APPENDIX B. MARINE RIPARIAN INVENTORY FOR SAN JUAN COUNTY

Introduction

Riparian vegetation provides important habitat and process functions to freshwater and marine systems, including microclimate, structure, fish prey production, water quality, wildlife habitat, nutrient input, shade and large woody debris (Brennan et al 2007). Recent local and regional research on juvenile salmon diets have identified insects from terrestrial sources as an important component (Brennan et al 2007, Barsh personal communication 2010) and also highlighted the role riparian vegetation plays in supporting prey items for juvenile salmon (Sobosinski et al 2010, Rice 2006). Riparian vegetation was the one remaining *Valued Ecosystem Component* (Leschine and Peterson 2007) that was not supported by an existing county-wide data set, limiting application of PSNERP strategic approaches to the finer scale county-wide analysis proposed within the project's request for proposal. Thus before fine scale analysis began, project partners completed an inventory of marine riparian vegetation (vegetation cover type and overhanging).

Information on vegetation type, coverage and height within riparian buffers supports spatially explicit analysis of habitat quality and quantity at the county-wide and shore process unit scale and inform geographic and project type prioritization efforts. The countywide inventory provided a baseline of current conditions, which can be used in future monitoring efforts to track changes over time. As information on the sources of terrestrially based salmon prey becomes more detailed, information on vegetation type, cover and height will be available to support additional, more refined analysis.

Riparian Inventory Methods

While few landscape scale assessments of marine riparian condition have been made in the region, attempts were made to research, and be consistent with, other riparian vegetation data collection efforts conducted to date, including multiple projects completed in Whatcom County. The riparian inventory method used in this project collected many of the same vegetation parameters and used comparable vegetation description categories. *Technical assistance in methods development provided by Paul Schlenger, Anchor QEA and Tim Hyatt Skagit Research Systems Cooperative. GIS and LiDAR technical assistance provided by San Juan County GIS.*

Riparian Inventory Assessment Units

Data was collected in assessment reaches along all marine shorelines of San Juan County. Two assessment reaches were used: DNR ShoreZone Inventory reaches and geomorphic shoreforms. Along DNR ShoreZone Inventory reaches, riparian vegetation data was collected in 50-foot and 200-foot buffers, landward of the Washington ShoreZone Inventory shoreline. Shoreform scale analysis of riparian vegetation was collected in 200-foot buffers, landward of the Washington ShoreZone Inventory shoreline, only. Resulting shoreform and DNR beach reach polygons were analyzed with LiDAR to determine vegetation type and coverage class and visually assessed to determine the presence or absence of overhanging vegetation. For riparian vegetation analysis a data layer was created that

buffered the shoreline to the upland side by 200 feet. This buffer was segmented by the shoreforms so that there was a separate buffer polygon for each shoreform segment in the shoreline layer.

Assessment of Riparian Vegetation Type:

The height of the riparian vegetation was estimated using San Juan County 2009 Light Detection and Ranging (LiDAR) at the 3 foot by 3 foot resolution. A raster analysis was conducted that utilized a DEM height assessment to classify vegetation into four primary vegetation types: forest (>15 feet), shrub (2-15 feet) and below 2 feet. An intensity analysis was conducted on TIF files for the below 2 foot coverages to determine vegetated versus unvegetated condition. Coverages were then classified into five categories: 0, .01-25%, 25-50%, 51-75% and 76-100%. This raster based analysis was conducted for the major islands only; LiDAR in San Juan County is not yet available for outer islands. Outer islands were analyzed using visual assessment of high resolution infrared vertical (DNR and FSJ 2004 and 2006) and full color aerial photographs (WA Dept. of Ecology, 2008, as well as Ecology Oblique aerial photographs (2002).

Riparian Inventory Results:

The majority of San Juan County's marine shorelines are forested, with the exception of embayment lagoon and artificial shoreforms. See Table 2. Marine riparian vegetation type below. For details of the GIS and LiDAR based analysis, see Appendix B. Marine Riparian Inventory and Map books.

Table 2. Marine Riparian Vegetation Type

Shoreform	0% Forest		0.1-25% Forest		26-50% Forest		51-75% Forest		76-100% Forest	
	count	miles	count	miles	count	miles	count	miles	count	miles
Artificial	0	0	6	1.4	4	1	1	0.1	0	0
Barrier beach	11	1.6	62	13	49	6.4	35	2.9	28	1.7
Transport zone	12	0.5	57	4	85	6.6	139	11	111	12.4
Feeder bluff	3	1.1	75	4.8	105	6.5	158	11.6	91	5.4
Embay-estuary	0	0	7	4.8	11	3.1	11	2.6	9	1.2
Embay-lagoon	0	0	9	3.6	5	1.1	2	0.77	0	0
Pocket beaches	25	0.64	97	7.2	178	12.5	357	17	288	11.1
Rocky	153	14.3	160	34	189	36	401	96	282	69.3
Forest totals	204 (6%)	18 (4%)	473 (15%)	72.8 (18%)	626 (19%)	73.2 (18%)	1104 (34%)	142 (35%)	809 (25%)	101 (25%)
	0% Shrub		.01-26% shrub		26-50% Shrub		51-75% Shrub		76-100% Shrub	
	count	miles	count	miles	count	miles	count	miles	count	miles
Artificial	0	0	11	2.5	0	0	0	0	0	0
Barrier beach	8	0.37	172	25	5	0.24	0	0	0	0
Transport zone	9	0.18	372	33.3	23	1	0	0	0	0
Feeder bluff	5	0.16	406	28.5	21	.86	0	0	0	0
Embay-estuary	0	0	37	11.7	1	.05	0	0	0	0
Embay-lagoon	0	0	14	5.3	2	0.23	0	0	0	0
Pocket beaches	16	0.36	902	47	26	1	1	0.01	0	0
Rocky	78	6.5	1058	230.5	49	12.6	0	0	0	0
Shrub totals	116 (3%)	7.6 (2%)	2972 (92%)	384 (94%)	127 (4%)	16 (4%)	1 (<1%)	0.01 (<1%)	0	0
	0% below 2 ft. vegetated		.01-25% below 2 ft. vegetated		26-50% below 2 ft. vegetated		51-75% below 2 ft. vegetated		76-100% below 2 ft. vegetated	
	count	miles	count	miles	count	miles	count	miles	count	miles
Artificial	0	0	7	1.3	4	1.2	0	0	0	0
Barrier beach	7	0.4	62	5	69	9.8	41	9.6	6	0.7
Transport zone	9	0.4	251	23.5	106	7.7	32	2.4	6	0.5
Feeder bluff	8	1	273	18.2	105	8.3	39	1.7	7	0.3
Embay-estuary	0	0	25	4.2	10	5.1	3	2.4	0	0
Embay-lagoon	0	0	5	1	9	3.7	2	0.8	0	0
Pocket beaches	28	1	643	28.5	193	13.9	69	4.4	12	0.6
Rocky	71	20	773	160	219	47	109	22	13	1.2
Below 2 ft. veg. totals	123 (4%)	23 (5%)	2039 (63%)	242 (59%)	715 (22%)	97 (24%)	295 (9%)	43 (10%)	44 (1%)	3.3 (1%)

Overhanging Marine Riparian Vegetation Assessment

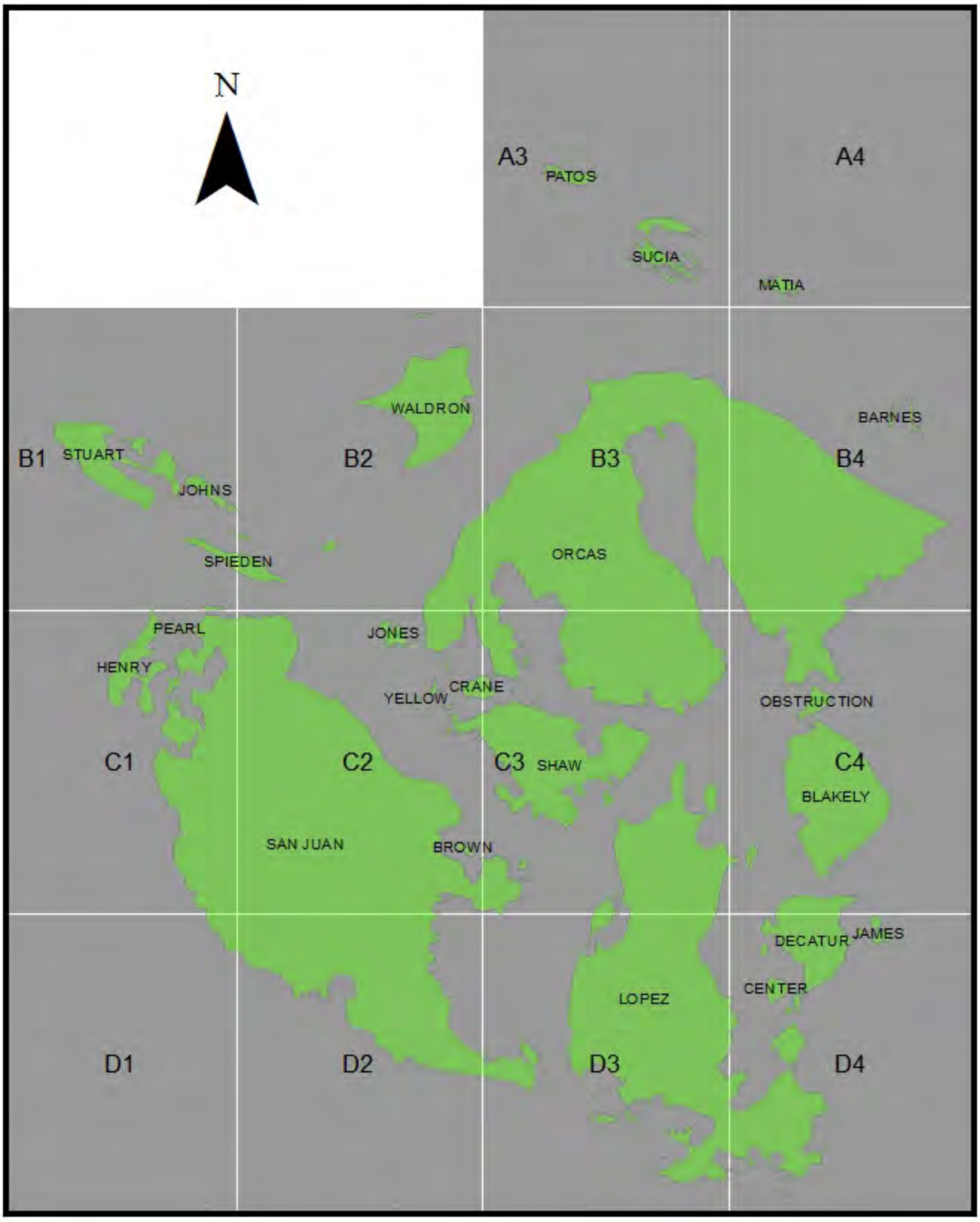
The presence or absence of overhanging vegetation was assessed with aerial photometry using infrared vertical aerials (FSJ and DNR 2004 and 2006), true color orthophotos (Ecology 2008) and aerial oblique photographs (Ecology 2002). In general the most recent imagery was used to determine current conditions while older imagery was used to confirm and improve the assessment of vegetation conditions. As with vegetation type, classification assessment results were organized into percentage of coverages of 0, .01-25%, 25-50%, 51-75% and 76-100% for each geomorphic shoreform. Overhanging vegetation uses the actual shoreline as determined visually using the same ortho photo sets as used in the coverage analyses. The criteria considers only the vegetation (shrubs and or trees) that overhangs the shoreline; no specific consideration for shade, such as aspect and orientation, is given. The percentage of overhanging vegetation is based on its relationship to the total shoreline segment and then binned into 5 categories of overhanging vegetation coverage.

