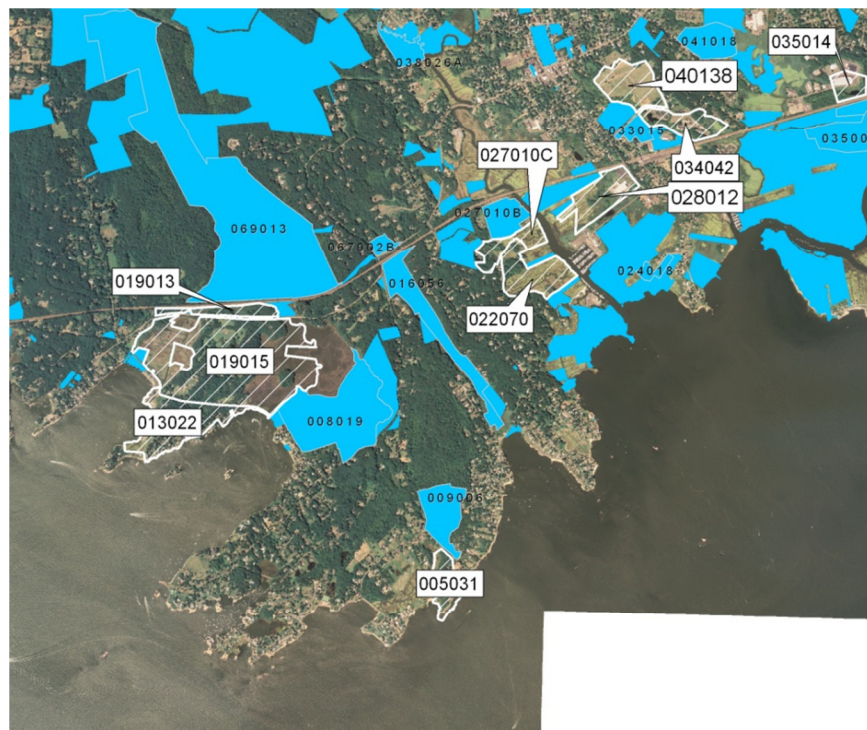


A Salt Marsh Advancement Zone Assessment of Guilford, Connecticut



Front cover image: Open space and unprotected parcels critical to the conservation of marsh advancement corridors; from the accompanying Comprehensive Map Book of Guilford, CT.

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RECOMMENDED CITATION:

Pardo, S. and A. W. Whelchel. 2013. A Salt Marsh Advancement Zone Assessment of Guilford, Connecticut. The Nature Conservancy, Coastal Resilience Program. Publication Series #1-D, New Haven, CT.

Introduction

In 2006, The Nature Conservancy established the Coastal Resilience Program (www.coastalresilience.org) that provides tools and a solution framework to support decisions that reduce the ecological and socio-economic risk of coastal hazards and comprehensively improve community resilience. The Program focuses on helping decision-makers explore locally relevant, downscaled, coastal flooding scenarios from sea-level rise and/or storm surge, analyze the potential ecological, social and economic impacts of each scenario at a local, state and regional scale, and facilitate progressive solutions to address these issues. Since that time, The Nature Conservancy has assisted many coastal communities in Connecticut by providing critical information and a comprehensive, community-based, engagement process designed to improve overall resilience and sustainability.

There is a universal recognition by coastal communities in Connecticut that natural infrastructure – wetlands, forests, floodplains – is a cost effective, long-term solution to help make people, infrastructure and natural systems more resilient to extreme weather and climatic change. Fortunately, our state has a remarkable diversity and abundance of natural resources that provide habitat for wildlife and fisheries, enhance the aesthetics and quality of life for residents, and, of course, serve to buffer the shoreline and rivers as natural defenses against hazards such as storm surge, inland flooding, and sea level rise. The presence of natural resources in the state – in particular beaches/dunes, salt marsh, forested headwaters, and river floodplains – is the result of previous recognition and commitment to long-term conservation and the requisite balance with socio-economic growth. In order to maintain these natural resources it will require 1) routine and on-going management activities as well as the restoration of degraded areas, 2) forward-looking planning to accommodate changes in habitat composition and location due to climatic change and 3) enforcement, modification and/or development of new land use policies and growth strategies. There are also opportunities to integrate the services (surface runoff storage and infiltration, wave attenuation, pollutant sorption, etc...) provided by natural infrastructure via new development, redevelopment, or realignment activities. Economically important co-benefits from natural infrastructure include services such as improved filtering of pollutants from runoff, erosion control, and improved aesthetics and desirable public amenities. Taken in total, the immediate and longer-term management of and for natural infrastructure by the State, Towns, private property owners, non-profit organizations, and others will help to reduce the hazard risk and improve the resilience within Connecticut.

While longer-term changes in temperature and precipitation patterns will alter the species composition and type of habitats in a given location, the more immediate implication is the upslope migration or advancement of habitats such as salt marsh in response to continued sea level rise. Sea level rise and the impacts of flooding have and will continue to alter the presence and abundance of natural resources in Connecticut. One of the most noticeable changes is occurring at the shoreline's edge where salt marsh is in the process of advancing upslope with sea levels into areas now considered uplands. In order to clearly identify where this will occur along Guilford's shoreline, The Nature Conservancy presents the following report to assist with future planning for natural resources in the context of overall risk reduction and resiliency improvement for the community. Ultimately, it is our hope that this report will serve to inform the community about future marsh advancement locations, current land use of those

locations and which parcels are critical for securing advancement into suitable sites to ensure the persistence of natural resources in Guilford over the long-term.

The Salt Marsh Advancement Model used in this analysis was co-developed by The Nature Conservancy and the University of Connecticut's Department of Natural Resources Management and Engineering. A full discussion of the Model and underlying methodology is beyond the scope of this report¹, but a few important details are needed to put the following analysis into context and define how to use the results for planning and implementation.

Suitable vs. Unsuitable Advancement

In the following tables and figures suitable advancement areas are abbreviated as “Yes” and unsuitable areas are abbreviated as “No”. Suitable areas are classified based on the current land cover type - “forest” or “agrigrass” – and are expected to convert to salt marsh as hydrologic conditions change in response to sea level rise. Land cover types currently classified as “urban” (i.e. roads, buildings, parking lots, etc...) are considered to be unsuitable for marsh advancement at this time. Though much of our analysis is grouped by parcel ID and associated characteristics, these classifications – suitable and unsuitable – exist independent of the parcel boundaries. In other words, a given residential parcel can have both suitable (lawn) and unsuitable (building footprint) advancement areas.

Marsh Advancement vs. Wetland Extent

There is a key distinction in this report between the current wetland extent in a municipality and the marsh advancement areas analyzed herein. Marsh advancement areas include only the future projected wetland extent clipped to current upland land cover. Therefore, no assumption should be made about net gain or loss of current wetland extent based on this advancement area analysis. Another key consideration is that in some cases the identified advancement area will include land that converts to wetlands and subsequently to open water over time. This further demonstrates that net change in both existing and future wetland extent should not be inferred from our analysis.

Planning for the Future

The advancement and eventual establishment of coastal marshes will occur over the course of several decades and as such our analysis extends out to the 2080s. The rate of change is slow and decadal, yet at the same time it is inevitable. There is an abundance of existing property, infrastructure and natural resource assets clustered along the Connecticut coast and communities will need to formulate growth and realignment plans well in advance of the 2080s scenario presented here. The following data analysis and associated map book can assist with a resilient transition through the presentation of marsh advancement areas and an accounting of the projected changes to coastal property.

¹ Detailed methods for advancement zone can be found on the Long Island Sound coastal resilience site (lis.coastalresilience.org) and downloaded directly from here: http://lis.coastalresilience.org/xml/Advancment_Zones.pdf

Total Marsh Advancement

The full extent of marsh advancement by the 2080s is projected to be 925 acres, with 752 acres (81%) considered to be suitable for wetland migration in Guilford. Currently, 173 acres (19% of total) are occupied by built structures and associated infrastructure (“urban”).

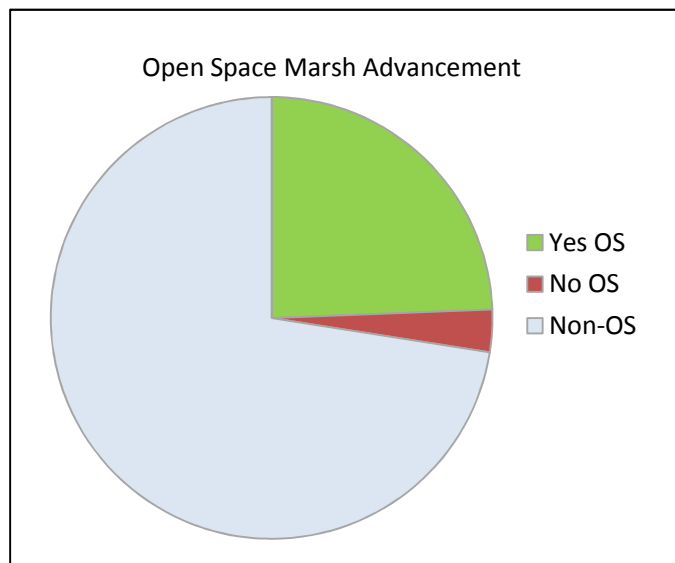
Total Marsh Adv by 2080s		
Marsh Adv	Acres	Percent (%)
Yes	752	81
No	173	19
Total	925	100

Protected Open Space

Existing protected open space (OS) consists of state or municipal parks, conservation easements on private property, or simply properties owned by land trusts. The unifying characteristic of these properties, and what makes them a critical component of long-term community resilience, is that they currently have little to no development and are the most likely areas to remain undeveloped through the 2080s. The recognition of their role in future wetland extent and improved resilience in Guilford is vital information for land management, economic development, and planning.

Total OS Advancement

Protected OS parcels contain 254 acres of marsh advancement area with nearly that entire sum (226 acres – 24% of overall total) classified as suitable for future wetlands in Guilford. Further analysis of the much larger proportion of unprotected open space parcels (Non-OS) can be found in the “All Parcels” section below.

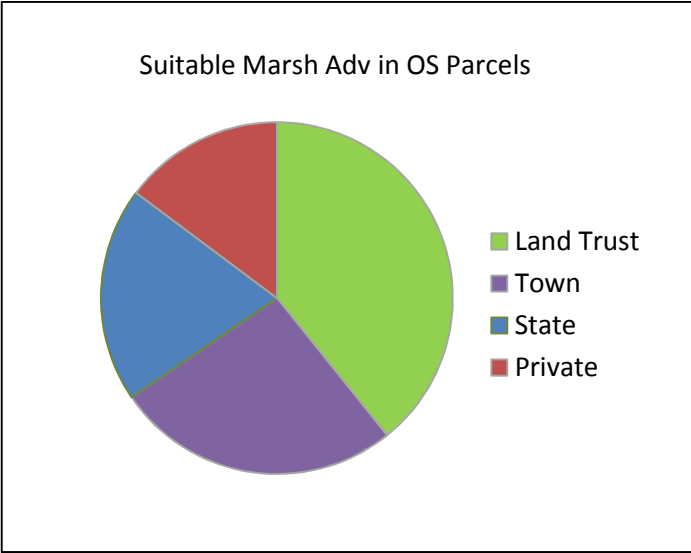


Open Space Marsh Advancement		
OS type	Acres	Percent (%)
Yes OS	226	24
No OS	28	3
Non-OS	671	72
Total	925	100

(next page)

Suitable OS Advancement by Owner

A closer look at the protected OS advancement (226 acres – 24% of total advancement (925 acres)) reveals that Land trust organizations such as the Audubon Society of Connecticut and the Guilford Land and Conservation Trust are the largest owners of suitable marsh advancement accounting for 89 acres, or 39% of the OS total. Yet, this amount represents only 10% of the overall suitable advancement area in Guilford. The Town itself is the next largest owner of suitable OS advancement area with 59 acres, which accounts for 26% of the OS total and 6% of the overall total. State-owned property and private interests, such as Yale, cemeteries, or individuals, are not far behind with 45 and 33 acres, respectively.

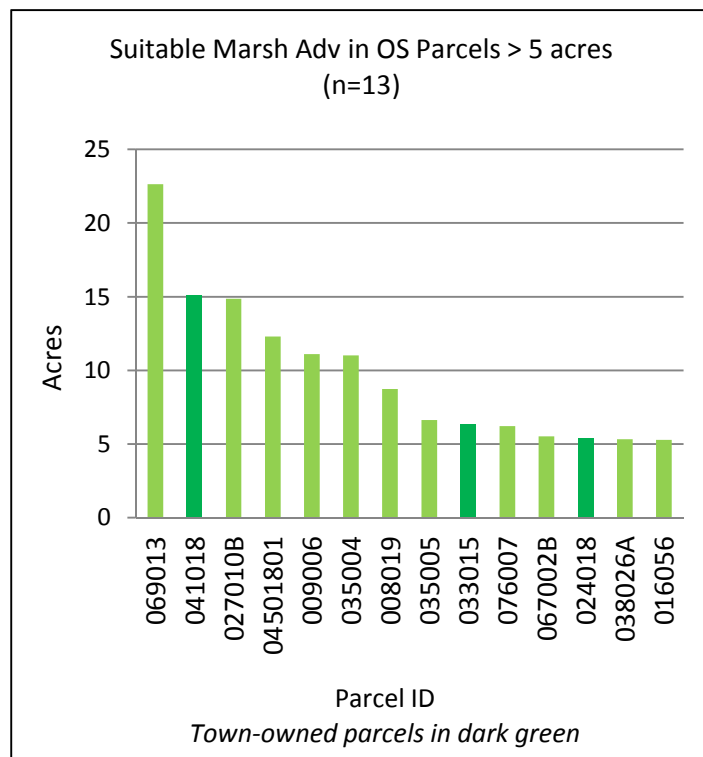


Suitable Marsh Adv in OS Parcels			
Owner type	Acres	% of total "yes" OS	% of total "yes" adv
Land Trust	89	39	9.6
Town	59	26	6.4
State	45	20	4.8
Private	33	15	3.6
Total	226	100	24.4

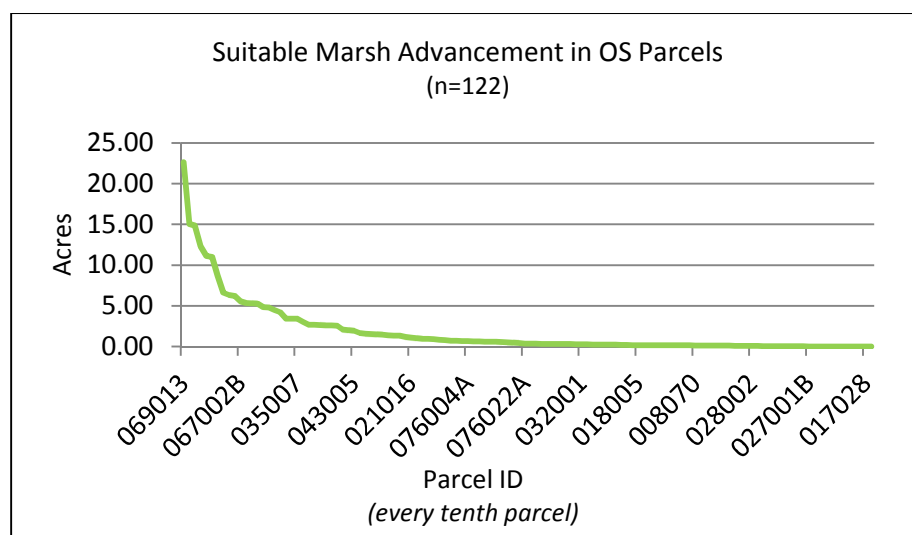
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Suitable Advancement by OS Parcel

There are over 120 protected OS parcels that contain suitable advancement in Guilford, but as is typically the case, the distribution is skewed toward the top quintile (line graph at bottom of page). The graph and chart immediately below represent OS parcels with greater than 5 acres of suitable advancement (n=13). This subset totals 136 acres of suitable advancement, or 60% of “yes” OS. The specified parcels can be viewed via the corresponding Map Book pages indicated in the table below.



