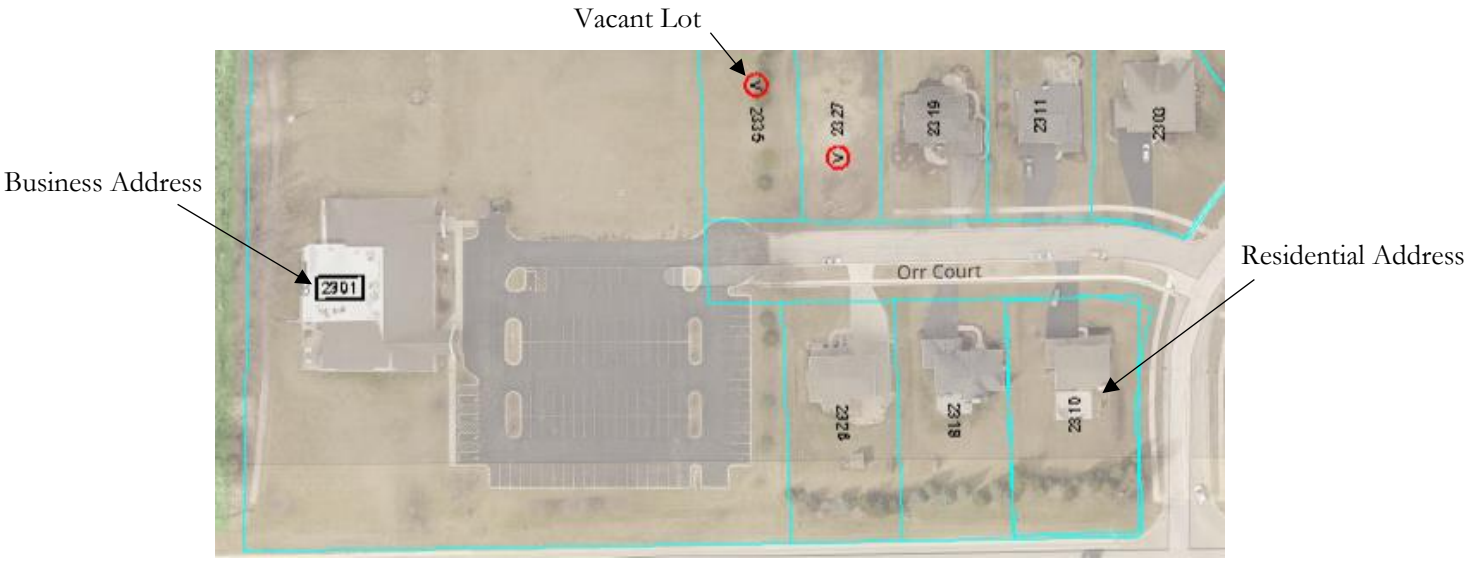


Figure 1.2.10: Addresses on 3-GIS

1.2.11. Miscellaneous

1.2.11.1. Slack loops – When field technicians need to work on a section of fiber cable, whether aerial or underground, it is necessary for there to be slack in the line to allow mobility. Sections of slack cable, known as slack loops, are generally placed on poles or in structures to solve this problem. On 3-GIS, they are typically offset from the actual structure itself, but it understood that they are stored in the structure. Each section of UG cable requires a 20ft slack loop; each AE section of cable requires a 50ft slack loop. Longer cables require an additional 100ft slack loop.

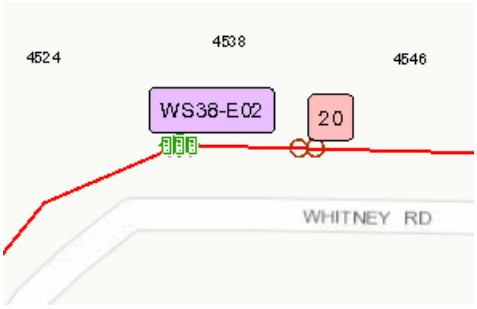


Figure 1.2.11.1: 20 ft of slack loop

1.2.11.2. Excluded Areas – For various reasons, many plots of land in a market are sometimes "excluded" from design or construction. This may be due to a high cost to build, a lack of interest in the area, or an MDU-type section of buildings that Metronet does not design to. Excluded areas are denoted on 3-GIS by hatched out areas, as shown:

Figure 1.2.11.2: Excluded areas

1.3. Basics of 3-GIS

1.3.1. Login and starting up

1.3.1.1. The website for accessing 3-GIS is located at https://arc-gis.metronetinc.com/3gisweb/ (as of 8-8-2018). Bookmark this website. Sign in using credentials. Choose Telecom_Production to open the GIS map.

1.3.2. Layout

1.3.2.1. In the default screen that loads, the navigation tools are located in the top left corner. The toolbar with all the important editing features is located along the bottom of the screen. The zoom scale, comments bar, and commit button are located at the top of the screen. The menu and table of contents are located in the top right of the screen. A mini street map is located in the bottom right of the screen, (this can be minimized to free up space).

1.3.3. Navigating

1.3.3.1. Use the navigation tools in the top left of the screen to pan and zoom the screen. The scroll wheel on the mouse can be used for easy zooming, (I am not aware of an easy way to pan other than using the pan button in the navigation tools, although this would be nice).

1.3.4. Table of Contents

1.3.4.1. Hover and click on the small Earth icon in the top right of the screen to open the table of contents. The default window that drops out shows all of the current layers, (Telecom_Production and World Topography). Press the small green plus sign in the top right of this window to view more available layers. Press the Layer List button (three horizontal dashes), to return to the default screen. The visibility of each layer can be adjusted by moving the appropriate slider on this screen. Press the settings icon on any given layer to view its properties, (this is especially important on the Telecom_Production layer). Shown below is the settings window of the Telecom_Production layer:

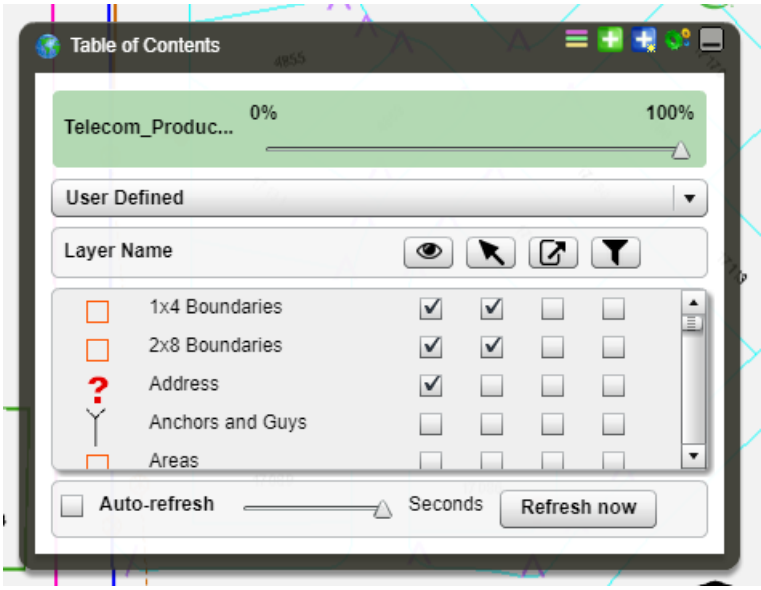


Figure 1.3.1: Layer settings menu

1.3.4.2. This is where the visibility and "selectability" of all fiber production materials are located. The first column of check boxes determines if a particular item is visible on screen; the second column determines if a particular item is selectable. A good default for these settings is to have all of the items discussed in section 1.2 to be visible and selectable, (addresses should only be visible, not selectable). Once skill and pattern-recognition with these items is acquired, it may be easier to have visible and selectable only those items

which are necessary for a given task. The table below provides a good default setting for all of these items:

Item	Visibility	Selectable
1x4 Boundaries	✓	✓
2x8 Boundaries	✓	
Address	✓	
Conduit	✓	✓
Excluded	✓	✓
FiberCable	✓	✓
FiberEquipment	✓	✓
LCP Boundaries	✓	✓
Parcels	✓	
Pole	✓	✓
Riser	✓	✓
Slack Loop	✓	✓
SpliceClosure	✓	✓
Strand	✓	✓
Structure	✓	✓

Table 1.3.1: Default Telecom_Production Settings

1.3.5. Layers

1.3.5.1. The default layers in 3-GIS are the Telecom_Production layer, which contains all fiber production equipment, and the World Topography layer, which is a mostly blank layer showing roads and road names. Two more very useful layers are the Open Street Map (OSM) layer, which is similar to the World Topography layer, and the World Imagery ESRI layer, which is a Google Earth satellite view of the map. To add these layers, press the green plus icon in the top right corner. Find and select the new layers in the drop down menu, and press the larger green plus icon; the new layers are now visible on the Layer list screen. It is very useful to use a combination of these layers for the best results. Below are examples of these layers on screen, as well as a recommended combination of layers:

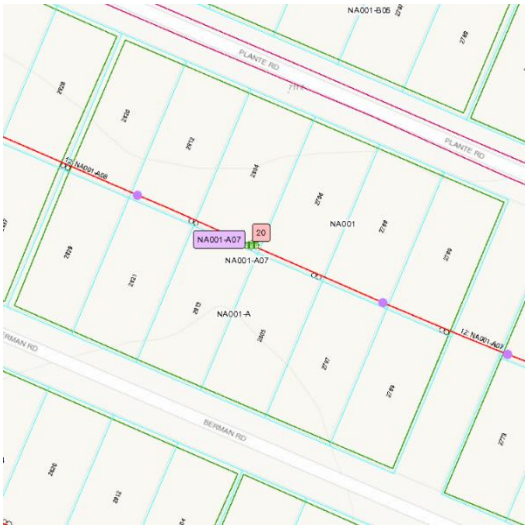


Figure 1.3.2.1: World Topography

Figure 1.3.2.2: World Imagery ESRI

Figure 1.3.2.3: World Imagery ESRI and Open Street Map

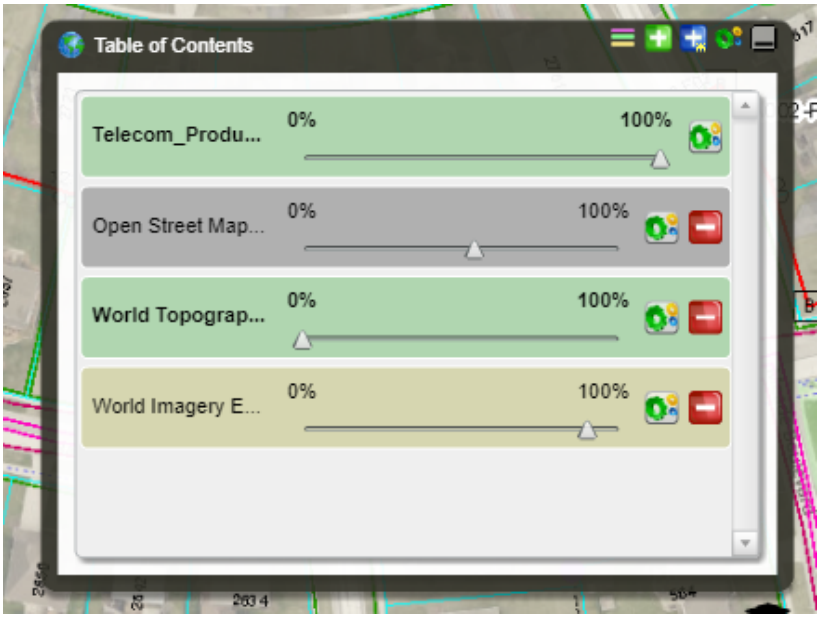


Figure 1.3.2.4: Recommended Layer Combination

1.3.6. Find Tool

1.3.6.1. The first icon on the left in the toolbar, located at the bottom of the screen, is the find tool. The find tool is most useful for seeking and zooming to target LCP's. To search an LCP, in the "Layers" field, click Areas. In the "Fields" field, click Area Name. Then, type in the name of any given LCP (ex. DV004) and press the binoculars icon. A Results table will pop up with all the items that matched your search. Click on the appropriate area name and hit zoom to bring the LCP into view. The find tool also works with other production items in a similar manner.

1.3.7. Select Tool

1.3.7.1. The second icon from the left in the toolbar is the select tool. Use the arrow icon on the select tool window to click and drag an area of selection on the map screen. All available items in this selection area will become available for viewing in the results table that pops up. To clear the selection, press the blue clear button on the selection tool window. Change the "Action" field to "add" in order to continue selecting new items while retaining old selections. One of the most useful features of the select tool is the selection set geometry tool. To select all of the items in a given area (ex. LCP boundary), first make sure that boundary has been selected. Then press the selection set geometry icon and choose that boundary from the drop down menu. The system can select up to 2000 items at once, but

takes longer for larger selections. This tool can also be used in creative ways with cables and running lines to select all of the structures or poles attached to a given cable.

1.3.8. Query Tool

1.3.8.1. The fourth icon from the left is the query tool. The query tool is a more powerful version of the find tool. With the query tool, one can search for specific items that meet given conditions defined in the arguments field. One might use the query tool to search for all fiber cables with a name that is like a given LCP's name in order to select all LCP cables within that LCP. Using the query tool in combination with selection set geometry provides many ways to mass-select items rather than searching out each individual item.