Overhanging Marine Riparian Results

A significant portion of San Juan County's marine shorelines have overhanging vegetation. Shoreforms with the lowest percentages of overhanging vegetation include artificial, embayment lagoon and barrier beach shoreforms. For lagoons and barrier beaches, the lack of overhanging vegetation is often the result of naturally low vegetation cover, which is also common on some rocky shores within San Juan County. See Table 3. Overhanging Marine Vegetation. For details of the GIS and aerial photo interpretation analysis and results, see Appendix B. Marine Riparian Inventory and Map books.

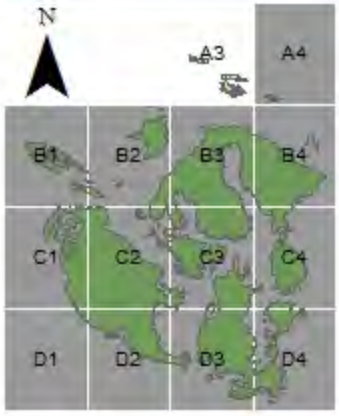
Table 3. Overhanging Marine Riparian Vegetation

Shoreform	0% OH		.01-25% OH		26-50% OH		51-75% OH		76-100% OH	
	count	miles	count	miles	count	miles	count	miles	count	miles
Artificial	2	0.7	5	1.1	4	0.7	0	0	0	0
Barrier beach	38	8.5	77	10.4	17	2.4	18	2.3	35	1.9
Transport zone	36	1.7	37	3.2	32	2.2	57	5.4	242	22
Feeder bluff	16	1.4	59	4	32	2.6	61	6.7	264	14.7
Embayment Estuary	6	3.2	3	1	2	0.9	9	2.8	18	3.8
Embayment Lagoon	11	4.3	2	0.3	0	0	2	0.7	1	.09
Pocket beaches	44	1.4	172	10.3	126	8.1	161	9.4	442	19
Rocky	234	24	184	36.5	149	41.3	187	50.7	431	97.2
OH veg. totals	387 (12%)	45 (11%)	539 (17%)	67 (16%)	362 (11%)	58 (14%)	495 (15%)	78 (19%)	1433 (27%)	159 (39%)



San Juan County
Marine Riparian Inventory Mapbook
Forest Coverage Class

San Juan County Marine Riparian Inventory



FOREST CLASS
% of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

- **0 = No Coverage**
- **1 = .01-25%**
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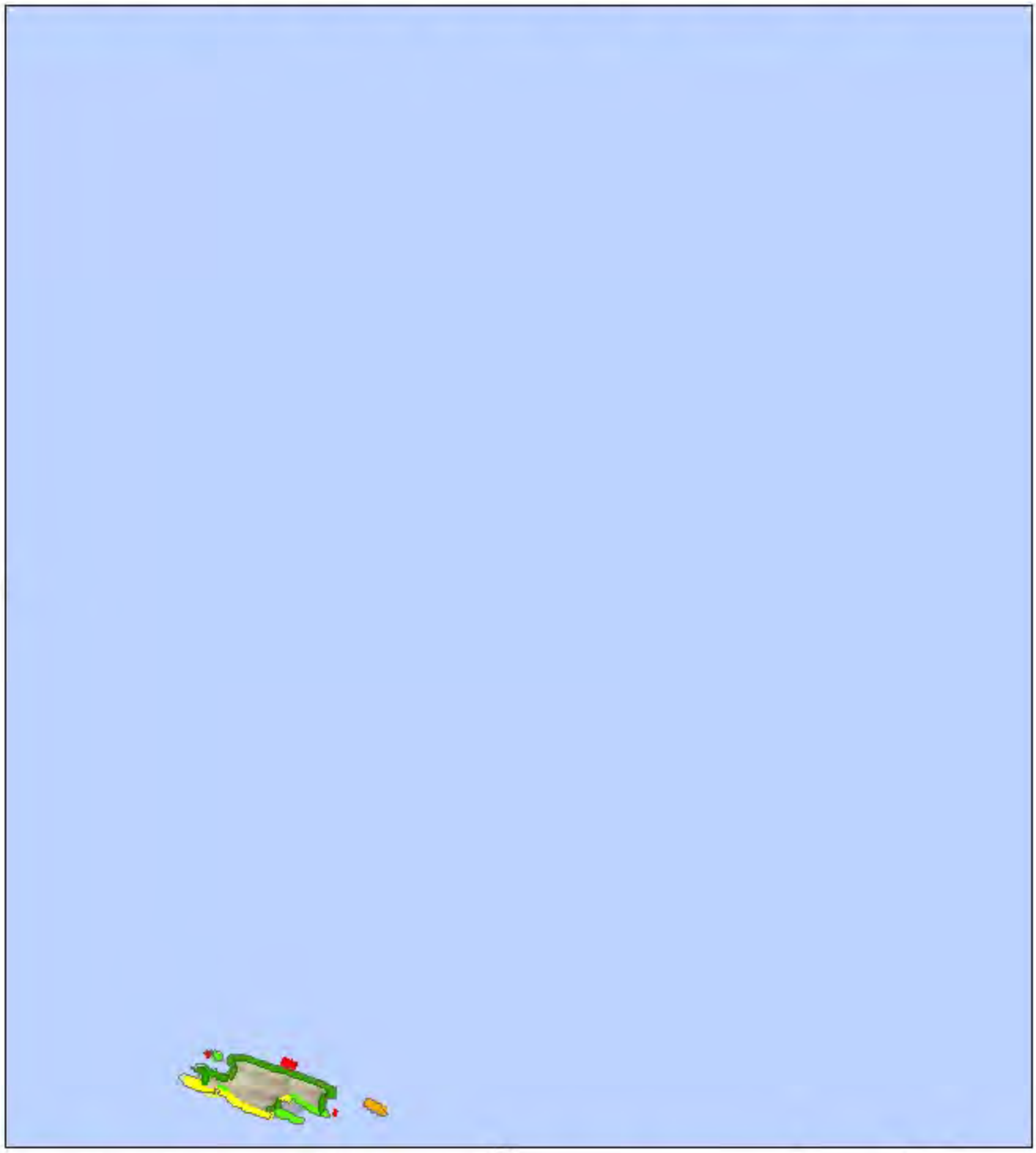
- **3 = 51-75%**
- **4 = 76-100%**

A3

San Juan County Marine Riparian Inventory



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FOREST CLASS
% of Coverage

Unit of Analysis:
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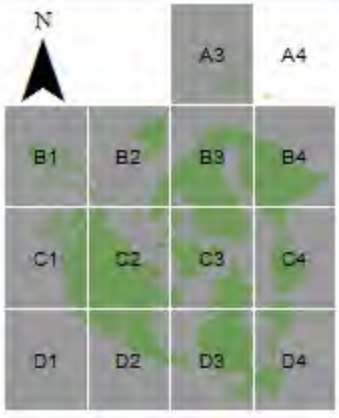
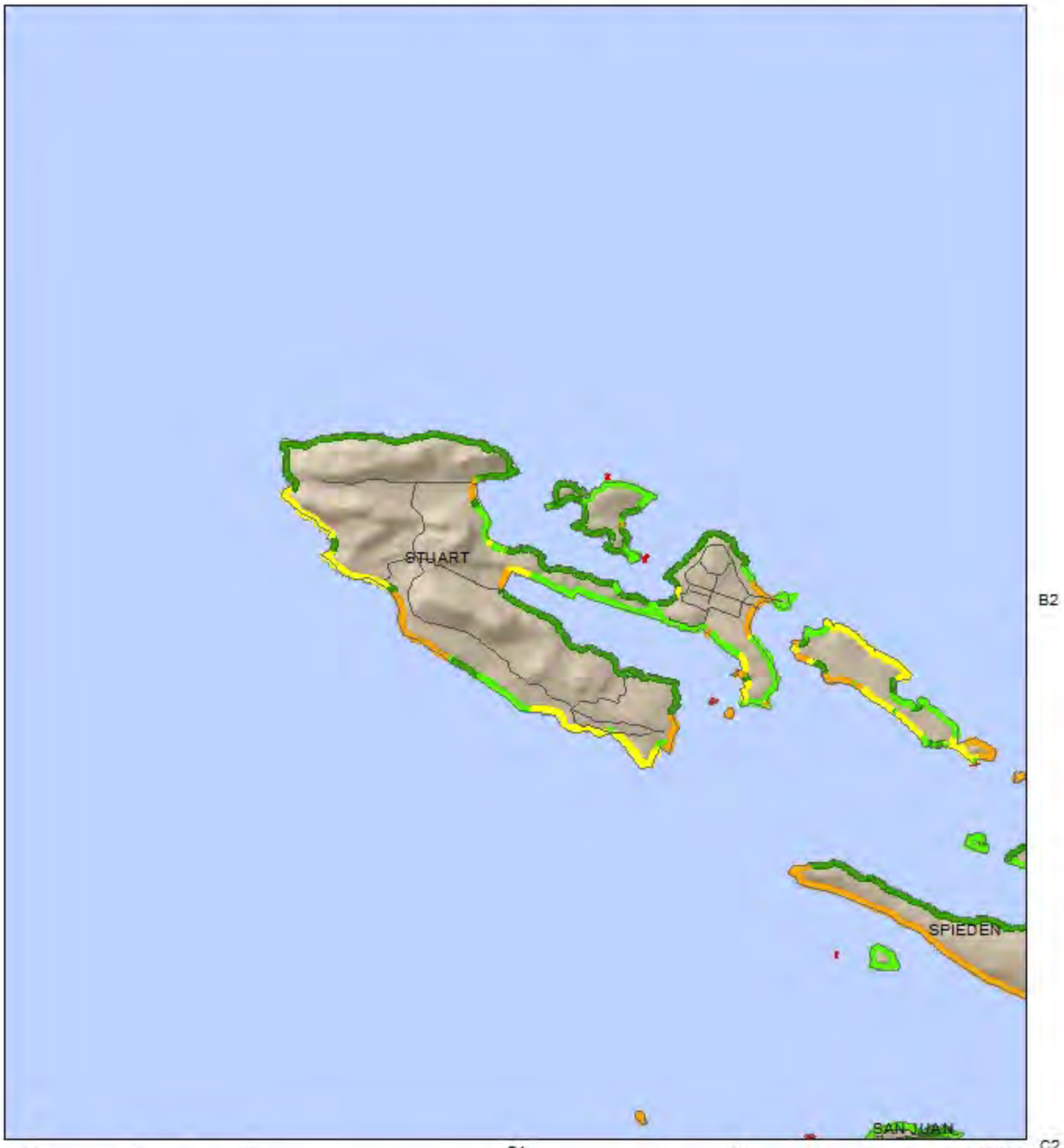
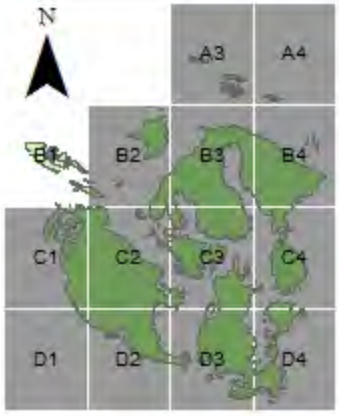
A4