Suitable Marsh Adv in OS Parcels > 5 acres				
Parcel IDs (MapLot #)	Acres	% of total "yes" OS	Owner	Map Book Page #
069013	22.6	10	State	6
041018	15.1	6.7	Town	7
027010B	14.9	6.6	Land Trust	6
04501801	12.3	5.5	Land Trust	6
009006	11.1	4.9	Land Trust	6
035004	11	4.9	Private	7
008019	8.7	3.9	State	6
035005	6.6	2.9	Private	7
033015	6.3	2.8	Town	7
076007	6.2	2.8	Land Trust	7
067002B	5.5	2.5	Land Trust	6
024018	5.4	2.4	Town	7
038026A	5.3	2.4	Land Trust	6
016056	5.3	2.3	Land Trust	6
Total	136.3	60.4		

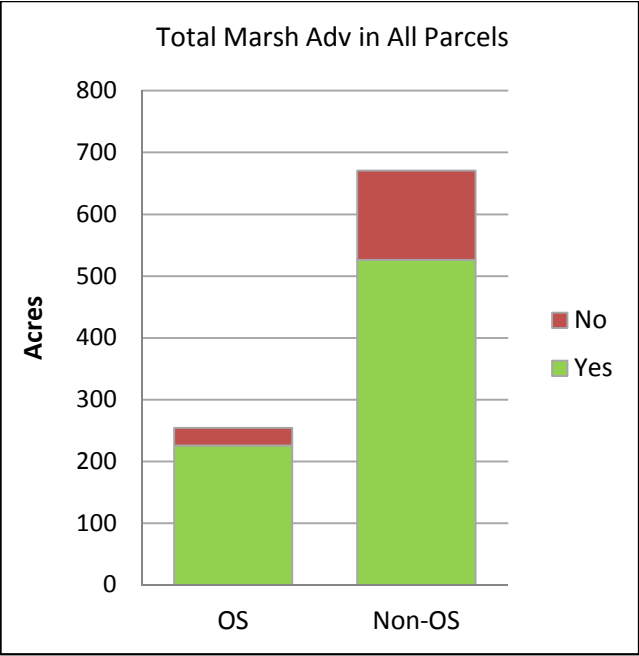


All Parcels

This section provides an analysis of suitable marsh advancement in all parcels, whether they are classified as protected open space or not. The results help to put the OS analysis into perspective, as well as identify important unprotected private parcels in the advancement landscape.

Total Advancement: Protected (OS) vs. Unprotected (Non-OS)

The total advancement found in unprotected parcels (Non-OS) parcels is 526 acres, an amount almost twice as large as the total protected (OS) advancement at 226 acres. As expected, OS advancement has a larger ratio of suitable to non-suitable advancement versus the unprotected parcels. This information has two important implications for future planning; 1) today’s unprotected property will play a vital role in maintaining Guilford’s wetland resources in the future, and 2) a large amount of critical development (145 acres), namely residences and transportation infrastructure, will be in conflict with rising seas and advancing marshes.

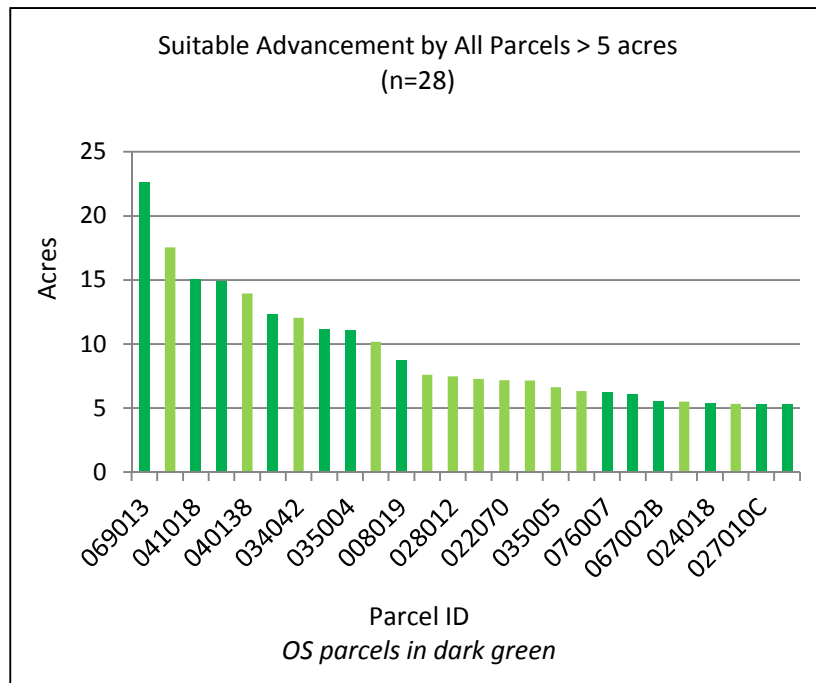


Total Suitable Advancement			
Parcel type	Yes	No	Total
OS	226	28	254
Non-OS	526	145	671
Total	752	173	925

(next page)

Suitable Advancement in All Parcels

There are over 1,000 parcels that contain at least some measureable suitable advancement in Guilford by the 2080s; yet, the subset of parcels holding greater than 5 acres (28) account for more than a third of the overall total (34%). The specified parcels can be viewed via the corresponding Map Book pages indicated in the table below.

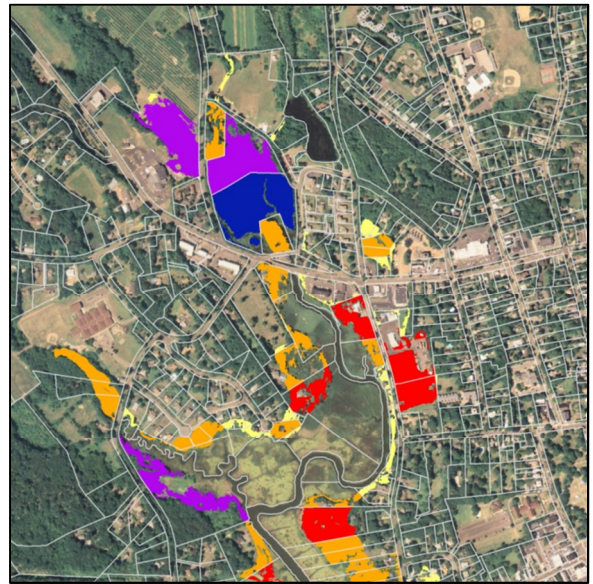
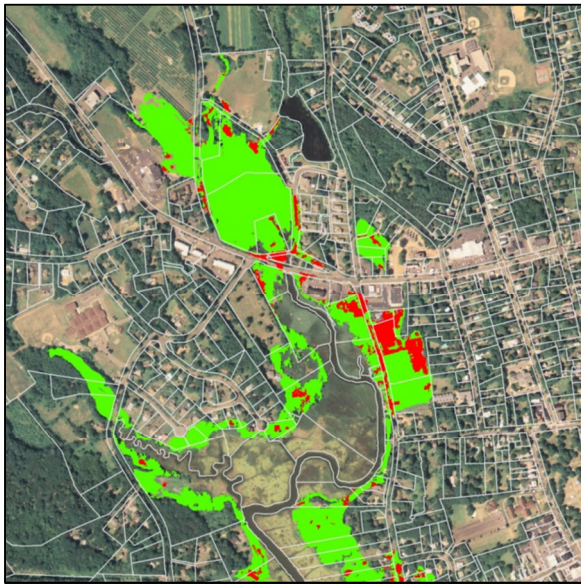


Suitable Marsh Advancement by Parcel > 5 acres <i>*Indicates protected OS parcel</i>			
Parcel ID (MapLot #)	Acres	% of total "Yes" Adv	Map Book Page #
069013*	22.6	3	6
019015	17.5	2.3	4, 6, 16, 20
041018*	15.1	2	7
027010B*	14.9	2	6
040138	14	1.9	5, 7, 12, 13
04501801*	12.3	1.6	6
034042	12.1	1.6	5, 7, 13, 18
009006*	11.1	1.5	6
035004*	11	1.5	7
013022	10.2	1.4	4, 6, 16, 20
008019*	8.7	1.2	6
035014	7.6	1	5, 7, 13
028012	7.5	1	5, 7, 17, 18
052007	7.3	1	4, 6, 12
022070	7.2	1	4, 6, 17
045017	7.2	1	4, 6, 12
035005*	6.6	0.9	7
033015*	6.3	0.8	7
076007*	6.2	0.8	7
019013	6.1	0.8	4, 6, 16
067002B*	5.5	0.7	6
005031	5.5	0.7	4, 6, 21
024018*	5.4	0.7	7
038026A*	5.3	0.7	6
027010C	5.3	0.7	4, 6, 17
016056*	5.3	0.7	6
Total	243.6	34	

Appendix

Please consult your Marsh Advancement Resource Disc for the complete list of suitable and unsuitable advancement per parcel.

Comprehensive Map Book of Guilford, Connecticut



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Overview Maps

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Unprotected Parcels 4

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Inset Maps

Unprotected Parcels 9

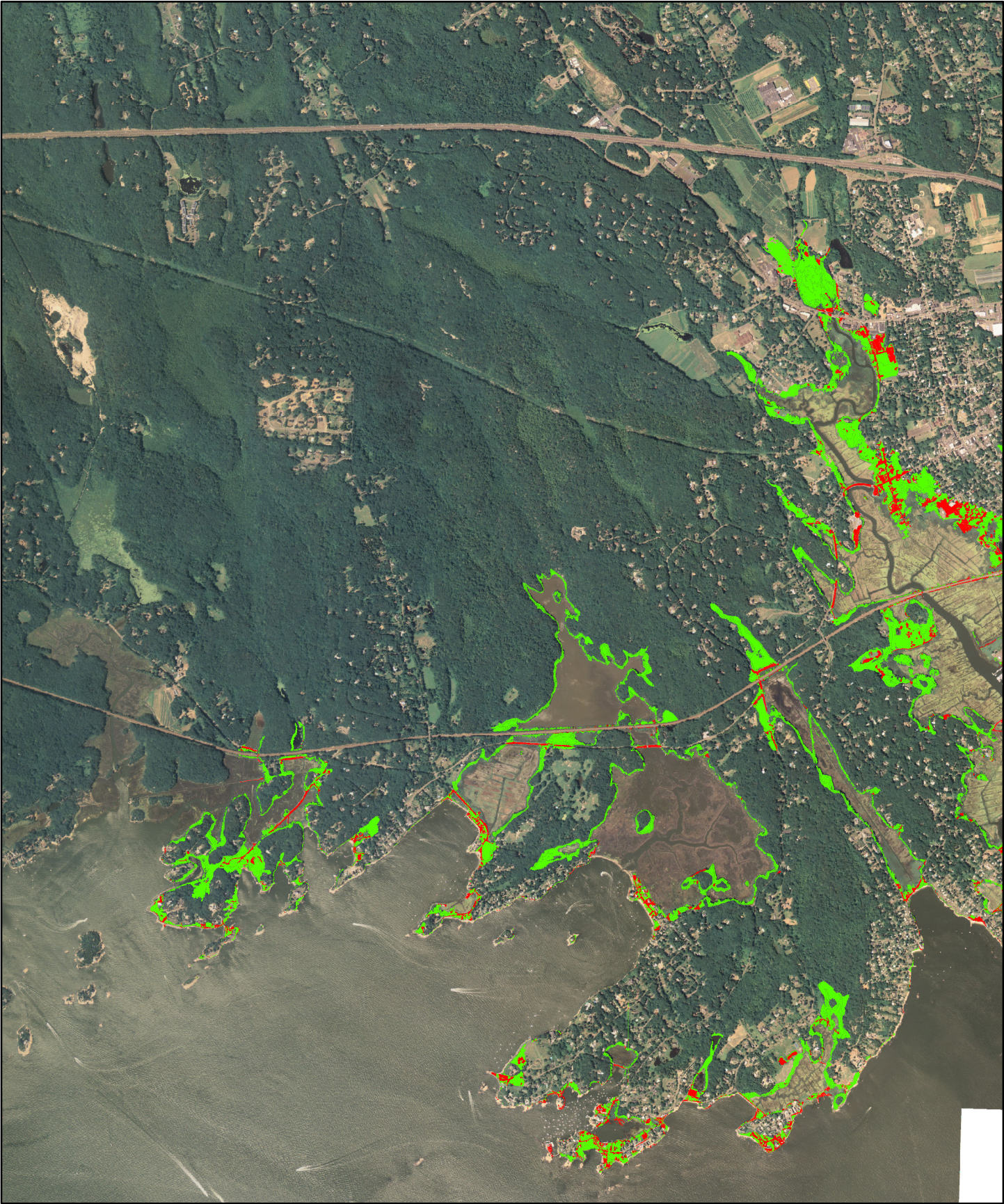
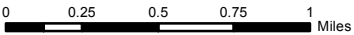
Advancement per Parcel 23

Marsh Advancement by the 2080s
Town of Guilford, CT
Marsh Advancement - West



Marsh Advancement

Red	Developed Land Cover
Green	Forest, Grass, Ag Land Cover



Marsh Advancement by the 2080s

Town of Guilford, CT

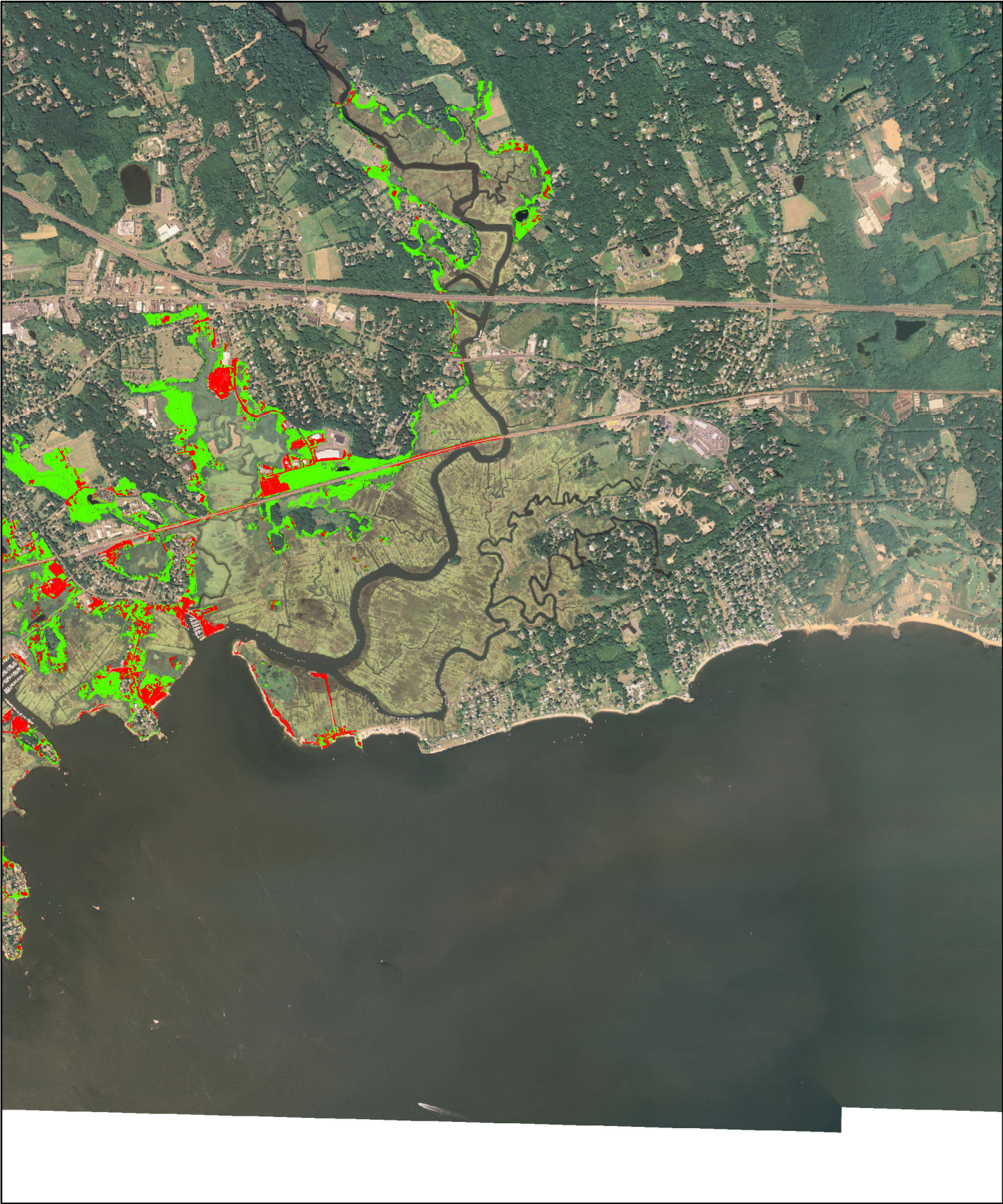
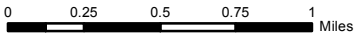
Marsh Advancement - East



Marsh Advancement

Developed Land Cover

Forest, Grass, Ag Land Cover



Marsh Advancement by the 2080s

Town of Guilford, CT

Unprotected Parcels - West



Note: Only parcels with greater than 5 acres of suitable advancement are shown.