1.3.9. Edit Tool

1.3.9.1. The seventh icon from the left is the edit tool. The edit tool works very similarly to the select tool, except it has options for moving, creating, deleting, and reshaping features on 3-GIS. Here are the most common edit tools and how to use them:

Feature	Icon	How to Use	Common Use
Reshape	Black jagged arrow	Highlight an area; select reshape feature; highlight desired item; move vertices; double click to finish; commit changes	Move running lines/cables through a different route; resize/adjust terminal boundaries
Move Coincident	Green line with blue indicator	Highlight an area; select move feature; highlight desired item(s); CTRL click multiple coin. items; move vertex; double click to finish	Pick up splice closures/ fiber equipment/structures/cables and move to new location
Split Linear	Disconnected black line	Highlight an area; select split linear feature; draw line across desired split point; commit changes	Split long conduits/strands into smaller sizes; splitting fiber cable in order to change from UG to AE or vice versa
Merge Linear	Red-Blue line with a plus	Highlight an area; select merge linear feature; highlight desired item(s); choose the two items to merge in merge window; commit changes	Undo actions listed in the split linear section
Create Feature	Rest of edit window	Choose feat. type; choose proper subtype; fill in all attributes according to naming conventions; click on screen to place; commit changes	Place new structures/conduits that were placed during field work, but not during original design

Table 1.3.2: Edit Feature Tools

1.3.9.2. Snapping Items – In order for items to snap to one another, each item must be selected before using an edit tool. Example: To snap a vertex of a conduit to a utility box, first use the arrow select tool to highlight both the conduit and the utility box. Then, use the reshape feature to highlight and select the conduit. Finally, snap the vertex of the conduit to the utility box, double click, and press the green check mark to commit.

1.3.9.3. Creating Items – Every feature on 3-GIS, whether a structure, fiber cable, conduit, etc., has certain attributes that must be filled out before placed. Reference the naming conventions packet provided separately to properly fill out these attributes before creating and placing any feature. Note: Many features already placed on the map do not follow the most recent naming conventions, if any. However, all new features should be placed with respect to the current naming convention standards.

1.3.10. Results Table

1.3.10.1. Anytime any feature is selected, a results table will pop up on screen. The left-hand column of the results table provides a categorized list of all features that are currently selected. Right-clicking on a specific feature (ex. A conduit), provides an alternate method of editing that feature. The right-hand column lists all of the attributes of a selected item, including its name, type, account code, and creation/editing data. The fields in the attributes column will vary depending on the feature type.

1.3.11. Results Analysis Table

1.3.11.1. The twelfth icon from the left on the toolbar is the results analysis table. The results analysis table is a more detailed version of the results table. Using the drop-down menu from the results analysis window, a certain feature type can be selected and viewed in a table. Pressing the small 'select all' box indicated in the figure below selects all of the items of the current feature type, (conduit in this case). Using the Field and Value drop down lists (indicated below), a mass-update can be performed on a certain attribute of all like features in a given selection area. This tool is very useful when used in combination with the selection set geometry tool. Using the selection set geometry tool, all of the features within an LCP can be selected. From the results analysis table, all of the conduit in the LCP can be selected at once. Then, the inventory status code of all the conduit can be entered as "As-Built" and mass-updated by clicking the "Enter" button indicated in the figure below:

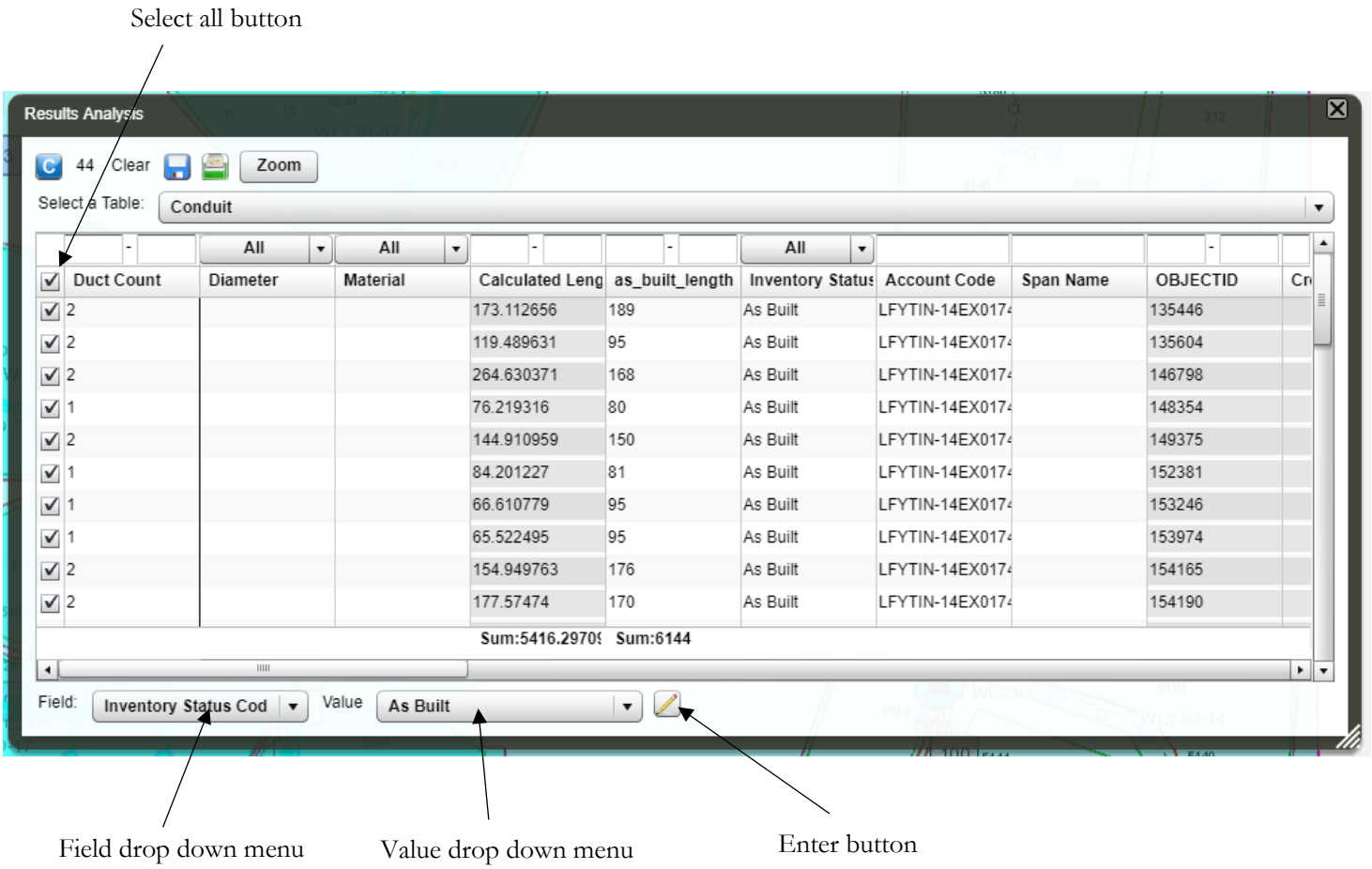


Figure 1.3.3: Results Analysis Table

1.3.12. Plotting Tool

1.3.12.1. The sixth icon from the left is the plotting tool. The plotting tool is used to generate pdf drawings of the LCP's, or areas shown on screen. Any desired template can be chosen from the template drop down menu. Then, after checking the "plot at scale" box, a scale value can be entered into the box. This value can be estimated from the zoom scale shown at the top of the screen, although often times the value to be entered varies from this zoom scale depending on the type of plot. Before plotting, it is often desirable to zoom to the given LCP so that it is prominent and center on the screen. The plotting tool essentially takes a screenshot of what is shown on screen and prints to a pdf following the chosen template settings.

2. Metronet Design Process

2.1. OSP Fiber Design Overview

2.1.1. General

2.1.1.1. All of the work completed by the OSP (Outside plant) Design department comes in the very early stages of telecom production. Once the company has performed market research and set new business models, new markets are passed into the design phase. Currently, new market designs are outsourced to Cyient, a large contracting company. Cyient places all of the equipment and routes all of the running lines and cables in 3-GIS in a rough draft implementation of Metronet's network in a new market. These drafts come back to Metronet in the OSP Fiber Design department for revision and continuation in design.

2.1.2. Design Tasks

2.1.2.1. It is the department's responsibility to generate construction drawings and a bill of materials for each LCP in a new market for cost analysis and permitting. These completed designs will eventually be released for construction. The department continues to track the construction of each LCP until they are complete. Upon completion, the field sends back documents outlining any changes to the designs that were made during construction. These documents are known as "as-builts". It is the final responsibility of the OSP Design department to update 3-GIS with the changes outlined in the as-built documents. The figure below outlines the workflow of the OSP Design department.

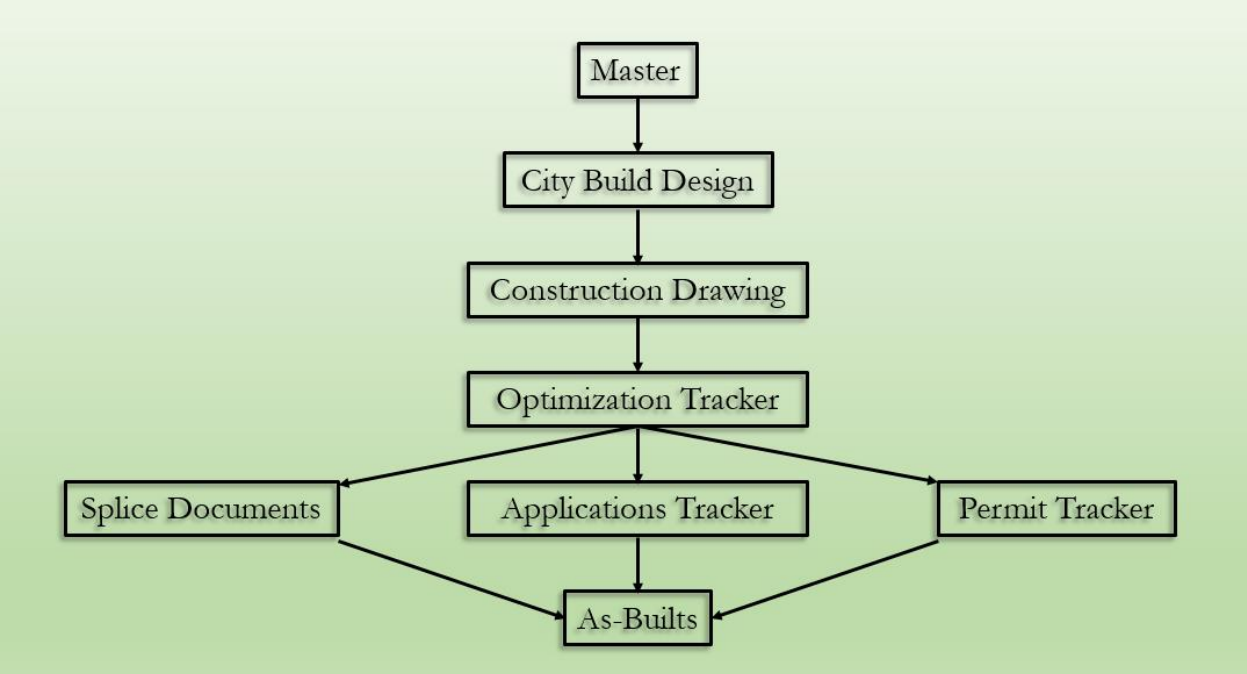


Figure 2.1.1: OSP Design Workflow

2.1.3. As-Builts

2.1.3.1. In the past, it has been the responsibility of interns to complete and document as-built tasks on 3-GIS and footprints. This process will be explained in further detail in sections 3 and 4 of this document. As of June this year (2018), there was a backlog of roughly 400 as-built tasks to be completed. In an effort to greatly reduce this number, many of these tasks were outsourced to Cyient for completion, and then processed in house for quality control and closing out. The completion of these as-built tasks is not vital to the forward momentum of the company, but it is certainly necessary and important to the company as a whole.

2.2. Types of Projects

2.2.1. General

2.2.1.1. Every area that Metronet designs to and services is categorized as one of four different project types during design: city build, expansion, joint trench, or cables and terminals. Each project is then assigned a project code based on its project type. This project code is unique to that area and is stored in 3-GIS on most features in that region as the 'account code'. The naming convention for project codes has changed over the years, and is still subject to change.

2.2.2. City Build (CB)

2.2.2.1. By far the most common type of project is the city build. In every new market, the vast majority of the original design for that market is categorized as a city build. Most LCPs within a single market will share the same city build project code. City build projects can be identified by the presence of a "CB" somewhere in the project code.

2.2.3. Expansion Projects (EX)

2.2.3.1. After a city build design has been completed, new areas around an LCP that were originally excluded or not designed to will express interest in Metronet's services. These new areas are labeled as expansion projects. Expansion projects are usually much smaller than an LCP, sometimes even just a small subdivision. They usually cluster together geographically, are named after the group of buildings or location, and are then broken into different sections with different project codes. Expansion projects can be identified by the presence of an "EX" somewhere in the project code.

2.2.4. Joint Trench Projects (JT)

2.2.4.1. In areas where cities are currently building, or plan on building, new sections of homes or buildings, Metronet will take up a joint trench project in the area. In joint trench projects,

Metronet bores out trenches and places conduit, along with other companies, before any roads, sidewalks, or homes have been built in that area. Joint trench projects can be identified by the presence of a "JT" somewhere in the project code.

2.2.5. Cables and Terminals (CT)

2.2.5.1. After a joint trench project has been completed, it will move toward a cables and terminals project. Cables and terminals projects are essentially the rest of the joint trench project. This is where cables are pulled through existing conduit and terminals are placed along the way. Cables and terminals projects can be identified by the presence of a "CT" somewhere in the project code.

2.3. Important File Locations

2.3.1. General

2.3.1.1. This section provides an overview of all the important file locations for starting off and for the completion of as-builts. All share drives are located on the network 'share.ad.qservco.com'. This is the assumed starting location for all paths discussed here. The main share drives covered in this section are the metronet and metronet tech share drives.