San Juan County Marine Riparian Inventory





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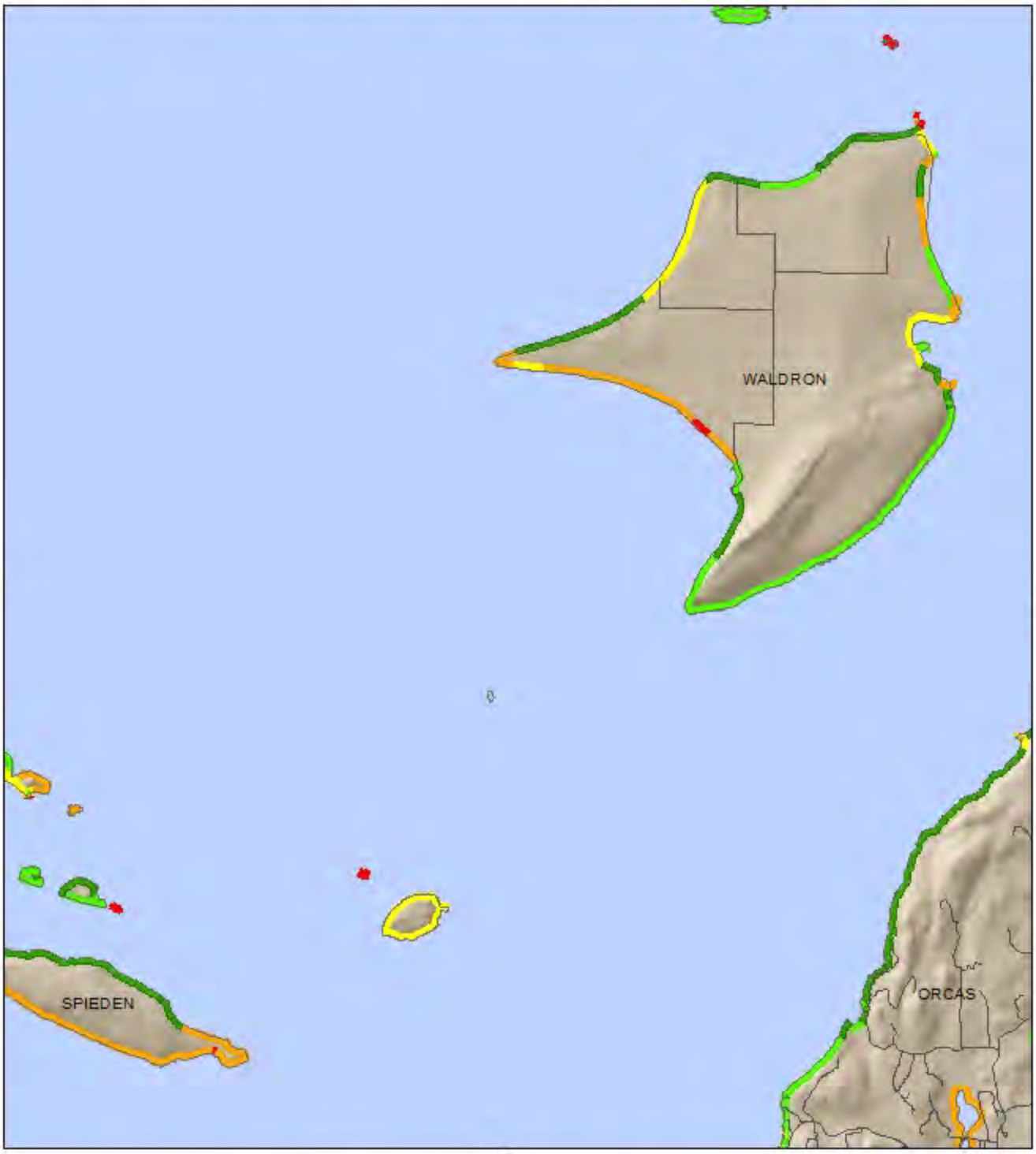
B1

San Juan County Marine Riparian Inventory



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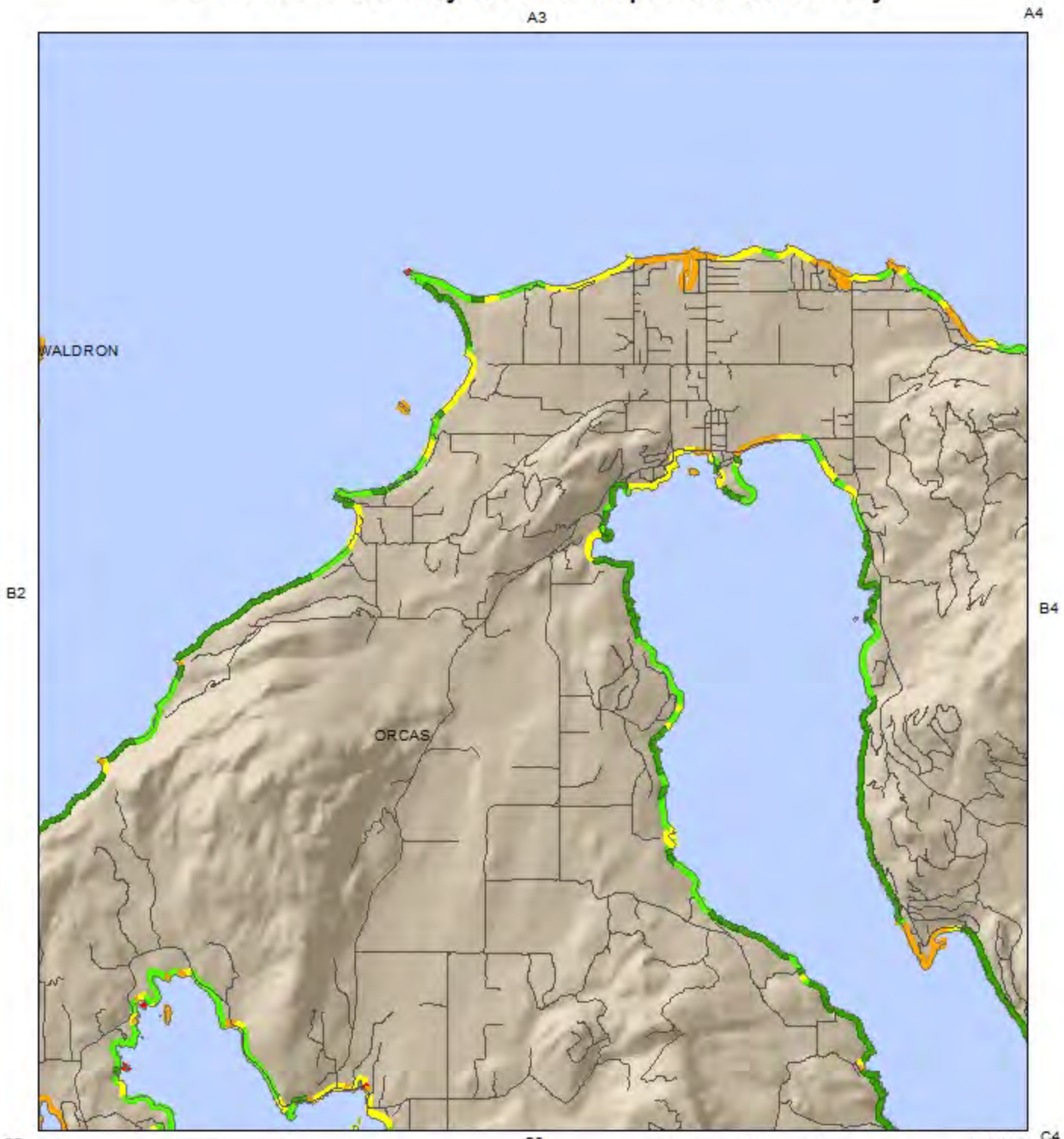
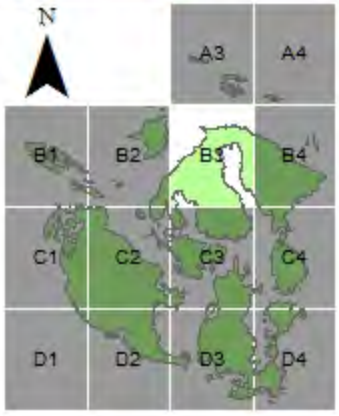
FOREST CLASS
% of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