0 0.2 0.4 0.6 0.8 Miles

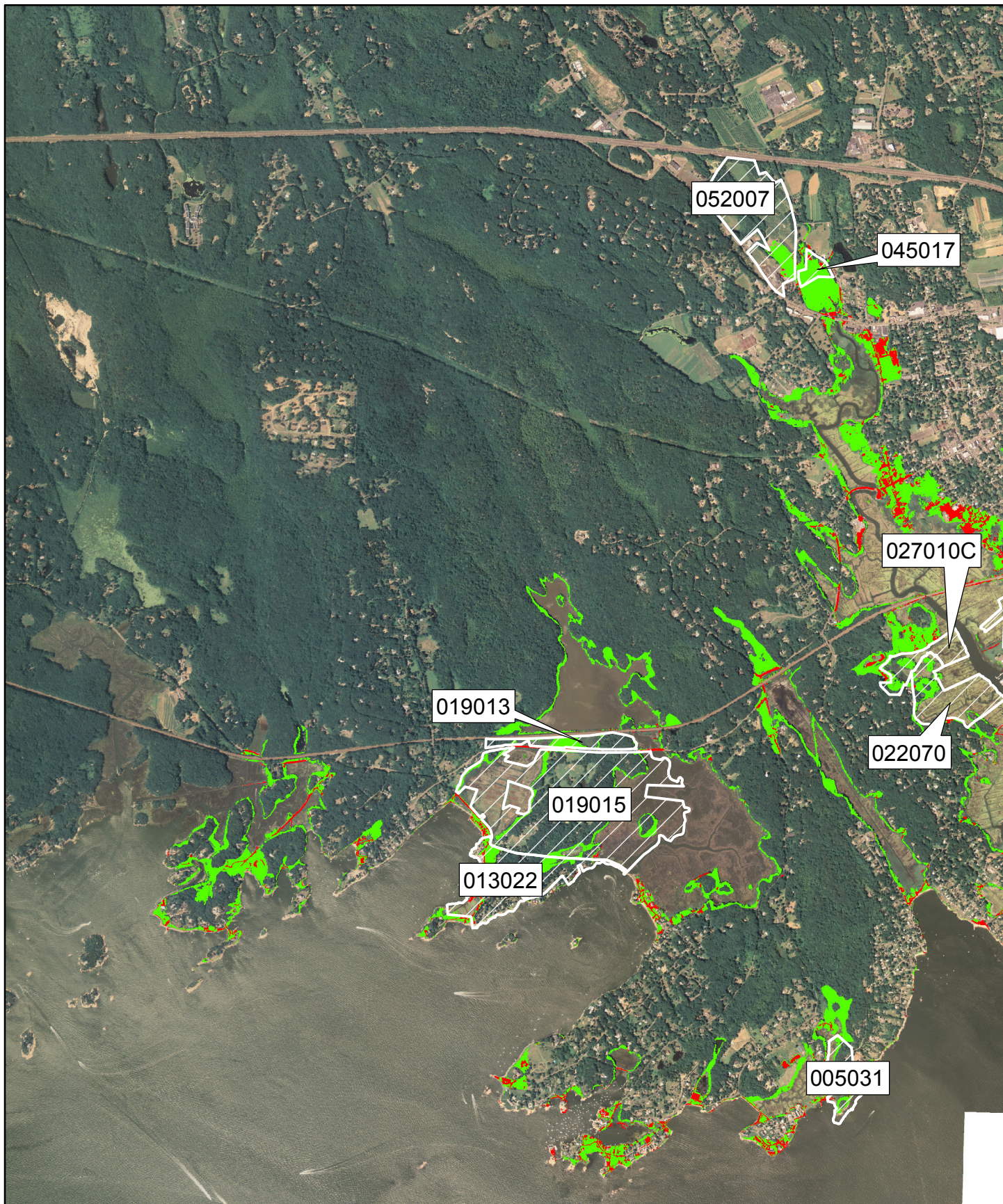
Parcels

Unprotected Parcels

Advance

Developed Land Cover

Forest, Grass, Ag Land Cover



Marsh Advancement by the 2080s

Town of Guilford, CT

Unprotected Parcels - East



Note: Only parcels with greater than 5 acres of suitable advancement are shown.

0 0.2 0.4 0.6 0.8 Miles

Parcels

Unprotected Parcels

Advance

Developed Land Cover

Forest, Grass, Ag Land Cover



Marsh Advancement by the 2080s
Town of Guilford, CT
Critical Parcels - West

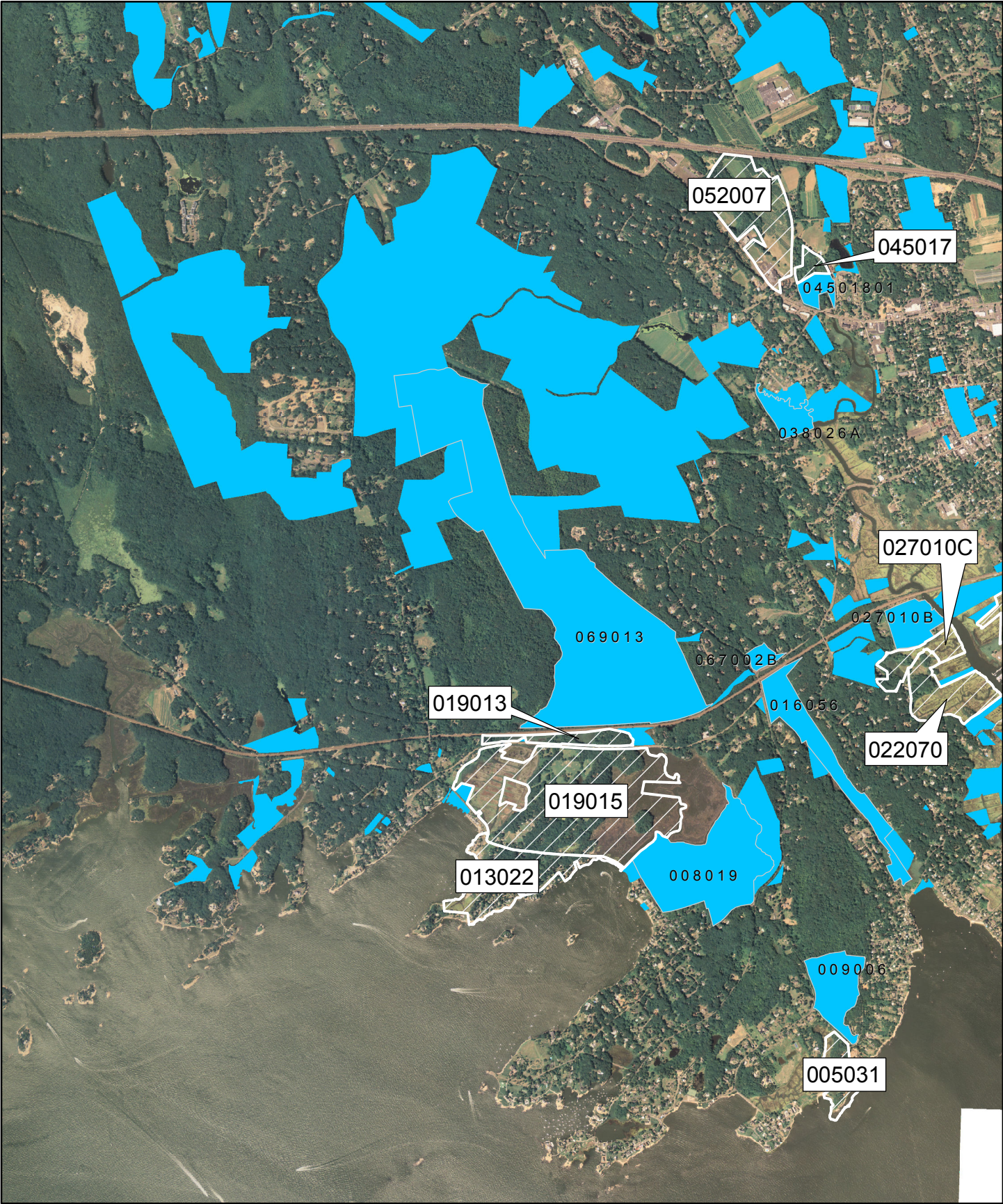
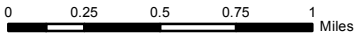


Note: Only parcels with greater than 5 acres of suitable advancement are labeled and outlined

Parcels

Unprotected Parcels

Protected Open Space



Marsh Advancement by the 2080s

Town of Guilford, CT

Critical Parcels - East

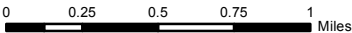


Note: Only parcels with greater than 5 acres of suitable advancement are labeled and outlined

Parcels

Unprotected Parcels

Protected Open Space

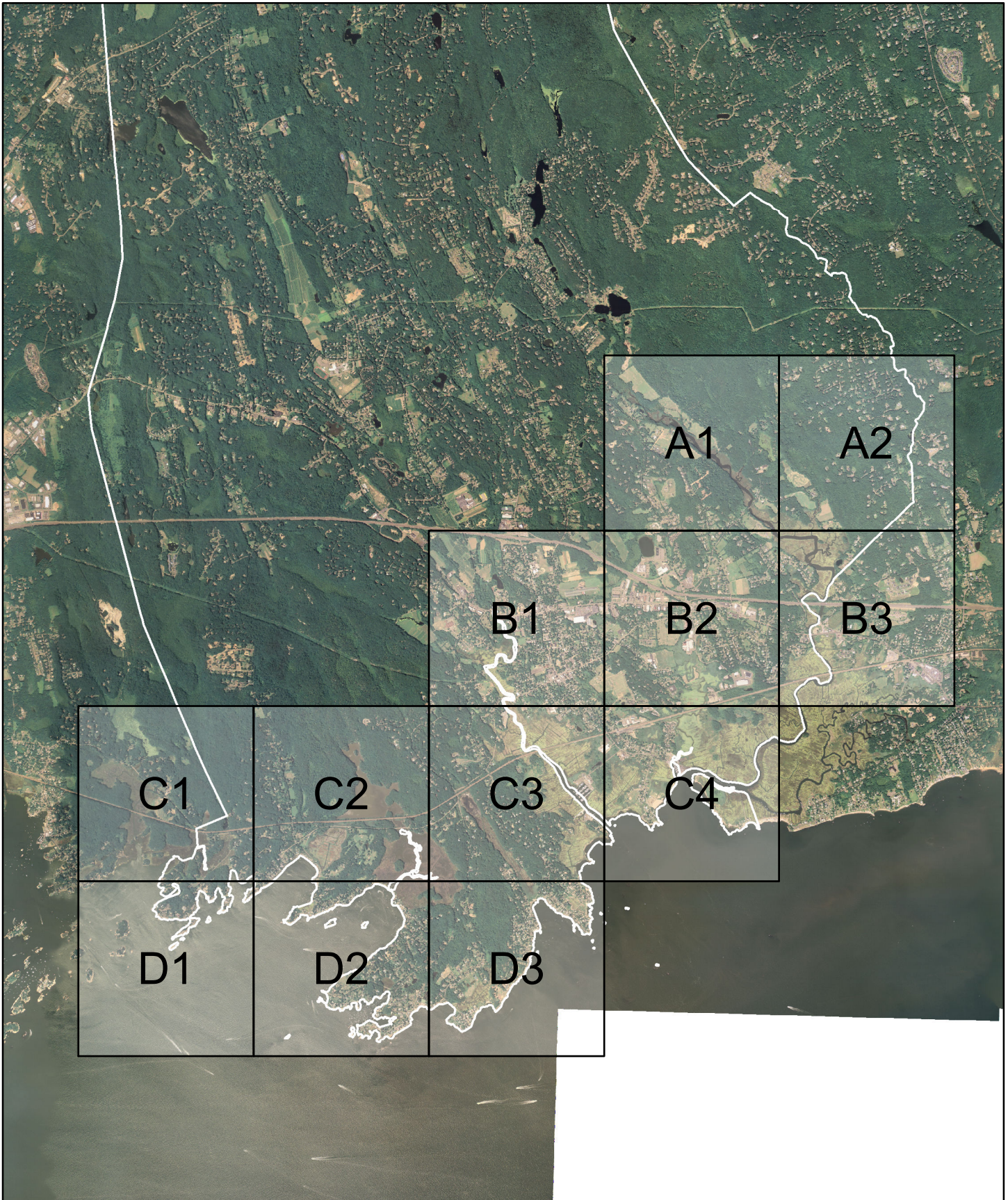


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Marsh Advancement by the 2080s

Town of Guilford, CT

Map Index - Unprotected Parcels





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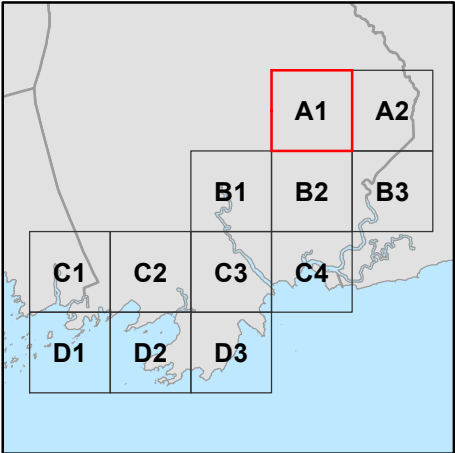
Marsh Advancement by the 2080s

Town of Guilford, CT

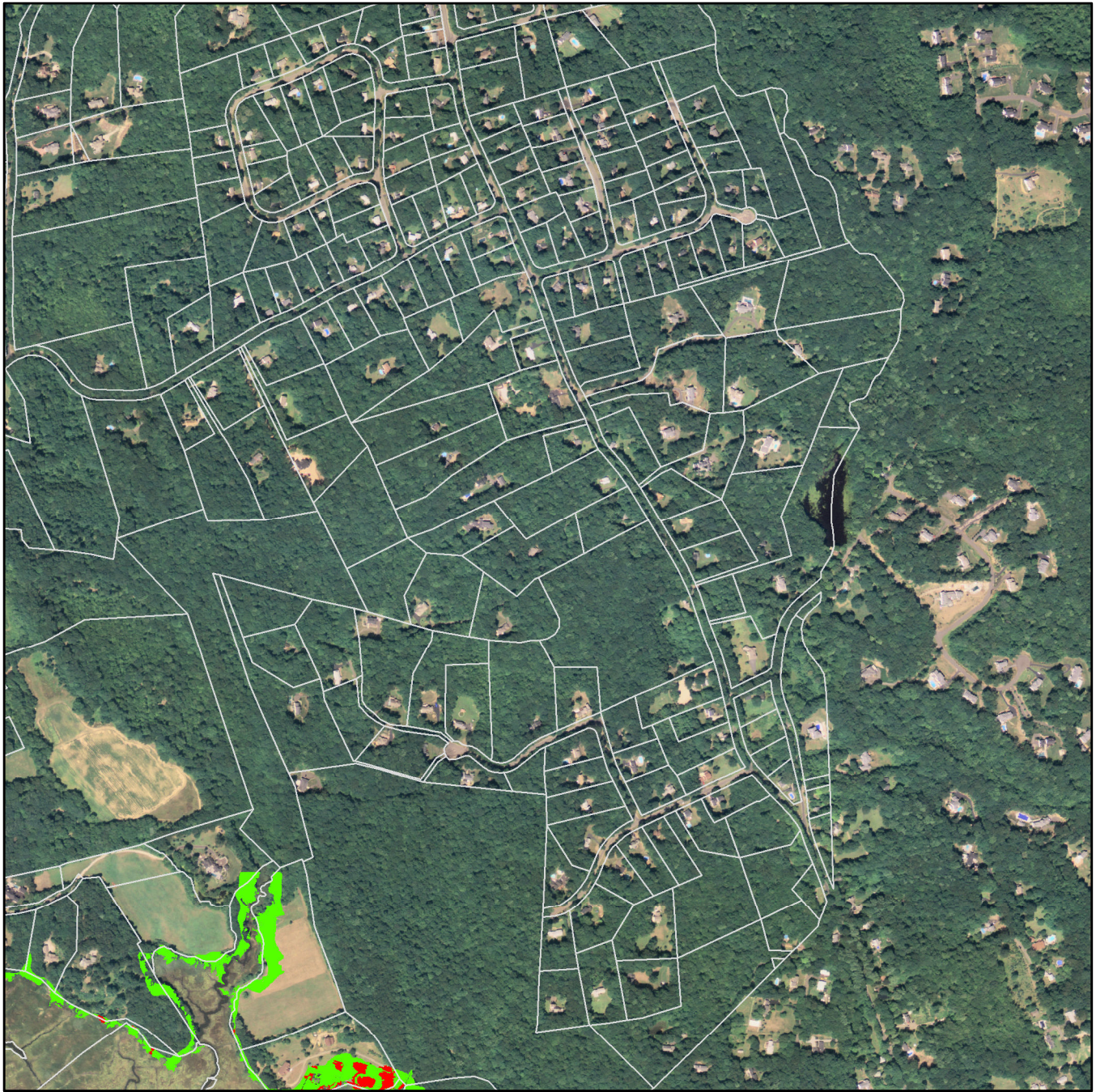
Unprotected Parcels - Map A1



Note: Only unprotected parcels with > 5 acres of "green" marsh advancement are pictured.



