WESTERN CONNECTICUT COUNCIL OF GOVERNMENTS

Regional GIS Web Application Recommendations Report

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** Appendices are not included, but are available upon request.

EXECUTIVE SUMMARY

Axiomatic, in partnership with WestCOG and its member communities, has conducted a study to determine the possibility for regional cooperation of Property Appraisal, and the viability of a regionalized Real Property Computer Assisted Mass Appraisal (CAMA) system. One of the primary findings of Task 1 of the study was the need for a Regional GIS solution to provide access to aggregated municipal appraisal and Parcel data.

Creating a regional GIS, in addition to supporting regional planning and economic development, would allow nine of the WestCOG member communities who currently devote resources to maintaining individual web-based municipal GIS portals to phase out those systems. Providing a regional solution for all of the member communities would also provide those remaining municipalities without portals with access to those tools and features (e.g. abutter list generation, area measurements, printing of lot lines). With an expanded CAMA data export (Level 3 data including sales, building, and land tables) it would be possible to replace individual online assessor's databases and portals, as well, providing additional cost savings to the communities.

In support of the regional GIS, Axiomatic conducted a study of the nine municipal GIS sites to determine both existing functionality and necessary municipal and regional data layers needed for a successful deployment. The recommended layers and their sources are contained in the Regional GIS Layers section. This study included the development of a Regional GIS Schema and Two Regional CAMA Schemas and establishes three levels of functionality if GIS and CAMA integration are pursued, as outlined in Table 1.

Function	Level 1	Level 2	Level 3
Flat CAMA Integration	✓	✓	✓
Internal Flat Property Record Cards	✓	✓	✓
Link to Property Record Cards Site		✓	✓
Vision PDF Property Record Card Export		✓	✓
Expanded CAMA Integration			✓
Internal Expanded Field Cards			✓

Table 1: CAMA integration levels and respective functionality.

Level 3 integration does allow functionality sufficient to eliminate the individual municipal GIS portals and the assessor database websites, however the export contains multiple tables and requires more time and effort for WestCOG and the participating municipalities. For this reason is recommended that the Flat CAMA integration be utilized to achieve Level 1 and Level 2 functionality and encourage participation. If the Regional GIS site is successful, Level 3 Data can be added to achieve full consolidation of the services.

There are several additional factors to consider to effectively deploy a regional GIS which are discussed in brief below:

- **Data Collection:** To reduce cost and maintain maximum control it is recommended that WestCOG manage the data collection internally if resources permit. If this services is contracted it is recommended the agreement be fixed cost and include solicitation and collection of all desired updates.

- **Standardization:** The data standardization tools are the heart of the regional GIS and are the most difficult to recreate. The tools used to convert the local data into the regional standardize and aggregate it into a contiguous data set should be owned and controlled by WestCOG. To this end they should be developed internally, or via contract which ensures they are wholly owned by WestCOG. To reduce costs it is possible to contract for template standardization tools, which can be used by WestCOG to replicate in each community. This report contains best management practices for processing and standardizing data as well as recommended update cycles. Following review of Massachusetts, New York, New Hampshire, and American Planning Association land use standards, the Massachusetts standard is recommended for use in WestCOG.

- **Online GIS Platform:** Axiomatic reviewed five potential GIS platforms. Their configuration ranges from complete custom solution, to hosted Commercial-Off-The-Shelf, to enterprise web GIS platform. Costs and a summary of functionality are provided in *Deployment & Maintenance: Platforms and Estimated Costs* and Appendix E.

The cost of the regional GIS can vary considerably depending on which portions (if any) are performed by WestCOG staff, and which GIS solution is chosen. For costing and return on investment (ROI) purposes WestCOG staff time was billed at $75.00 per hour, and consultants at $125.00 per hour. The first-year cost for year one ranges from $47,200.00-$57,200.00, with most the cost revolving around developing the standardization and aggregation tools. This first-year cost is driven largely driven by the cost associated with developing the standardization tools, which is estimated assuming it is performed by an external contractor. The estimated annual maintenance ranges from $17,950.00-$27,950.00, once again depending on which GIS solution is chosen, and the hosting configuration. With the assumptions outlined in the *Cost Summary & Return on Investment* the system has the potential for a $19,650.00

EXISTING SITE SURVEY

To improve adoption rates among the WestCOG communities with existing GIS and Assessor Database Portals, a regional solution must both incorporate the features and functionality of those portals and make efforts to expand or improve upon them. The core functionality that is provided by the existing sites must be present and fully-operational at the time of launch, as this is one of the critical adoption periods for a scenario such as this. Considerations must also be given to features and functionality that may affect the attainment of long-term goals, such as the implementation of data schemas or software that would prevent or complicate future enhancements.

To identify the required data and functionality for a regional GIS site, Axiomatic developed an inventory of existing municipal GIS and assessor database portals in the eighteen WestCOG communities. An overview of the identified solutions is shown in Table 2.

Municipality	GIS Portal		Assessor Database Portal	
	Deployed	Maintainer	Deployed	Maintainer
Bethel	Yes	Tighe & Bond	Yes	Tyler
Bridgewater	No	N/A	Yes	Vision
Brookfield	Yes	NE GEO	Yes	Vision
Danbury	No	N/A	Yes	Vision
Darien	Yes	Yes	Yes	Unknown
Greenwich	No	N/A	No	N/A
New Canaan	No	N/A	Yes	Appraisal Online
New Fairfield	Yes	Tighe & Bond	Yes	Vision
New Milford	Yes	App Geo	Yes	Vision
Newtown	Yes	NE Geo	Yes	Vision
Norwalk	No	N/A	Yes	Vision
Redding	Yes	CDM	Yes	Vision
Ridgefield	No	N/A	Yes	PropertyRecords
Sherman	No	N/A	No	N/A
Stamford	Yes[1]	Internal	Yes	Vision
Weston	No	N/A	Yes	qpublic
Westport	Yes	Sewell	Yes	Vision
Wilton	No	N/A	Yes	Vision

Table 2: Existing GIS and Assessor Database Web Portals

Nine of the eighteen communities have existing GIS web portals which, though featuring varying levels of GIS data, focus primarily on parcels and provide access to tax card (CAMA) information through separate assessor database web portals. There are five additional communities that, while they do not maintain a GIS portal, provide online assessor database web portals. Recommendations for required data and site functionality based upon the offerings of the existing solutions can be found in the GIS Files and Schemas and Recommended CAMA Implementation Strategy sections. Comprehensive GIS layer and site functionality breakdowns can be found in Appendix A.

[1] *Does not contain parcels only map index.*

GIS FILES AND SCHEMAS

REGIONAL GIS LAYERS

EXISTING GEOSPATIAL LAYERS IN MUNICIPAL GIS PORTALS

Axiomatic inventoried the existing WestCOG community GIS portals to determine the scope and variety of the geospatial data provided by each. These layers were then assigned a category based upon the data that they contained and their context to produce an abstracted "meta-inventory", shown in Table 3 through Table 6. This meta-inventory helps identify the critical geospatial datasets that are used across many of the existing GIS portals and those that are only implemented by a small subset of the communities but would be useful to include in the regional site.

	Bethel	Brookfield	Darien	New Fairfield	New Milford	Newtown	Redding	Stamford	Westport
Basemap/Raster Layers									
Imagery, Aerial	No	Yes	No	Yes	Yes	Yes	Yes	No	No
Imagery, Satellite	Yes	No	No	Yes	Yes	No	Yes	No	Yes
Street Map	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes
Thematic	No	No	No	Yes	No	No	No	No	Yes
Topographic	Yes	No	No	Yes	Yes	No	Yes	No	Yes
Planimetric	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes

Table 3: Existing base map services and raster layers.

	Bethel	Brookfield	Darien	New Fairfield	New Milford	Newtown	Redding	Stamford	Westport
Elevation Layers									
Contours	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes
Spot Elevations	No	Yes	No	No	No	Yes	Yes	No	Yes
Hydrology Layers									
Rivers/Streams	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Lakes/Ponds	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Watersheds	No	Yes	No	No	Yes	No	Yes	No	Yes
Wetlands	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes

Table 4: Existing physical geography layers.

	Bethel	Brookfield	Darien	New Fairfield	New Milford	Newtown	Redding	Stamford	Westport
Infrastructure Layers									
Drainage	No	Yes	No	No	No	Yes	No	No	Yes
Railroads	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Roads, Centerlines	No	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Roads, Polygons	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Sidewalks	No	No	No	No	Yes	No	No	No	Yes
Utilities	Yes	Yes	No	No	No	Yes	Yes	No	Yes
Structure Layers									
Fences/Walls	No	Yes	No	No	No	Yes	Yes	No	Yes
Buildings	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Pools	No	Yes	No	Yes	No	Yes	No	No	Yes
Paved Areas	No	Yes	No	Yes	Yes	Yes	No	No	Yes

Table 5: Existing human geography layers.