B2

San Juan County Marine Riparian Inventory





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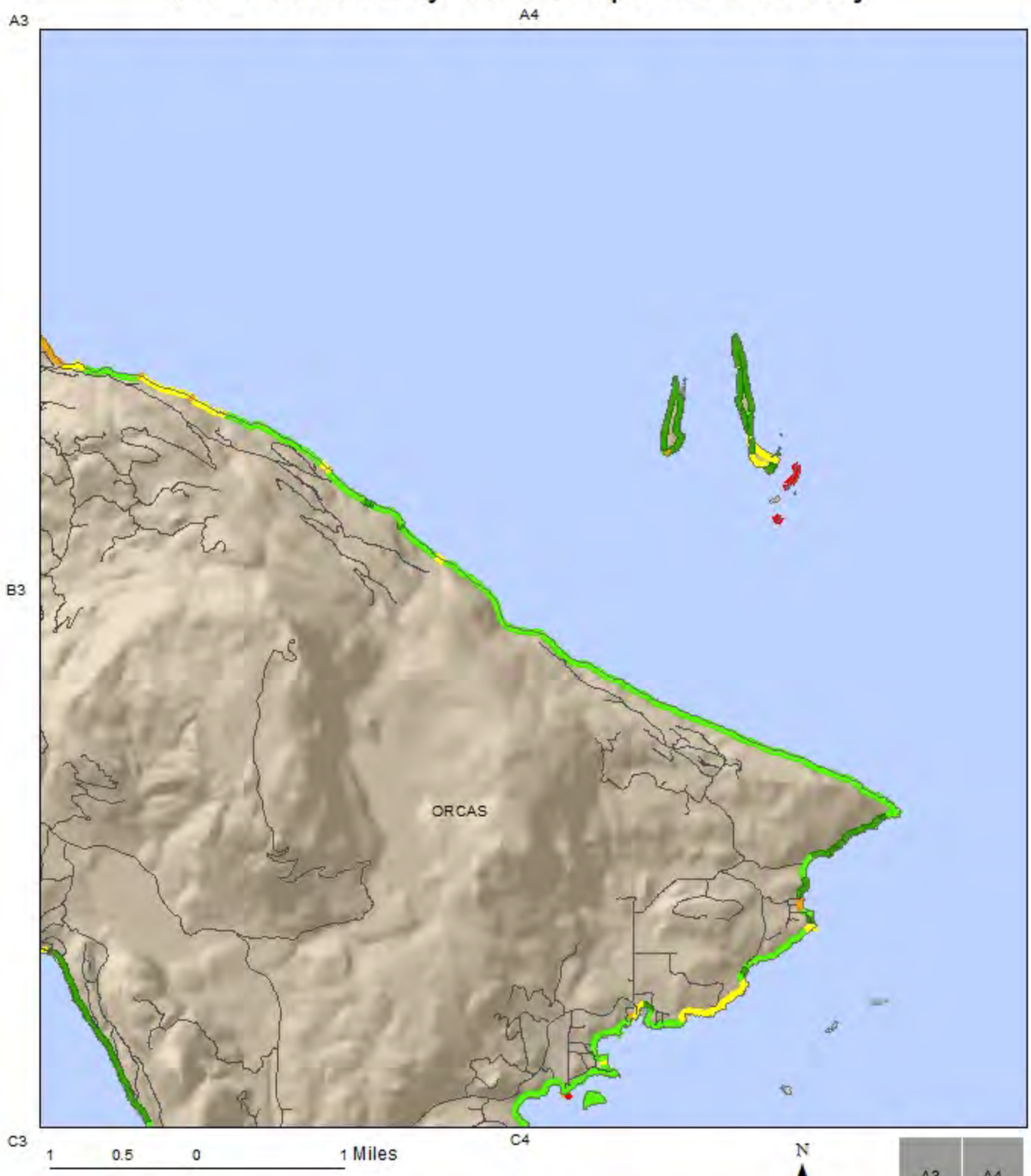
B3

San Juan County Marine Riparian Inventory



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FOREST CLASS
% of Coverage

Unit of Analysis:
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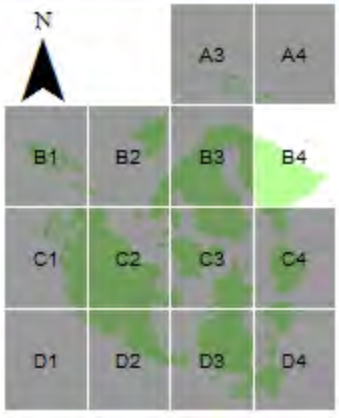
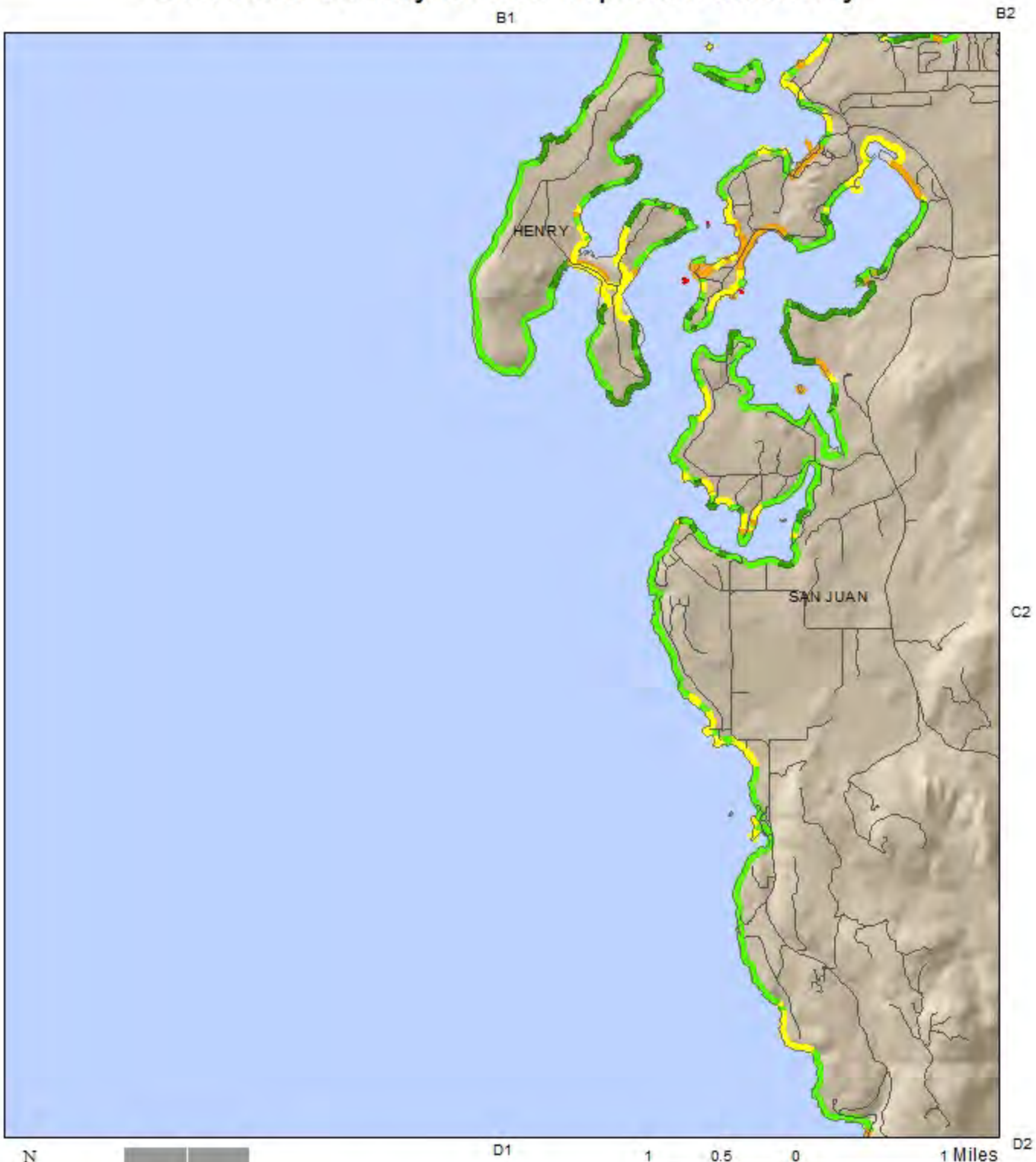
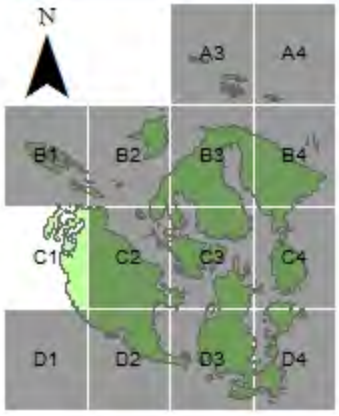
B4



San Juan County Marine Riparian Inventory





FOREST CLASS
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C1

San Juan County Marine Riparian Inventory

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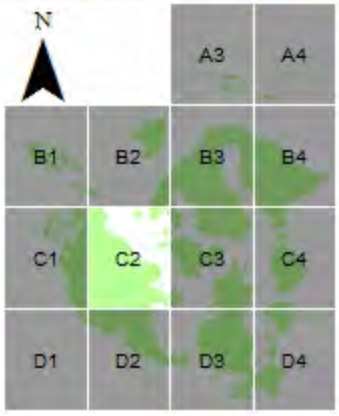
4 = 76-100%

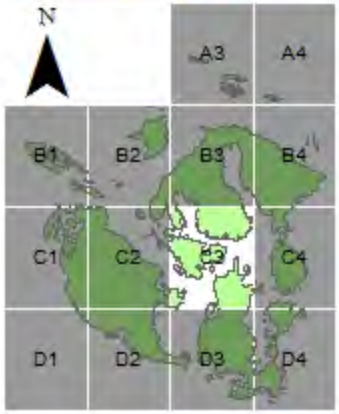
FOREST CLASS
% of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