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0 500 1,000 2,000 3,000 Feet

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Marsh Advancement by the 2080s

Town of Guilford, CT

Unprotected Parcels - Map A2

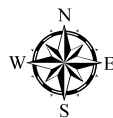
Parcels

Unprotected Parcels

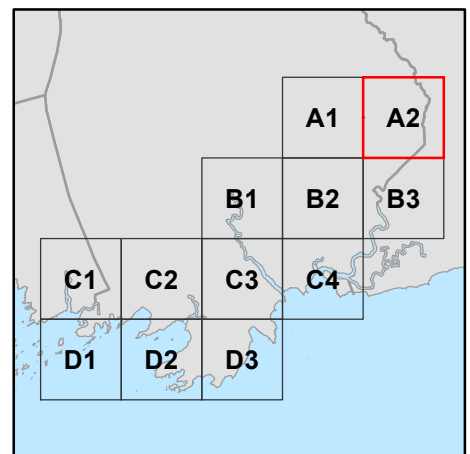
Marsh Advancement

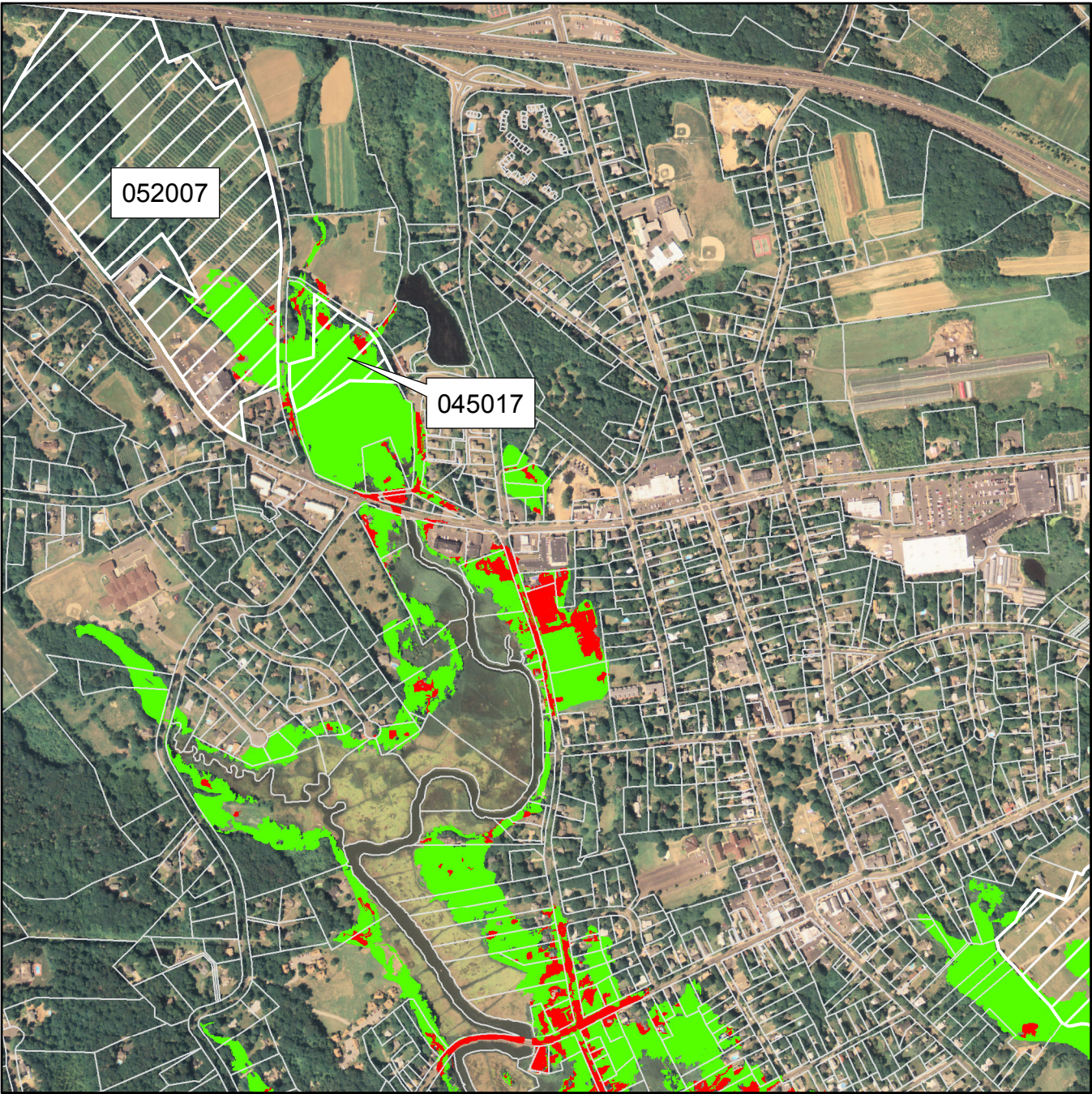
Developed Land Cover

Forest, Grass, Ag Land Cover



Note: Only unprotected parcels with > 5 acres of "green" marsh advancement are pictured.





0 500 1,000 2,000 3,000 Feet

see page 17

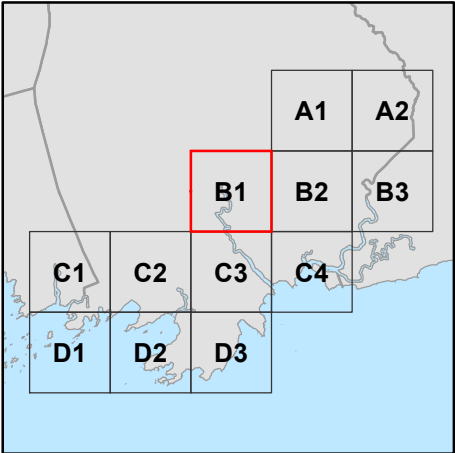
Marsh Advancement by the 2080s

Town of Guilford, CT

Unprotected Parcels - Map B1

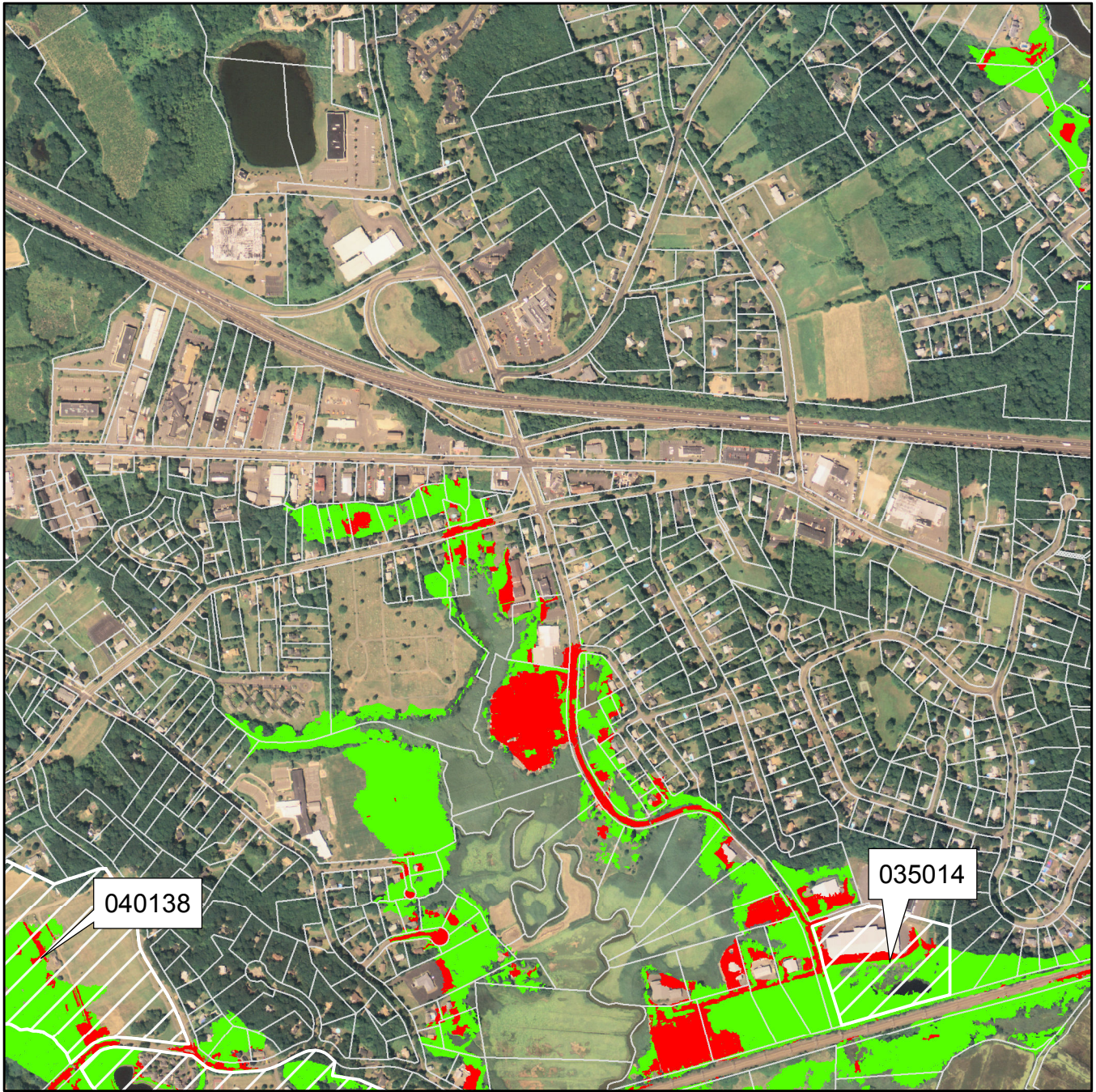


Note: Only unprotected parcels with > 5 acres of "green" marsh advancement are pictured.



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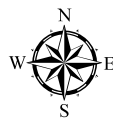


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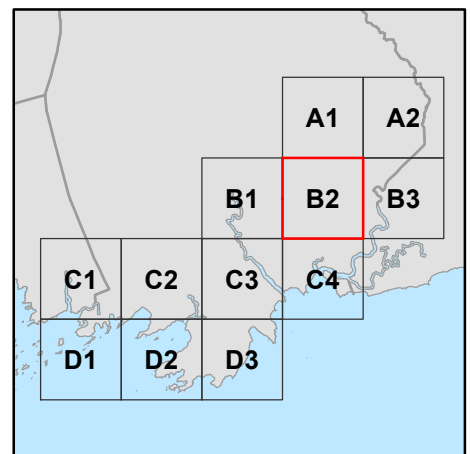
Marsh Advancement by the 2080s

Town of Guilford, CT

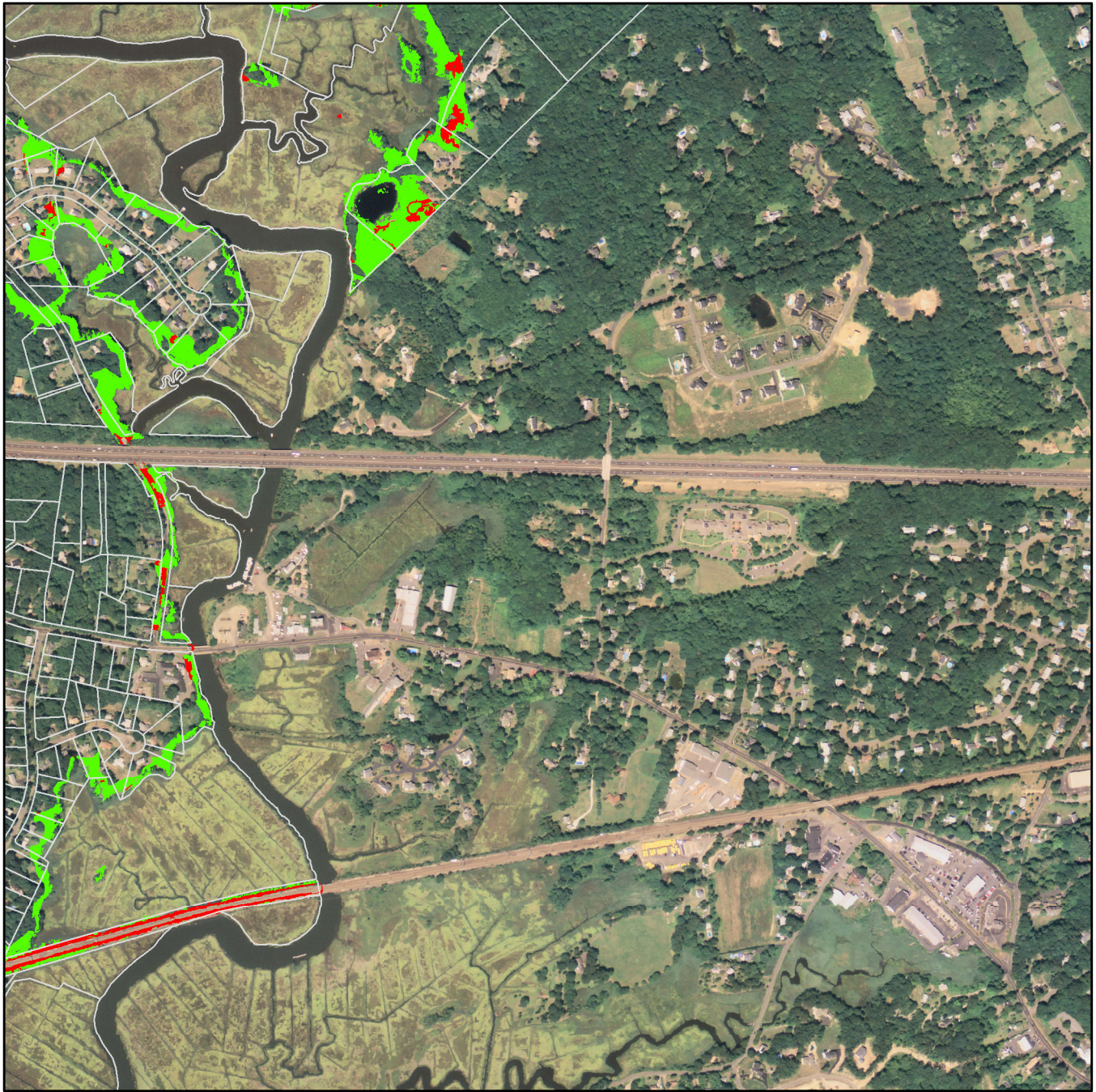
Unprotected Parcels - Map B2



Note: Only unprotected parcels with > 5 acres of "green" marsh advancement are pictured.