	Bethel	Brookfield	Darien	New Fairfield	New Milford	Newtown	Redding	Stamford	Westport
Boundary Layers									
Administrative	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Easements	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Ecological	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes
Flood Zones	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes
Land Cover/Use	No	No	No	Yes	No	Yes	Yes	No	Yes
Parcels	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Permits	No	No	No	No	No	No	No	No	Yes
Soils	No	Yes	No	Yes	Yes	No	Yes	No	Yes
Zoning/Districts	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Annotation Layers									
PID	No	Yes	No	No	No	No	No	No	No
Map	No	No	No	No	No	No	No	No	No
Lot	Yes	No	Yes	Yes	Yes	No	No	No	Yes
Sublot	No	No	No	Yes	Yes	No	No	No	No
Acreage	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
Dimensions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Road Names	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Street Number	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Survey Number	No	No	No	No	No	No	No	No	Yes

Table 6: Existing boundary and annotation layers.

RECOMMENDED GEOSPATIAL LAYERS FOR REGIONAL SITE

In addition to the information provided in Appendix A, Axiomatic reviewed the inventory for two Connecticut's state GIS clearinghouses: University of Connecticut Libraries' Map and Geographic Information Center (MAGIC) and the Connecticut Department of Energy and Environmental Protection (CTDEEP). Based on the available datasets in these clearinghouses and the datasets currently in the possession of WestCOG, Axiomatic recommends that the layers listed in Table 7 be integrated into the regional GIS site. Each layer is categorized and includes a description, coverage (complete or partial) and the recommended authoritative source.

Category	Subcategory	Description	Coverage	Source
Ownership	Parcels	Parcel boundaries	Complete	Municipal
	Easements	Easement boundaries	Partial	Municipal
Annotation	Acreage	Parcel calculated acreage	Partial	Municipal
	Dimensions	Parcel boundary dimensions	Partial	Municipal
	Street Number	Parcel Street Number	Partial	Municipal
	Lot	Parcel Lot Number	Partial	Municipal
	Parcel ID	Parcel ID Number	Complete	Municipal
	Road Names	Road Name Labels	Complete	Various
Structures	Fences/Walls	Fences and walls	Partial	Municipal
	Buildings	Building footprints	Partial	Municipal
	Paved Areas	Paved areas (roads, driveways)	Partial	Municipal
	Pools	Pool footprints	Partial	Municipal
Districts	Zoning	Zoning Maps	Partial	Municipal
	Flood	Flood Insurance Risk Zones	Complete	CT DEEP
	Land Use	Land Use	Complete	WestCOG
Boundaries	County	County Boundary Lines	Complete	MAGIC
	Municipal	Municipal Boundary Lines	Complete	MAGIC
	CT State House	CT State House Districts	Complete	MAGIC
	CT State Senate	CT State Senate Districts	Complete	MAGIC
	Zip Codes	Zip Code Boundaries	Complete	MAGIC
	Soil	SSURGO	Complete	CT DEEP
	Bedrock	Bedrock polygons	Complete	CT DEEP

Roads	Road Centerline	Centerline including road name	Complete	WestCOG
Elevation	Contours	Two-foot elevation contours	Complete	CT DEEP
Names	GNIS	Geographic Names Info System	Complete	CT DEEP

Table 7: Proposed geospatial layer inventory.

GIS SCHEMA

Axiomatic has developed initial recommendations for optimized data schemas for point, line, and polygon features. The schemas are designed to carry the minimum amount of information that is required to support the regional GIS sites functionality and display requirements. These schemas are designed for efficiency and additional attribute fields may be required to accommodate specific use cases. The details of the data schemas can be found in Appendix B.

A separate schema has been provided for the parcel layer, accommodating the core requirements for both initial implementation of the regional GIS solution and for the needs of anticipated future enhancements (e.g. unique identifiers and linking identifiers). The schema for the parcel polygon file is detailed in Appendix B.

CAMA FILES AND SCHEMA

EXISTING CAMA DATA AND INTEGRATION LEVELS

Axiomatic inventoried each of the WestCOG communities Assessor Database Portal, and CAMA data exports (collected during Task 1 of the CAMA Regionalization Study) to determine the attributes required for each of the proposed levels of a regional GIS site. Thirteen of the WestCOG communities use Vision CAMA which means that there is already a high degree of interoperability with respect to a WestCOG-wide CAMA schema.

Municipal CAMA systems rely on complex relational databases that store temporal data in various tables. Many of these systems include pre-designed data exports that can provide external users with basic property information. For more advanced, custom data exports it requires municipal or vendor resources to build the appropriate export file.

Axiomatic has proposed three levels of integration between GIS and CAMA to support a regional GIS site as detailed in Table 8. Each integration point is further detailed in the following sections. Recommendations for implementation are provided in the *Recommended CAMA Implementation Strategy* section.

Function	Level 1	Level 2	Level 3
Flat CAMA Integration	✓	✓	✓
Internal Property Record Cards	✓	✓	✓
Link to Property Record Card Site		✓	✓
Vision PDF Property Record Card Export		✓	✓
Expanded CAMA Integration			✓
Internal Expanded Field Cards			✓

Table 8: CAMA integration levels and respective functionality.

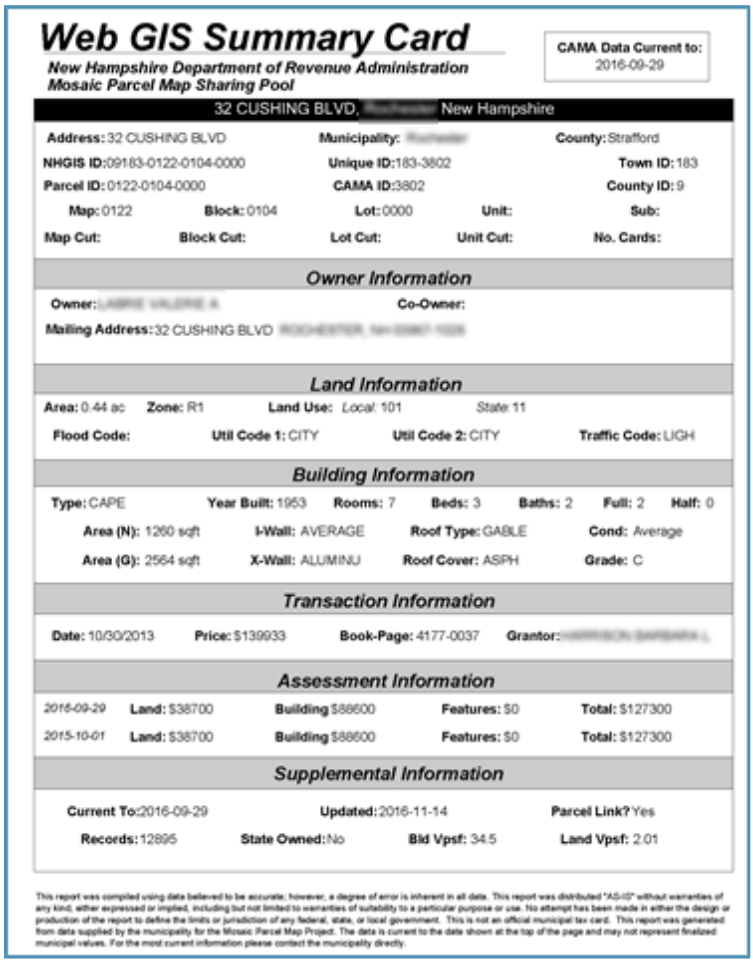
FLAT CAMA INTEGRATION

Example Site: Westport, CT
https://geopower.jws.com/westport/ApplicationsPage.jsp

"Flat" CAMA integration is the most common form seen in parcel-based GIS data portals. Flat integrations involve the linking of a single record per property. Information related to the property, such as multiple building sections or extra

features, is aggregated into a summary or simply into totals and stored in the record, as there is no support for one-to-many parent/child relationships with this type of implementation. Data from this type of system is easily exported to delimited text files. The flattening process generally only has an impact on more complex properties and would have little effect on the single-family residential properties in WestCOG, which make up most the records. The flat file typically contains summary information regarding the properties identification, current ownership, land, primary building, valuation, and last sale.

Flat CAMA integration will allow users of a regional GIS site to search for properties by all the standard attributes (e.g. owner, address, parcel identification number). It will also allow WestCOG to develop a summary-level property record card as shown in Figure 1. Note that the card contains high-level information about the property and does not provide in-depth information regarding building sections, outbuildings, or extra features.