C2



San Juan County Marine Riparian Inventory



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C3

San Juan County Marine Riparian Inventory

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FOREST CLASS
% of Coverage

Unit of Analysis:
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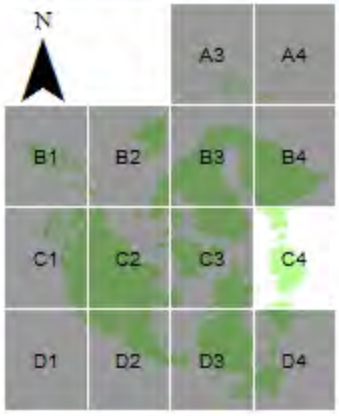
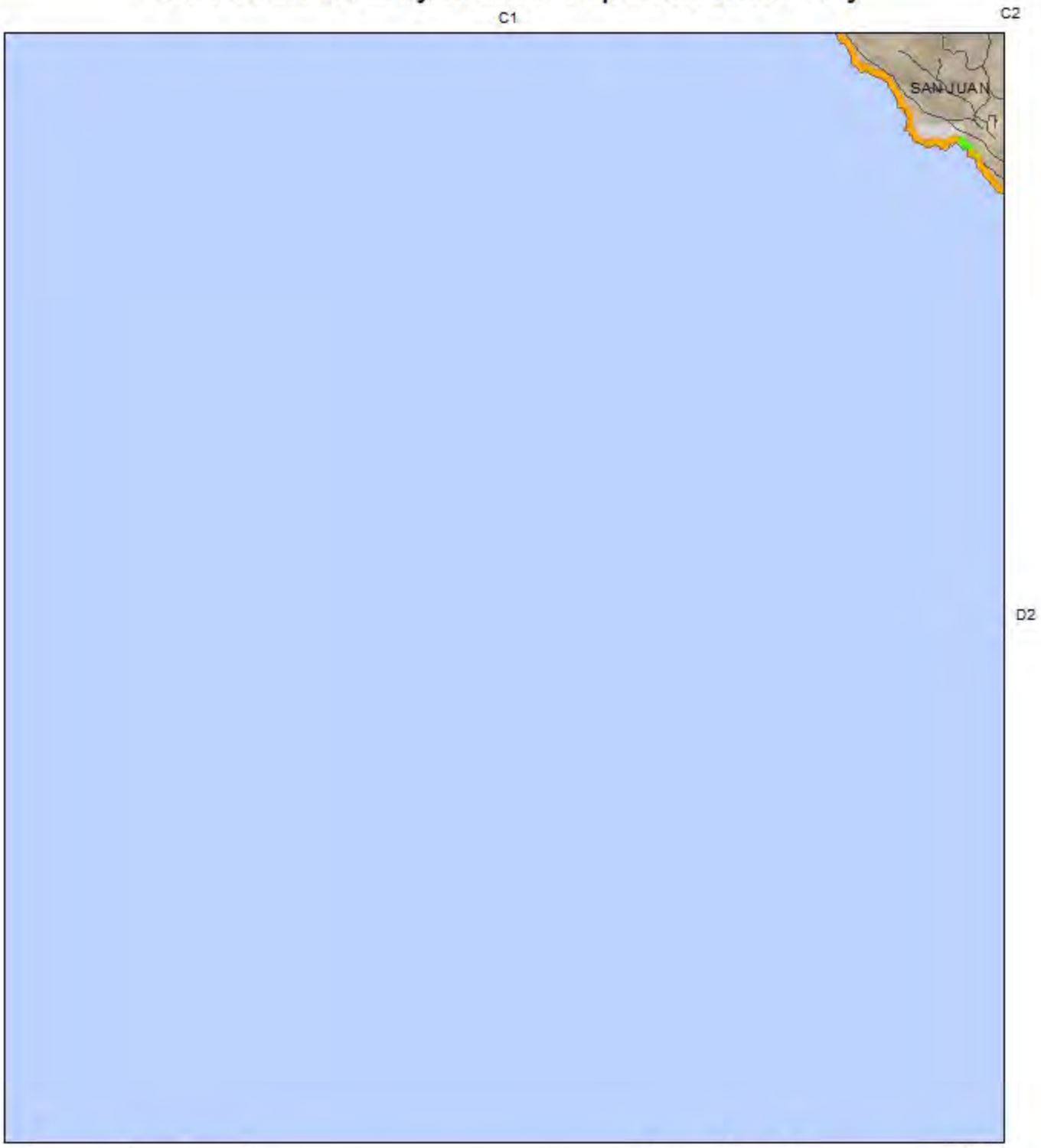
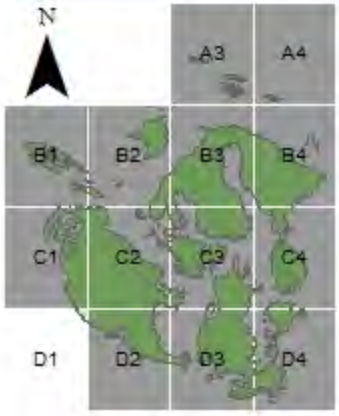
C4



San Juan County Marine Riparian Inventory





1 0.5 0 1 Miles

FOREST CLASS
% of Coverage

Unit of Analysis:
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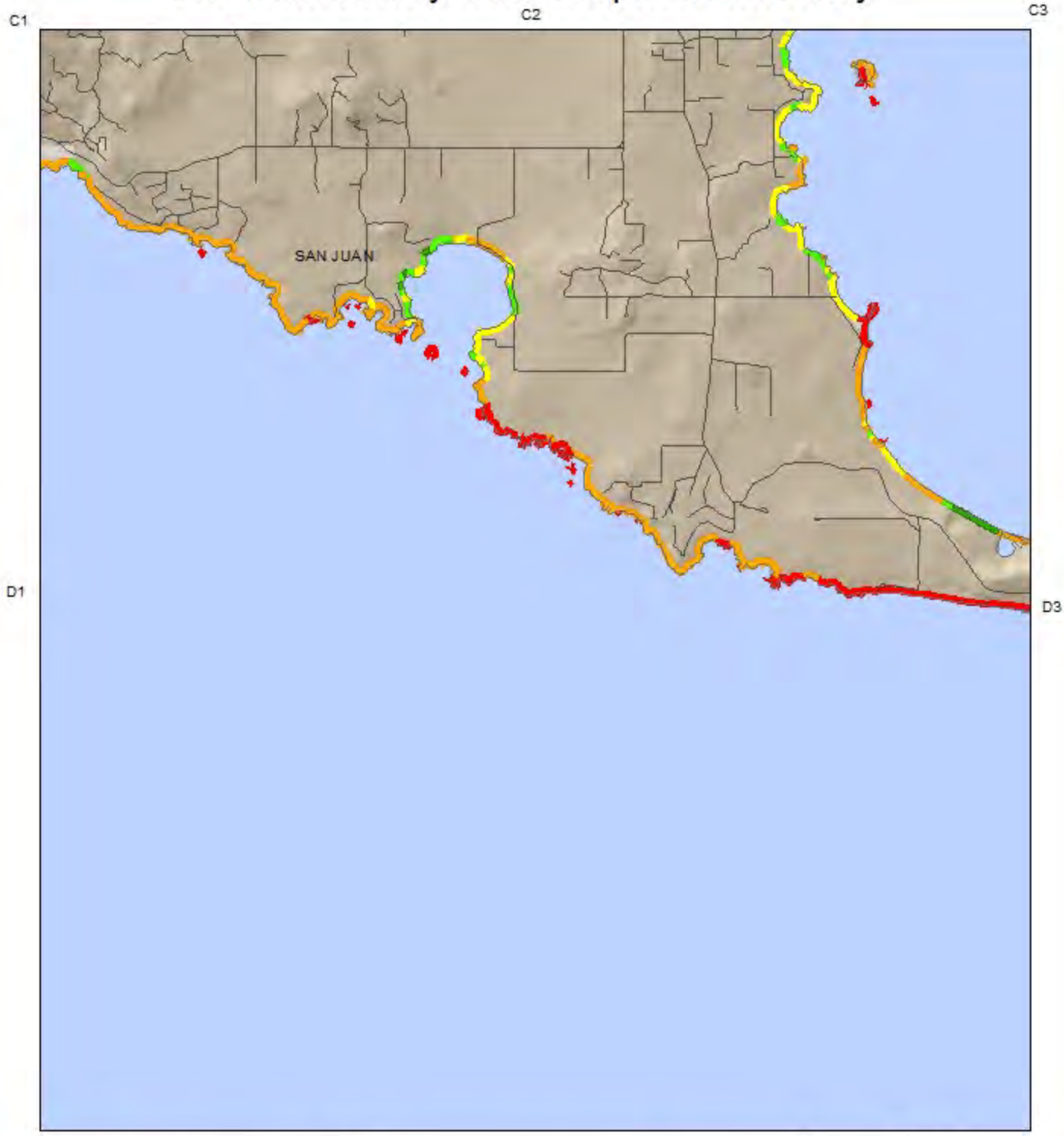
D1

San Juan County Marine Riparian Inventory



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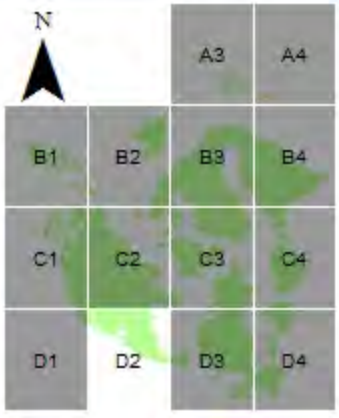
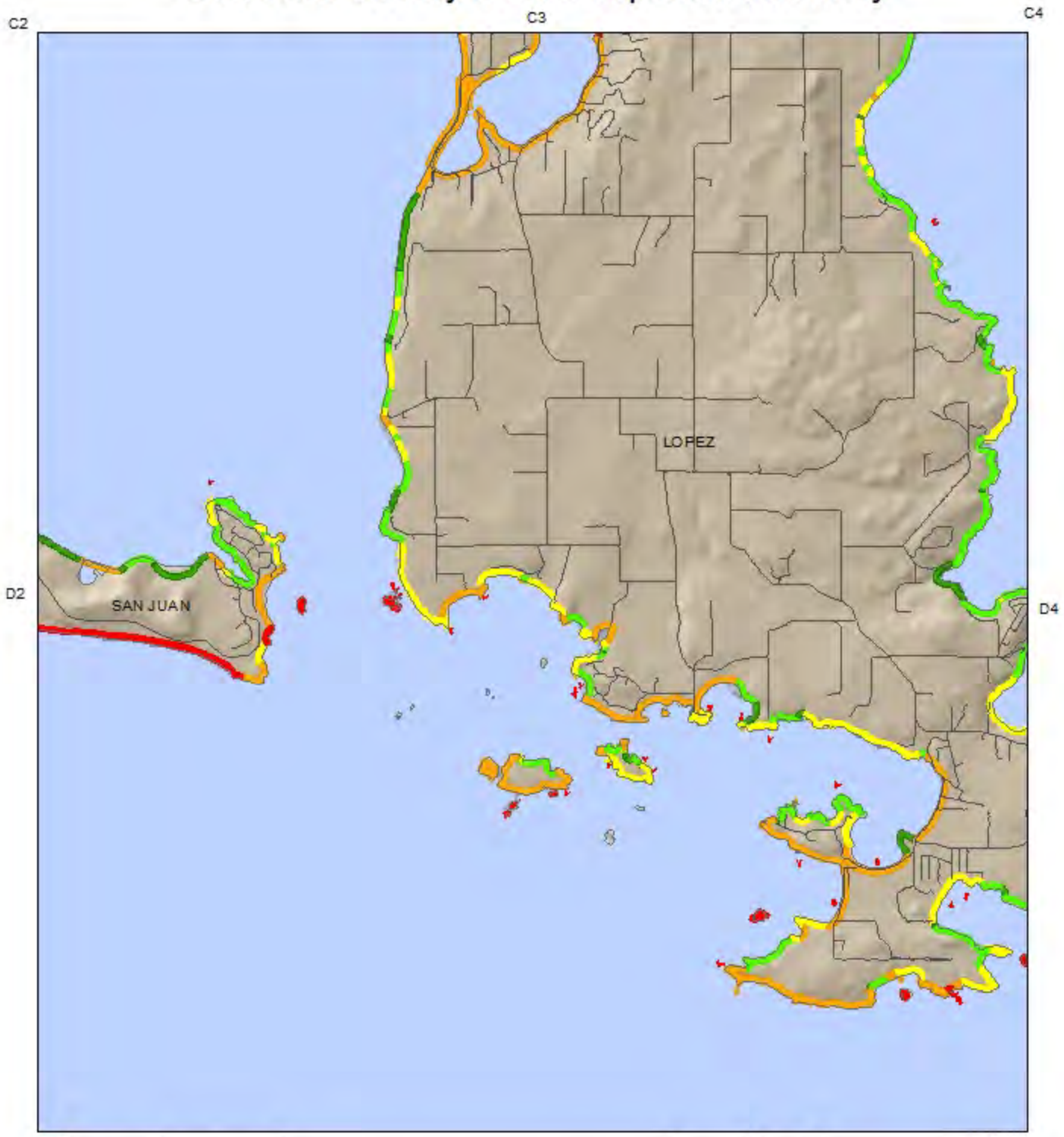
FOREST CLASS
% of Coverage