2.3.2. Metronet Share Drive

2.3.2.1. The main important folder located in the Metronet share drive is the 'Cinergy Metronet_FTTP' folder, (this folder from here on out will be referred to as the "FTTP drive"). Within the FTTP drive is a list of folders for all the current markets of Metronet, (preceded by CMN –FTTP). Each market folder has a similar setup. Three significant folders within each market folder are the As-builts, Documents, and Other Design Maps folders. When searching for any kind of as-built documentation, it is sometimes helpful to check within the As-built or Documents folder for any stray documents, (the main as-built location will be discussed in section 2.3.5). The Other Design Maps folder will contain an LCP tracking map, which shows the hut and ring locations for a given market.

2.3.3. Metronet Tech Share Drive

2.3.3.1. Within the Metronet Tech drive, (just as in the Metronet drive), there are many random and stray files and folders laying around. The only important folder for as-built documentation is the MNT Projects folder

2.3.4. MNT Projects

2.3.4.1. In the MNT Projects folder, similarly to the FTTP drive, is a list of folders for all current markets. Within each market folder are the following folders: Field Engineering, OSP Design, Proj Controls. Construction drawings for all LCPs within a market are located in the OSP Design folder. Outside of the market folders are several project folders for individual projects in different markets, primarily Lafayette and Westfield. These folders are named by project code followed by the name of the project, (ex. WSFDIN-15EX0311 Spring Mill Park). Checking within the Engineering and Construction folders inside each project folder is a good way to check for more stray as-built documentation.

2.3.5. Redlines Folder

2.3.5.1. The most important folder for as-built documentation is located in the AS-BUILTS-REDLINES-CITY PERMITS folder inside the MNT drive, (this will be referred to as the "redlines folder"). This is a good folder to add to the desktop, because it will be used frequently. The vast majority of as-built documentation is (and should) be located within the redlines folder, (the term "redlines" is often used interchangeably with "as-built", more on this in section 4). Redlines are categorized first by state, then by market (city), and finally by LCP. An example: as-built documentation is desired for the city build project in WS38. First, navigate to the MNT projects folder from the metronet tech drive, and then to the redlines folder. Since WS38 is a Westfield LCP, navigate to the Indiana redlines folder, then to the Westfield folder, and finally to the WS38 folder. Any as-built documentation for any projects in WS38 should be located here.

2.3.6. Construction Reports

2.3.6.1. An important part of tracking as-built tasks is updating its construction status on Footprints, (see Section 3). The project coordinator for Metronet is responsible for sending out a weekly excel sheet containing a construction report of all past and ongoing projects. It is important for completing as-built tasks that the reader is signed up to receive these weekly emails from the project coordinator. On a construction report, the second sheet on the excel document provides a construction release schedule for all projects. This sheet contains the important information for properly updating a project's construction status.

2.3.7. Footprints As-Built Reports

2.3.7.1. Another important part of tracking as-built tasks are the daily as-built reports sent out by Footprints, (section 3). Two excel sheets are sent out daily with updated lists of completed as-built tasks and active as-built tasks, respectively. These lists pull useful information for each as-built task from Footprints and summarize them in an excel

spreadsheet. The reader should be signed up to receive these reports, should they be responsible for updating as-built tasks.

3. Footprints Task Tracking

3.1. General

3.1.1. Footprints

3.1.1.1. Footprints is a work management software that stores and tracks data on all 'tasks' used by the company. It is also used for automated workflows, emails, and ticket routing. As of the writing of this manual, the address for accessing footprints is located at footprints.qservicesco.com/MRcgi/MRentrancePage.pl. Bookmark this website, as it will be used frequently. Use network credentials to log in.

3.1.2. Types of Tasks

3.1.2.1. Every task has a type and a subtype, depending on what department and what project is being worked on. As tasks are created, they are assigned a task number. Each LCP city build has a set of tasks that fall under a 'master task'; these tasks follow the OSP Design workflow shown in Figure 2.1.1. As a city build project is carried out in the OSP Design department, each successive task in the workflow is updated and closed on Footprints. The project is in its final stages when it reaches the As-Built Update task. Closing off the as-built task will close off the master task for that project.

3.1.3. Navigation

3.1.3.1. The default screen after logging in is the home screen. This shows all of the assigned tasks to the current user. Hitting the home button at the top left of the screen will return the user to this screen. The search box at the top of the screen will be used to navigate to any desired task. The new task button (next to the home button) can be used to create new tasks (section 3.5). Any other capability of the website is beyond the scope of this manual.

3.1.4. Time Tracking

3.1.4.1. The OSP Design department uses Footprints as a method of tracking and recording not only the progress of projects, but also the amount and distribution of work hours spent by all associates. Whenever a project is being worked on, it is important when the user goes into Footprints to update their progress, that they also log the amount of time spent on that task in the time tracking field. The amount of time logged in Footprints for each associate should be close to 40 hours per week. Every piece of work that an associate completes is logged in some fashion on Footprints, (excluding lunch and bathroom breaks).

3.2. As-Built Tasks

3.2.1. General

3.2.1.1. From this point forward, it is assumed the reader has a general understanding of all the concepts discussed in sections 1 and 2. This section deals with many concepts discussed in section 4 regarding the documentation of as-builts. It is advised that section 3 and section 4 be viewed together for a full understanding. This section provides a thorough description of all the current fields contained within a Footprints As-Built Update subtype request. Note: these fields are subject to change as the needs of the company change. WS28 will be used as an example to demonstrate the task fields.

3.2.2. Basic Task Information Fields

3.2.2.1. **Title** – This field generally contains the LCP name of the current as-built (WS28). If the project is not a city build, the title will usually be the name of the LCP followed by the name of the project (WS28 – Grand Park Fieldhouse). If there is more than one project per LCP, it is important that the title be labeled appropriately. In the case of WS28, there is a city build task and an expansion project. So the two tasks should be labeled WS28 – City Build and WS28 – [expansion project name], respectively. In an ideal world, every task created insofar would be labeled this way; however, this is often not the case. Oftentimes, city build tasks and expansion tasks are used interchangeably, causing confusion on what as-builts have been received and what hasn't, what has been completed and what hasn't been started, etc. In many cases, there are duplicate tasks for the same thing, or some projects aren't labeled with an LCP name at all. All of these issues are due to a lack of standard procedure for naming tasks on Footprints. The goal of this manual is to provide a standard for all future as-built tasks.

3.2.2.2. **Status** – This field reflects what state the task is in: Open → not currently being worked on; Working → in progress; Closed → task has passed through QC. There is not much reason to use the other choices.

3.2.2.3. **Request Type / Subtype** – These should always show OSP-Design and As-Built Update, respectively, for as-built tasks, (some may have OSP-CADD; OSP-Design is the desired type.)

3.2.2.4. **Work Classification** – If the project is a city build project, then this is City Build Work; this is Non-City Build Work for any other type of project.

3.2.2.5. **Project Code** – This is where the project code for each task should be stored. This will also reflect the type of project the task is, (city build, expansion, etc.).

3.2.2.6. **Market / LCP/Route** – These fields should reflect the city and LCP name of the given project.

3.2.2.7. **Pass Count / Vacant Lots** – These fields should already be filled in. They can also be pulled from the construction report most of the time. Optional.

3.2.2.8. **UG or AE** – This field was created to document the type of cables in Westfield for reporting to Duke Energy. Optional at this time.

3.2.2.9. **Due Date** – This field is generally left blank for as-built tasks.

3.2.2.10. **Priority / Revision** – Priority is generally set to "3" and Revision is set to "No" for as-built tasks.

3.2.3. Issue Information Fields

3.2.3.1. **Dates** – 'Work Started' should reflect the day someone began working on the as-built task. 'Work Completed' should only be filled out the day the as-built has passed QC.

3.2.3.2. **Outsourced** – This field is set to "Yes" when the as-built is sent to Cyient for completion, and "no" otherwise. When it is set to yes, five more fields appear; the only two that need to be filled out are "Contractor → Cyient" and "Work Order Requested? → Yes".

3.2.3.3. **Construction Status** – This field should reflect the status of the LCP on the construction report, (see section 2.3.6). On the Construction Release Schedule sheet in the "Total % released" column, if there is a 100%, then the construction status is "Fully Released"; if there is any number between 0-100, then the construction status is "Partially Released". If there is a 0%, but as-built documentation has been received in the redlines folder, then there is clearly a contrast: how can there be as-built documents for an LCP if it hasn't even been constructed yet? While there is not a clearly justified solution to this problem as of the writing of this manual, it is practice to just label the LCP as "Bored Out" to show that at least something has been done. If an LCP or project cannot be found on the construction report (CTRL+F is a good friend here), then the construction report status should be entered as "Unknown". As of the writing of this manual, there is no consistent way to determine if the cables have been pulled through conduit or placed aerially. The Construction Status Date should be the last date that the construction status was verified.

3.2.3.4. **As-Builts Received** – This field provides information on how thorough any received as-builts from the field are. This is another gray area where no clear definition existed as to what defines a "full as-built." This manual will attempt to construct this definition. Field workers are able (and should) record the amount of conduit/strand they use per each section, what path these running lines take, any changes to the placement of equipment, and

the fiber 'markers' along the cable as it is placed (these are simply markings to show where in a roll of cable the current section is; commonly referred to as fiber footages). If an as-built contains all of these qualities, then the As-Builts Received field should be marked as a "full as-built". If the as-built has only fiber footages, but no conduit/strand footages or paths (redlines), then it should be marked as "splicing redlines only". If it has only conduit/strand footages and redlines, then it should be marked as "conduit/strand redlines only", (if these redlines themselves are incomplete, then it should be marked as "partial redlines"). If the as-built was not checked thoroughly for these conditions, then it is left as "Yes-not reviewed for completeness". If no as-built documentation whatsoever has been received, then it should be marked simply as "No", (it should never be left as "no choice"). The Date As-Builts Received field should be entered as the date in the redlines folder when the latest as-built document from the field was uploaded to the folder.

3.2.3.5. **As-Built Update Status** – This field provides a more thorough description of the progress of work on the as-built itself. If work on the as-built has not started, it needs to have a reason, whether that be it is missing as-built documents, it is not completely constructed, it has projection issues (see section 4), Cyient has sent it back, or it simply has not been approached yet. If work on the as-built is in-progress, if it has been completed but needs QC, or if it has passed QC, then this field should reflect that state appropriately. The As-Built Update Status field should align with the Status field in the basic information section; if the task is open, then the as-built update status should be "not started" or "on hold" in some fashion; if the task is working, then the as-built update status should be "in-progress" or "completed, ready for QC"; if the task is closed, then the as-built update status needs to be "Passed QC", (or "no choice" if the task was cancelled).

3.2.3.6. **Inventory Status Updated** – This field reflects the state of the inventory status code of all items in an LCP or project area (as will be discussed in section 4). If all items in an area on 3-GIS have been updated to say "As-Built", then this field should say "Yes"; if not, then it will say "No." In order for a task to be closed and passed QC, this must say "Yes".

3.2.3.7. **GIS System** – As of the writing of this manual, the GIS system should always be "3-GIS".

3.2.3.8. **Issue Info. Updated** – This field reflects the state of the Footprints task itself. If a project has been cancelled, then this field should say "No – Cancelled". If the current task needs to be closed because it is redundant with another task, then this field should say "No – Cancelled – Duplicate Task". This field should only be changed to "Yes" when everything else in the Footprints task has been completely updated to the best available knowledge.

3.2.3.9. **Splicing Affected** – The state of this field is unknown at the time of writing of this manual.

3.2.4. Time Tracking

3.2.4.1. This field reflects how much time was spent working on an as-built when the Footprints task was being updated. This is a required field. Comments are only viewable by the user to note what they worked on.

3.2.5. Description

3.2.5.1. Any description that has been entered in the past can be viewed here. Any time a change is made while working on an as-built, this change should be noted here so others can see what has been completed. Other important notes and comments about a task should be noted here.

3.2.6. Assignees

3.2.6.1. This field is where all current assignees to an as-built task can be viewed/edited. Many as-built tasks have the assignee "OSP CADD". The "Design – As-builts" team is the preferred assignee here. Double-click on groups/people to assign/un-assign them. Always uncheck the "Send Email to Assignees" box; no one likes spam.

3.2.7. History

3.2.7.1. The history section can be expanded to see what changes have been made to this Footprints task in the past.

3.2.8. Save

3.2.8.1. Always save a Footprints task after changing anything to commit the changes. If an error was made while editing the task, simply close out the window to remove any changes.

3.3. Time-Off / Reporting Tasks

3.3.1. Time-Off

3.3.1.1. As mentioned in section 3.1.4, all associates should enter about 40 hours every week; this includes time-off. A separate task must be created for each individual user to log time spent off work (vacation, family, etc.). Creating tasks is covered in section 3.4. The only update to "time-off" tasks is simply adding in the proper amount of hours that were taken off in the time tracking field.

3.3.2. Reporting

3.3.2.1. Many work-related tasks don't focus on just one LCP or project, but rather moving between several projects and updating/generating reports and lists. For this type of reporting task, if it is involved with As-Builts; time should be logged in task 21515, along with a description of the reporting work that was completed.

3.3.3. Training

3.3.3.1. Time spent in training, in meetings, or in similar work duties should be logged under a "Training" task created individually for every associate, similarly to the "Time-off" task.

3.4. Creating Tasks

3.4.1. General

3.4.1.1. As mentioned in previous sections under Section 3, there are scenarios when tasks must be created. These scenarios include, but are not limited to, time-off tasks, reporting/training tasks, and as-built tasks.

3.4.2. As-Built Tasks

3.4.2.1. Create a new task by pressing the new task button in the upper left corner of the home screen on the Footprints website, and then pressing new task from the drop down menu.