Web GIS Summary Card

New Hampshire Department of Revenue Administration
Mosaic Parcel Map Sharing Pool

CAMA Data Current to: 2016-09-29

32 CUSHING BLVD, [redacted] New Hampshire

Address: 32 CUSHING BLVD | Municipality: [redacted] | County: Strafford
NHGIS ID: 09183-0122-0104-0000 | Unique ID: 183-3802 | Town ID: 183
Parcel ID: 0122-0104-0000 | CAMA ID: 3802 | County ID: 9
Map: 0122 | Block: 0104 | Lot: 0000 | Unit: | Sub:
Map Cut: | Block Cut: | Lot Cut: | Unit Cut: | No. Cards:

Owner Information

Owner: [redacted] | Co-Owner:
Mailing Address: 32 CUSHING BLVD [redacted]

Land Information

Area: 0.44 ac | Zone: R1 | Land Use: Local 101 | State 11
Flood Code: | Util Code 1: CITY | Util Code 2: CITY | Traffic Code: LIGH

Building Information

Type: CAPE | Year Built: 1953 | Rooms: 7 | Beds: 3 | Baths: 2 | Full: 2 | Half: 0
Area (N): 1260 sqft | I-Wall: AVERAGE | Roof Type: GABLE | Cond: Average
Area (G): 2564 sqft | X-Wall: ALUMINU | Roof Cover: ASPH | Grade: C

Transaction Information

Date: 10/30/2013 | Price: $139933 | Book-Page: 4177-0037 | Grantor: [redacted]

Assessment Information

2016-09-29	Land: $38700	Building $88600	Features: $0	Total: $127300
2015-10-01	Land: $38700	Building $88600	Features: $0	Total: $127300

Supplemental Information

Current To: 2016-09-29 | Updated: 2016-11-14 | Parcel Link? Yes
Records: 12895 | State Owned: No | Bld Vpsf: 34.5 | Land Vpsf: 2.01

This report was compiled using data believed to be accurate; however, a degree of error is inherent in all data. This report was distributed "AS-IS" without warranties of any kind, either expressed or implied, including but not limited to warranties of suitability to a particular purpose or use. No attempt has been made in either the design or production of the report to define the limits or jurisdiction of any federal, state, or local government. This is not an official municipal tax card. This report was generated from data supplied by the municipality for the Mosaic Parcel Map Project. The data is current to the date shown at the top of the page and may not represent finalized municipal values. For the most current information please contact the municipality directly.

Figure 1: A sample summary level property field card from the New Hampshire Mosaic state-wide system.

LINK TO PROPERTY RECORD CARD SITES

Example Site: New Fairfield, CT
http://hosting.tighebond.com/NewFairfieldCT_Public_new/

All but two of the WestCOG communities maintain assessor database portals that provide access to detailed property record cards. These detailed records include information not present in the flat file, allowing users to use the portals to search across a variety of fields and attributes and view detailed information about a parcel (e.g. identification, ownership, land, building sections, out buildings, extra features, valuation, permits, sales, building photos, and sketches. A sample of a field card from the town of New Fairfield's assessor portal is shown in Figure 2. Many of the existing GIS portals provide

direct access to these portals to display detailed property record cards, allowing users to select a parcel on the GIS site and navigate directly to the related property record card in the assessor's database. Implementing this type of functionality gives regional site users access to the detailed property record information while only requiring WestCOG to collect and normalize a flat file export from the CAMA system. ***This level of integration would require that municipalities continue to maintain their existing Assessor Database Portals.***

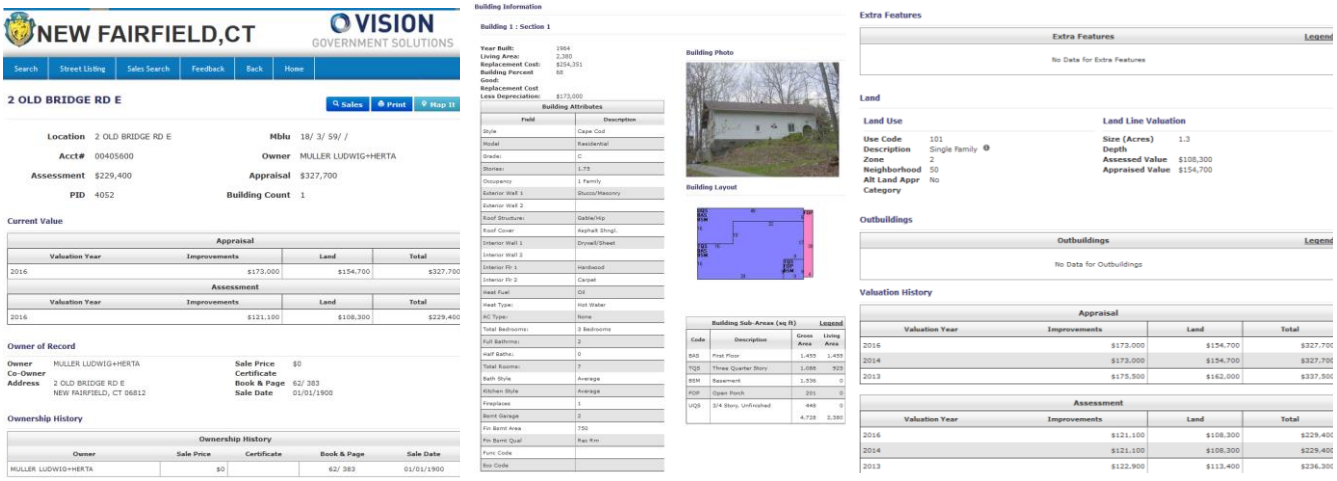


Figure 2: Sample property record card from New Fairfield's vision site (screen broken into three sections)

VISION PDF PROPERTY RECORD CARD EXPORT

Example Site: Montville, CT

https://www.axisgis.com/MontvilleCT/

For Vision CAMA users, it is possible to batch-print property record cards to PDF. The batch prints can then be associated with the appropriate CAMA record via a batch file naming process. The property record card PDF contains detailed property information including building photos, sketches and related information including building sections. Implementing this type of functionality gives regional site users access to the detailed property record information while only requiring WestCOG to collect and normalize a flat file export from the CAMA system. A sample of a Vision property record card export is shown in Figure 3. ***This level of integration may enable some municipalities to discontinue their existing Assessor Database Portals.***

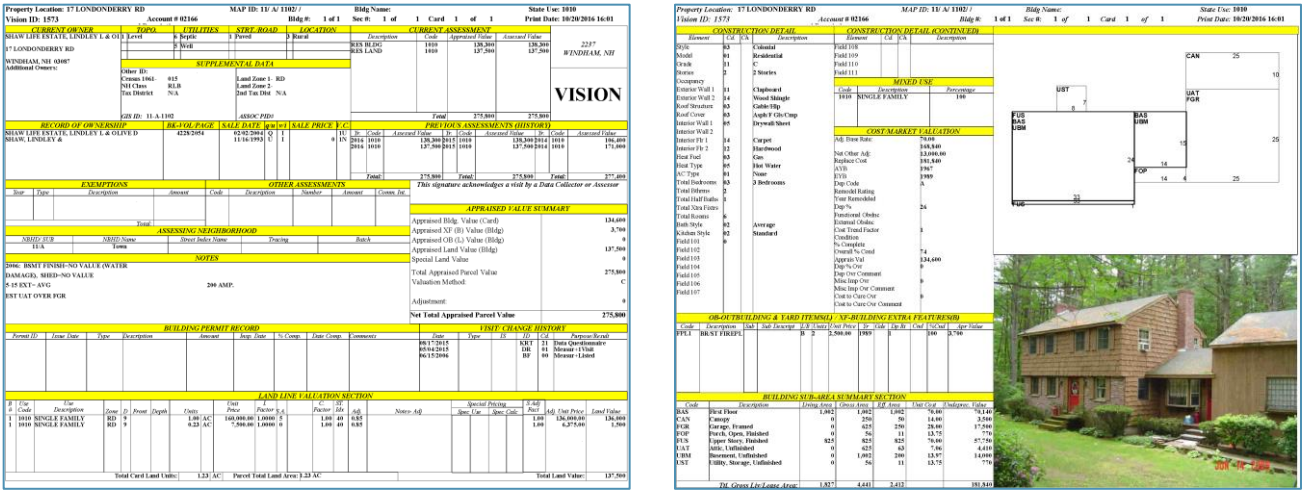


Figure 3: Example of a batch-printed Vision property record card.