see page 13



0 500 1,000 2,000 3,000 Feet

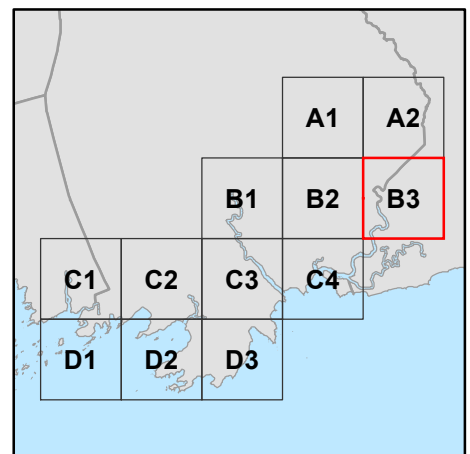
Marsh Advancement by the 2080s

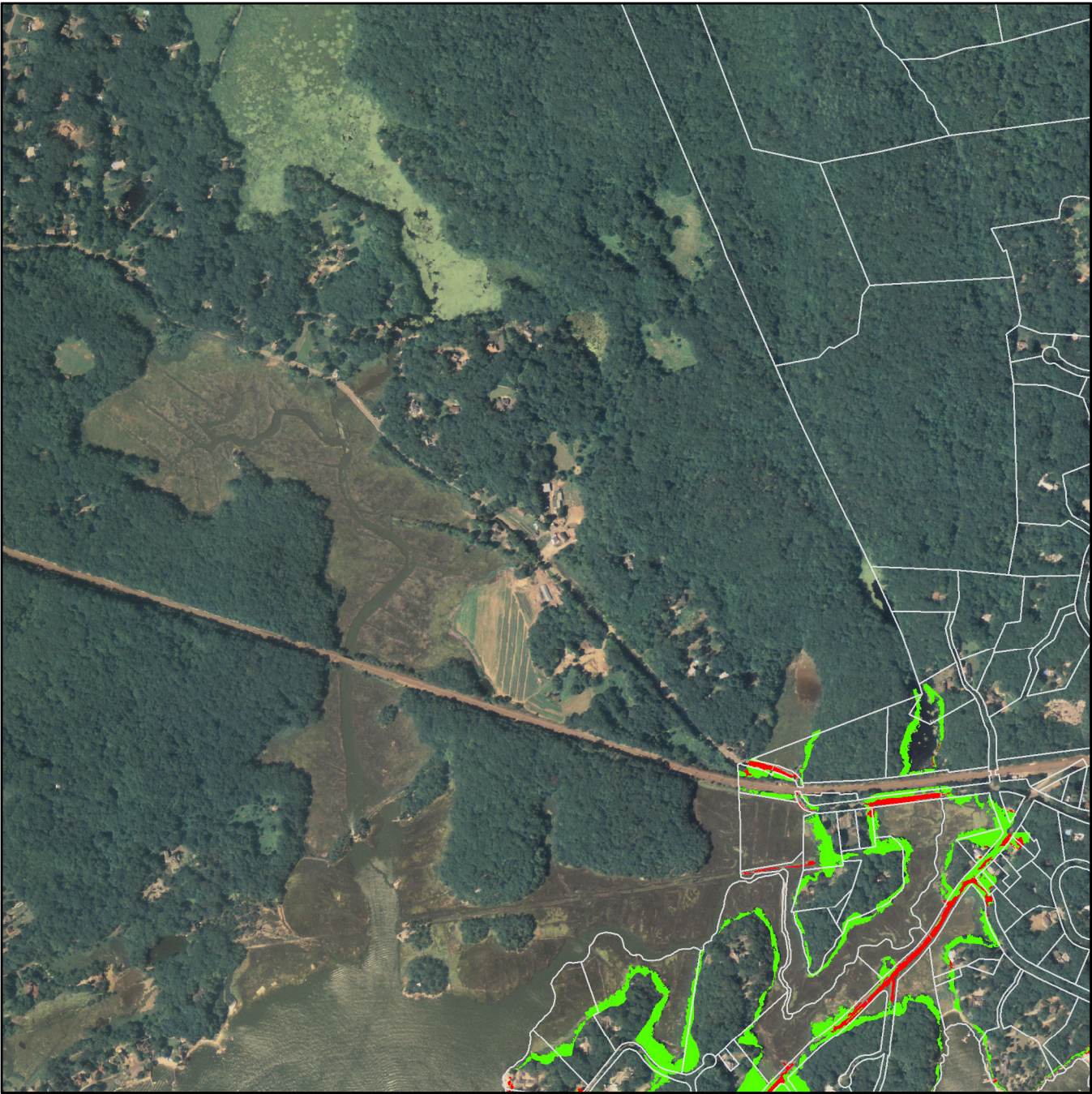
Town of Guilford, CT

Unprotected Parcels - Map B3



Note: Only unprotected parcels with > 5 acres of "green" marsh advancement are pictured.





0 500 1,000 2,000 3,000 Feet

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Marsh Advancement by the 2080s

Town of Guilford, CT

Unprotected Parcels - Map C1

Parcels

Unprotected Parcels

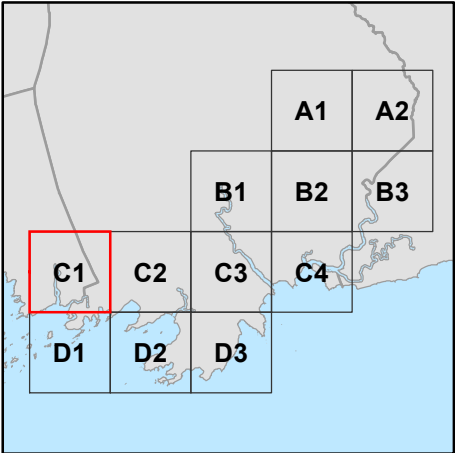
Marsh Advancement

Developed Land Cover

Forest, Grass, Ag Land Cover

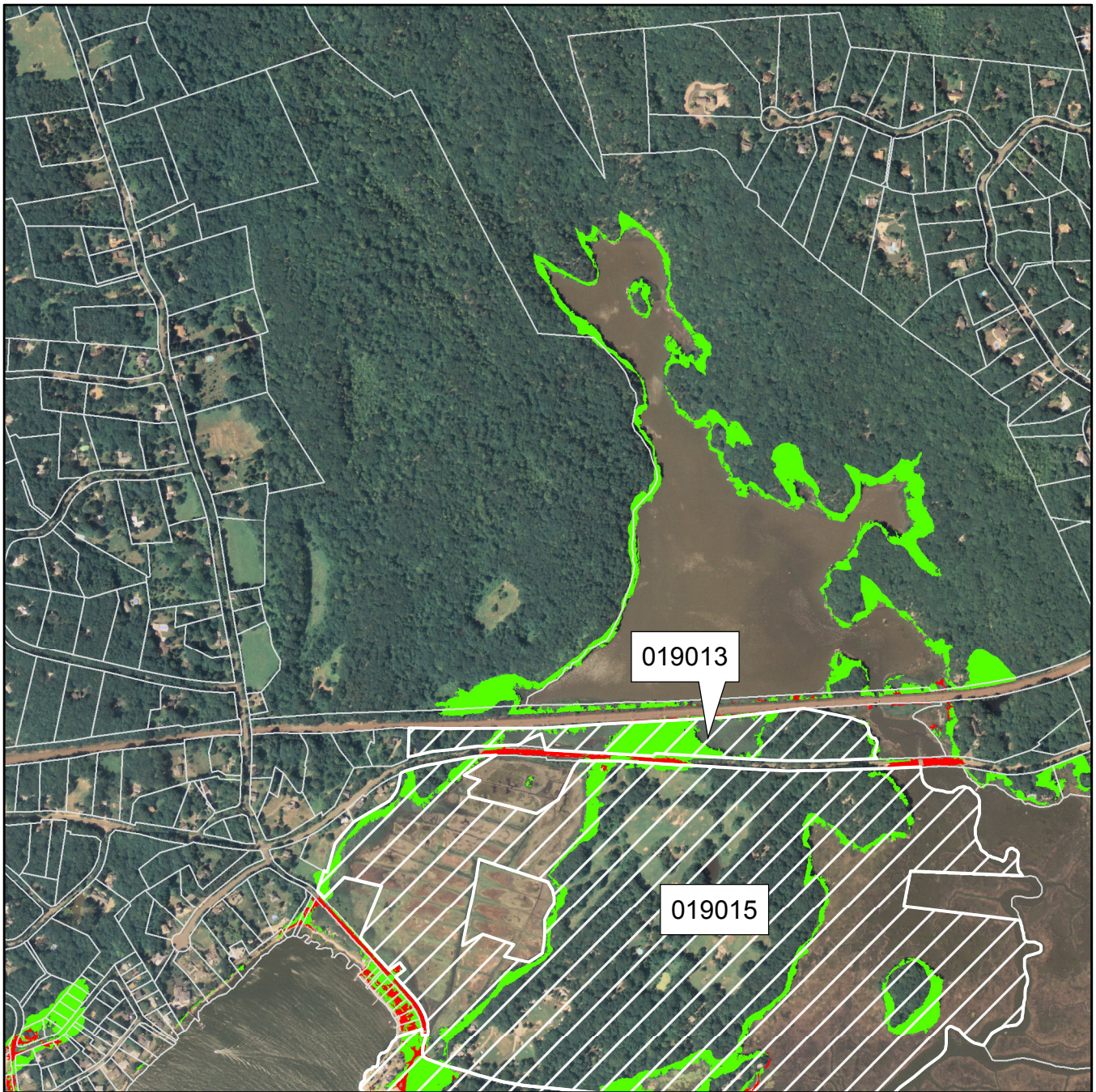


Note: Only unprotected parcels with > 5 acres of "green" marsh advancement are pictured.



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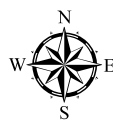
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see page 20

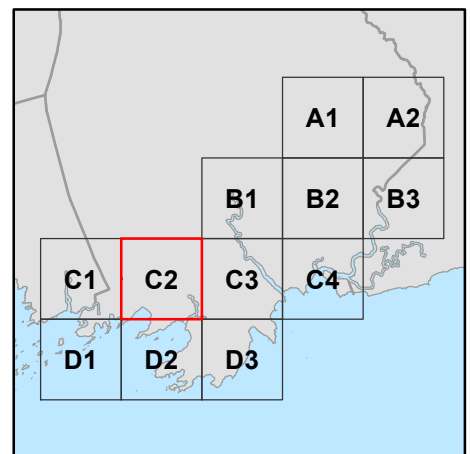
Marsh Advancement by the 2080s

Town of Guilford, CT

Unprotected Parcels - Map C2

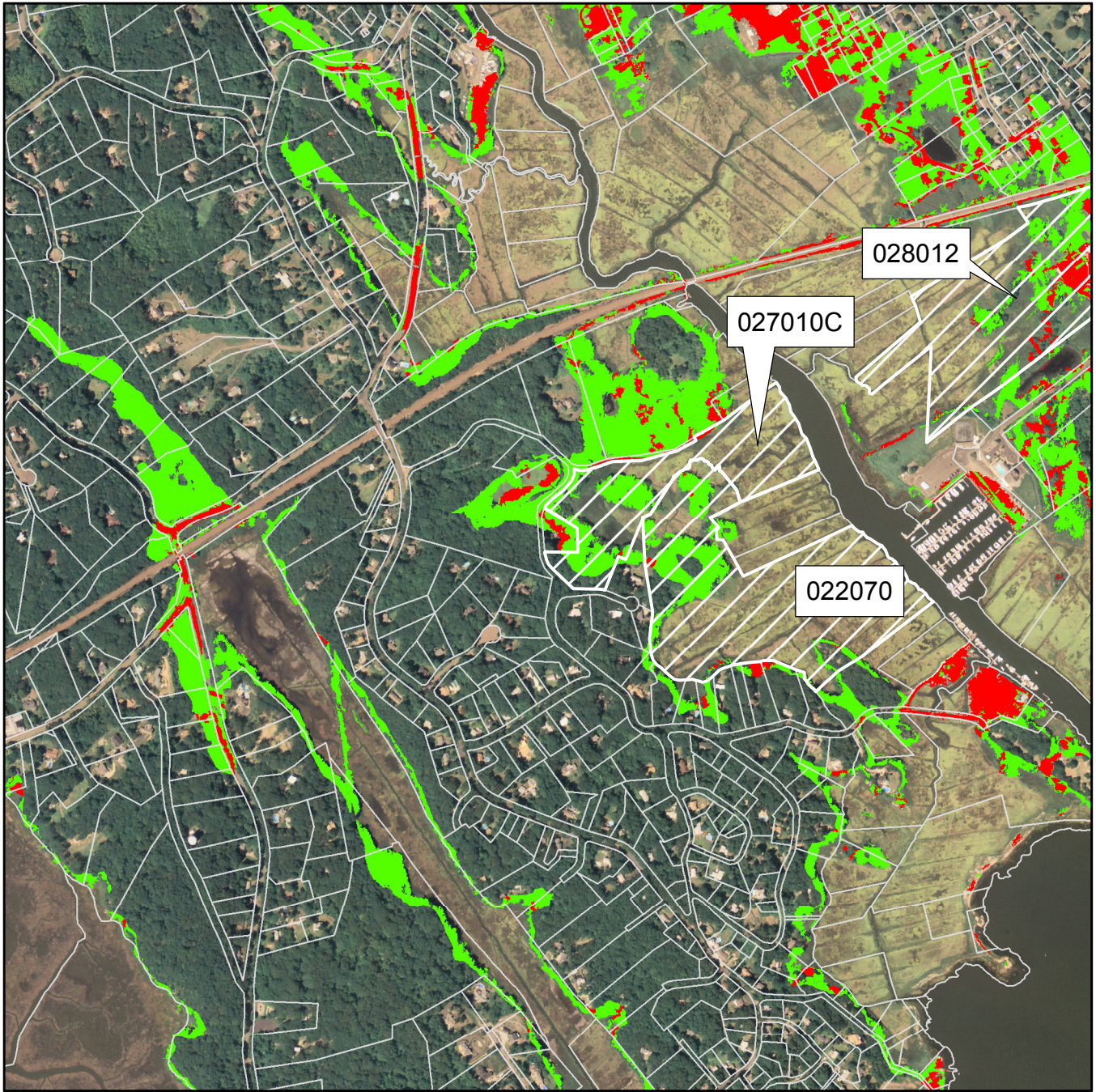


Note: Only unprotected parcels with > 5 acres of "green" marsh advancement are pictured.



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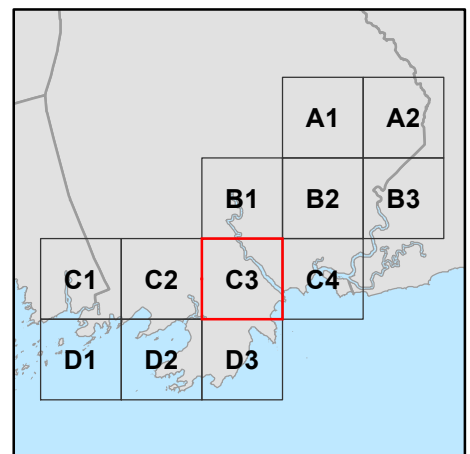
Marsh Advancement by the 2080s

Town of Guilford, CT

Unprotected Parcels - Map C3



Note: Only unprotected parcels with > 5 acres of "green" marsh advancement are pictured.



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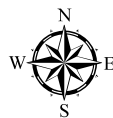


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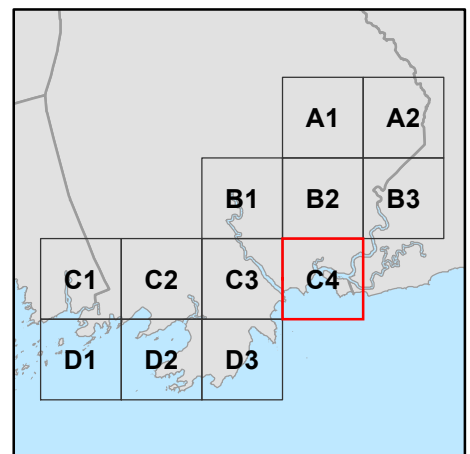
Marsh Advancement by the 2080s

Town of Guilford, CT

Unprotected Parcels - Map C4



Note: Only unprotected parcels with > 5 acres of "green" marsh advancement are pictured.





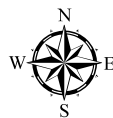
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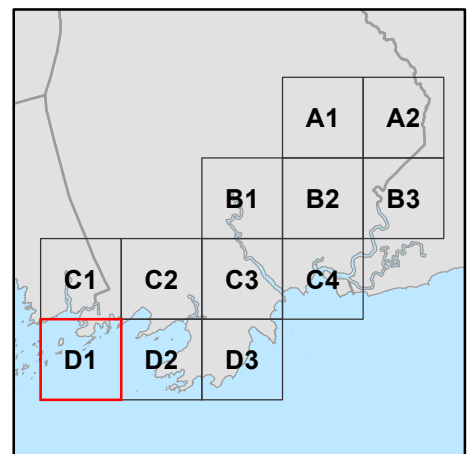
Marsh Advancement by the 2080s

Town of Guilford, CT

Unprotected Parcels - Map D1



Note: Only unprotected parcels with > 5 acres of "green" marsh advancement are pictured.



see page 19

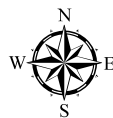
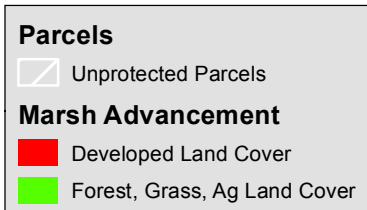
see page 21



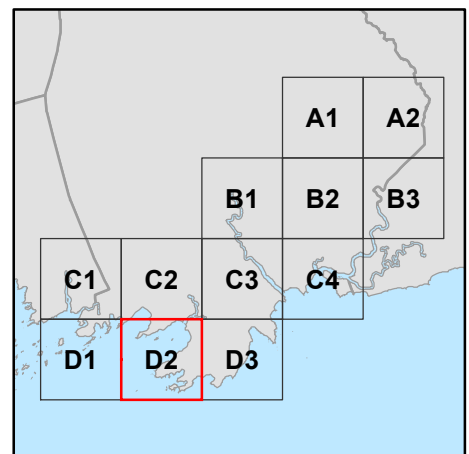
Marsh Advancement by the 2080s

Town of Guilford, CT

Unprotected Parcels - Map D2



Note: Only unprotected parcels with > 5 acres of "green" marsh advancement are pictured.