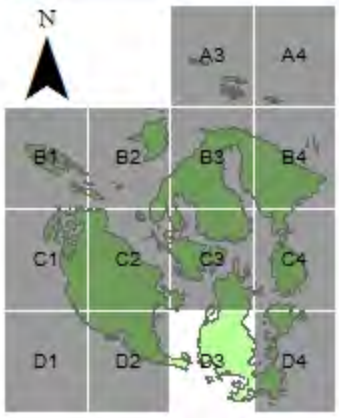
Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

D2



San Juan County Marine Riparian Inventory





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FOREST CLASS
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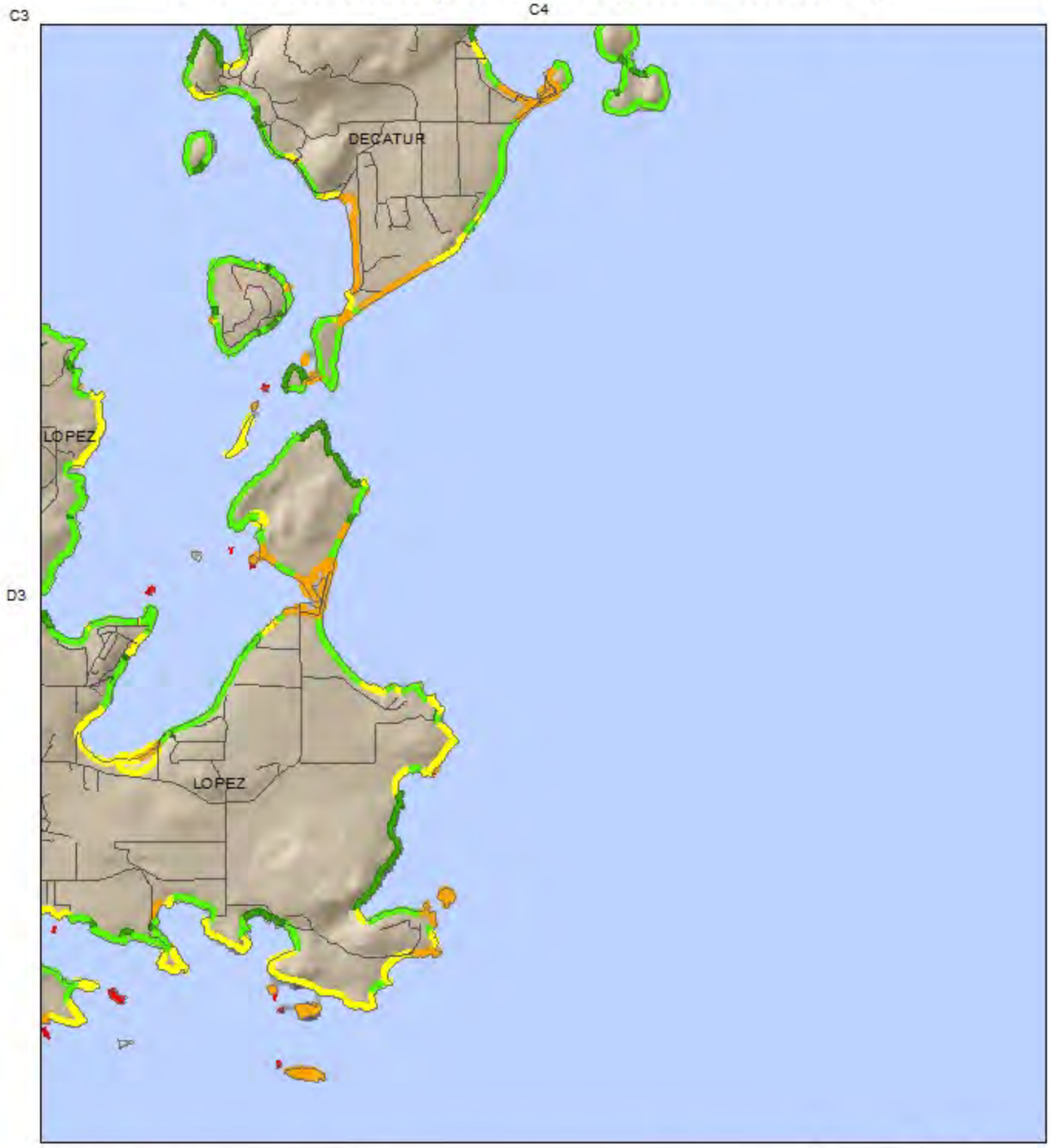
D3

San Juan County Marine Riparian Inventory



1 0.5 0 1 Miles

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FOREST CLASS
% of Coverage

Unit of Analysis:
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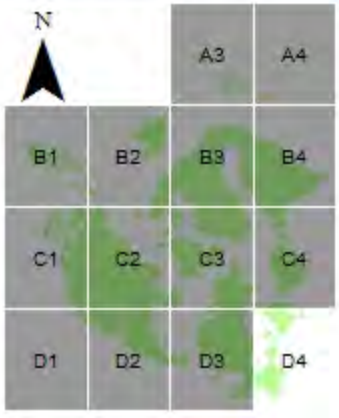
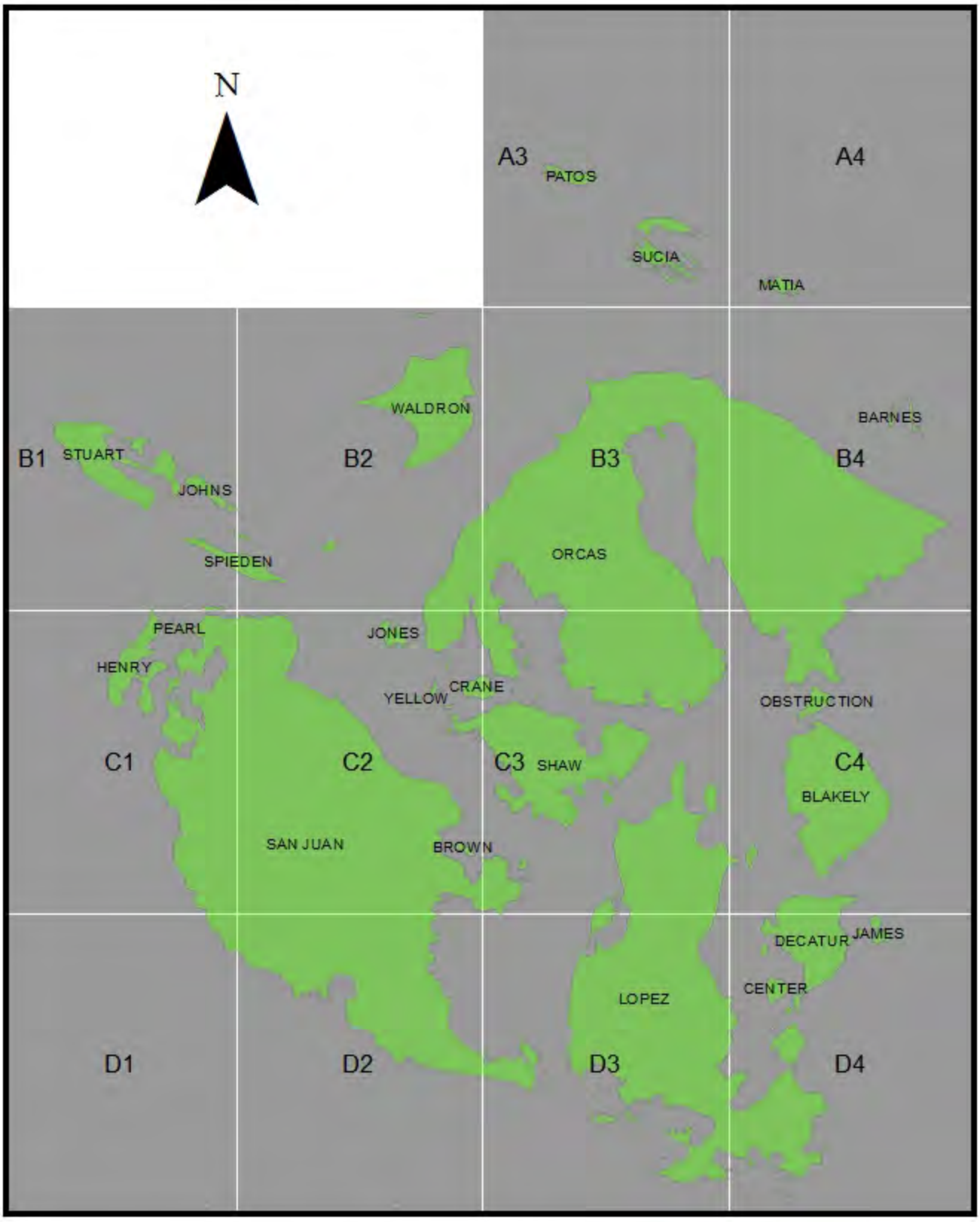
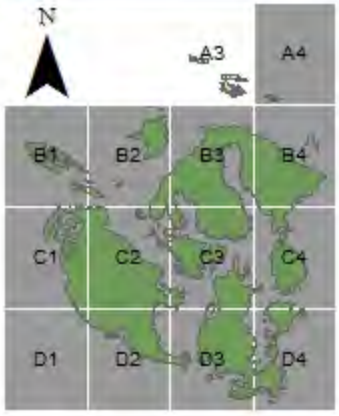
D4