EXPANDED CAMA INTEGRATION

Expanded CAMA integration is the most complicated form of integration when developing a GIS site, as it maintains the many-to-one relationships of buildings, extra features, and land. It requires exporting several tables from a municipalities CAMA system and creating a more complex relational database to manage the various child records (building sections, out buildings, extra features, permits, etc.) Utilizing an expanded CAMA integration allows for querying by any property attribute, but is typically more complex than most online GIS platforms can handle in their out of the box configuration.

INTERNAL EXPANDED PROPERTY RECORD CARDS

Example Site: Darien, CT

http://assessment.darienct.gov/pt/search/commonsearch.aspx?mode=owner

Once expanded CAMA integration is developed, the internal property record cards can be expanded to include as much information as an externally hosted property record card site. This would allow a municipality to discontinue hosting CAMA data on a standalone site and would provide a one-stop-shop for all GIS and CAMA records for the WestCOG region. A screenshot of the internal property record card site for Darien is shown in Figure 4. Note that the categories at left provide a detailed breakdown of the valuation for residential and commercial structures, outbuildings, and land.

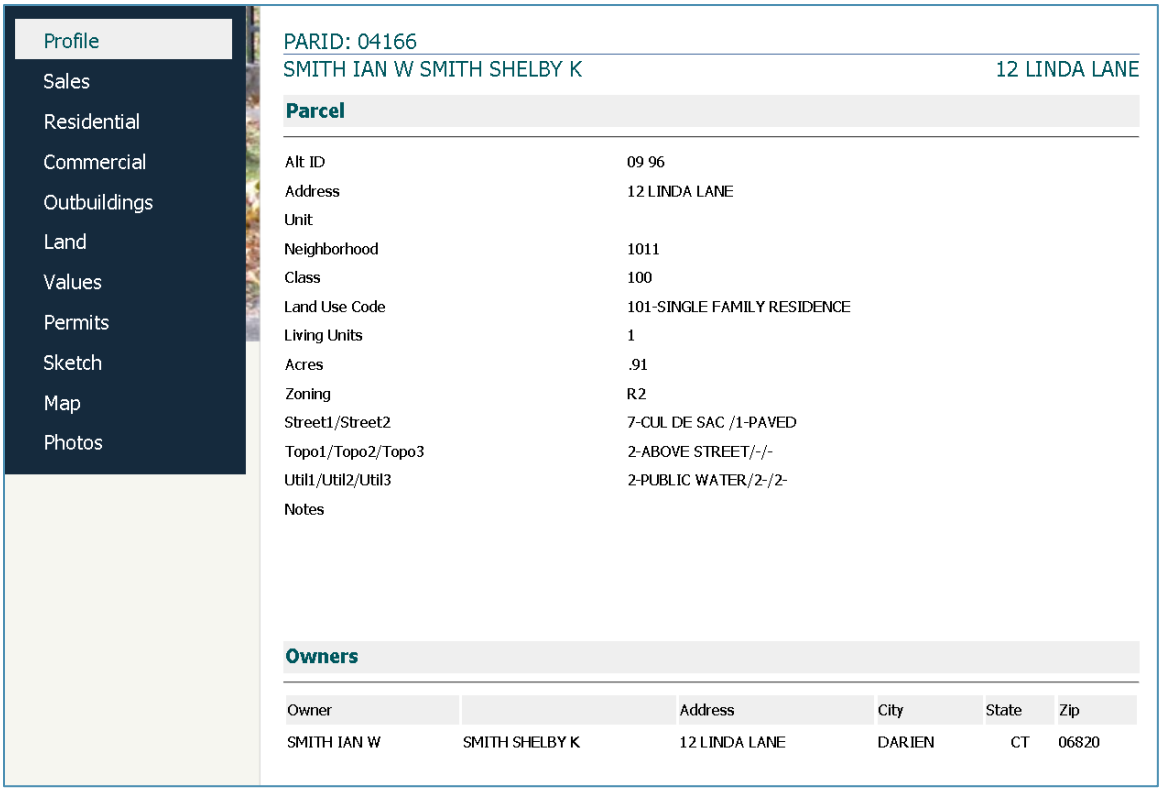


Figure 4: Example of an expanded internal property record card from Darien, CT.

CAMA SCHEMA

Axiomatic is providing WestCOG with two proposed CAMA schemas. The first is flat, (buildings, out buildings, extra features and land lines are flattened to provide summary level information). The second schema is expanded to include multiple tables in a relational structure. This allows for a complete picture of municipal improvements which are related to a master parcel. Note that the flat schema is designed so that it can be transitioned into the expanded schema over time.

FLAT SCHEMA

The flat schema (corresponding to Level 1 and Level 2 of GIS and CAMA integration) flattens related information like buildings, out buildings, extra features and permits. A flat schema is the fastest and easiest way to integrate CAMA information into a GIS site. The flat schema contains attributes categorized as follows, identification (parcel ID, address, etc.), ownership, land, building, valuation and last known transaction. The full flat schema including field names, descriptions and types is provided in Appendix C. The flat schema has been designed to facilitate a transition to the expanded schema. For simplicity, Figure 6 only shows the Primary Key (camaidregional) for each unique assessing record, and the foreign key (linkid) to relate the CAMA file to the geospatial Parcel layer. Due to the many-to-one relationships (like Condos), this foreign key will not be a unique value in this table.

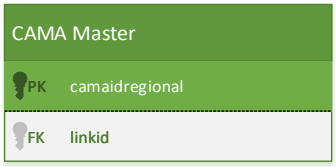


Figure 5: CAMA schema diagram showing primary and foreign keys.

EXPANDED SCHEMA

The expanded CAMA schema (GIS and CAMA integration Level 3) requires multiple export files be run from a CAMA system to obtain the necessary related data tables. The schema contains a primary CAMA table (CAMA Master) and six (6) related data tables, CAMA Sales, CAMA Building, CAMA Outbuilding, CAMA Extra Features, CAMA External. Each of the related tables uses the primary key "camaidregional". Figure 6 shows the expanded schema structure displaying only primary and foreign keys for simplicity. The expanded CAMA schema details are provided in Appendix C.

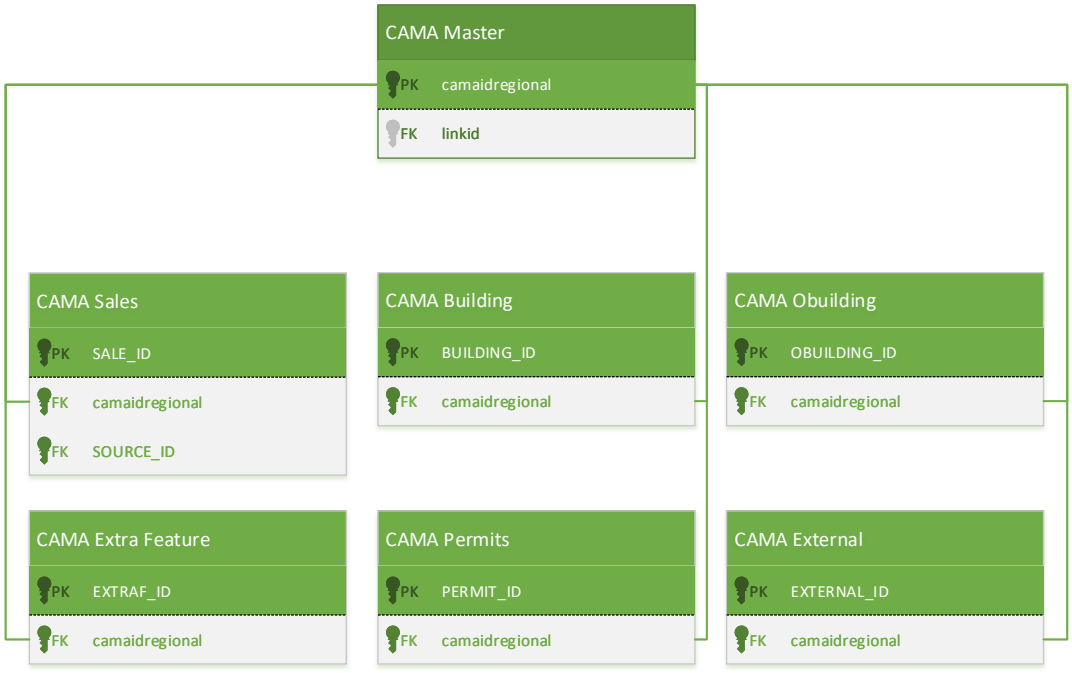


Figure 6: CAMA schema diagram showing primary and foreign keys.