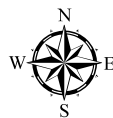
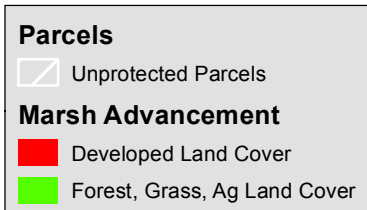
see page 20



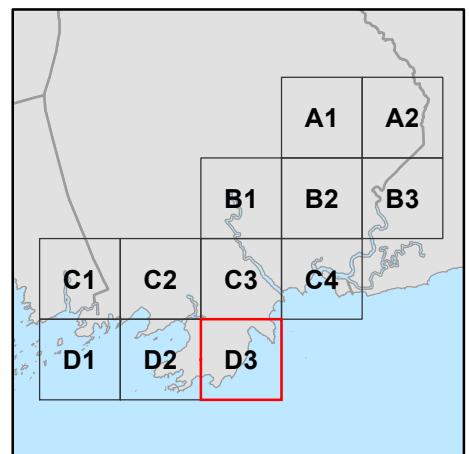
Marsh Advancement by the 2080s

Town of Guilford, CT

Unprotected Parcels - Map D3



Note: Only unprotected parcels with > 5 acres of "green" marsh advancement are pictured.

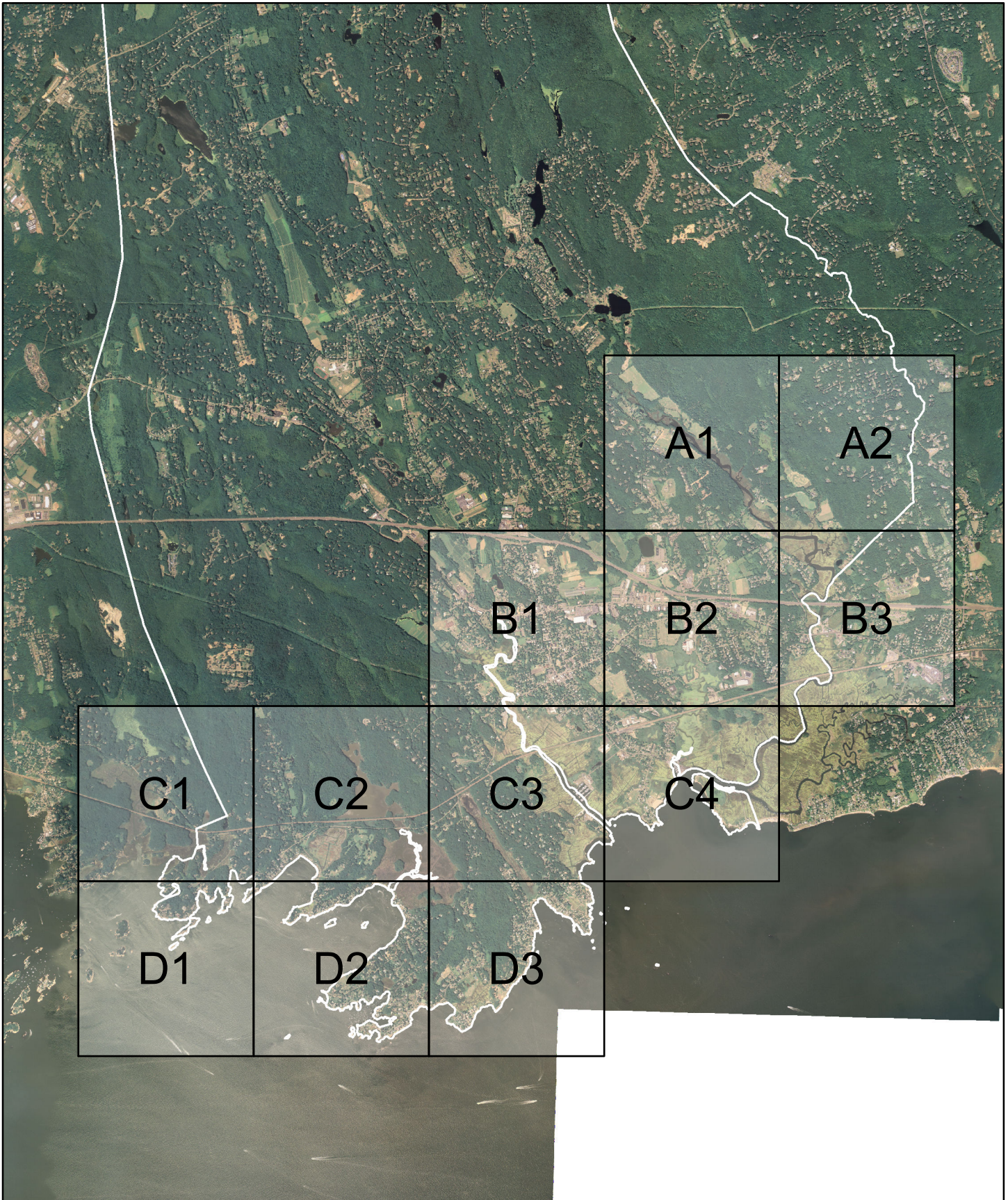


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Marsh Advancement by the 2080s

Town of Guilford, CT

Map Index - Advancement per Parcel



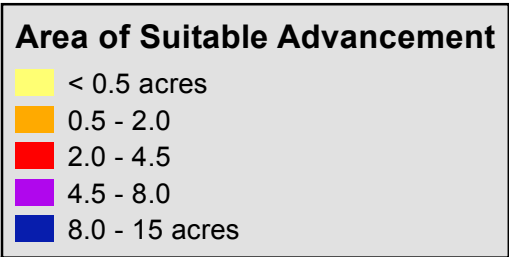


see page 27

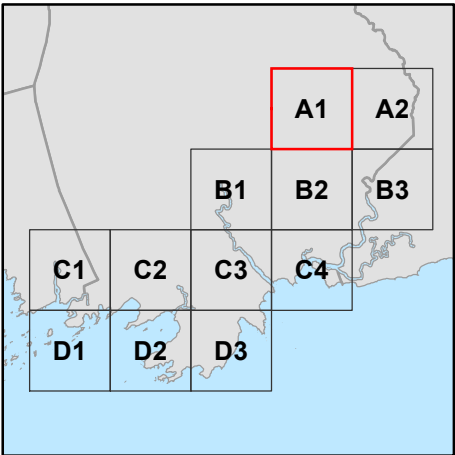
Marsh Advancement by the 2080s

Town of Guilford, CT

Advancement per Parcel - Map A1



Notes: 1) Most, but not all, colored polygons are delineated by individual parcel boundaries;
2) Data for this set of maps is derived from a different source as used for the first set.



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0 500 1,000 2,000 3,000 Feet

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Town of Guilford, CT

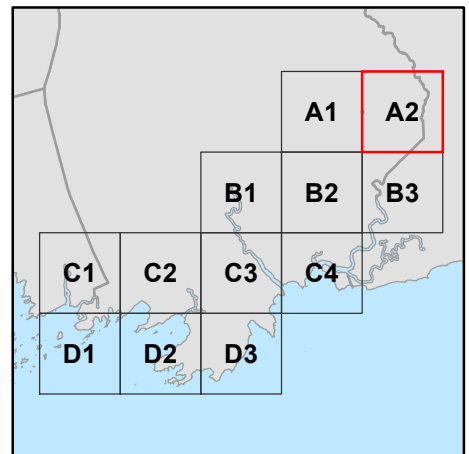
Advancement per Parcel - Map A2

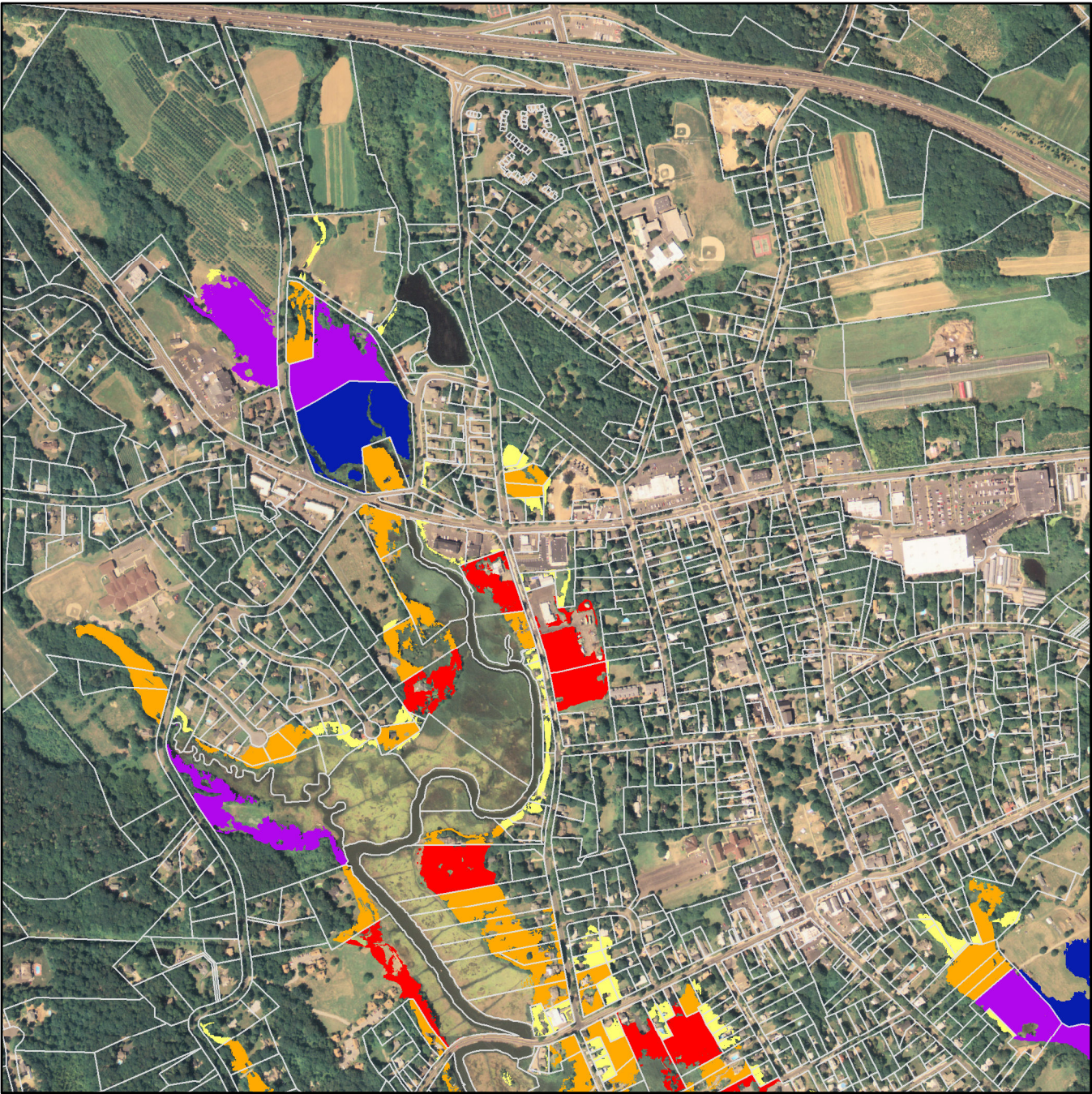


Area of Suitable Advancement

- < 0.5 acres
- 0.5 - 2.0
- 2.0 - 4.5
- 4.5 - 8.0
- 8.0 - 15 acres

Notes: 1) Most, but not all, colored polygons are delineated by individual parcel boundaries;
2) Data for this set of maps is derived from a different source as used for the first set.





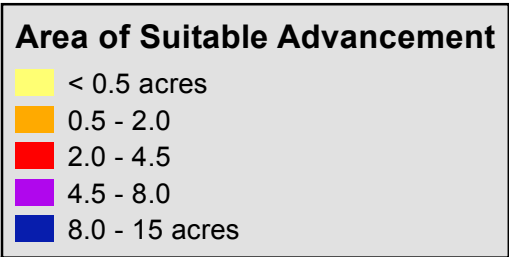
0 500 1,000 2,000 3,000 Feet

see page 31

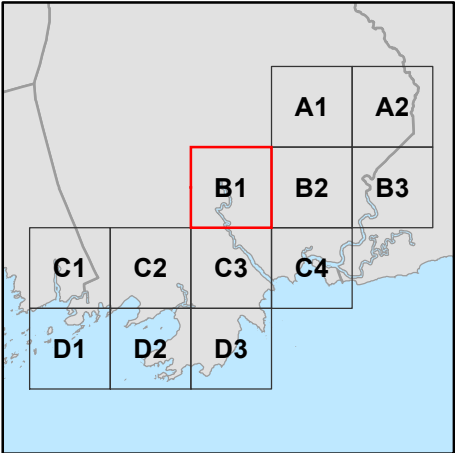
Marsh Advancement by the 2080s

Town of Guilford, CT

Advancement per Parcel - Map B1

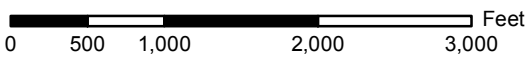
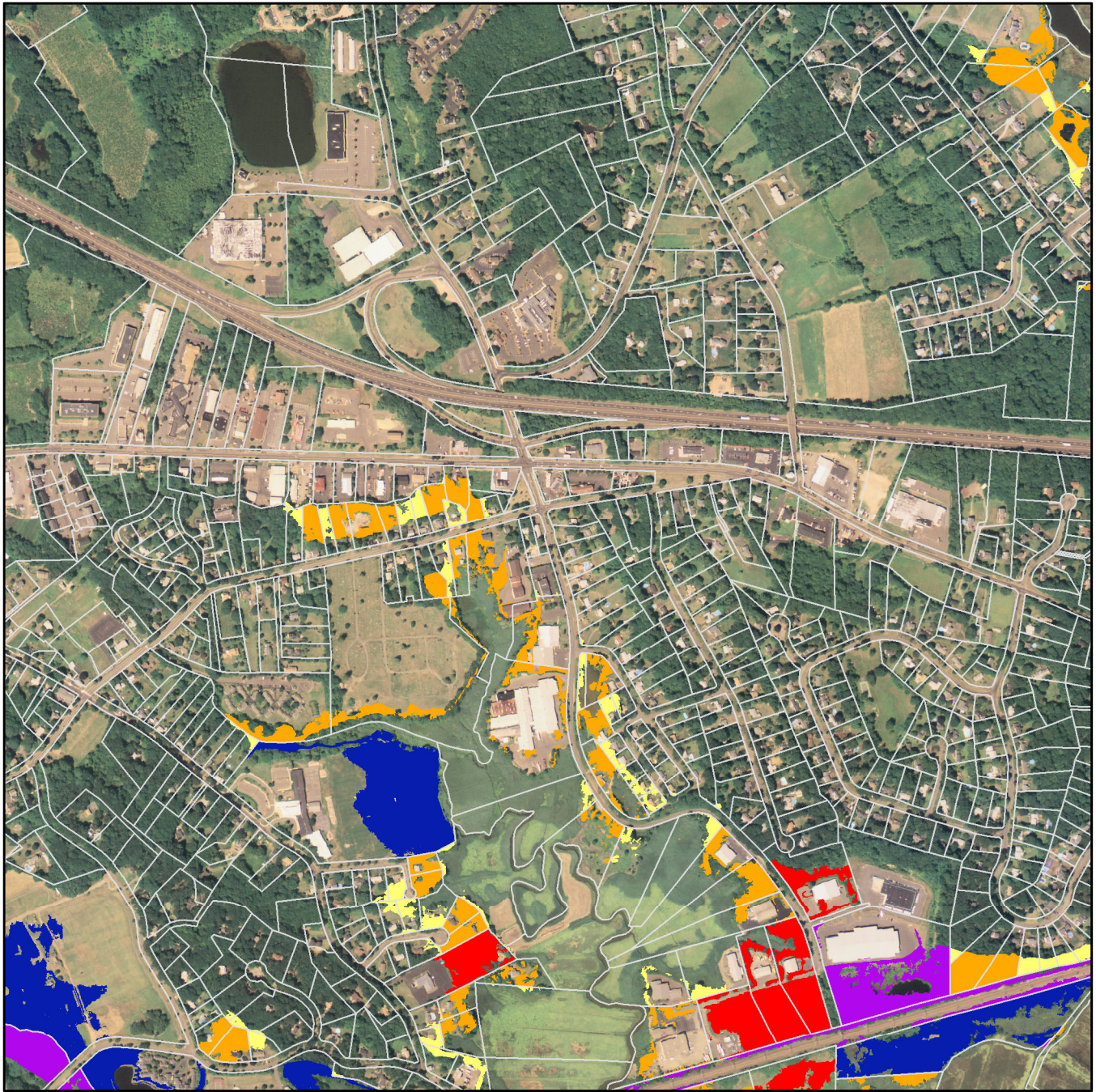


Notes: 1) Most, but not all, colored polygons are delineated by individual parcel boundaries;
2) Data for this set of maps is derived from a different source as used for the first set.