3.4.2.2. Enter the Request Type as "OSP Design" and the subtype as "As-Built Update".

3.4.2.3. Pull the project code, pass count, and vacant lot count from the Construction Report if possible. It might be necessary to pull the project code for some projects from the project code Excel document, or directly off of as-built documents in the redlines folder if a project is not on the construction report.

3.4.2.4. See section 3.2 for procedures on how to fill out all other fields in the As-Built update task.

3.4.2.5. The time tracking data must be entered as "0 minutes" for the creation of the task.

3.4.3. Time-Off Tasks

3.4.3.1. Create a new task (see procedure step 3.4.2.1).

3.4.3.2. Enter the title as something related to time-off, (perhaps just "Time-Off).

3.4.3.3. Keep the status as "open".

3.4.3.4. Change the Request type to "OSP Administration" and the Subtype to "Time-Off". Change Work Classification to "Operations".

3.4.3.5. Enter the Market as "0-Non-Location Request".

3.4.3.6. Enter the Priority as "10" and Revision as "No".

3.4.3.7. Enter proper number of time in the time tracking field. Append a description if necessary to describe what kind of time-off.

3.4.3.8. Assign yourself to the task and uncheck the "Send Email" box.

3.4.3.9. Leave all blank fields as is. Save. Any new time-off can be logged under the same task in the future.

3.4.4. Training Tasks

3.4.4.1. Follow the section 3.4.3 procedures exactly, only changing the Subtype to "Training."

4. As-Builts

4.1. General

4.1.1. About

4.1.1.1. This section assumes the reader has a full understanding of all previously mentioned topics. As mentioned in various sections, as-builts are the final stage in telecom production. While an LCP or project area is being built, it is the responsibility of the field to take notes on several aspects of the building process, primarily recording conduit/strand footages, redlines, fiber footages, and any adjustments to the original design, (see section 3.2.3.4). These notes are recorded on one or several documents (primarily in PDF or TIF file format) and uploaded to the share drive in the redlines folder. The final task of the OSP Design department is to take all changes and footages noted in the as-built documents and make those changes on the 3-GIS software directly. This task, and all associated responsibilities, is covered thoroughly in this section.

4.1.2. Notes

4.1.2.1. In an ideal world, all fiber production equipment and cables would appear neatly and organized on 3-GIS, and all as-built documents from the field would be standardized and predictable, and the task of transferring information from the as-built documents to 3-GIS would be quick and straightforward. However, in the real world, cables and conduits and strands run through houses and building and nothing appears the way it should on 3-GIS. In the real world, not every field worker is the same, and not every field worker is capable of being clear and unambiguous when creating as-built documents. There is no standard for what is included in as-built documents; there is no standard for how as-built documents are completed; there is no standard for how as-built documents are submitted or stored on the share drive. In the future, hopefully such issues may be resolved. But for now, oftentimes it is left to the person reading the as-built documents to make their best guess on what was actually built in the field.

4.2. Completing As-Builts

4.2.1. Active / Closed As-Built Reports

4.2.1.1. Within the Active and Closed As-Built Reports, (mentioned in section 2.3.7), lies all current, active as-built tasks. All as-built tasks on the closed list should show they have either passed QC, or have been cancelled in some way. Any as-built task that has not been started, is in progress, or is awaiting QC is on the active as-built list. No inactive as-built tasks will show up on either list. As soon as all other tasks under the master task for a given LCP have been closed, the as-built task for that LCP will go active and show up on the active list. It is helpful to format these lists as tables in Excel, and then use sort and filter features to quickly sort tasks by categories, (ex. filtering active list alphabetically by "As Built Update Status" to show which tasks are "Not Started").

4.2.1.2. To start working on an as-built, filter by As Built Update Status and choose a task that has received some amount of as-built documents.

4.2.1.3. Open 3-GIS and use the find tool to zoom to the chosen LCP (or project).

4.2.1.4. Locate and open all as-built documents associated with the LCP in the redlines folder.

4.2.2. Common Symbology

4.2.2.1. Dots or circles drawn onto a conduit, or the letters "FP", generally indicate the placement of a utility box. See figure 4.2.2.1.

4.2.2.2. Squares, whether empty or filled, drawn onto a conduit generally indicate a small hand-hole. The letters "SHH" also indicate the placement of a small hand-hole. If these squares are intended to be a large hand-hole, the letters "LHH" will typically appear near the square. If the square is drawn near a 2x8 splice closure, it can generally be assumed that that is simply the new location of that 2x8 and the underlying large hand-hole, not a new hand-hole. See figures 4.2.2.1- 4.2.2.3.

4.2.2.3. Small triangles drawn onto conduit, or the letters "Ped", indicate the placement of a pedestal. Generally, new pedestals are not placed; they are moved around. When there is an indication of a pedestal in a new location, there is generally an arrow pointing from a terminal to that new location; this means the whole terminal (fiber equipment, cables, splice closure, and pedestal included) is to be moved to that new location. See figure 4.2.2.4.

4.2.2.4. Running lines are marked on as-builts with some kind of marker, generally red, green, or yellow, to show the path that was followed in the field. Most of the time, these marker paths, or "redlines", follow the same path as was designed. Sometimes there are multiple colors drawn on the same document. In these cases, one color is typically used to represent the conduit/strand, and the other color is used to indicate the actual fiber cable. This can

get confusing when they don't indicate which color is which, or when they use red marker to indicate the path of aerial cable (which is blue on 3-GIS) or blue marker to indicate the path of underground cable (which is red on 3-GIS). By rule-of-thumb, these scenarios do not typically mean huge changes like moving entire sections of cable from underground to aerial; if a major change like this were desired, they would have indicated in writing off to the side. See figure 4.2.2.3.

4.2.2.5. Small X's drawn through conduit or cable indicate that the conduit/cable was not placed in that location. This generally means they were re-routed elsewhere. Re-routes for conduit are indicated by small, dashed pen line most of the time; otherwise they will be indicated by a normal redline. It is assumed when conduits/strands are re-routed, that the fiber cable (if any) running with the conduits/strands is moved to the same location. If any splice closures or structures are located on the conduit being re-routed, it is assumed they also move to the new location in a reasonable manner. See Figure 4.2.2.1.

4.2.2.6. Small pen-written numbers (usually in the range of 10-500) directly above or below sections of conduit/strand indicate the as-built length of that section of conduit/strand. See figure 4.2.2.1.

4.2.2.7. Larger written numbers (usually in the range of 1000-20,000) that come in pairs, and have a fiber count nearby, indicate fiber footages for any nearby cable. This data is not currently entered on 3-GIS in any way. See Figure 4.2.2.5.

4.2.2.8. Written letters and numbers, like “UG18” and “UG21”, are field codes for different structures. Reference a field code guide when dealing with these. See Figure 4.2.2.6.