CAMA-PARCEL LINK

CAMA data will be related to the GIS parcel file via the field "LINK_ID". This will allow many-to-one and many-to-many relationships between the data sets to be managed appropriately. The link between the GIS parcel and CAMA schema is shown in Figure 7. The linking ID is typically constructed during the Extract Transform Load ("ETL"), with the generic format of a leading municipal ID, followed by a municipal specific ID.

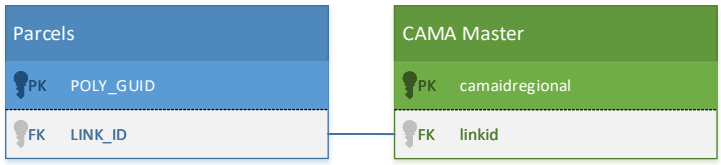


Figure 7: CAMA schema diagram showing primary and foreign keys.

RECOMMENDED CAMA IMPLEMENTATION STRATEGY

The level of functionality attainable for a regional GIS site is largely based on the level of detail in the CAMA data export which is acquired from each municipality. As this export becomes more complex (adding related tables for improvements, extra features, sales etc.) it requires more time from the municipality to generate as well as a more complex standardization (extract, transform, load ("ETL")) effort for WestCOG.

For this reason, Axiomatic has outlined GIS and CAMA integration with respect to functionality and data in three (3) levels. These levels correspond to level of effort to implement as well as WestCOG's short and long-term goals.

- **Level 1: GIS Site with Flat CAMA:** A GIS site with parcels, supporting GIS layers and integrated flat CAMA. This is the most basic level of integration and allows for viewing of GIS information and the ability to search and view basic property attributes. This type of integration has become common place for individual municipalities across Connecticut, New England and the US.

- **Level 2: GIS Site with Flat CAMA and Access to External Property Record Cards**: A GIS site with parcels, supporting GIS layers and integrated flat CAMA with links to external property record card sites (like Vision's Online Assessor Database). This is an intermediate level of integration as it allows for access to full CAMA data via the assessors stand-alone site. There is also an ability to integrate batch printed PDF property record cards to link to the parcel layer, reducing the reliance on the stand-alone Assessor Database. Integration is typically straightforward as many other communities use this type of cross site linkage. Most WestCOG communities will still need to support standalone Assessor Database Portals at their own cost to maintain complex searches (e.g. comparable sales search).

- **Level 3: GIS Site with Full CAMA Integration**: A GIS site with parcels, supporting GIS layers and expanded CAMA that can be used to fully replicate external property record card sites. This option allows for full CAMA integration without the municipalities continuing to support standalone Assessor Database Portals at an additional cost. The amount of information that must be extracted from the municipal CAMA systems is substantially higher than for Levels 1 and 2. This type of functionality is not typical for a municipal or regional GIS site but is becoming more common.

Function	Level 1	Level 2	Level 3
Flat CAMA Integration	✓	✓	✓
Internal Flat Property Record Cards	✓	✓	✓
Link to Property Record Card Site		✓	✓
Vision PDF Property Record Card Export		✓	✓
Expanded CAMA Integration			✓
Internal Expanded Property Record Cards			✓

Table 9: GIS levels and respective functionality.

Each successive level of GIS and CAMA integration will require an increased level of effort for both WestCOG and the municipalities. As the data becomes fully integrated in a single system (Level 3) with functionality sufficient to replace both the local GIS, and Assessor Database Portals the effort to ETL the information into the regional site increases significantly. A fully integrated site also requires more robust features and functionality which necessitate more resources to develop and maintain. A breakdown of the estimated effort for municipal effort, ETL, site maintenance and external dependencies is shown in Table 10.

Item	Level 1	Level 2	Level 3
Municipal Effort	>10 min per export	>20 min per export	>40 min per export
ETL Complexity	Average	Average	High
Database Design	Average	Average	Complex
Site Features	Minimal	Average	High
External Dependencies	Low	High	Low

Table 10: Estimated effort per level

Recommendations
❖ Begin with Level 1 to quickly establish a regional GIS site and minimize municipal time commitment to get a basic site running.
❖ Pilot Level 2 with select communities to establish amount of time required, and gain buy in. Incrementally include level 2 functionality for all municipalities.
❖ Study Level 3 integration with pilot communities. To better determine time commitments & willingness to consolidate online systems.

DATA STANDARDIZATION & CONVERSION REQUIREMENTS

LAND USE CODING

In Connecticut, there is no single, unified land use code standard. This presents a usability issue when aggregating data for use in a regional or statewide GIS and CAMA data portal. For that reason, it is necessary to create or adopt a regional

standard and translate each municipal specific code into the regional standard. While ideally all participating communities would adopt the regional standard, in practice this is not a realistic expectation.

Axiomatic analyzed and compared several national, and New England based land use coding standards to determine their feasibility for use in WestCOG. Brief summaries of each, and a recommendation for a WestCOG regional standard are included herein.

MASSACHUSETTS

The Massachusetts Department of Revenue, Division of Local Services has developed a robust land use coding guideline that is employed by most municipalities in the state. The land use coding structure calls for a three-digit identifier with each digit representing a classification. The first digit represents the major classification ranging from zero to nine that represents multiple-use, residential, open space, commercial, industrial, personal, forest, agricultural, recreational and exempt property respectively. The second digit represents a major division and the third digit represents a subdivision.

For example, a residential, single family property would have the major classification of one for residential, a major division of zero for residences and a subdivision of one for single family. The result is a land use code of “101” for a single-family residence. The Massachusetts system is well designed and has been adopted as the default land use coding system for major CAMA system developers such as Vision and Patriot which are both have their headquarters in the Bay State. The entire Massachusetts state land use code guide values can be found in Appendix D.

NEW YORK

The New York Office of Real Property Services has developed a robust land use coding classification system that is required for assessment oversight. Like in Massachusetts the system consists of a three-digit code that identifies classification, major division and subdivision respectively. New York has added an additional set of waterfront and ownership codes to categorize waterfront property that have complex ownership types like time shares, condominiums, etc.

For example, a residential, single family property would have the major classification of two for residential, a major division of one for single family and a subdivision of zero for year around residence. The result is a land use code of 210 for a single-family residence. The New York system is well designed and has been adopted as the default land use coding system for municipalities in New York. The entire New York state land use code guide values can be found in Appendix D.

NEW HAMPSHIRE

In New Hampshire there is no state guideline for standardized land use coding. The Department of Revenue Administration transforms local land use codes into a state standard that is used for property tax equalization. New Hampshire utilizes a two-digit land use code that identifies major classification and major divisions. New Hampshire also utilizes a set of two-digit suffix codes to identify waterfront and water access.

For example, a residential, single family property would have the major classification of one for residential and a major division of one for single family. The result is a land use code of 11 for a single-family residence. The New Hampshire system is adequate for the purposes of property tax equalization and general property identification but lacks the granularity that is desired for non-taxable property. The entire New Hampshire state land use code guide values can be found in Appendix D.

AMERICAN PLANNING ASSOCIATION

The American Planning Association ("APA") has developed the Land Based Classification Standard ("LBCS") which expands land use coding in five dimensions, activities, functions, building types, site development charter and ownership constraints. The LBCS is complicated and suggests that each property must have five distinct, four-digit codes to accurately describe its use. The APA defines the five dimensions as:

- **Activity**: Activity refers to the actual use of land based on its observable characteristics. It describes what actually takes place in physical or observable terms (e.g., farming, shopping, manufacturing, vehicular movement, etc.).
- **Function**: Function refers to the economic function or type of establishment using the land. Every land-use can be characterized by the type of establishment it serves.
- **Structure**: Structure refers to the type of structure or building on the land.
- **Site**: Site development character refers to the overall physical development character of the land. It describes "what is on the land" in general physical terms.
- **Ownership**: Ownership refers to the relationship between the use and its land rights.

Each of the dimensions has a four-digit identifier which delineates major classification, major division, minor division and subdivision respectively. For example, a residential, single family property with standard use and ownership would have the following coding:

- **Activity**: 1100-Residential activities/household activities
- **Function**: 1100-Residence or accommodations/private household
- **Structure**: 1110-Residential buildings/single-family buildings, detached units
- **Site**: 6000-Developed site with buildings
- **Ownership**: 1000-Not constraints-private ownership

The LBCS is very well constructed and provides immense details if utilized correctly. It is burdensome to implement however, as it requires much more insight into the property then is typically employed for property taxation. The entire APA-LBCS can be found in Appendix D.

LAND USE CODE STANDARD RECOMENDATION

Axiomatic recommends WestCOG utilize the Massachusetts Land use code standards. The Massachusetts system provides major classification, major division and subdivision delineations. This will provide the necessary granularity to provide WestCOG and its member communities with insight into the use of a property without being overly complicated.

