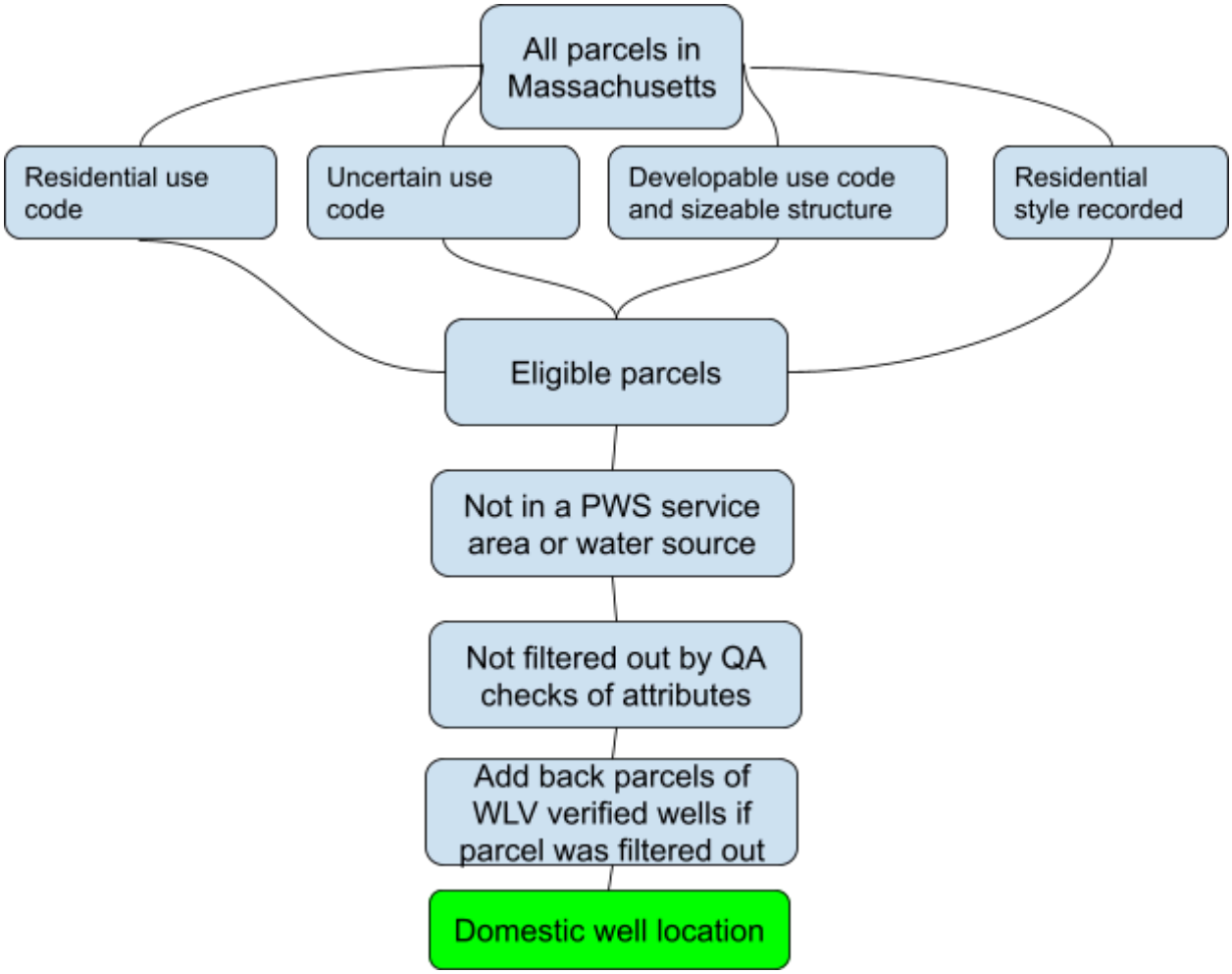
APPENDIX M-1: METHODOLOGY FOR THE MA RESIDENTIAL PRIVATE WELL LAYERS



1. The first step is to request statewide parcel data, which comes with parcel attributes and assessors' information already merged into one table. This bypasses the steps of downloading every municipality's parcel data individually, merging it with assessors' table data, and performing multiple computationally large merge operations to combine parcel data across towns.
   https://www.mass.gov/forms/massgis-request-statewide-parcel-data
   a. East Parcels: 1,883,524 parcels
   b. West Parcels: 669,537 parcels