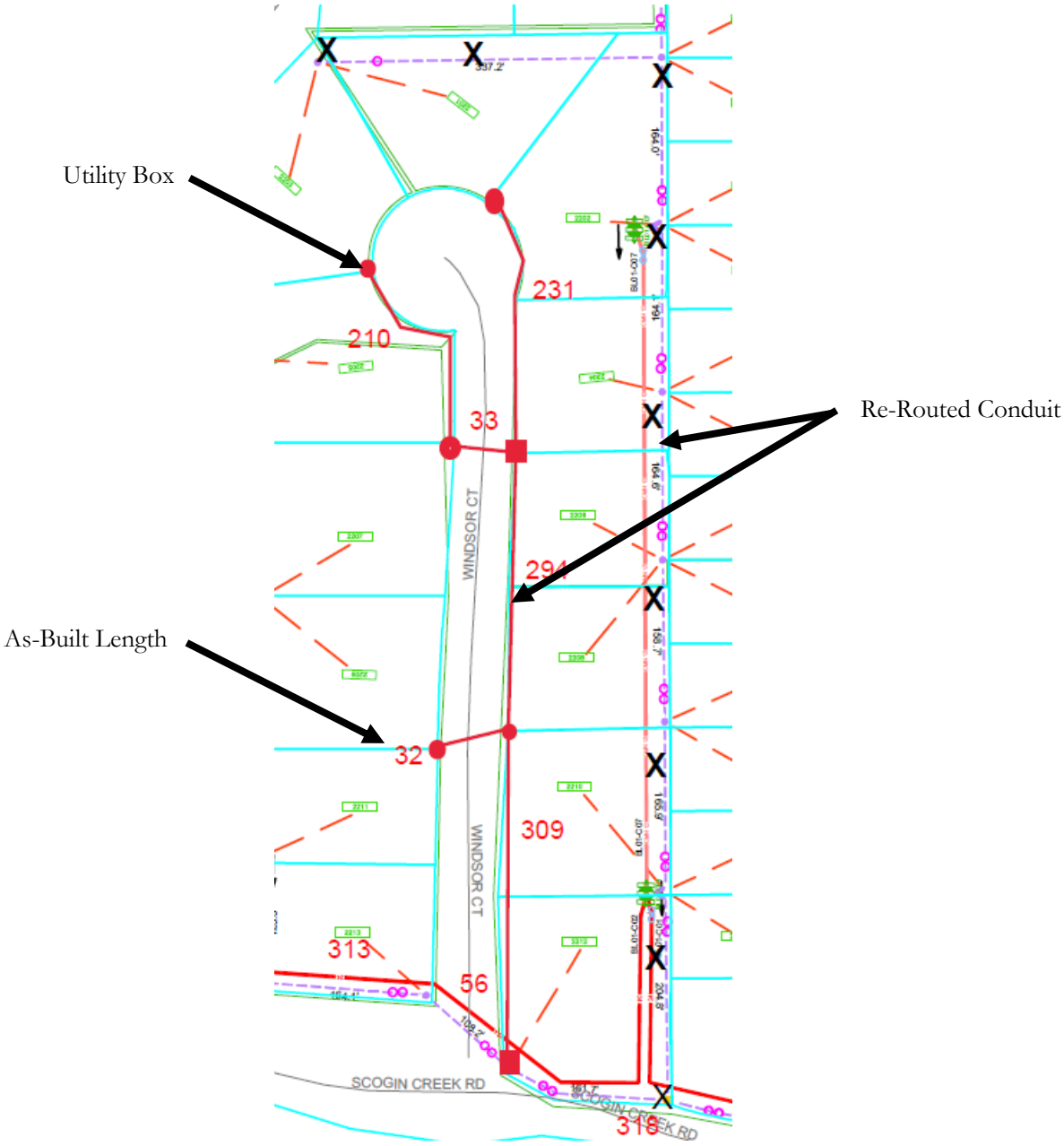


Figure 4.2.2.1: BL01 Example As-Built

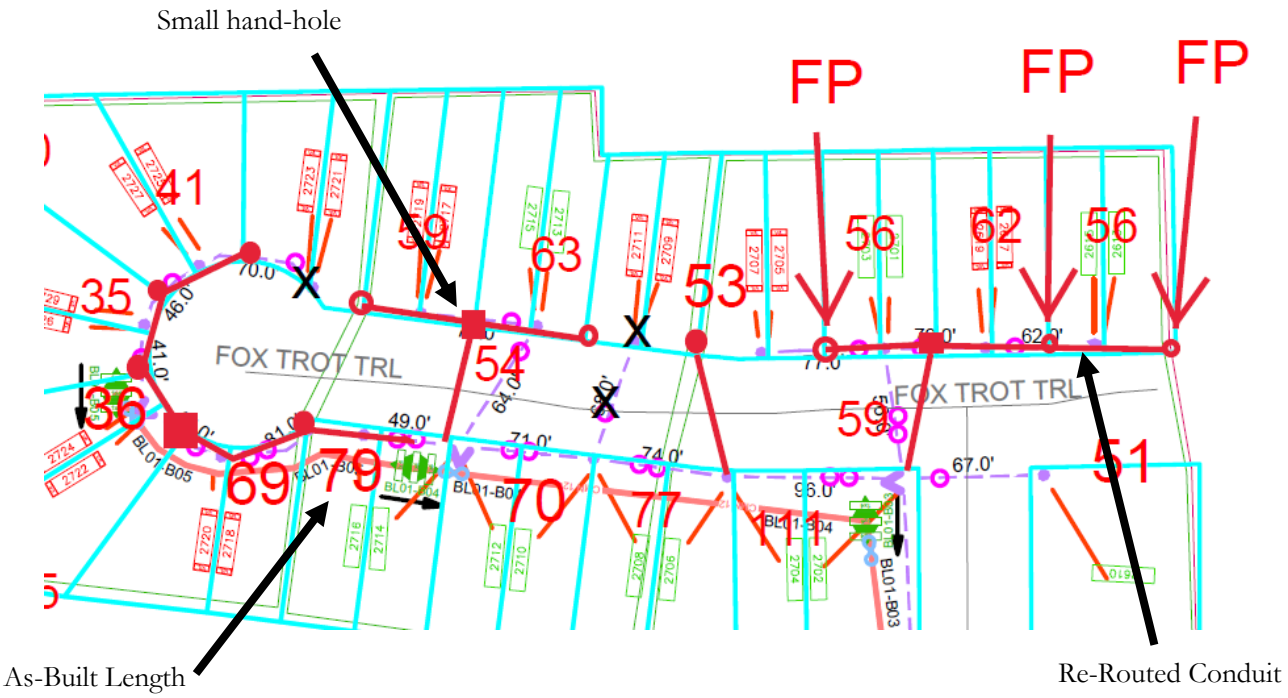


Figure 4.2.2.2: BL01 Example As-Built

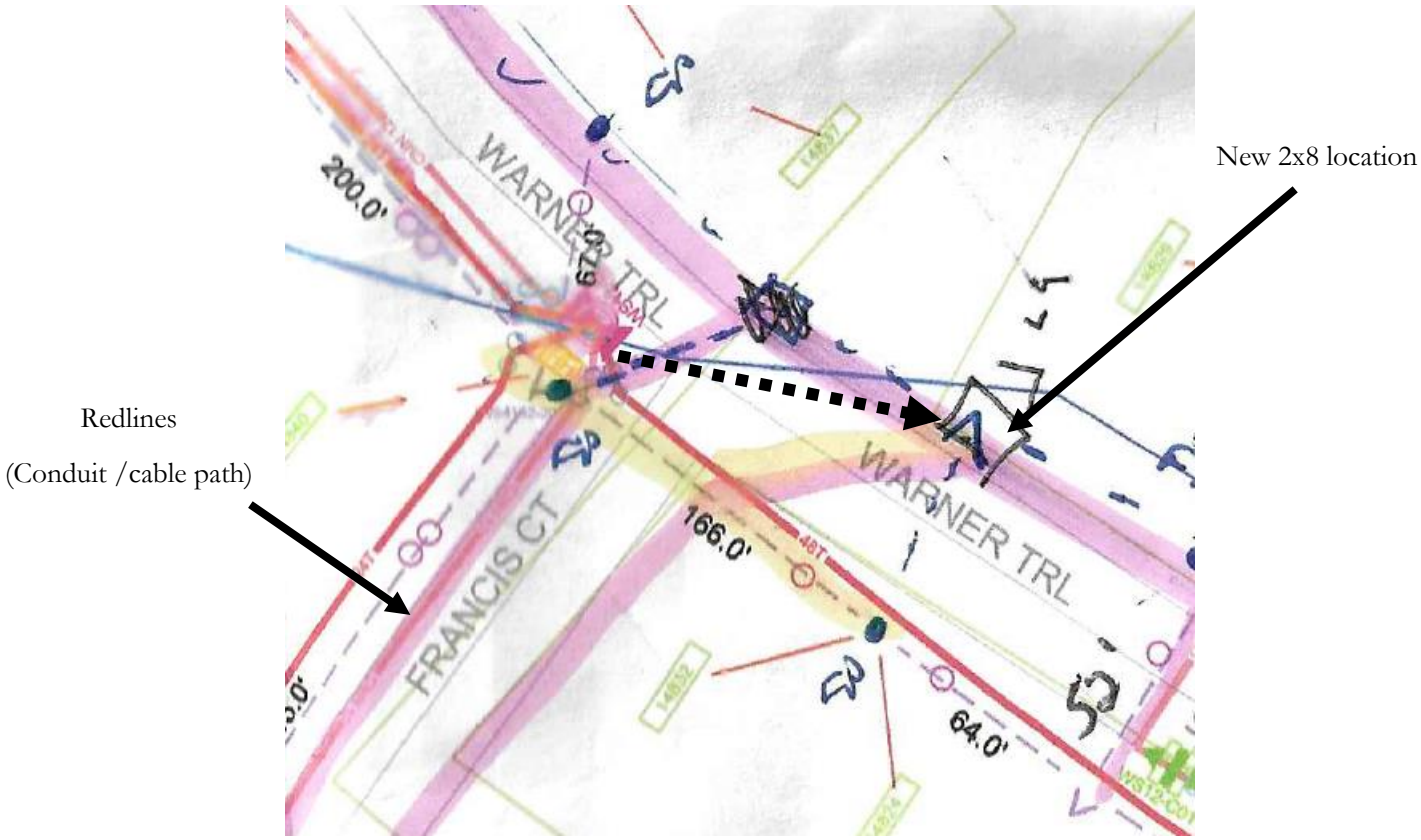


Figure 4.2.2.3: WS12 Example As-Built

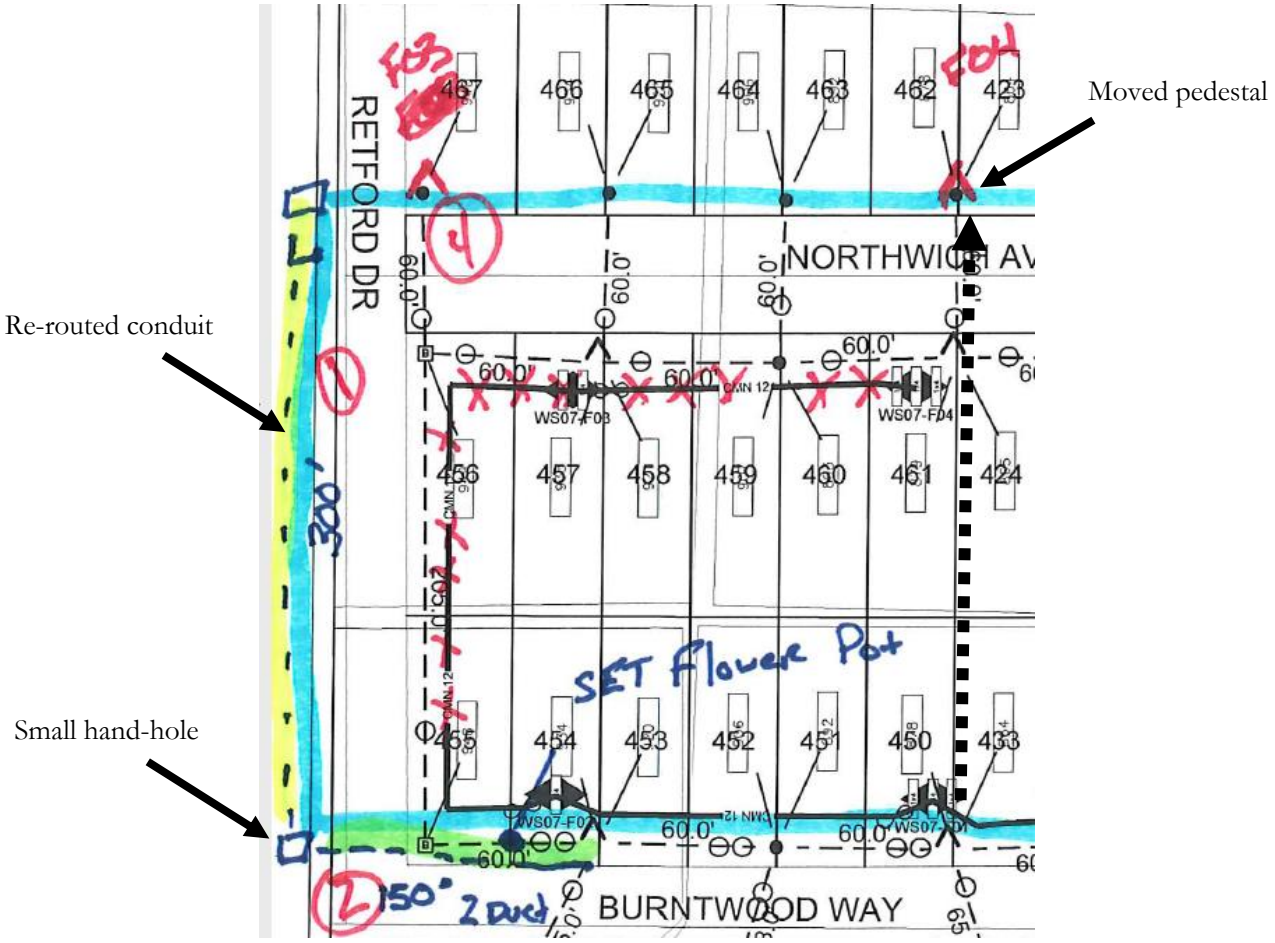


Figure 4.2.2.4: WS07 Example As-Built

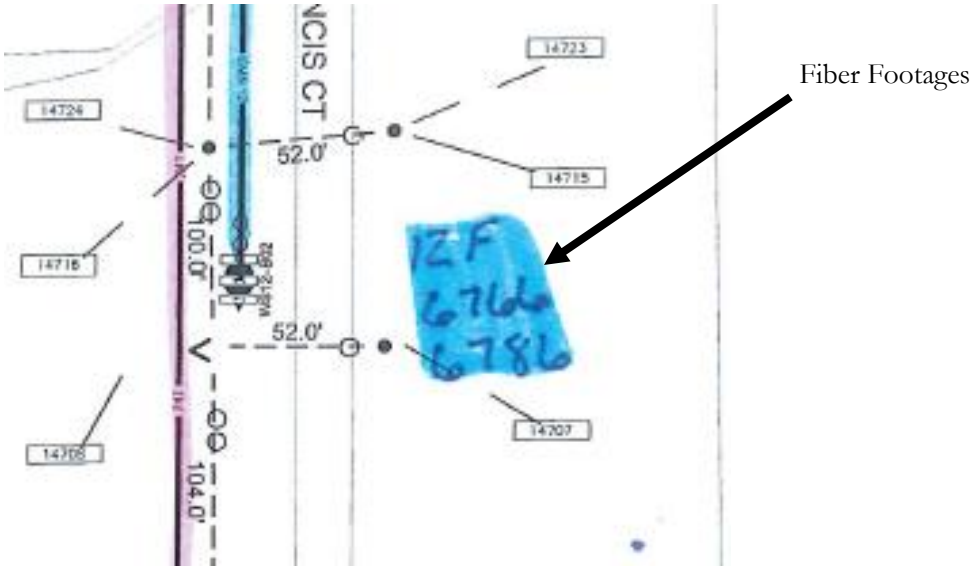


Figure 4.2.2.5: WS12 Example As-Built

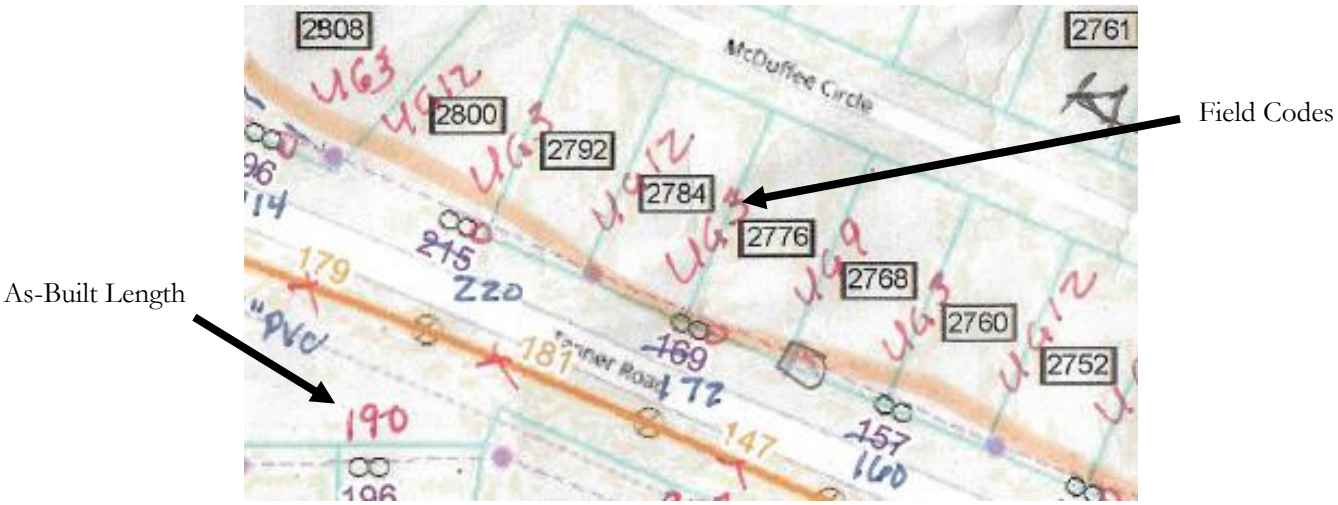


Figure 4.2.2.6: NA001 Example As-Built

4.2.3. Projection Issues

4.2.3.1. After zooming to an LCP in 3-GIS, it is necessary to check for "projection" issues before beginning work on the as-built. If no projection issues are noticed, then proceed with the as-built as normal. If projection issues are noticed, there are two options: navigate to the LCP's footprints task and place it on hold for projection issues, or fix the projection issues manually before continuing with the as-built. See section 4.4.6 for details on identifying and dealing with projection issues.

4.2.3.2. It is also necessary to deal with "duplicate structure" issues. See section 4.4.3.

4.2.4. As-Built Footages

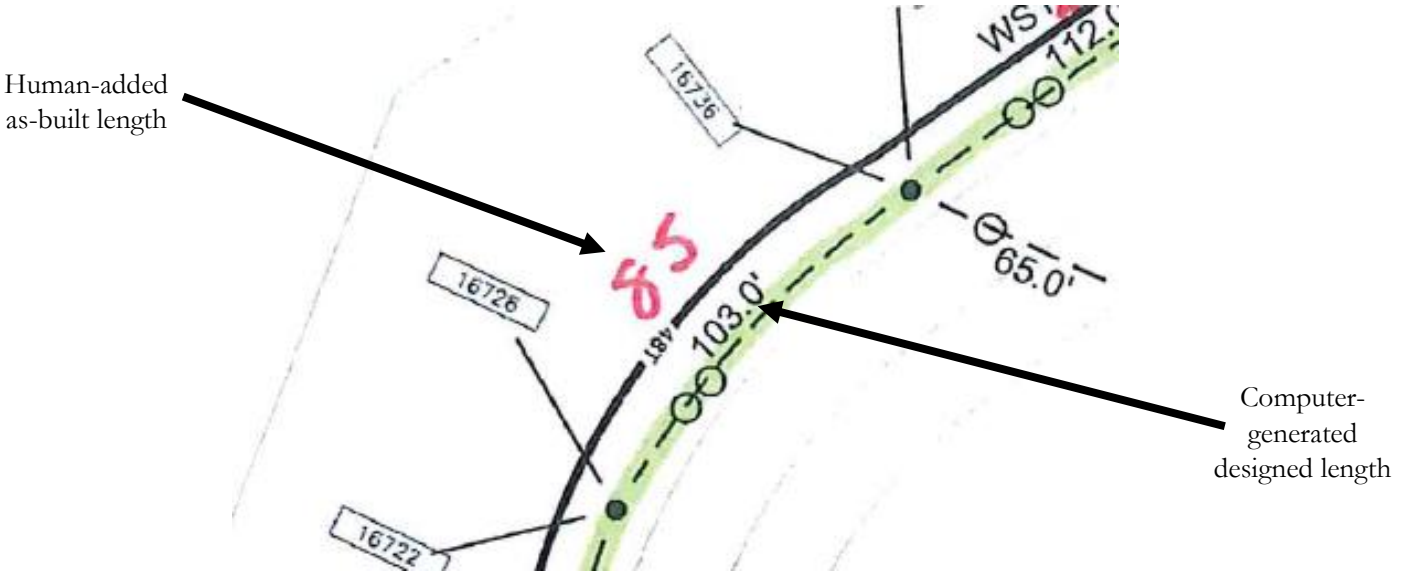
4.2.4.1. Start in a corner of the chosen LCP on 3-GIS and select all running lines within a small, manageable area. Navigate to this location on the respective as-built document in a different window.