It will be necessary perform a transformation on municipal CAMA data to implement a standardized land use coding system. During Axiomatic's initial review of the WestCOG communities, CAMA exports were obtained from the majority and analyzed for consistency in land use coding. Thirteen of the eighteen WestCOG communities use Vision CAMA platform, which maintains the Massachusetts land use coding system as their baseline configuration. Most municipal users create custom coding to identify specific property types that might not be specifically addressed in the baseline code list (e.g. waterfront). The land use code identifier for a single-family home for the CAMA databases collected during Task 1 are shown in Table 11. Note that the majority of the listed towns are using 101 as their indicator for a Single-family home. Based on the inventoried land use code systems, this best aligns to the Massachusetts standard.

Entity	Property Code
Bethel	101
Bridgewater	101
Brookfield	101
Danbury	101
Darien	101
Greenwich	101
New Canaan	101
Newtown	1010
Norwalk	101
Redding	101
Stamford	101
Westport	101
Wilton	1-1

Table 11: Local land use codes for a single-family home.

As most WestCOG communities are already utilizing a variation of the Massachusetts standard the required transformations will be substantially simpler and less time consuming than implementing a totally different system like LBCS. There is also a higher likelihood that WestCOG communities would be open to adopting a single regional standard over time if it is not a substantial deviation from their current coding system.

Recommendations
❖ Implement the Massachusetts land use coding system for the regional GIS site, transforming local data as needed for conformance.
❖ Encourage adoption of the MA land use coding system by WestCOG communities as a long-term goal.

ALIAS COMMON FIELD NAMES

There are several description fields that will contain unique values per municipality that could be aliased to a WestCOG specific list if desired. The alias fields will allow WestCOG to enforce consistency in data which can be useful for advanced queries and reports. The alias field values will be determined based on the most common nomenclature among the WestCOG communities CAMA systems. It must be recognized that the source field value must be maintained in addition to the alias field to ensure that WestCOG can replicate municipal attributes on property record cards. A list of fields to be potentially aliased is listed in Table 12.

Field Name	Example(s)
Building Style	*Colonial, Cape, Gambrel*
Building Model	*Single Family, Multi Family*
Building Grade	*Poor, Average, Good*
Building Condition	*A, B+, B*
Out Building Description	*Pool, Tennis Court*
Extra Feature Description	

Table 12: Additional common fields that can be aliased.

Recommendations
❖ Begin developing alias fields for common attributes and the corresponding transformation process(es) as necessary.

DATA PROCESSING & UPDATES BEST MANAGEMENT PRACTICES

EXTRACT, TRANSFORM, LOAD (ETL) PROCESS

The ETL process will allow WestCOG to take individual municipal data file and process them into a normalized regional file. This process will be critical for the long-term success of a regional initiative. It is recommended that the ETL tools be developed internally or procured in a manner that gives WestCOG control and ownership of them, as these tools will become the heart of the regional GIS.

STEP 1: COLLECTION OF GIS & CAMA DATA

The initial step in creating a regional GIS site will be to develop a repeatable data export for each communities CAMA and GIS data. The attributes included in each data export should align to the WestCOG master schema to ensure data completeness. Once the repeatable data export process for each community has been established it should be documented thoroughly.

CAMA DATA UPDATE FREQUENCY

In Connecticut property is valued annually to be current to October 1 (Chapter 203 - Sec. 12-62a) by each municipality. The municipality has until February 1 to create the "grand list" which contains all the taxable and tax-exempt property current to the assessment date. This is essentially the "official" valuation record for the year (although some municipalities do not complete the list until the end of February).

It is imperative that the underlying CAMA information in a WestCOG regional GIS data portal contains the official records for each property. This ensures that the information being displayed on the site coincides with property tax billing information. For this reason, CAMA exports should be collected by WestCOG at a minimum annually to coincide with grand list.

CAMA data is updated daily by municipalities to add new construction, update attributes for renovations, or record ownership changes. It is important to capture these changes regularly to ensure the data on the GIS website maintains utility (current owner and mailing address are critical for abutter notifications).

After deployment, it is recommended that WestCOG obtain more frequent CAMA updates. This allows the valuation information to remain consistent with the grand list while displaying the correct ownership information. The recommended quarterly CAMA data collection and update schedule is shown in Table 13.

Data	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CAMA		Primary Collection				Update			Update			Update

Table 13: CAMA data collection and update schedule

Recommendations

- WestCOG should collect CAMA data at a minimum annually from each community with the primary solicitation occurring during February and March. Supplemental ownership updates should be received every quarter (June, September, December) if desired.

GIS DATA UPDATE FREQUENCY

GIS parcel maps should be updated at a minimum annually to coincide with the assessment date of October 1. Many WestCOG communities are proactive with parcel map maintenance. Table 14 shows the update frequency for GIS data among the WestCOG communities as determined during part of Task 1 of the CAMA Regionalization Study. Note that only one respondent has GIS parcel information that is more than one year out of date. Axiomatic recommends that parcel information be updated at a minimum annually.

Municipality	Maintainer	Update Schedule	Last Update
Bethel	Tighe & Bond	Annually	10/01/2015[2]
Bridgewater	Assessor/WestCOG	On Demand	2016
Brookfield	Sharlow Tech Group & New England Geo	Quarterly	Q4 2016
Danbury	Sewall	Monthly	10/01/2016
Darien	Assessor	Daily	Ongoing
Greenwich	Assessor	Monthly	Ongoing
New Canaan	Tighe & Bond	Monthly	Ongoing
New Fairfield	Assessor	Semi-Annually	In Progress
New Milford	Assessor	Annually	10/01/2016
Newtown	IT/GIS	3 Years	10/01/2016
Norwalk	Internal	Monthly	Ongoing
Redding	CDM Smith	Annually	In Progress
Ridgefield	Internal	Ongoing	Ongoing
Sherman	-	-	-
Stamford	Internal	Ongoing	Ongoing
Weston	New England GEO	Annually	10/1/2016
Westport	Internal/Sewell	Quarterly	Ongoing
Wilton	CAI	Annually	10/1/2016

Table 14: Summary of Parcel Map Maintenance

For communities that update their information more regularly it is suggested that a second export is taken at the midpoint of the year. The recommended GIS data collection and update schedule is shown in Table 15.

Data	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Parcel	Primary Collection						Update					

Table 15: GIS parcel data collection and update schedule

Recommendations

- WestCOG should collect parcel data at a minimum annually from each community with the primary solicitation occurring during January and February. Supplemental parcel data updates should be received semi-annually (July) if desired.

[2] *Date from survey indicates the map was not updated last year. Verified through Tighe & Bond website.*

STEP 2: PROCESSING OF GIS & CAMA DATA

Once the CAMA and GIS data for each community is collected through the standard export process it must be normalized to the WestCOG master schema. Data processing may require a specific processor for each community or for common CAMA systems. This section contains best practices for processing the municipal specific data. There are a number of data transformation tools available to standardize the CAMA data, however Microsoft Access is one of the most commonly used platforms due to its cost, availability, and simplicity. This section outlines logical best practices for CAMA and Parcel data standardization and processing.

It is recommended that the ETL tools be developed internally or procured in a manner that gives WestCOG control and ownership of them, as these tools will become the heart of the regional GIS.

BASE PARCEL PROCESSING

Collected parcel (and other municipally sourced geospatial) data should be processed using ArcGIS desktop tools and custom python models. The python models standardize file types, field names, clean and repair geometry and remove extraneous attributes. Each python model is designed to run based on the standard export files defined in Step 1.

CAMA NORMALIZER AND PARCEL CROSS CHECK

CAMA data should be processed using a database tool that is tailored to each specific municipality. The database tool normalizes field names, transforms coding (like land use) and performs error identification and cross reference with GIS parcel data. The error identification and rectification process is critical for creating a well-constructed GIS site. The steps below are CAMA normalization best practices.

- **CAMA Normalization**: The CAMA data field names, types and sizes are aligned to the master schema. The “link id” (field that relates CAMA to parcels) is created from the parcel identification number.
- **Initial CAMA/Parcel Crosscheck**: CAMA records that do not have a matching GIS parcel record and GIS parcel records that do not have matching CAMA records are identified. These records are flagged for error resolution.
- **CAMA Error Resolution:** CAMA record “link id” fields can be modified to adjust for inconsistency, complex relationships or other issues that were identified in the initial CAMA/Parcel Crosscheck. Error resolution is managed through a series of “IF” statements that are designed to address specific error patterns. CAMA records flagged in the initial crosscheck are updated based on the error resolution process. The goal of the error resolution is to build a “link id” which can be successfully linked to the parcel layer.
- **Secondary CAMA/Parcel Crosscheck:** CAMA records that do not have a matching GIS parcel record and GIS parcel records that do not have matching CAMA records are re-checked. These records are considered final and are flagged as such. This allows users of the regional GIS site to understand they are looking at a record that does not have a corresponding CAMA or parcel record. It is best practice to share this list with the participating community so that the appropriate data changes can be made, to result in a successful CAMA/Parcel link.
- **Code Transformation**: Based on translation tables the CAMA data codes (like land use) can be transformed to the WestCOG standard. Doing code transformation at the local level is conducive to streamlining long-term maintenance.
- **Export**: Final CAMA and parcel files are exported from the process standardized and ready for aggregation.