2. The second step is to select parcels with residential land use codes listed in residential_use_codes.xlsx and save them to a separate shapefile. The state uses a system of numeric values to classify the use of a parcel, and several are used to indicate a residential parcel, such as 101 for single-family and 102 for condominium. The large spreadsheet of use codes is necessary to list out various discrepancies and errata across towns. For example, some “101” codes were recorded with a preceding 0: “0101” and must be included.
    a. Inputs: June 2025 east parcels, June 2025 west parcels
    b. Outputs: Residential parcels east, Residential parcels west
    c. Residential parcel count: 1,577,308 (east), 513,943 (west)
    d. All other parcels: 306,216 (east), 155,594 (west)

3. Of the parcels without a residential use code, those with a use code listed in the uncertain use codes file total 47,861 for the east and 24,947 for the west. The RES_AREA value being less than a BLDG_AREA value implies a likely residential parcel that happened to be recorded with an uncertain use code. Some assessors record RES_AREA as the same value as BLDG_AREA for parcels that do not have a residential area, and therefore are not residential, and this step filters out those cases. The uncertain parcels with this residential area less than building area filter is exported to a separate shapefile.
    a. Inputs: Non-residential parcels (#2d)
    b. Outputs: Uncertain parcels
    c. Uncertain parcel count with building area filter: 5,810 (east), 3,377 (west)
    d. All other parcels: 42,051 (east), 21,570 (west)

4. The parcels not filtered from Step 3 are checked against a list of developable land use codes. The parcels with a developable land use code are compared against the MassGIS 2D Structures data layer to see if they contain a structure greater than 50 square meters (about 538 square feet) in area. The result was saved as a separate shapefile. In the original methodology, 50 square meters was decided as the most reasonable threshold for eliminating outbuildings and other small structures, while minimizing the number of residences accidentally eliminated by the criteria.
    a. Inputs: Non-residential parcels (#3d)
    b. Outputs: Developable parcels
    c. Developable parcel count with building area filter: 3,110 (east), 1,844 (west)
    d. All other parcels: 42,051 (east), 21,570 (west)
    e. Continue QA inspecting with street view; eastern part of the state; explain garages/outbuildings; possibly randomly sample to be systematic with QA; make sure type of selection (property line/intersect) is correct

5. “Style” is an attribute recorded with the parcel data that can describe characteristics of the parcel. There are many style values, for example “colonial” for a colonial-style home, that can indicate whether a parcel is a residence. A residential style may indicate the presence of a domestic well. The selected parcels in this step were saved as a separate shapefile.
    a. Inputs: All other parcels (#4d)
    b. Outputs: Residential Style parcels
    c. Counts: 3,950 (east) and 1,374 (west)

6. The exported shapefiles created by filters in Steps 2-5, both east and west, are merged into one shapefile that contains a total of 2,110,716 parcels.
    a. Inputs: residential parcels (2), uncertain parcels (3), developable parcels (4), residential style parcels (5), totalling 2,110,716 parcels
    b. Output: Eligible parcels shapefile

7. Parcels that are located outside of a Public Water System (PWS) service area were selected. A PWS service area intersecting with a parcel strongly suggests the parcel is part of a PWS and therefore does not contain a domestic well. Notice the counts below carefully, this step filters out over 90% of the eligible parcels.
    a. Inputs: All eligible parcels (step 2-5 outputs combined)
    b. Outputs: Parcels outside PWS
    c. Counts: 2,110,716 in input, 204,599 in output

8. We assume that all parcels that contain a water supply source do not have a private domestic well.
    a. Inputs: Eligible parcels (#7b)
    b. Outputs: Parcels-filtered-for-PWS-source
    c. Counts: 203,823 (filters out 776 parcels statewide)