4.2.4.2. Check the as-built documents for written as-built lengths near the conduits/strands in the current selection area. If there are no written as-built lengths, then identify the smaller, typed, computer-generated footages placed near the conduits/strands. Note: these are not as-built lengths, they are original-design lengths placed on the document during plotting. When no written as-built lengths are present, these numbers are acceptable to use as an alternative, (although ideally, every document would have written as-built lengths). If even

these computer-generated numbers are not present, then round up the number in the "calculated length" field to the nearest whole number to use as another alternative.

4.2.4.3. On the results table on 3-GIS, click through each conduit and type in their respective as-built lengths into the "as-built length" field under the attributes column.

4.2.4.4. Proceed in this fashion along the length of every conduit and strand located in the LCP. Again, the priority of the number typed into the as-built length field is as follows: hand-written or human-added as-built lengths, computer-generated design lengths, rounded-up calculated lengths, (with human-added as-built lengths being the primary option).



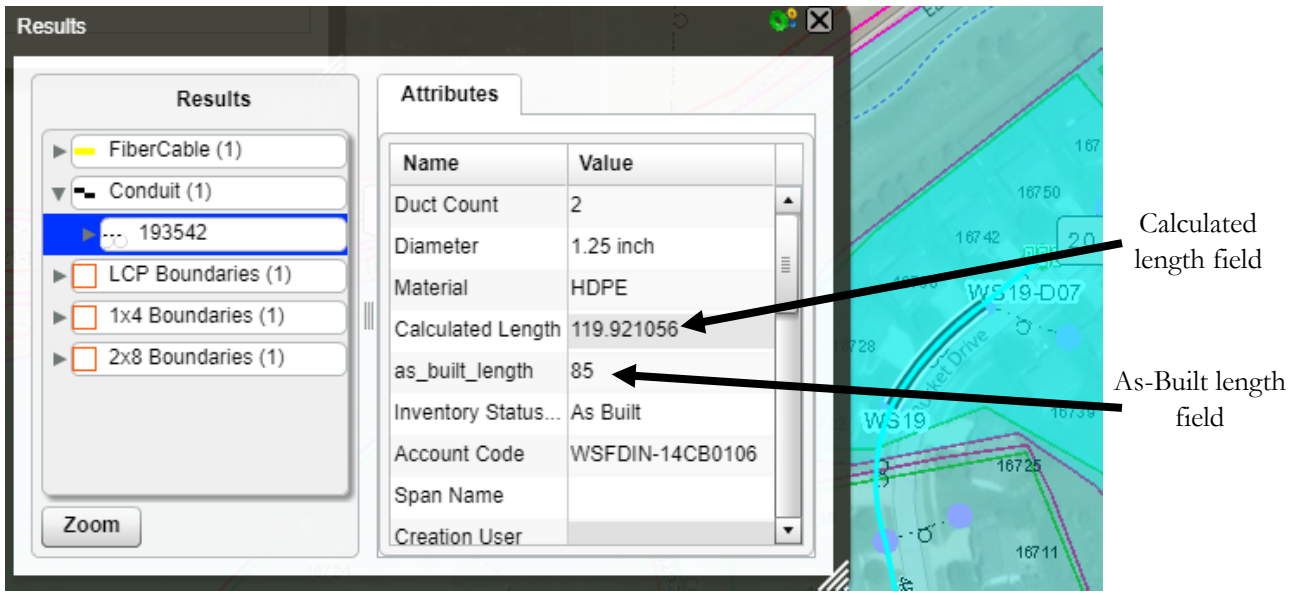


Figure 4.2.3: Example As-Built Footages

4.2.5. Running Line Adjustments

4.2.5.1. While moving through the LCP in the fashion described above, make changes to conduit/strand re-routes as they appear. See figure 4.2.2.1 for an example conduit re-route. In order to make these changes, use the coincident move tool to move conduits and structures at junction points to new locations. Use the reshape feature to realign conduit and strand to new locations. Use the coincident move tool to move any structures or equipment that are on the conduit being re-routed; do not simply delete those, unless indicated. Use the create tool to place new conduit and strand when called for.

4.2.6. Equipment/Structure Adjustments

4.2.6.1. Use the coincident move tool to move groups of equipment to new locations as indicated. The most common types of structure adjustments are pedestal relocations, 2x8 relocations, and utility box/hand-hole relocations. When moving pedestals, also move the associated splice closure, fiber equipment, fiber cable, and conduit with it. When moving 2x8's, also move the associated splice closure, fiber equipment, fiber cable, conduit, and large hand-hole with it. It is common on 3-GIS in older LCPs for the running lines and structures to be separated from the fiber cable and fiber equipment. In these cases, two coincident moves will be needed: one for the splice closure, fiber equipment, and fiber cable, and one for the structure (ped or LHH) and conduits. When moving utility boxes or hand-holes, also move the connected conduits. See section 1.3.

4.2.7. Updating Inventory Status Codes

4.2.7.1. Once all as-built lengths have been entered and all adjustments have been made, use the selection set geometry to select all items within the LCP or project area. Open the results analysis table to view all items in categories. Use the select all and mass update features to update the inventory status codes to "As-Built" for all conduits, strands, poles, structures, fiber cables, fiber equipment, risers, and splice closures. See section 1.3.11.

4.2.7.2. Any features within an excluded boundary are to be left out of the mass update; their inventory status code should be left as "Designed." It may be necessary to go back through and select all items within an excluded boundary (using selection set geometry) and mass update their inventory status codes back to "Designed" in a similar fashion.

4.2.7.3. For large LCPs, it may be necessary to update the inventory status codes of different categories of features one by one, due to the large number of items overall. To do this, navigate to the Telecom_Production Layer settings in the Table of Contents (section 1.3.4) and only allow one (or a few) category(ies) of feature(s), (ex. Structure), to be selectable. Then perform mass updates as usual. Repeat until all features have been updated.

4.2.8. Updating Footprints

4.2.8.1. Open Footprints and use the search box to find and open the As-Built Update task associated with the current LCP project, (type in the LCP name). When the results appear, it is sometimes helpful to use the filter button on the drop-down menu of the "Request Subtype" to filter out only the As-Built Update tasks for a given search. If the search does not pull up any as-built tasks for the current project, and the project is a non-city build project (EX, CT, JT…), it may be necessary to search for the name of the project itself rather than the LCP, (ex. Spring Mill Park, rather than WS45). Be very general with the search and avoid typing out the full name exactly as it appears; there are many variations on how to type these names (capital letters, punctuation, abbreviations, etc.), and the search box only looks for exact matches of the entry. As a last resort, if the correct project cannot be found, it may be necessary to create a new as-built task for it, (see section 3.4.2).

4.2.8.2. Once the correct task is open, and all of the procedures in section 4.2 have been completed, change the Status to "Working", change the As-Built Update Status to "Completed ready for QC", change the Inventory Status Updated to "Yes", add the amount of time worked and any comments in the Time Tracking field, append a description of what was worked on and any important comments, uncheck the Send Email box, and save the task. It is always good procedure to check the construction status and the completeness of the as-built documents as well and update the associated fields, (see section 3.2).

4.2.8.3. If the as-built task was worked on, but not completed, only update those fields which apply to the work that was performed. For example, if the as-built lengths for half of an LCP were entered, but not all re-routes were completed and the inventory status codes weren't updated, then the Status would be set to "Working", the As-Built Update Status would be set to "In-Progress", the Inventory Status Updated would be set to "No, the amount of time worked would be added in Time Tracking, and a description would be added that mentions that half of the as-built lengths were entered.

4.3. Quality Control

4.3.1. General

4.3.1.1. Once an as-built task has been completed, (following the procedures in section 4.2), in order for it to be closed out, it must pass a round of quality control (QC). The process for QC on as-builts is simply a fresh set of eyes looking through someone's work on an as-built task and making sure no huge mistakes were made and all proper procedures were followed. The person performing QC will usually just make any small changes as needed and close out the task. If major issues are noticed, then the first person will be informed of the

mistakes and be asked to review their work and make all the suggested changes. As of the writing of this manual, Cyient was given a large portion of as-built tasks to complete. As-builts completed by Cyient must also pass through a round of QC, (see section 4.5).

4.3.1.2. To find a task ready to be QC'd, open the active as-built report, format as a table, and filter alphabetically by As-Built Update Status. Choose any LCP or project whose As-Built Update Status is listed as "Completed Ready for QC".

4.3.2. Checking Projection Issues

4.3.2.1. Navigate to the chosen LCP or project on 3-GIS and open all associated as-built documents. Quickly overview the LCP on 3-GIS and check that any major projection issues (if any) have been resolved. Essentially, terminal boundaries should be rounded and fit well around a group of buildings, addresses should lie on top of or near buildings, cables and running lines should be coincident or closely offset, running lines should follow generally straightforward paths along easements and not through buildings and parking lots, and structures and poles should be placed along streets and easements in a similar fashion. If major projection issues have not been resolved, do not pass the LCP through QC and note the major problem areas, (see section 4.4 for more detail on projection issues).

4.3.3. Checking Redlines

4.3.3.1. Navigate through the as-built documents as normal and check that the cable and running line paths on 3-GIS follow the redlines indicated on the as-built documents. Minor differences can be adjusted as needed, but major mistakes, such as not re-routing an entire line of conduit, should be noted and sent back to the person who completed the as-built.

4.3.4. Checking Footages

4.3.4.1. While checking for redlines, occasionally do a spot check on some of the as-built lengths of conduit and strand and see if they match the indicated lengths on the as-built documents. Spread these spot checks throughout the LCP to be sure their work was consistent. It is not necessary to check every single as-built length. If an error is noticed, fix it and continue to check nearby conduit or strand. If the errors were consistently made in a large area, do not pass the LCP through QC and make appropriate notes

4.3.5. Checking Inventory Status Codes

4.3.5.1. If the LCP is decently small, perform a selection set geometry and check the results analysis table as if updating the as-built lengths personally. Make sure the inventory status code of each category, (conduits, strands, structures, etc.), has been updated properly to "As-Built." If some categories were missed, go ahead and perform the update and move on,

but make note and let the person who completed the as-built know. If the LCP is large, perform spot checks throughout the LCP using the select tool with the Action set to "Add" and the results analysis table.

4.3.6. Plotting

4.3.6.1. Once an LCP or project has been determined to pass all of the above conditions, two plots need to be made of the finished LCP: a plot of all the running lines, and a plot of all the cables. Note: It is important that the LCP name be entered into the "areaname" field exactly as is, with no extra spaces or enters. The plot tool uses this field to know which boundaries to not hatch out. If this field does not exactly match the LCP boundary's name, then the plot tool will hatch out the LCP being plotted.

4.3.6.2. **Cables** – Use the find tool to search and zoom to the full size of the LCP. Open the plot tool and choose the template "Construction 11x17 Cables". Set the Scale to "Y", where "Y" is a variable that depends on the current zoom level "X" (located at the top of the screen). The value of "Y" will change from monitor to monitor; on a 16x9 monitor, Y seems to be given by "Y=X+600" most of the time. Use trial and error on this procedure to get a good zoom level. Once a scale is entered, press generate plot. On the plotting window that pops up, enter in the "areaname" field the name of the LCP, even if it is a special project inside the LCP, (ex. WS28). Enter "project" as "[market name] City Build", (ex. Westfield City Build), if the project is a city build. If the project is non-city build (EX, CT, JT…), then enter the name of that project, (ex. WS45-Spring Mill Park). Enter the market name and state in the "location" field, (ex. Westfield, Indiana). If the LCP is centered, large, and completely fits in the plot that opens up, download the pdf file of the plot and save it into the redlines folder in the proper LCP folder as "[LCP name] Updated As-Built Cables", (ex. WS28 Updated As-Built Cables).

4.3.6.3. **Running Lines** – For the Running Lines plot, repeat all of the above procedures with a few minor changes. Instead of the "Construction 11x17 Cables" template, use the "Construction 11x17 Running Lines" template. On the plotting window, there are two new fields not on the Cables plotting window: the "route" field and the "project_number" field. Enter the route field as "[LCP name] As-Built", (ex. WS28 As-Built). Enter the project code for the given LCP or project into the "project_number" field. Save the generated plot into the appropriate LCP redlines folder as "[LCP name] Updated As-Built Running Lines", (ex. WS28 Updated As-Built Running Lines).

4.3.7. Updating Footprints

4.3.7.1. Once an LCP or project has completely passed all the requirements of QC, and both plots have been made and downloaded to the redlines folder, the task must be closed out on Footprints.