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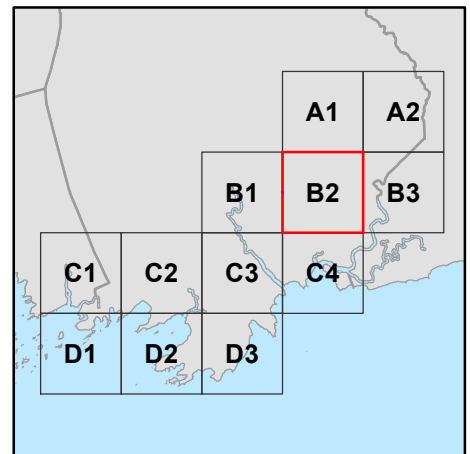
Advancement per Parcel - Map B2

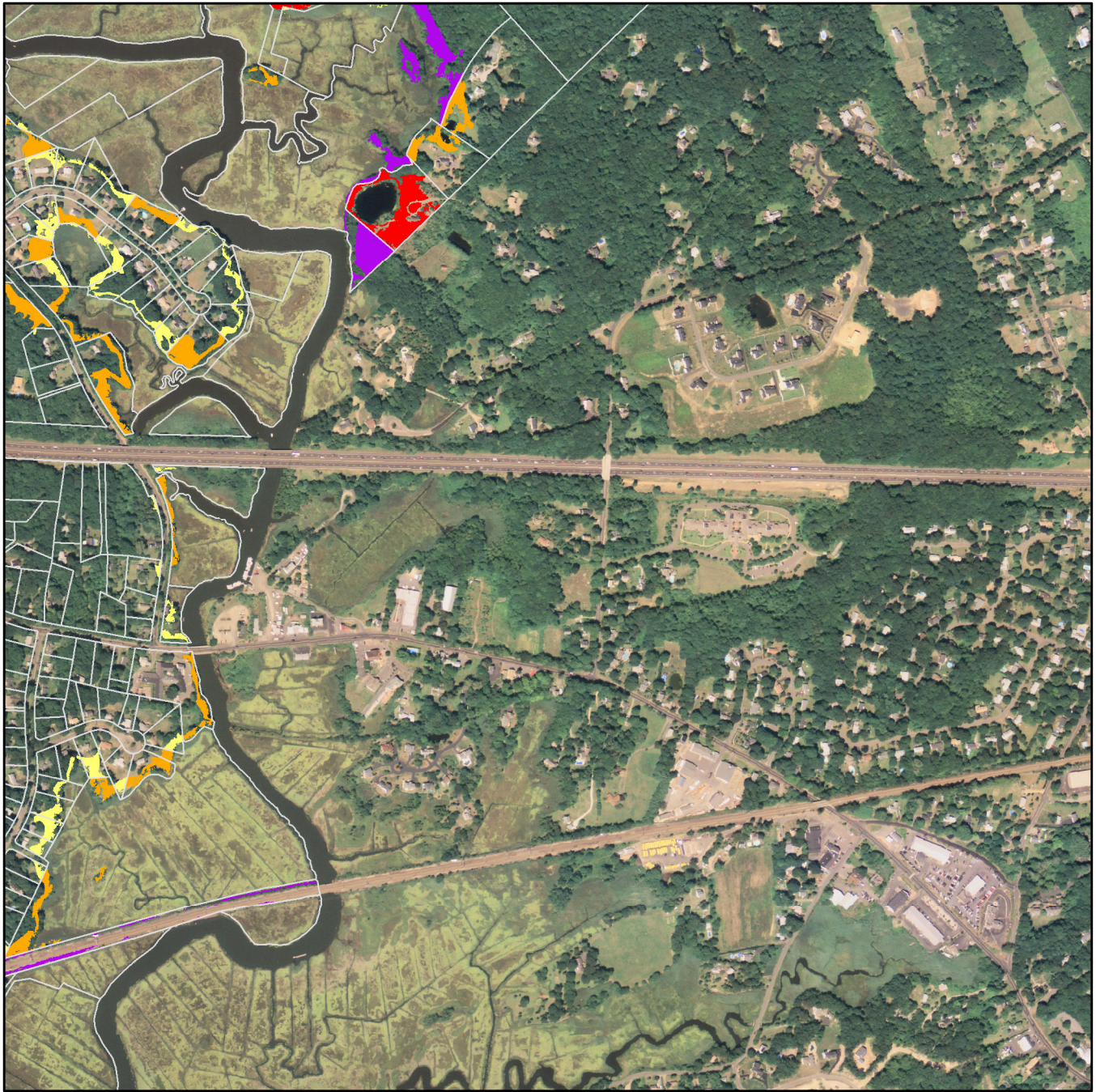


Area of Suitable Advancement

- < 0.5 acres
- 0.5 - 2.0
- 2.0 - 4.5
- 4.5 - 8.0
- 8.0 - 15 acres

Notes: 1) Most, but not all, colored polygons are delineated by individual parcel boundaries;
2) Data for this set of maps is derived from a different source as used for the first set.





0 500 1,000 2,000 3,000 Feet

Marsh Advancement by the 2080s

Town of Guilford, CT

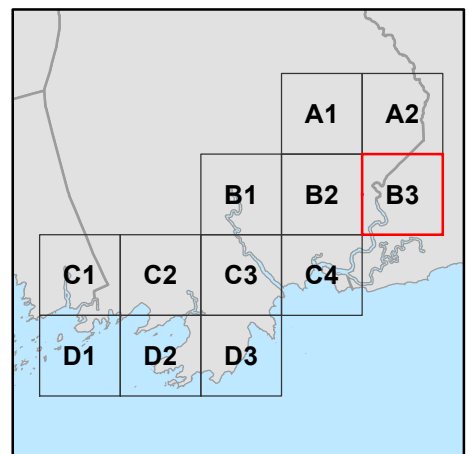
Advancement per Parcel - Map B3

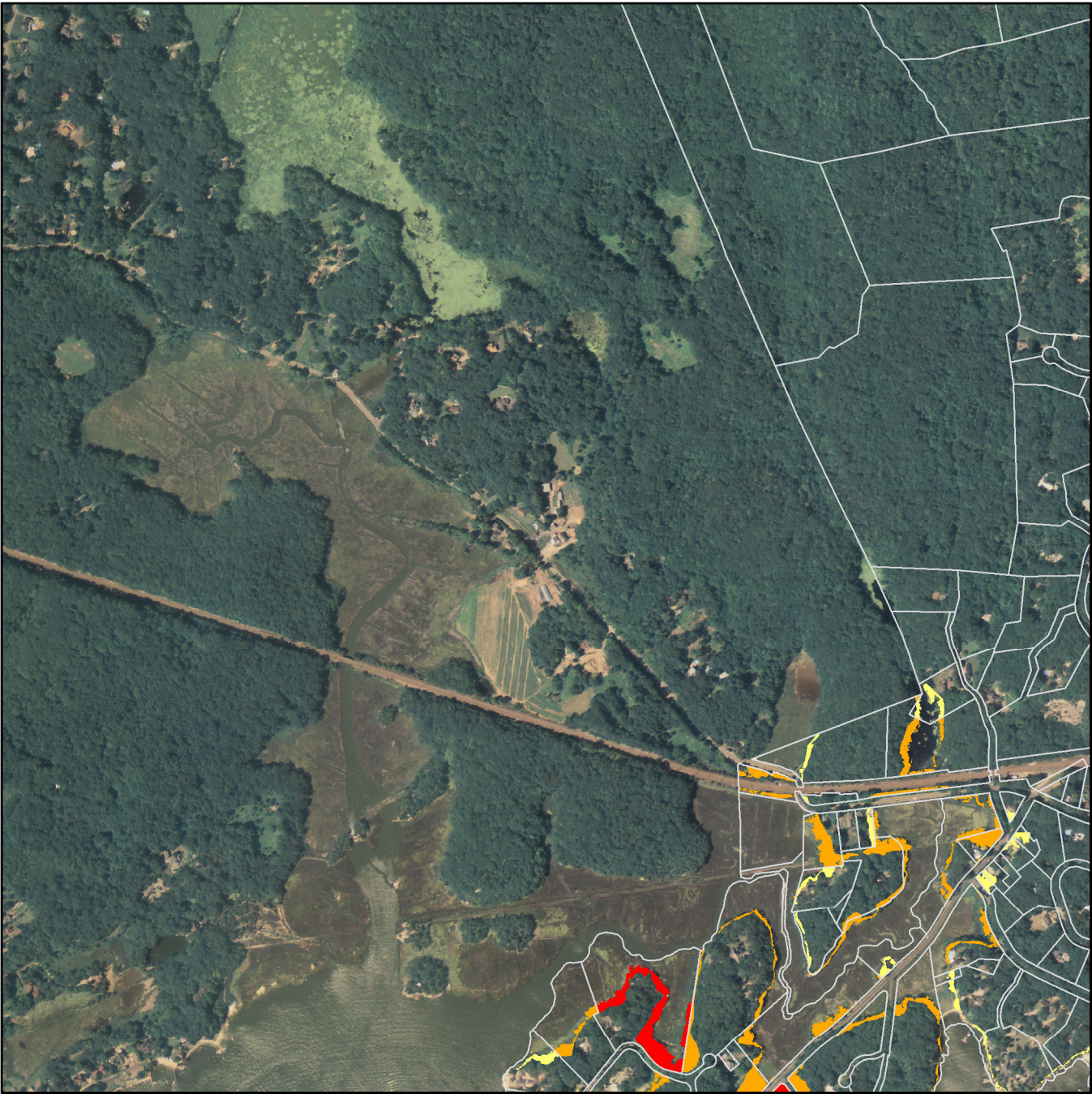
Area of Suitable Advancement

- < 0.5 acres
- 0.5 - 2.0
- 2.0 - 4.5
- 4.5 - 8.0
- 8.0 - 15 acres



Notes: 1) Most, but not all, colored polygons are delineated by individual parcel boundaries;
2) Data for this set of maps is derived from a different source as used for the first set.





0 500 1,000 2,000 3,000 Feet

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Marsh Advancement by the 2080s

Town of Guilford, CT

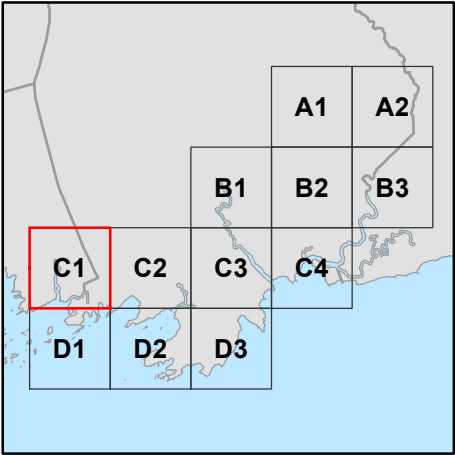
Advancement per Parcel - Map C1

Area of Suitable Advancement

- < 0.5 acres
- 0.5 - 2.0
- 2.0 - 4.5
- 4.5 - 8.0
- 8.0 - 15 acres

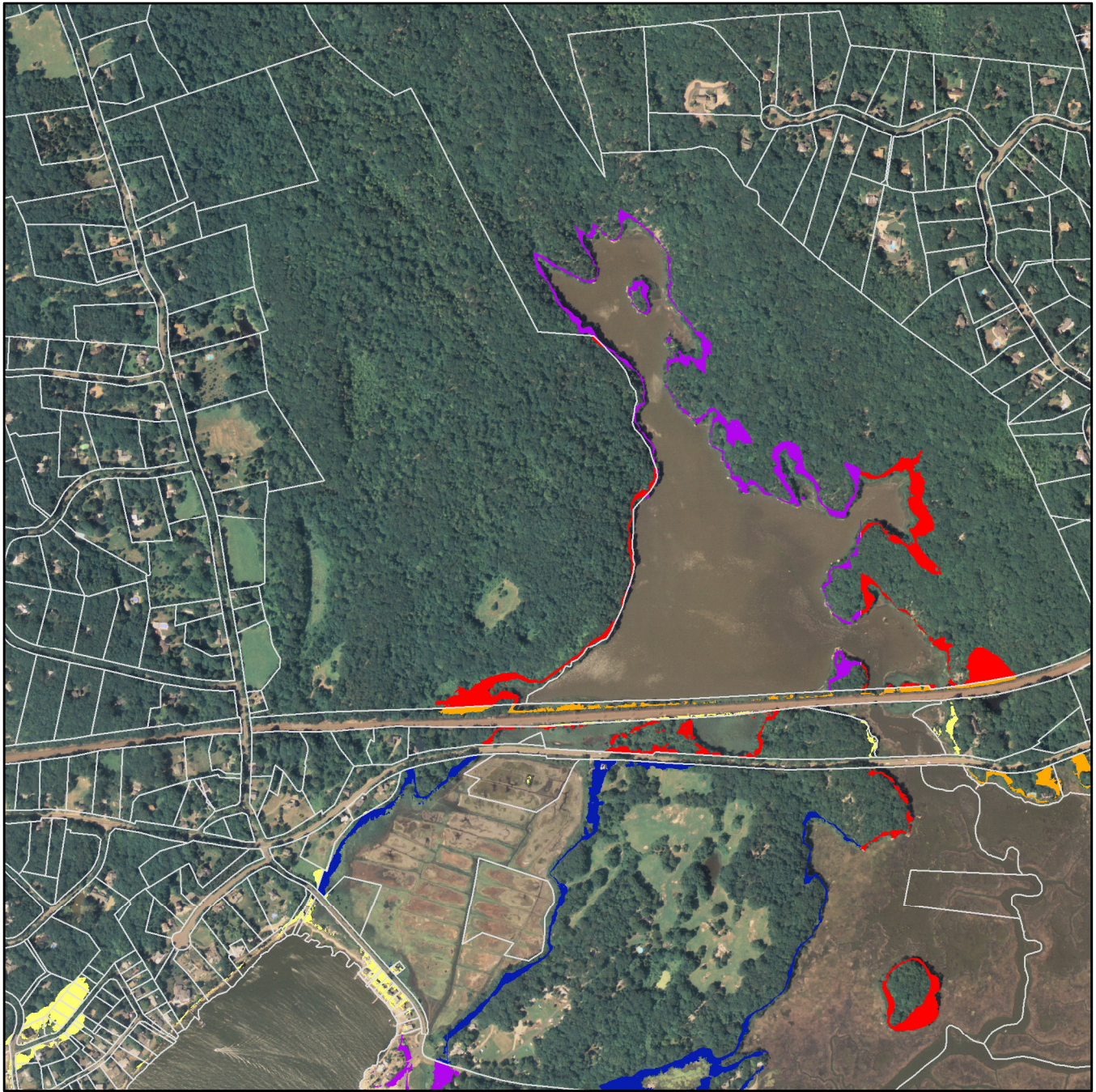


Notes: 1) Most, but not all, colored polygons are delineated by individual parcel boundaries;
2) Data for this set of maps is derived from a different source as used for the first set.