STEP 3: AGGREGATION

Once each community is normalized through the transformation process it can be aggregated into the regional file. For CAMA, the separate exports are merged into a single database table (or tables for a complex CAMA schema) containing all communities. For GIS, python models are run to combine the applicable files into a single geodatabase feature. Once the information is aggregated it can be loaded into the regional GIS site.

Recommendations
❖ WestCOG should develop or procure CAMA and GIS ETL tools in a manner such that WestCOG maintains ownership and control of processing tools without license or restricted use. ❖ The ETL process should also provide a method for updating ownership information without updating values, land and building attributes. The ETL process should allow for the identification and rectification of errors using a semi-automated process.

SITE FUNCTIONALITY

The functional requirements for a Regional GIS Site have been derived from a comprehensive inventory and review of municipal GIS and Assessor database web applications within the WestCOG region. The functional requirements inventory focused on documenting GIS site functionality including but not limited to browser compatibility, navigation, searching, reporting, measure tools, markup tools, buffer tools, printing and external integration. The full functional requirements inventory is provided in Appendix A.

From the functional requirements inventory Axiomatic developed a list of critical functionality for the WestCOG regional GIS site to have corresponding to integration levels 1, 2 and 3. The list of functional requirements is shown in Table 16 and Table 17. Each functional requirement is listed by phase and is classified as required, desirable or optional for each of the three levels of integration.

- **Required (R)**: must be present to meet the needs of participating communities.
- **Desirable (D)**: not required but should be highly-prioritized and included if possible.
- **Optional (O)**: non-essential but considered beneficial.

Recommended Search and Navigation Functionality				
Category	**Sub Category**	**Level 1**	**Level 2**	**Level 3**
Desktop Browsers	Microsoft Internet Explorer (v11+)	R	R	R
	Microsoft Edge (v38+)	R	R	R
	Mozilla Firefox (v52+ ESR, v54+)	R	R	R
	Apple Safari (v6.2.8+)	R	R	R
	Google Chrome (v52+)	R	R	R
	Opera (v39+)	R	R	R
Mobile Browsers	Chrome (Android/iOS)	R	R	R
	Safari (iOS)	R	R	R
Navigation	Typical Functions	R	R	R
	Layer Controls	R	R	R
Basic Search	Street Number	R	R	R
	Street Name	R	R	R
	Owner Name	R	R	R
	Parcel ID	R	R	R
Advanced Search	Land Use	D	D	R
	Building Information	D	D	R
	Land Area	D	D	R
	Sale Date	D	D	R
	Value	D	D	R
	Ability to enter ranges (e.g. sale dates)	D	D	R

Table 16: Recommended Search and Navigation Functionality

GIS Functionality & Integration				
Category	**Sub Category**	**Level 1**	**Level 2**	**Level 3**
Selection	From Search	R	R	R
	Point	R	R	R
	Polygon	D	D	R
	Radius	D	D	D
Measure	Linear	R	R	R
	Area	R	R	R
	Variable Units	R	R	R
Buffer	Variable distance	R	R	R
	Visible	R	R	R
	Printable	R	R	R
	Add/Remove Parcels	R	R	R
	Access Mailing List	R	R	R
Markup	Visible	D	D	R
	Printable	D	D	R
Property Record Cards	Internal	R	R	R
	External	D	R	R
	PDF Replication	D	R	R
External Links	Property Record Cards	D	R	R
	Plans	O	O	D
	Deeds	O	D	D
	Permits	O	O	D
Printing	Custom	R	R	R
	Standard	R	R	R
Integration	Oblique	R	R	R
	Street View	R	R	R
	Photo Tool Tips	O	R	R
	Building Photos	O	R	R

Table 17: GIS Functionality and Integration

DEPLOYMENT & MAINTENANCE: PLATFORMS AND ESTIMATED COSTS

There are three key elements to the deployment of a regional GIS: (1) Data Collection, (2) Data Standardization, and (3) Technology Platform. They are each discussed in the following section. The costs presented herein are characterized by the following assumptions:

Assumptions
All eighteen towns are participating
Level 2 integration
Internal (WestCOG) and external (contractor) labor are estimated at $75 and $100 respectively
WestCOG will perform data collection using their own resources
WestCOG will hire a contractor to develop ETL tools
WestCOG will operate ETL tools using their own labor resources after year 1

OUTREACH

An important component of a successful regional GIS is outreach and marketing of services to member communities. It is recommended that a kick-off meeting be held with local officials to review the scope of the project, and any municipal time or financial commitments required. It may be advantageous to enter a Memorandum of Understanding ("MOU") with each member community to establish the data pathways (including any contact with required vendors), and anticipated update schedules. Participating communities should place a link to the regional GIS be placed prominently on the town or cities website. It may also be beneficial to form a regional GIS workgroup, or advisory committee comprised of municipal representatives to guide and inform the development of the data and platform.

Recommendations
❖ Conduct a kick-off meeting with municipal stakeholders.
❖ Optionally prepare Memorandum of Understanding (MOUs) between WestCOG and participating communities to clarify responsibilities.
❖ Encourage each municipality to include links to the regional GIS on the town website.
❖ Form GIS workgroup or advisory committee comprised of municipal officials.

DATA COLLECTION & STANDARDIZATION

DATA COLLECTION

The data collection for a flat file CAMA export and associated GIS layers is not overly burdensome once data pathways have been established. Generally, the data export from the CAMA system takes 5-10 minutes and files are sufficiently small that they can be emailed (in the case of larger communities an FTP may need to be setup). The bulk of the effort related to data collection is spent in establishing contact, and reminding participating communities to send their data. For geospatial information, it is generally easiest to establish municipal specific FTP sites where GIS files can be uploaded. A conservative level of effort estimation for setup is provided in **Error! Reference source not found.** for level 1 and 2 flat file integration. Table 19 includes an estimated maintenance cost. These estimates assume it will take multiple attempts to request and obtain a data export. These values may easily be halved for most communities, and some might not require any communication beyond an email reminder

Estimated Setup Costs					
Type	Hrs. Per	Number	Total Hrs.	Rate	Total Cost
CAMA	1	18	18	$75	$1,350
GIS	1	18	18	$75	$1,350
Total			**36**		**$2,700**

Table 18: Setup data collection cost totals assuming WestCOG labor

Estimated Maintenance Costs					
Type	Hrs. Per	Number	Total Hrs.	Rate	Total Cost
CAMA	.5	18	9	$75	$675
GIS	.5	18	9	$75	$675
Total			**36**		**$1,350**

Table 19: Data collection maintenance cost totals

It is recommended that WestCOG manage the data pathways (contacts and agreements) either internally or through a contractor with an agreement which restricts use of the data and contacts to project tasks only. If the internal resources are available to manage this task this would be the least cost method of data collection. If conducted through a contracted service this data collection task should be on a fixed cost basis per solicitation and include remedy for WestCOG to seek the data directly if the participating communities do not provide it.

Recommendations
❖ Manage data collection internally if resources are available
❖ If necessary contract on a fixed cost basis for data collection. Include a remedy for WestCOG to see the data directly if a participating community is being non-responsive.

STANDARDIZATION OF GIS AND CAMA DATA

Developing the data standardization tools to convert the locally sourced GIS and CAMA files into a regional standard is the most critical step of the process. It is recommended that the transformation tools be developed internally or procured in a manner that gives WestCOG control and ownership of them, as these tools will become the heart of the regional GIS. Best practices and platforms for these processes can be found in the *Data Processing & Updates Best Management practices* section. To reduce the overall maintenance cost, it may be advantageous to retain a consultant to develop sample data transformation processors which WestCOG can operate. Labor estimates for developing standardization tools, for CAMA, GIS, Land Use Code Normalization, and aggregation are provided in Table 20 and Table 21 respectively.