4.3.7.2. Navigate to the proper task on Footprints and open it.

4.3.7.3. Set the Status field to "Closed". Set the As-Built Update Status field to "Passed QC – Updates Finalized".

4.3.7.4. Set the Work Completed date to the current date.

4.3.7.5. Check all other fields in the Footprints task and make sure they have been properly filled out according to the description is section 3.2.

4.3.7.6. Change the Issue Info. Updated field to "Yes".

4.3.7.7. Add time tracking data, append an appropriate description, uncheck the Send Email box, and save the task.

4.4. Common Problems

4.4.1. General

4.4.1.1. This section is important to read and understand before completing an as-built. There are many current issues with equipment on 3-GIS that occurred due to a recent migration of all OSP designs from Spatial software to 3-GIS. Some of these issues are minor and are left alone until the LCP is called upon for other purposes, while other issues should be fixed when noticed, even during the as-built stage.

4.4.2. Cable Offsets

4.4.2.1. It is clear in the real world that cables run *through* conduit and *on* poles and strands, not off to the side of them. However, many cables in older LCPs are offset from their respective conduits, poles, and strands. These issues are minor and are left alone at the as-built stage until further notice.

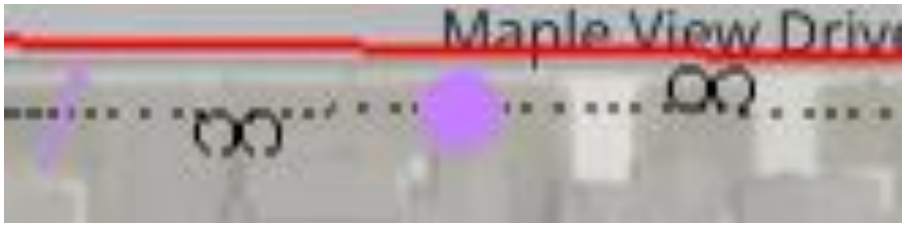


Figure 4.4.2: UG Cable Offset from Conduit

4.4.3. Duplicate Structures

4.4.3.1. Due to the migration, all pedestals and large hand-holes underneath splice closures were duplicated. The structure (a pedestal in this example) on the conduit in the figure below is a duplicate and is named by a random string of numbers. The real pedestal (in this example) is usually named and is already underneath the splice closure, as shown. The duplicate needs to be deleted, and the structure type and subtype code of the real pedestal (RM10-A03 in the figure) needs to be updated to "Pedestal".

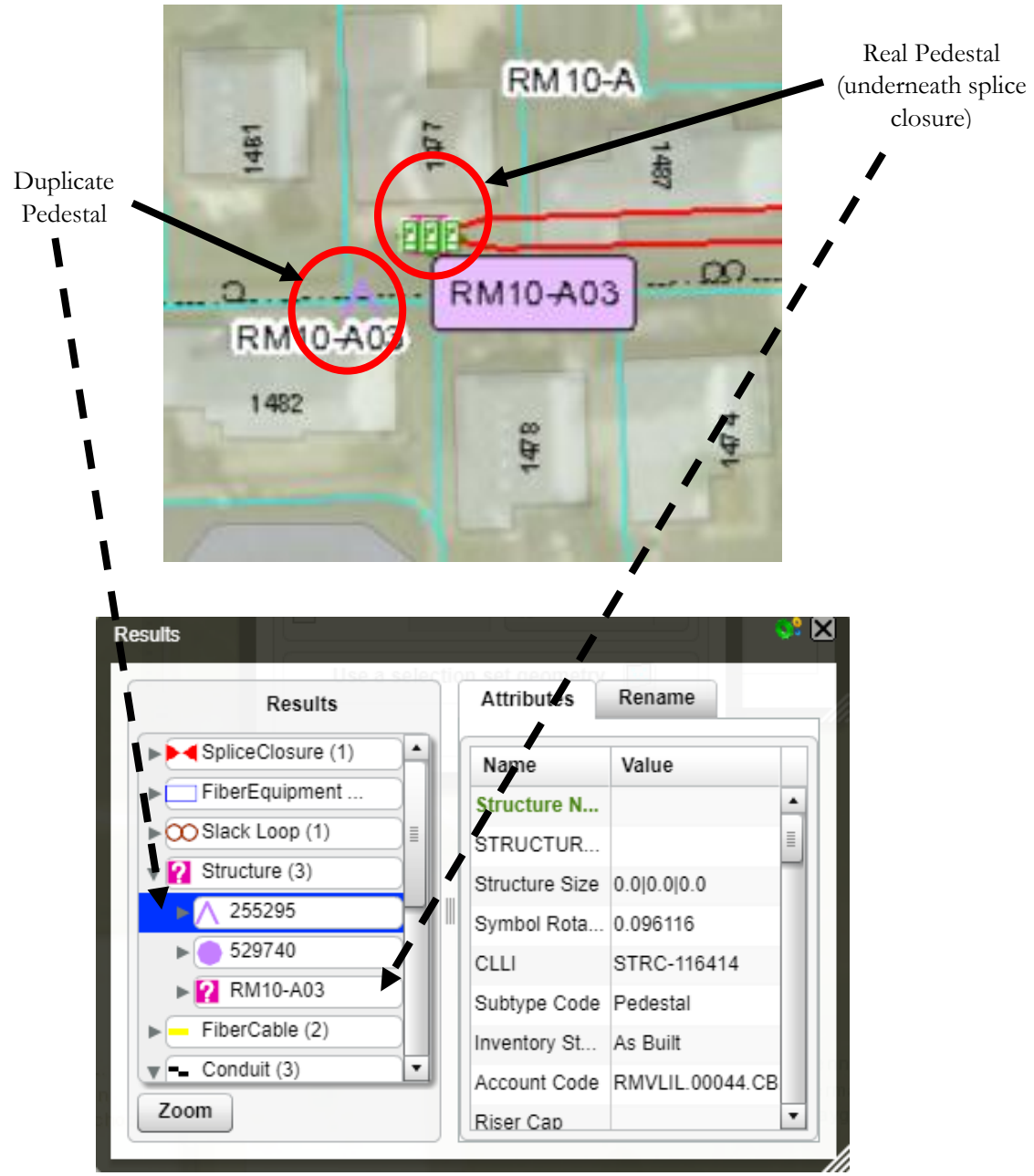


Figure 4.4.3.1: Duplicate Pedestal

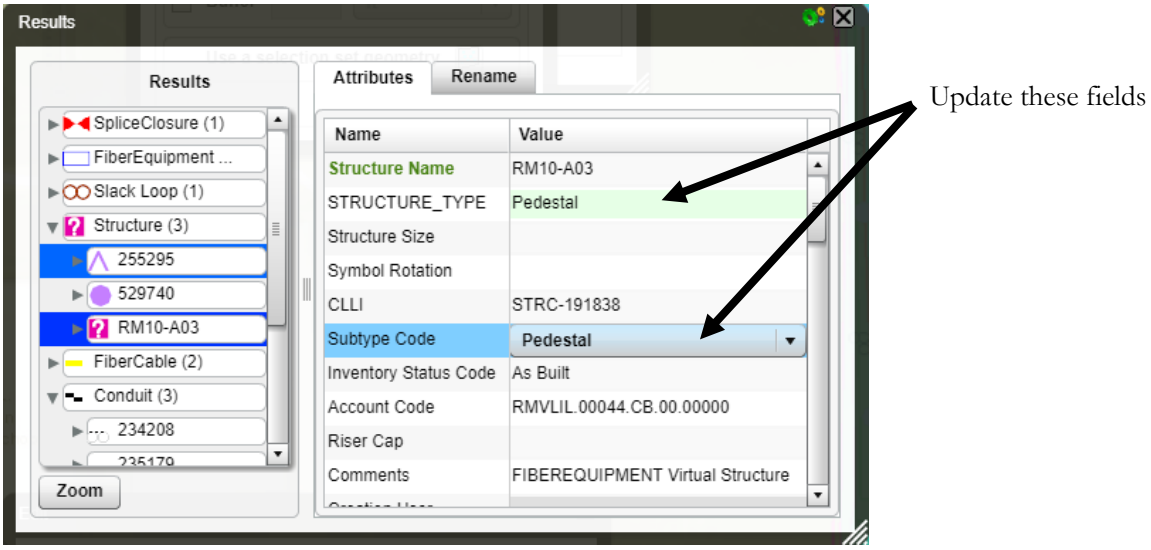


Figure 4.4.3.2: Real Pedestal Update

4.4.3.2. If an LCP has this problem, it usually occurs under every single terminal in the LCP. The same problem occurs with duplicate large hand-holes under 2x8 splice closures. Follow the same procedures to fix these issues, only changing the structure type and subtype codes to "Large hand-hole", rather than "Pedestal". Follow all proper naming conventions for pedestals and large hand-holes, (note: the naming convention above should be "RM10-A03-Ped" for the pedestal).

4.4.4. Splice Closures / Risers

4.4.4.1. Due to the migration, an unnecessary splice closure was placed on top of all risers. Although it is not critical that this splice closure be deleted, it should be deleted when encountered.

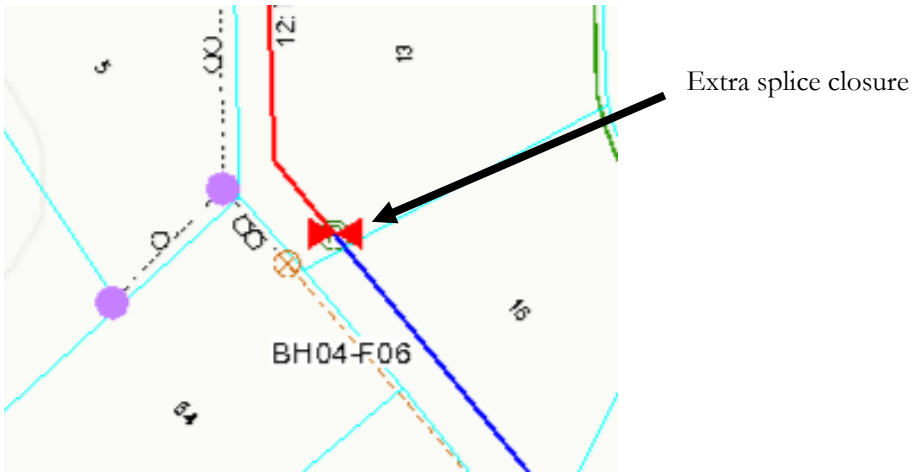


Figure 4.4.4: Extra splice closure

4.4.5. Missing Splice Closures

4.4.5.1. When fiber equipment is noticed by itself without a splice closure on top, (assuming the splice closure layer is selected as "viewable" in the Layer settings), a new splice closure needs to be created and snapped onto the fiber equipment. These issues need to be fixed when noticed. Follow proper naming conventions for the creation of the splice closure. The figure below provides an example of a splice closure created for an aerial, three 1x4 splitter terminal in Boulder Hill:

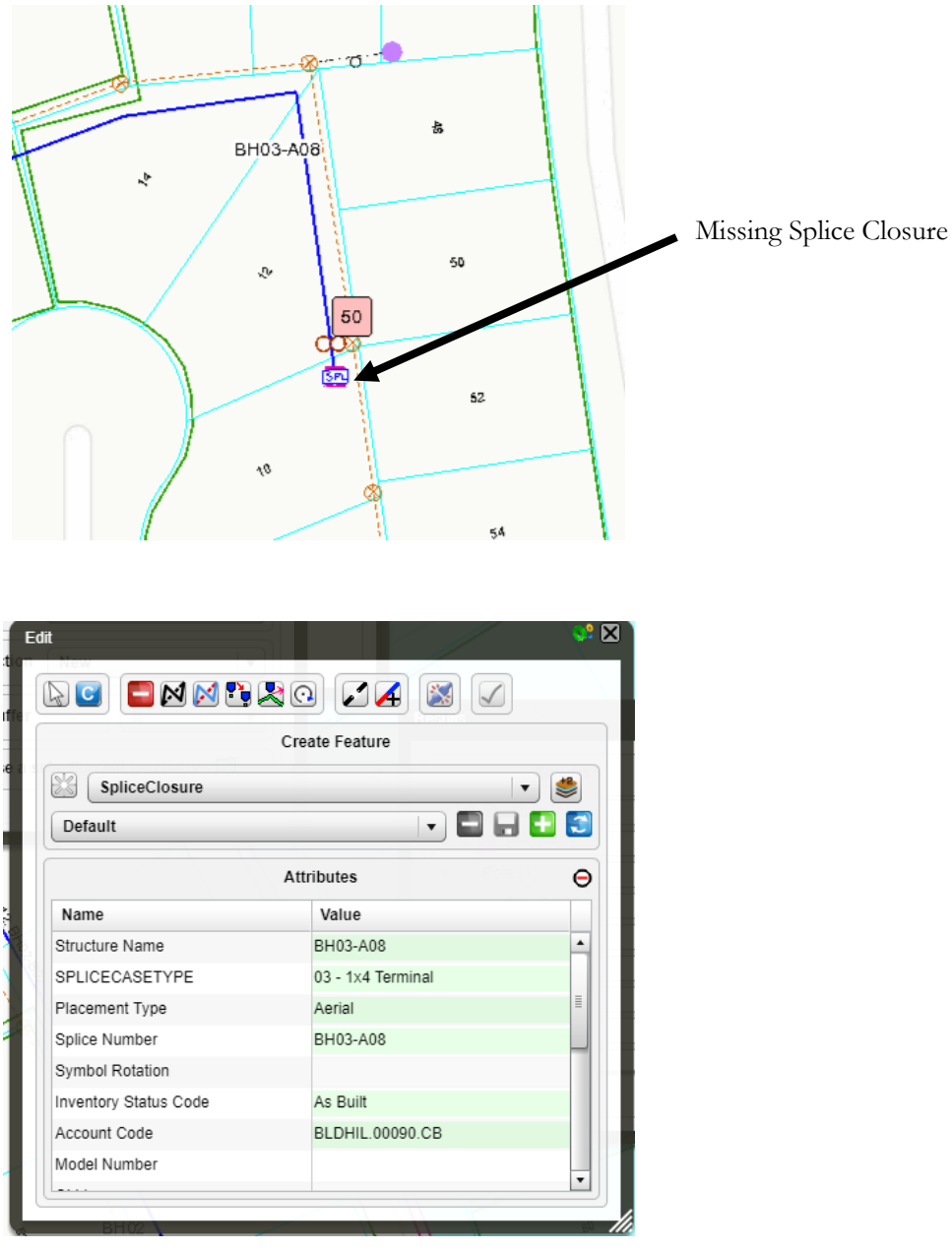


Figure 4.4.5: Splice Closure Creation

4.4.6. Structures on Aerial Terminals

4.4.6.1. Due to migration, underground structures were added to some aerial terminals. Because the terminals are obviously aerial, these underground structures are unnecessary and should be deleted when noticed.