9. This quality control step features a series of attribute filter combinations that make it unlikely for a residential parcel to be present. For example, the first step selects and removes parcels with no recorded style, no building area, no residential area, no address, and no building from the statewide buildings layer.
    a. Style = null / blank; Bldg_Area = 0; Res_Area = 0; Address number = 0; and a structure from the 2019 MassGIS 2D Structures layer is not in the parcel.
    b. Use_Code = 013, 014, 016, 0160, 017, 0170, 018, 0180, 959, 9590, 1333, or 071; Year_Built < 2015; and a structure from the 2019 MassGIS 2D Structures layer is not in the parcel.
    c. Address number = 0; Res_Area = 0; and use_code does NOT = 101, 1010, 102, 1020, 103, 1040, 109, 1090, 130, 1300, 131, or 1310.
    d. Style = 'outbuildings'; and City does NOT = Rehoboth (Rehoboth appeared to be the only municipality that assigned "outbuildings" to parcels with homes).
    e. Inputs: Pre-filtered parcels (#8d)
    f. Outputs: Filtered parcels
    g. Counts: 655 parcels filtered out
    h. All other parcels: 203,168 parcels
10. WLV (Well Location Viewer) data points from 2023 come from a survey that attempts to confirm locations of wells in the Commonwealth. These data points were filtered for only domestic wells that have an active registration. There were 6,875 parcels that were confirmed to have a domestic well that were filtered out by the estimated well methodology outlined in Steps 1 through 9. They are joined back to the layer in this step.
11. This methodology suggests that 210,698 parcels in the state of Massachusetts use a domestic well.

Parcel counts for each step

All parcels statewide	2,553,061
Residential parcels statewide	2,091,251
Uncertain parcels	9,187
Developable parcels with 50 m^2 structure	4,954
Residential style parcels	5,324
“Eligible parcels” - sum of residential + uncertain + developable + residential style parcels	2,110,716
Eligible parcels outside of PWS	204,599
Eligible parcels that do not contain water supply source	203,823

The remaining eligible parcels, plus additional parcels with confirmed domestic well from WLV 2023 Data	210,698
Eligible parcels after QA steps (final count)	210,698

MassGIS Data

Data layer	Date updated in original iteration	Date updated for current project
PWS service area boundaries	January 2019	March 2025
Structures (2D)	February 2019	November 2024
Tax Parcels	2020	May 2025

APPENDIX M-3: METHOD ASSUMPTIONS AND LIMITATIONS

The following outlines assumptions and limitations of the methodology.

Public Water System

The Public Water System service areas layer was released by MassGIS in May 2025.

In the original methodology, there was a “city query” filter that assumed six cities in the Commonwealth were 100% serviced by a PWS, despite the version of the PWS service areas layer showing that they were not. The most updated PWS service areas layer has an attribute that labels a service area confirmed or unconfirmed. All the cities affected by this query had a confirmed service area, so the cities’ parcels were filtered against the service area layer and this step was omitted. The most recent water system data has unconfirmed water service areas for the following municipalities: Everett, Wakefield, Westfield, Blandford, Topsfield, and a couple other regions. Manual examination of the water service areas showed that the data could be reasonably accurate. For example, the city of Everett’s unconfirmed service area is for the entire municipality, which is true of all its surrounding municipalities, while Blandford’s service area covers mostly for the main road in the town center, which also seemed plausible. Assuming that every municipality with an unconfirmed service area is 100% served by a public water system, which was the method followed in the previous iteration, would likely eliminate several parcels that contain domestic wells. Therefore, subtracting parcels in the unconfirmed service areas just as the methodology does for confirmed service areas was determined to be the most accurate method of handling unconfirmed service areas.

Public Water System service areas are divided into community water systems (“COM”) and non-community non-transient water systems (“NTNC”). The difference between these types is explained on the MassGIS PWS Layer Page. This methodology only considers COM service areas. NTNC service areas do not eliminate the possibility of a domestic well from the parcels contained in the area.