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0 500 1,000 2,000 3,000 Feet

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Marsh Advancement by the 2080s

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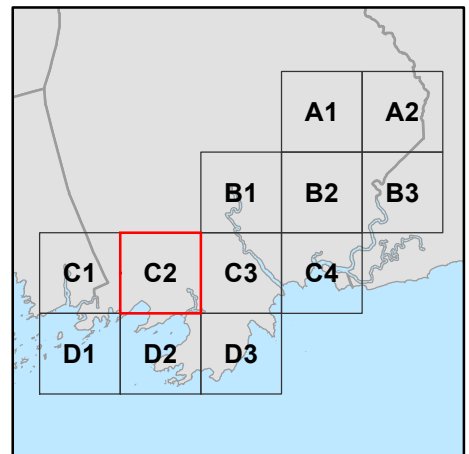
Advancement per Parcel - Map C2

Area of Suitable Advancement

- < 0.5 acres
- 0.5 - 2.0
- 2.0 - 4.5
- 4.5 - 8.0
- 8.0 - 15 acres

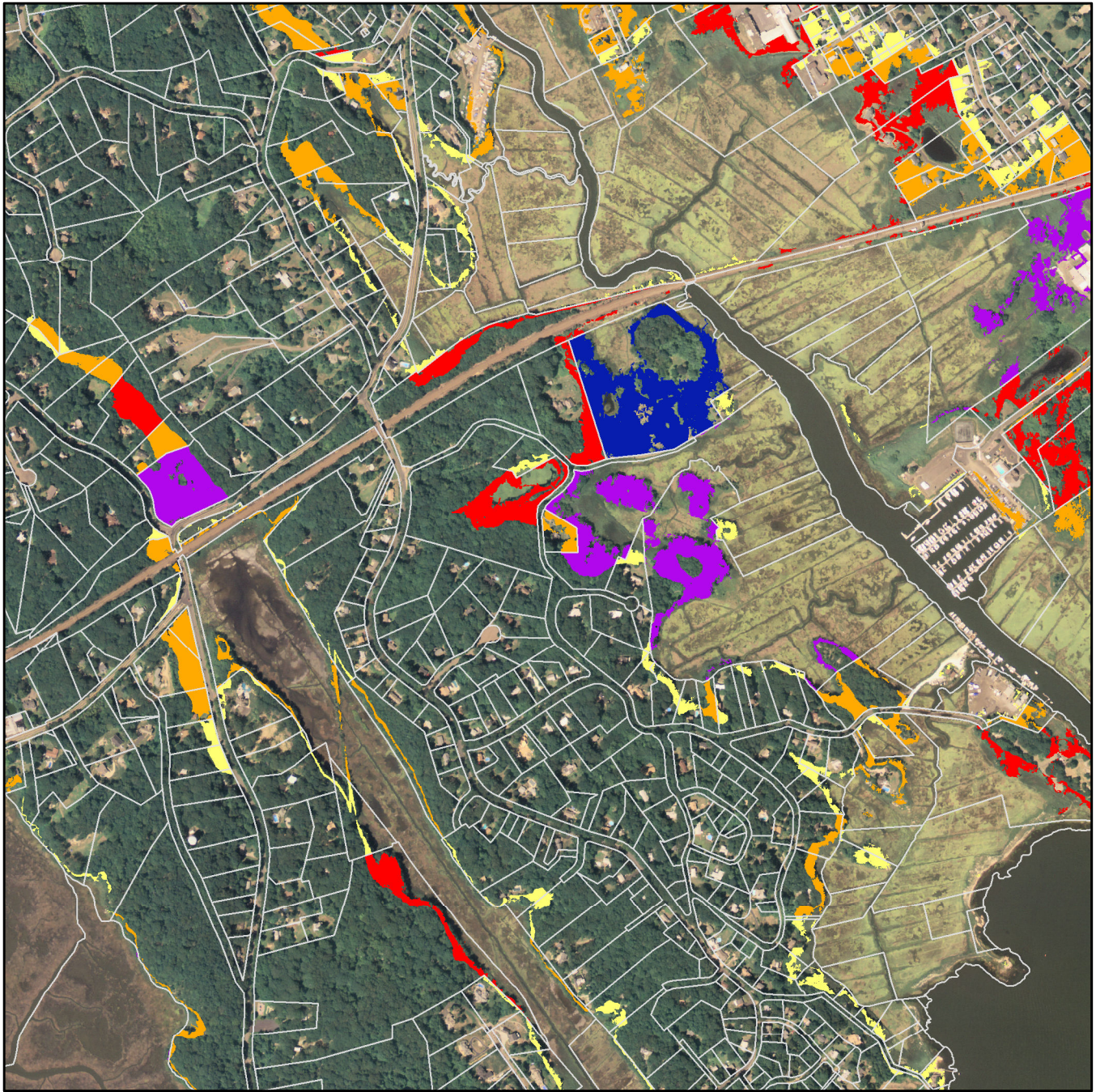


Notes: 1) Most, but not all, colored polygons are delineated by individual parcel boundaries;
2) Data for this set of maps is derived from a different source as used for the first set.



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0 500 1,000 2,000 3,000 Feet

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Marsh Advancement by the 2080s

Town of Guilford, CT

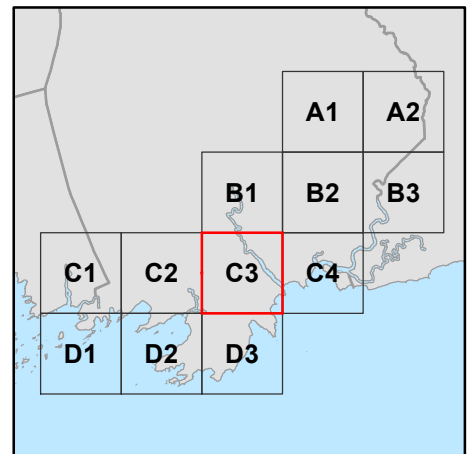
Advancement per Parcel - Map C3

Area of Suitable Advancement

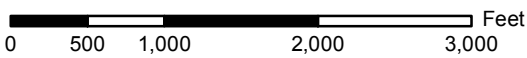
- < 0.5 acres
- 0.5 - 2.0
- 2.0 - 4.5
- 4.5 - 8.0
- 8.0 - 15 acres



Notes: 1) Most, but not all, colored polygons are delineated by individual parcel boundaries;
2) Data for this set of maps is derived from a different source as used for the first set.



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Marsh Advancement by the 2080s

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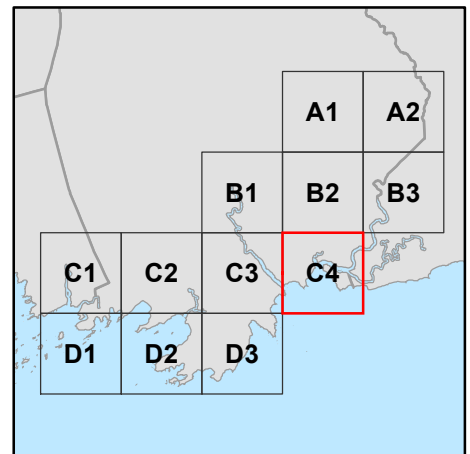
Advancement per Parcel - Map C4

Area of Suitable Advancement

- < 0.5 acres
- 0.5 - 2.0
- 2.0 - 4.5
- 4.5 - 8.0
- 8.0 - 15 acres



Notes: 1) Most, but not all, colored polygons are delineated by individual parcel boundaries;
2) Data for this set of maps is derived from a different source as used for the first set.





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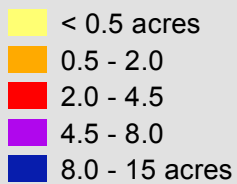


Marsh Advancement by the 2080s

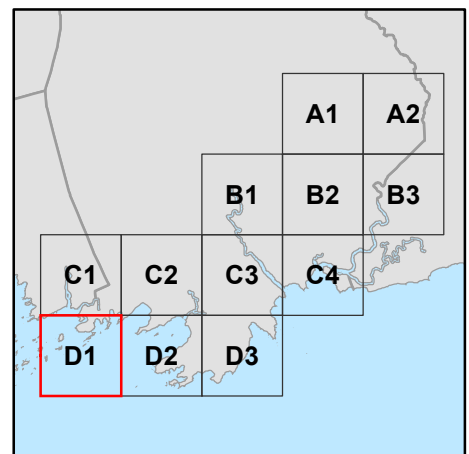
Town of Guilford, CT

Advancement per Parcel - Map D1

Area of Suitable Advancement

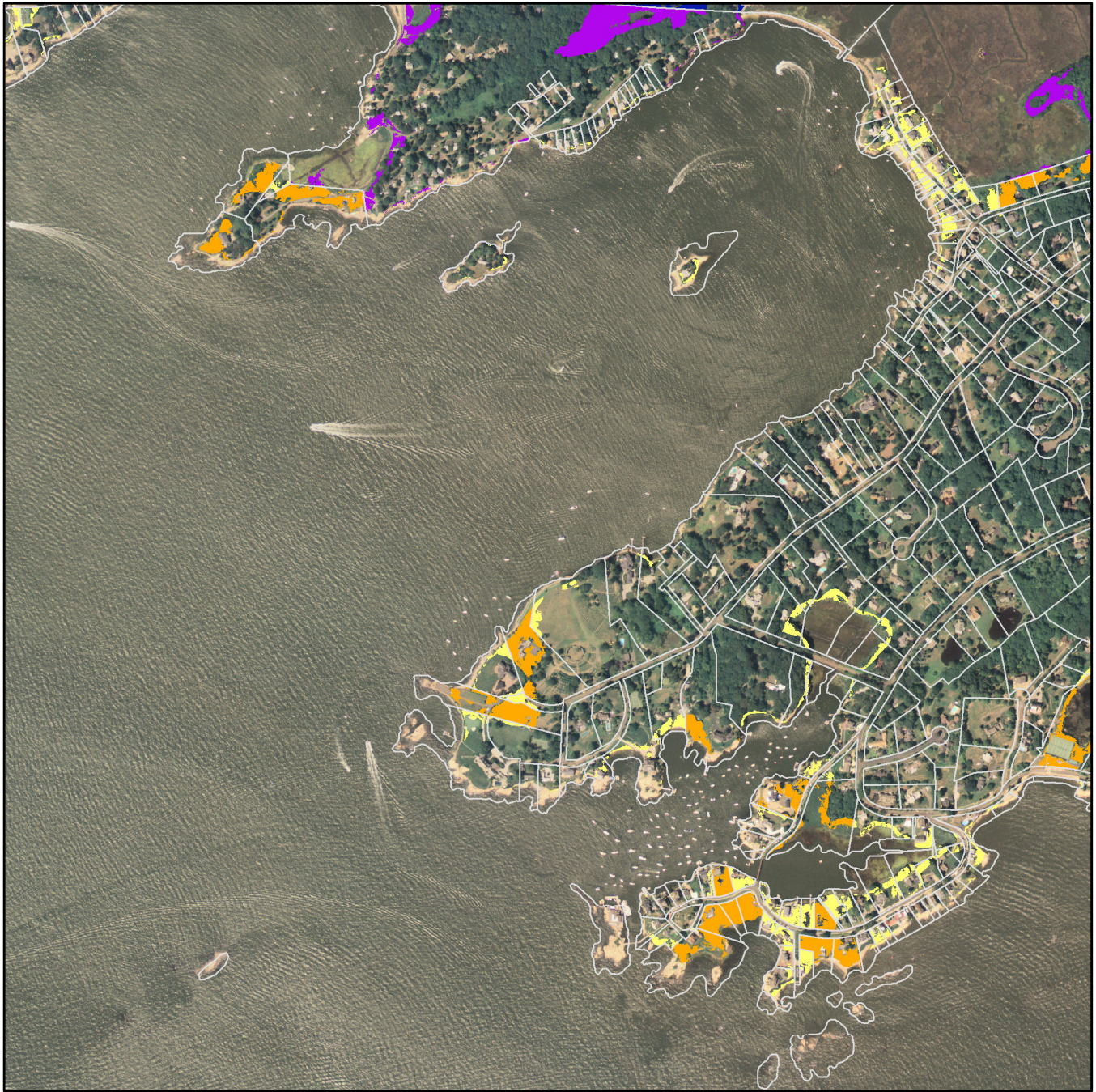


Notes: 1) Most, but not all, colored polygons are delineated by individual parcel boundaries;
2) Data for this set of maps is derived from a different source as used for the first set.



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0 500 1,000 2,000 3,000 Feet

Marsh Advancement by the 2080s

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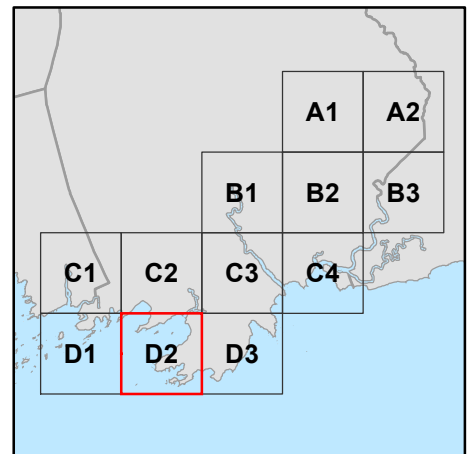
Advancement per Parcel - Map D2

Area of Suitable Advancement

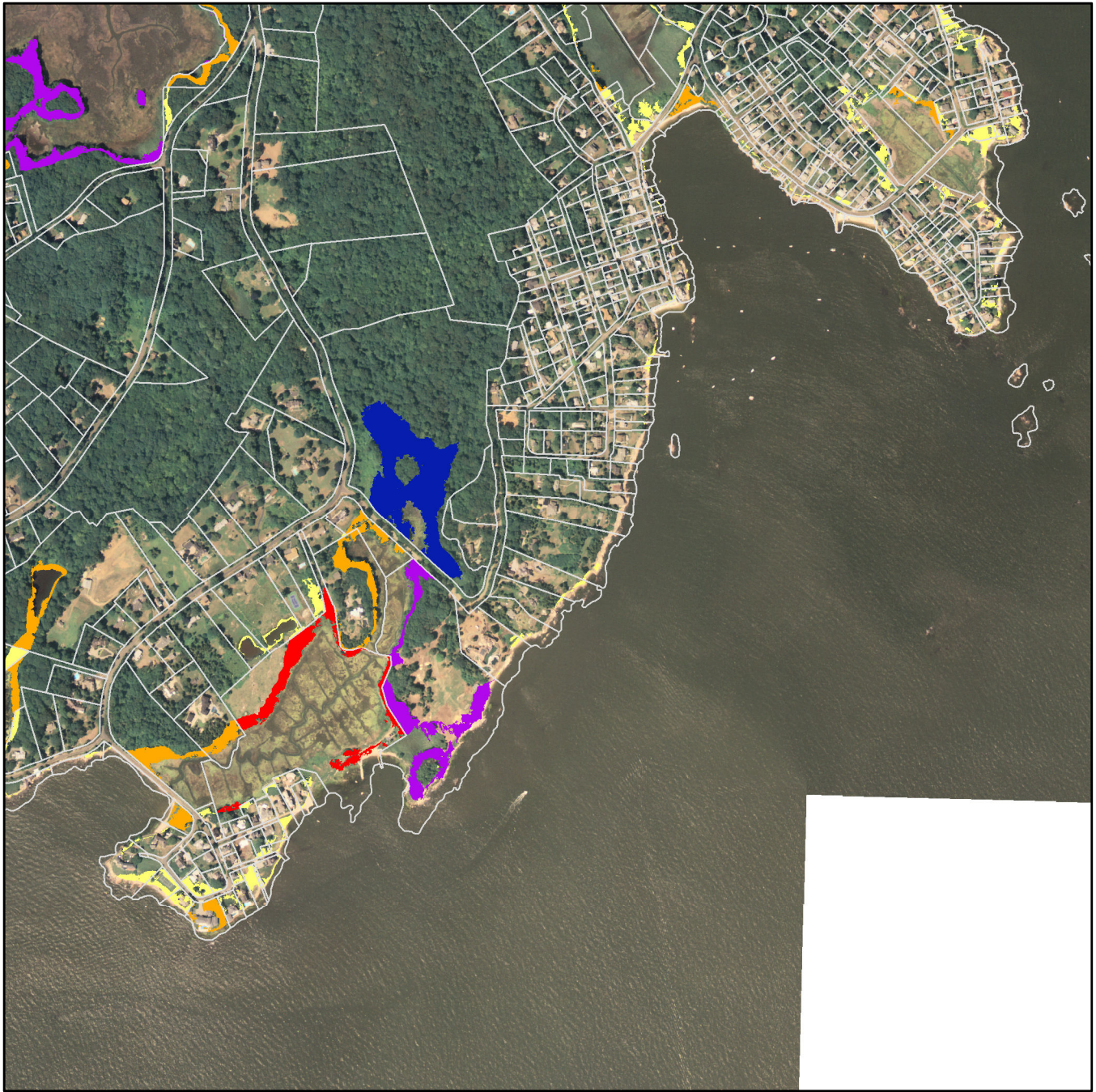
- < 0.5 acres
- 0.5 - 2.0
- 2.0 - 4.5
- 4.5 - 8.0
- 8.0 - 15 acres



Notes: 1) Most, but not all, colored polygons are delineated by individual parcel boundaries;
2) Data for this set of maps is derived from a different source as used for the first set.



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0 500 1,000 2,000 3,000 Feet

Marsh Advancement by the 2080s

Town of Guilford, CT

Advancement per Parcel - Map D3

Area of Suitable Advancement

- < 0.5 acres
- 0.5 - 2.0
- 2.0 - 4.5
- 4.5 - 8.0
- 8.0 - 15 acres



Notes: 1) Most, but not all, colored polygons are delineated by individual parcel boundaries;
2) Data for this set of maps is derived from a different source as used for the first set.