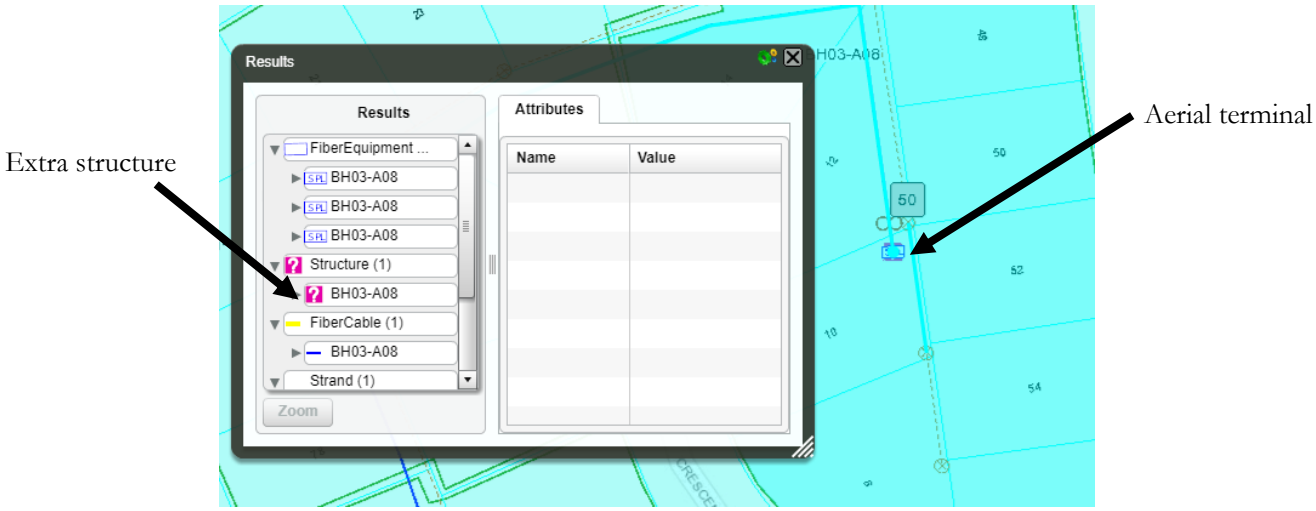


Figure 4.4.6: Structures on Aerial Terminals

4.4.7. Terminal Boundaries

4.4.7.1. Due to assorted issues with 3-GIS, sometimes while zooming to view certain locations within an LCP, all of the green terminal boundaries will suddenly disappear. The solution to this problem is beyond the scope of this manual. To deal with this issue, it is sometimes necessary to move the view of the screen around by panning or zooming to get the boundaries to reappear. This issue can be very frustrating, especially when realigning addresses and terminal boundaries; hopefully an easy solution will be developed soon.

4.4.8. Naming Conventions

4.4.8.1. Many features in older LCPs, including pedestals, large hand-holes, poles, and cables, do not follow current naming conventions. It is not necessary at this time to fix these naming issues for the sake of doing as-builts. Unless called upon for a different reason, these misnamed items can be left alone. All naming conventions are subject to change in the future as well.

4.4.9. Projection Issues

4.4.9.1. **General** – The most cited error in this manual is any error dealing with "projection" issues. The term "projection issues" refers to any problems in the placement of features on

3-GIS that occurred directly as result of the transfer of information from Spatial to 3-GIS. Common projection issues are misaligned addresses and terminal boundaries, and misaligned cables, running lines, and all associated equipment

4.4.9.2. **Terminal Boundaries** – Terminal boundaries should be rounded and wrapped around all parcels (up to 12) designated to a given terminal. Due to migration, terminal boundaries were constricted to link the exact address points together, as shown in the figure below. These boundaries need to be reshaped to wrap around the parcels of those addresses (light blue lines) using the reshape tool. First, all the addresses need to be placed directly on top of their respective buildings, (make the addresses selectable first and then use reshape tool; make sure World Imagery Layer is visible). There is no need to move all the addresses if they are relatively close to the buildings. If no parcel lines have been loaded into a given area, it may be necessary to open a county GIS map and navigate to the addresses to view the parcels. Once the parcels are viewable in some fashion, use the reshape tool to move the terminal boundary around the respective parcels. It is helpful during this process to hide and make "unselectable" all other features besides terminal boundaries and addresses.

Figure 4.4.9.1: Terminal Boundary Misalignment

4.4.9.3. **Other Misalignments** – In the figure below, it can be seen how the conduit and cable are running straight through the houses underneath them, and the structures are placed in yards and on buildings as well. The conduit and cable, and all structures and equipment attached to the conduit, should be running directly along the road, where the easement is. This is the most common type of major projection issue, and is also seen with poles,

strands, and aerial cables. Various other 3-GIS issues can be seen in this figure, including the absence of a visible terminal boundary. In order to complete an as-built that contains many projection issues like the ones shown, the projection issues must first be resolved before anything else. All it takes to resolve projection issues is using the reshape and move coincident tools to place all cables, conduits, and equipment where they seem to belong. This is a very time-consuming process.

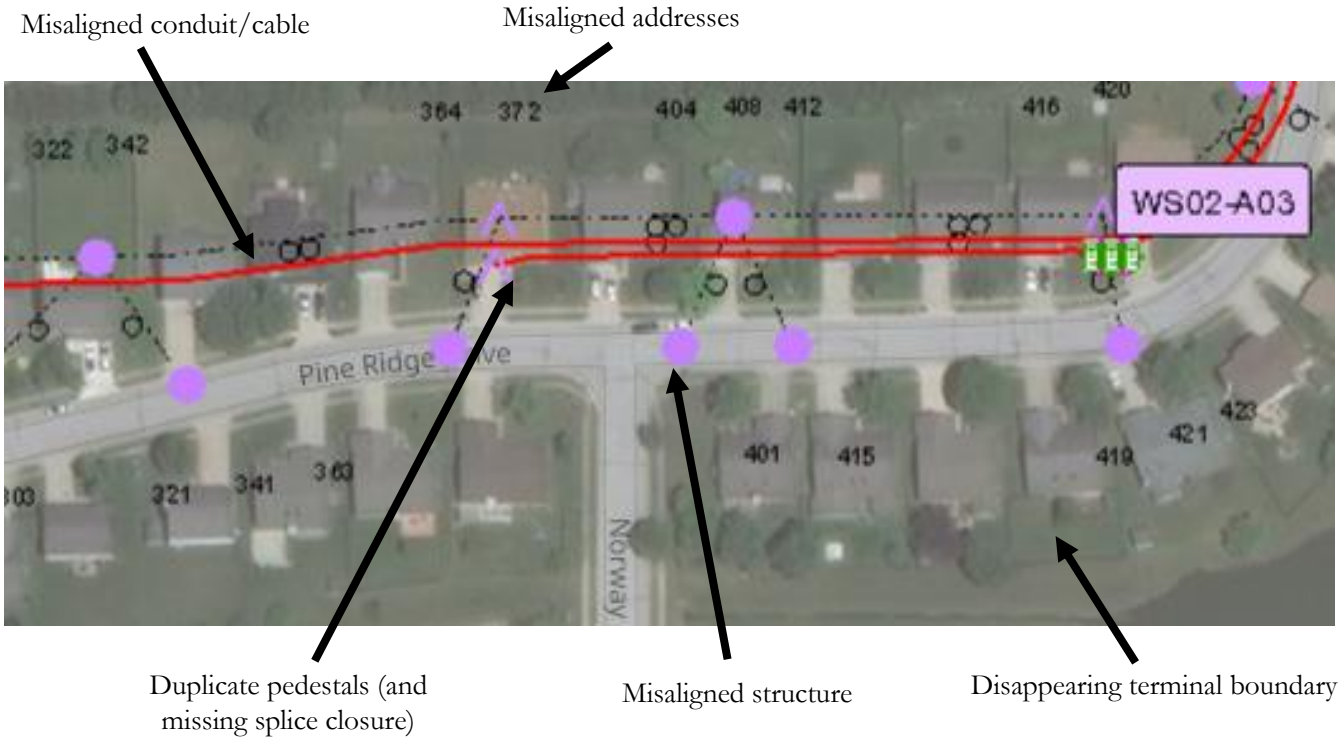


Figure 4.4.9.2: Various Projection Issues

4.5. Outsourcing

4.5.1. General

4.5.1.1. At the time of writing of this manual, there was a big push to complete the backlog of unfinished as-built tasks that had accumulated over the past years. In order to do this, the majority of the tasks were outsourced to Cyient for completion, and then QC'd and closed out in house. In the future, it may no longer be necessary to outsource any as-built tasks to Cyient; however, the procedures for doing so are included in this section.

4.5.2. Choosing Projects

4.5.2.1. In order for Cyient to accept and complete any as-built task, the main condition for what they will complete is that there must be very few projection errors. If they receive a

task and estimate that it will take longer than 10 hours to complete (due to projection issues), they will send it back for approval before accepting the task. These tasks are then usually placed on hold due to projection issues. So to choose as-built tasks to send to Cyient, first scan through the LCP or project area on 3-GIS for projection issues. Make sure these projects have received some kind of as-built documentation. Continue this process until a list with an acceptable amount of LCPs and projects is obtained.

4.5.3. Work Order

4.5.3.1. Once a list of LCPs and special projects is obtained, find and record the project codes for each respective project along with the project name. An example list of "ready to be" outsourced projects is shown below. Send this list to a reporting manager for approval and a work order. Once a work order is obtained, the list can be sent to Cyient.

Project	Project code
FK17 - Cumberland Trace Sec 2	FKLNIN.00316.JT
GN37	GNWDIN-14CB0103
GN45	GNWDIN.00038.EX.00.00000
GN47	GNWDIN.00038.EX.00.00000
GN54	GNWDIN.00038.EX.00.00000
GN56	GNWDIN-00214-EX
LF06	LFYTIN-14CB0092
LF08	LFYTIN-14CB0092
LF11	LFYTIN-14CB0092
LF12	LFYTIN-14CB0092
LF13 - Cobblestone IV	LFYTIN.00551.JT
LF14	LFYTIN-14CB0092
LF15	LFYTIN-14CB0092
LF33	LFYTIN-14CB0092
LF36	LFYTIN-14CB0092
LF41	LFYTIN-14CB0092
LF43 - Rainey Brooke	LFYTIN.00174.JT
WL22 -City Build	LFYTIN-14CB0092
WL22 - Oak Ridge Sec 1	LFYTIN.00485.JT
RM33	RMVLIL.00044.CB
RM34	RMVLIL.00044.CB
RM43	RMVLIL.00044.CB
WL23 - Winding Creek	LFYTIN-14EX0174
WL23 - Auburn Meadows	LFYTIN.00229.CT
CR105	CRMLIN.00086.CB

Table 4.5.3: Outsource List

4.5.4. Shared Folders

4.5.4.1. On the website shared between Cyient and Metronet, this list of LCPs and projects can be uploaded into the proper folder for Cyient to view. When Cyient has completed any given as-built task, they will move those tasks to a completed folder and send a notification email. See a reporting manager for more detailed procedures on how to carry out this process.

4.5.5. Updating Footprints

4.5.5.1. After the chosen list has been sent to Cyient, the Footprints task for each individual project needs to be updated to show this.

4.5.5.2. Open Footprints and navigate to the as-built update task for the first LCP or project on the list. Set the Status as "Working" and the As-Built Update Status as "In-Progress".

4.5.5.3. Change the Outsourced field to "Yes", the Contractor field to "Cyient", and the WO Requested field to "Yes".

4.5.5.4. Repeat these procedures for each LCP or project in the list.

4.5.5.5. When Cyient sends an LCP or project back incomplete, saying it will take more than 10 hours to complete, update the As-Built Update Status to "On Hold – Cyient Est. > 10 hours".

4.5.5.6. When Cyient completes an LCP or project and sends it back, continue through with QC and Footprints updating as outlined in section 4.3.

4.5.6. Kickback

4.5.6.1. While performing quality control on Cyient's work, if major issues are noticed, such as consistently entering wrong as-built footages, not addressing any of the major common problems in section 4.4, or not completing entire sections of an as-built, then the as-built task needs to be kicked back to Cyient. While this is not a common problem, the procedure for doing so is included in this section.

4.5.6.2. Make note of all the major mistakes noticed on the as-built. Take screenshots of example problem areas on 3-GIS and compile these mistakes into a word document, being sure to describe all of the mistakes thoroughly and clearly. Provide instructions on the correct way to solve these mistakes.

4.5.6.3. Move the tasks in the shared folder from the completed section back to the working section. See a reporting manager for more detail on how to do this.

4.5.6.4. Send an email to a Cyient representative with the project or projects that have issues, and attach to the email the word document that describes the mistakes.