San Juan County
Marine Riparian Inventory Mapbook
Shrub Coverage Class

San Juan County Marine Riparian Inventory



Shrub Class
% of Coverage

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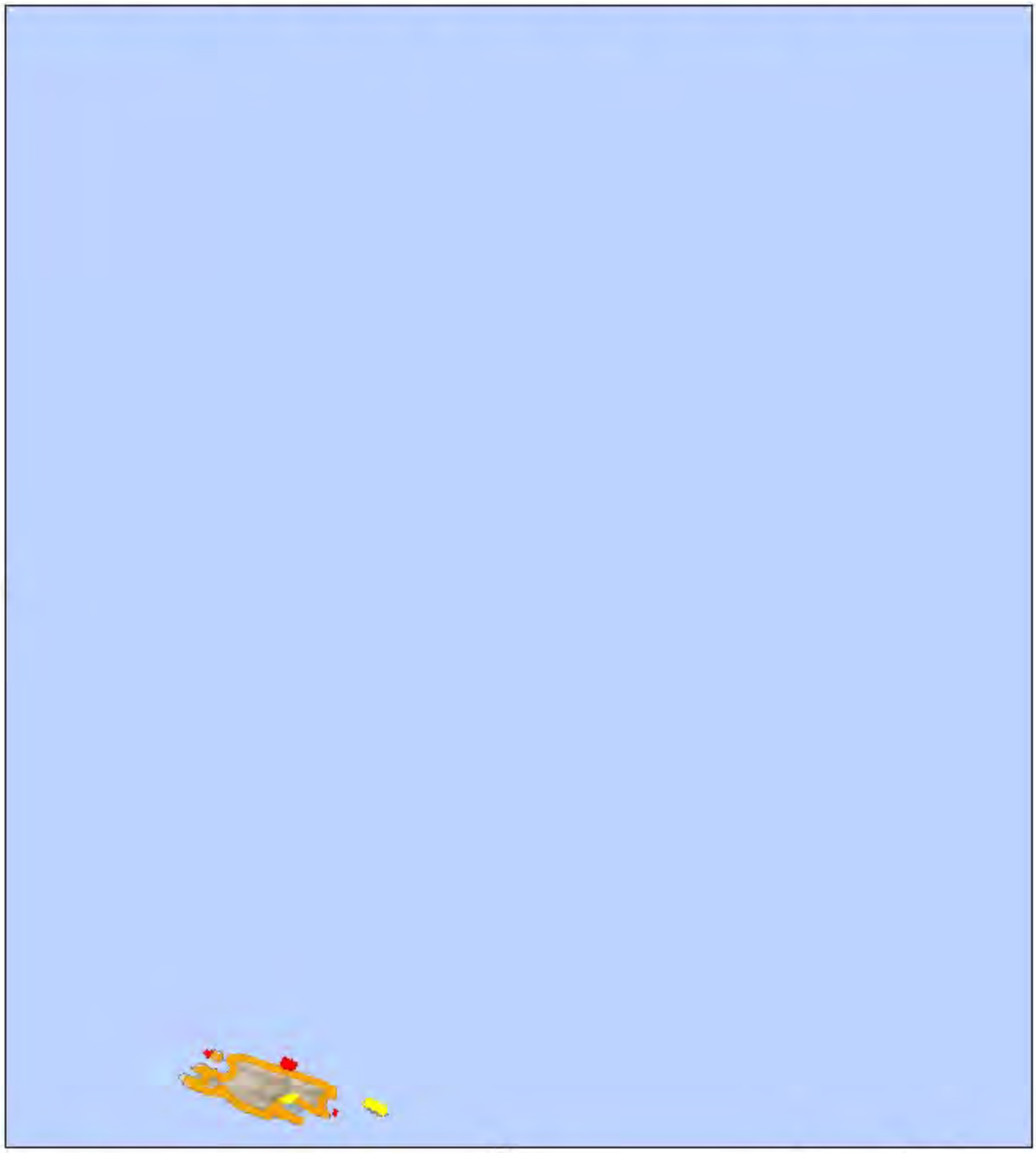
A3

San Juan County Marine Riparian Inventory



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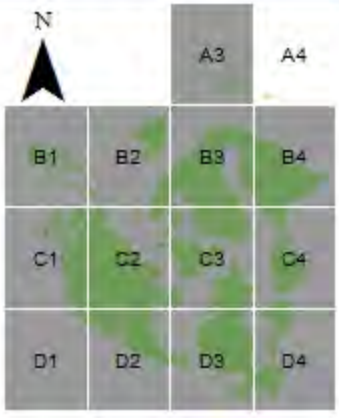
4 = 76-100%

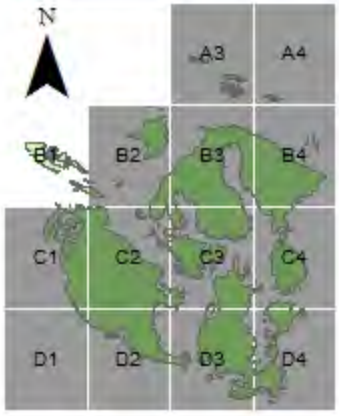
Shrub Class % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

A4



San Juan County Marine Riparian Inventory



Shrub Class
% of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

- **0 = No Coverage**
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B1

San Juan County Marine Riparian Inventory

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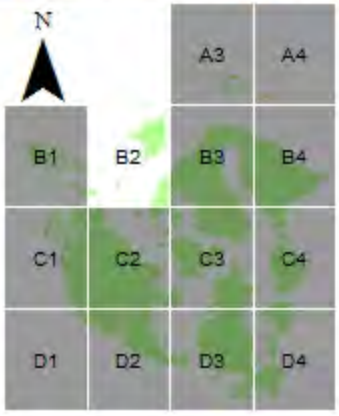
4 = 76-100%

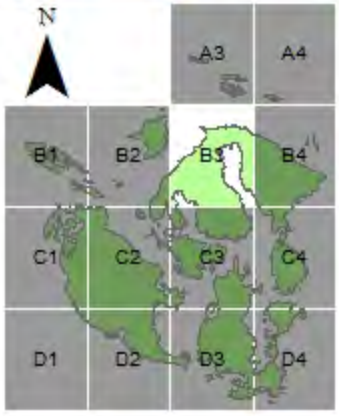
Shrub Class % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

B2



San Juan County Marine Riparian Inventory



Shrub Class
% of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

- **0 = No Coverage**
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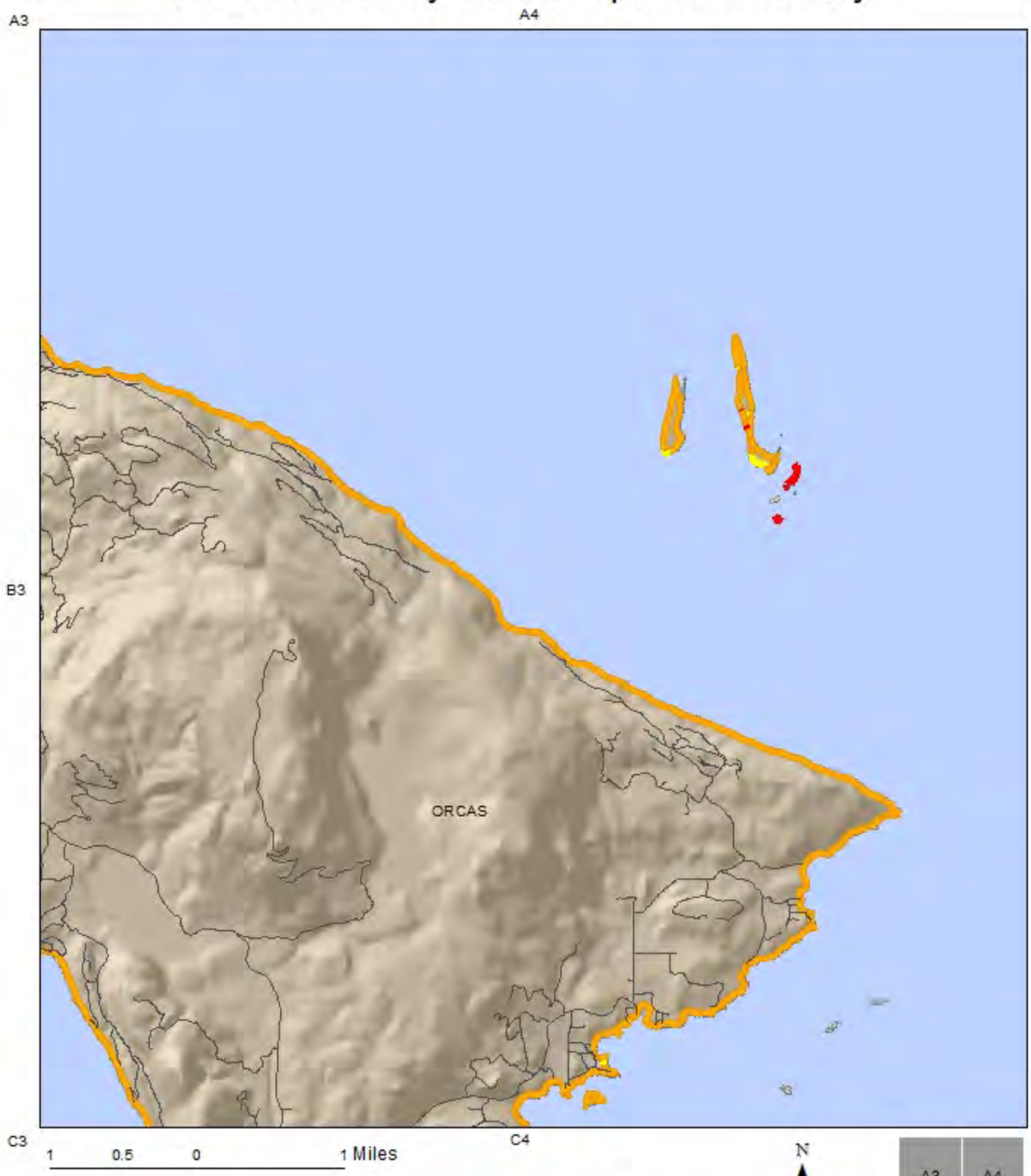
B3

San Juan County Marine Riparian Inventory



0 = No Coverage
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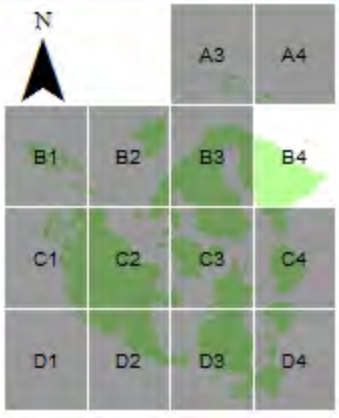
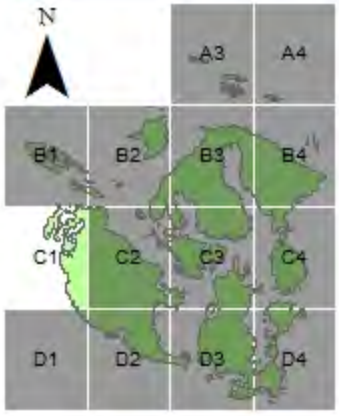
Shrub Class % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