Estimated Setup Costs					
Type	Hrs. Per	Number	Total Hrs.	Rate	Total Cost
CAMA	6	18	108	$125	$13,500
GIS	6	18	108	$125	$13,500
Aggregation	60	1	60	$125	$7,500
Total			**276**		**$34,500**

Table 20: Setup standardization processor cost totals assuming contractor labor

Estimated Maintenance Costs					
Type	Hrs. Per	Number	Total Hrs.	Rate	Total Cost
CAMA	2	18	36	$75	$2,700
GIS	2	18	36	$75	$2,700
Aggregation	16	1	16	$75	$1,200
Total			**88**		**$6,600**

Table 21: Standardization processors maintenance cost totals

Recommendations
❖ To reduce overall cost, it may be advantageous to retain a consultant to build data transformation processors, which WestCOG can leverage with internal resources.
❖ WestCOG should develop or procure CAMA and GIS Transformation tools in a manner such that WestCOG maintains ownership and control of processing tools without license or restricted use.
❖ The ETL process should also provide a method for updating ownership information without updating values, land and building attributes. The ETL process should allow for the identification and rectification of errors using a semi-automated process.

ONLINE GIS PLATFORMS

Axiomatic evaluated five, web based GIS platforms that could potentially be used by WestCOG for their regional GIS. The five solutions were chosen to represent a broad base of options from hosted solution to enterprise configuration management. The five evaluated solutions are listed with basic information in Table 22. Detailed information about each of the evaluated systems can be found in Appendix E. It should be noted that based on Axiomatic's research Integrator and CorsonGIS (custom) appear to be only platforms which could natively achieve Level 3 Integration without new development.

Application	Manufacturer	Map Engine	Hosting Options
AxisGIS	CAI Technologies	Esri ArcEnterprise	Hosted (Cloud)
CorsonGIS (custom)	CorsonGIS Solutions	Esri ArcEnterprise	Hosted (Cloud)
MapGeo	Applied Geographics	Carto	Hosted (Cloud)
MapXpress	New England GeoSystems	Esri/Geocortex	Hosted (Cloud) Internal
Integrator	mPower Innovations	Esri ArcEnterprise OSGeo Mapguide	Hosted (Cloud) Internal

Table 22: Evaluated web based GIS platforms

Each of the evaluated solutions was compared against the list of recommended search and navigation functionality by level (Table 16). Table 23 shows each of the evaluated applications ability to meet the functional requirements for the regional GIS application.

AxisGIS	CorsonGIS	MapGeo	MapXpress	Integrator

Desktop Browsers	Microsoft Internet Explorer (v11+)	Yes	Yes	Yes	Yes	Yes
	Microsoft Edge (v38+)	Yes	Yes	Yes	Yes	Yes
	Mozilla Firefox (v52+ ESR, v54+)	Yes	Yes	Yes	Yes	Yes
	Apple Safari (v6.2.8+)					
	Google Chrome (v52+)	Yes	Yes	Yes	Yes	Yes
	Opera (v39+)	Yes	Yes	Yes	Yes	Yes
Mobile Browsers	Chrome (Android/iOS)	Yes	Yes	Yes	Yes	Yes
	Safari (iOS)					
Navigation	Typical Functions	Yes	Yes	Yes	Yes	Yes
	Layer Controls	Yes	Yes	Yes	Yes	Yes
Basic Search	Street Number	Yes	Yes	Yes	Yes	Yes
	Street Name	Yes	Yes	Yes	Yes	Yes
	Owner Name	Yes	Yes	Yes	Yes	Yes
	Parcel ID	Yes	Yes	Yes	Yes	Yes
Advanced Search	Land Use	**No**	Yes	**No**	Yes	Yes
	Building Information	**No**	Yes	**No**	Yes	Yes
	Land Area	**No**	Yes	**No**	Yes	Yes
	Sale Date	**No**	Yes	**No**	Yes	Yes
	Value	**No**	Yes	**No**	Yes	Yes
	Ability to enter ranges	**No**	Yes	**No**	Yes	Yes

Table 23: Search & Navigation Required functionality matrix for WestCOG regional GIS

Each of the evaluated solutions was compared against the list of recommended GIS and integration functionality by level (Table 17). Table 24 shows each of the evaluated applications ability to meet the functional requirements for the regional GIS application.

		AxisGIS	CorsonGIS	MapGeo	MapXpress Integrator
Selection	From Search	Yes	Yes	Yes	Yes	Yes
	Point	Yes	Yes	**No**	Yes	Yes
	Polygon	**No**	Yes	**No**	**No**	Yes
	Radius	**No**	Yes	**No**	**No**	Yes
Measure	Linear	Yes	Yes	Yes	Yes	Yes
	Area	Yes	Yes	Yes	Yes	Yes
	Variable Units	Yes	Yes	**No**	**No**	Yes
Buffer	Variable distance	Yes	Yes	Yes	Yes	Yes
	Visible	Yes	Yes	Yes	Yes	Yes
	Printable	Yes	Yes	Yes	Yes	Yes
	Add/Remove Parcels	Yes	Yes	**No**	Yes	Yes
	Access Mailing List	Yes	Yes	Yes	Yes	Yes
Markup	Visible	Yes	Yes	Yes	**No**	Yes
	Printable	Yes	Yes	Yes	No	Yes
Property Record Cards	Internal	Yes	Yes	Yes	Yes	Yes
	External	Yes	Yes	Yes	Yes	Yes
	PDF Replication	Yes	**No**	**No**	Yes	**No**
External Links	Property Record Cards	Yes	Yes	Yes	Yes	Yes
	Plans	Yes	Yes	Yes	Yes	Yes
	Deeds	Yes	Yes	Yes	**No**	Yes
	Permits	Yes	Yes	Yes	**No**	Yes
Printing	Custom	Yes	Yes	Yes	**No**	Yes
	Standard	Yes	Yes	Yes	Yes	Yes
Integration	Oblique	Yes	Yes	**No**	Yes	Yes
	Street View	Yes	Yes	Yes	**No**	Yes
	Photo Tool Tips	Yes	Yes	**No**	Yes	Yes
	Building Photos	Yes	Yes	Yes	Yes	Yes

Table 24: GIS & Integration Required functionality matrix for WestCOG regional GIS

Table 25 Table 26 provide costs estimates for initial software fees, and ongoing hosting and maintenance. It should be noted that these costs will vary depending on the chosen platform as well as the hosting arrangement.

Estimated Setup Costs	
Type	Total Cost
Application Development/License	$10,000-$20,000

Table 25: Estimated Application Development or Licenses Costs

Estimated Maintenance Costs	
Type	Total Cost
Application Hosting/License	$10,000-$20,000

Table 26: Estimated Maintenance License & Hosting Costs

COST SUMMARY & RETURN ON INVESTMENT

Total Estimated costs for setup and Maintenance are provided in Table 27 Table 28 respectively.

Estimated Total Setup Costs	
Type	Total Cost
Data Collection	$2,700
ETL Processor Development (includes first year data processing)	$34,500
Application Development/License/Hosting	$10,000-$20,000
Total Estimated Setup Cost	$47,200-$57,200

Table 27: Estimated setup cost totals

Estimated Total Maintenance Costs	
Type	Total Cost
Data Collection	$2,700
ETL Processors	$6,600
Application License/Hosting	$10,000-$20,000
Total Estimated Maintenance Cost	$17,950-$27,950

Table 28: Estimated Total Maintenance Costs

RETURN ON INVESTMENT

To calculate the potential return on investment for the development of a regional GIS, Axiomatic has estimated the total five-year cost of the project as $160,350 as shown in Table 29.

Year	**Year 1**		**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Type	Setup	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance	
Cost	$52,200	$16,350	$22,950	$22,950	$22,950	$22,950	$160,350

Table 29: Five-year total cost for regional GIS

Currently nine (9) WestCOG communities have a hosted GIS application. For the purposes of this report, it is estimated that each community spends $2,000 annually to maintain their external GIS site. In addition to the realized (known) costs, there is the potential for the other 9 communities to have an unrealized savings of $2,000 annually each. The total municipal savings is shown in Table 30.

Total	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance	
Realized	$18,000.00	$18,000.00	$18,000.00	$18,000.00	$18,000.00	$90,000
Unrealized	$18,000.00	$18,000.00	$18,000.00	$18,000.00	$18,000.00	$90,000

Table 30: Five-year municipal cost (realized and unrealized) for regional GIS

Based on the estimated project cost and the existing (realized and unrealized) costs, it is estimated that the total savings over a five-year period is $19,650 as shown in Table 31.

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Total
WestCOG Cost	$(68,550)	$(22,950)	$(22,950)	$(22,950)	$(22,950)	$(160,350)
Municipal Cost	$36,000	$36,000	$36,000	$36,000	$36,000	$180,000
Municipal Savings	($32,550)	$13,050	$13,050	$13,050	$13,050	$19,650

Table 31: Five-year savings