B4



San Juan County Marine Riparian Inventory



Shrub Class
% of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

- **0 = No Coverage**
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C1

San Juan County Marine Riparian Inventory

0 = No Coverage
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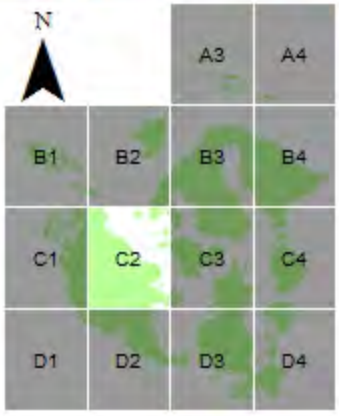
2 = 26-50%
3 = 51-75%
4 = 76-100%

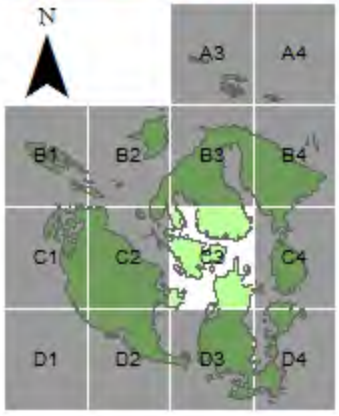
Shrub Class % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

C2



San Juan County Marine Riparian Inventory



Shrub Class
% of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

- **0 = No Coverage**
- **1 = .01-25%**
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C3

San Juan County Marine Riparian Inventory

0 = No Coverage
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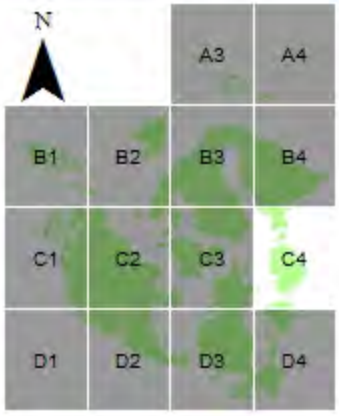
2 = 26-50%
3 = 51-75%
4 = 76-100%

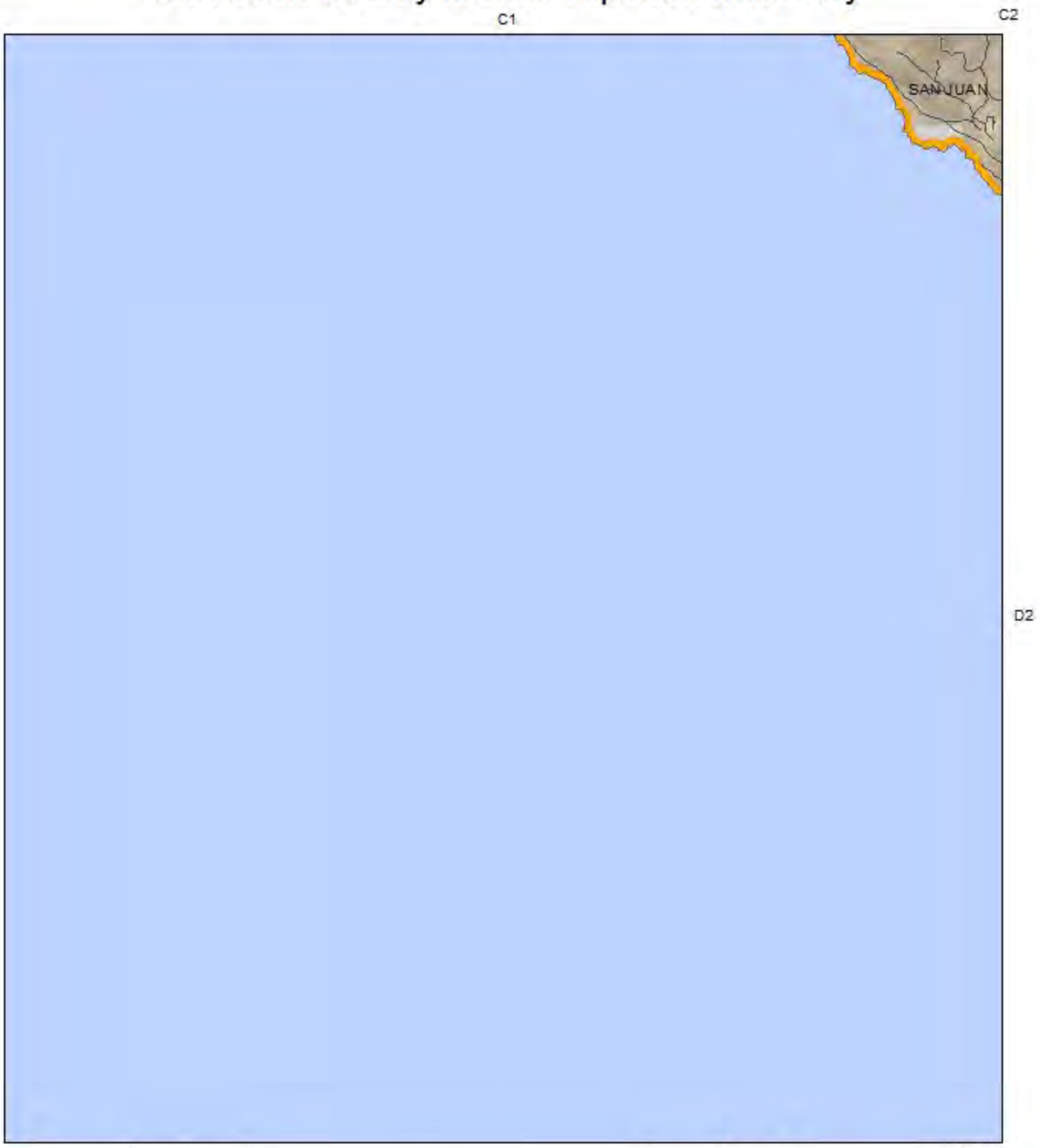
Shrub Class % of Coverage

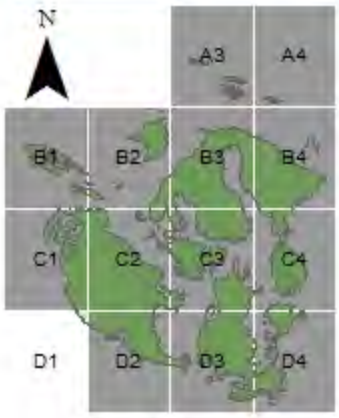
Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

C4



San Juan County Marine Riparian Inventory





1 0.5 0 1 Miles

Shrub Class % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

- 0 = No Coverage
- 1 = .01-25%
- 2 = 26-50%
- 3 = 51-75%
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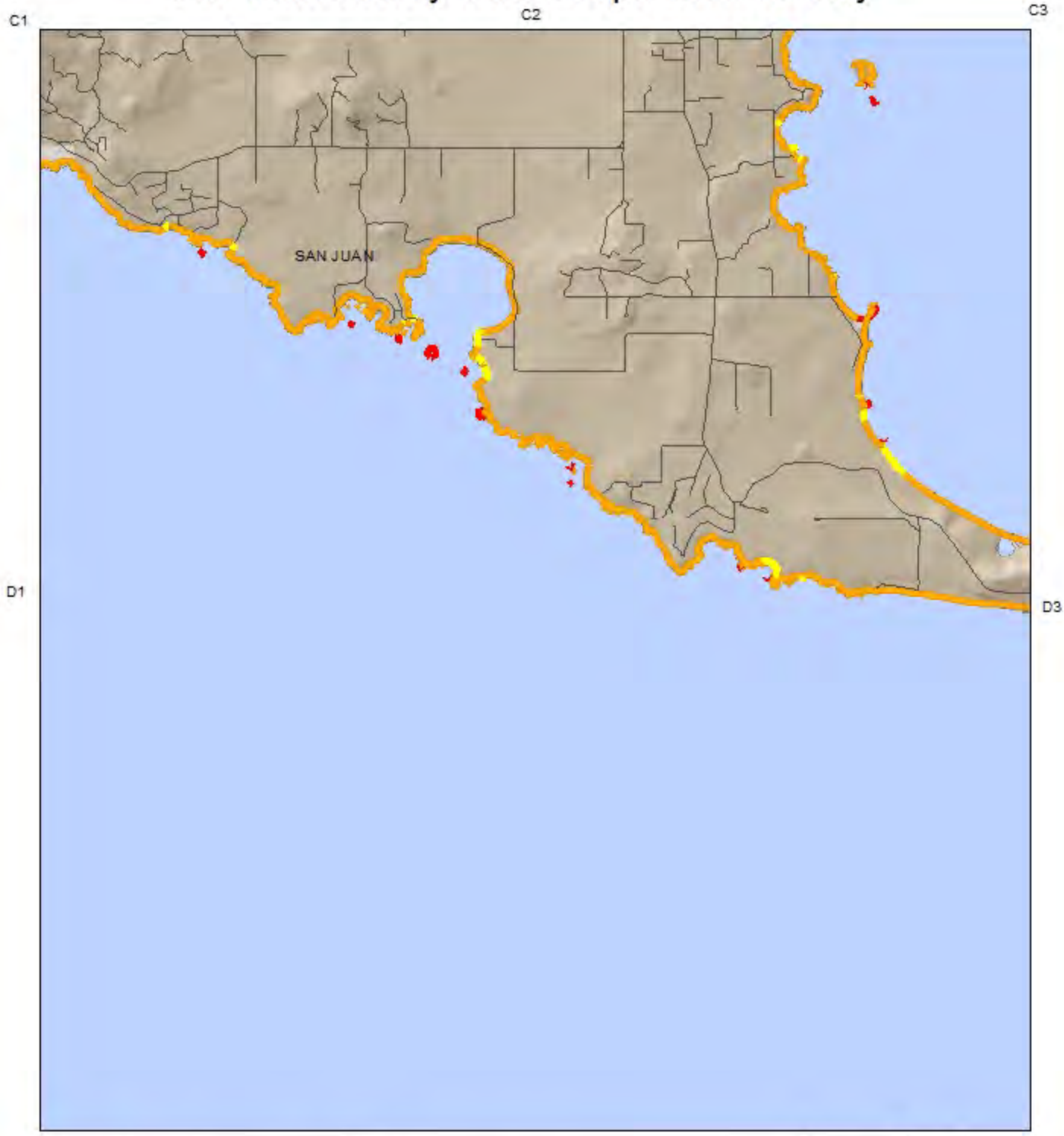
D1

San Juan County Marine Riparian Inventory



1 0.5 0 1 Miles

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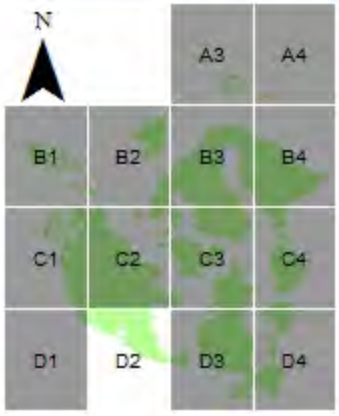
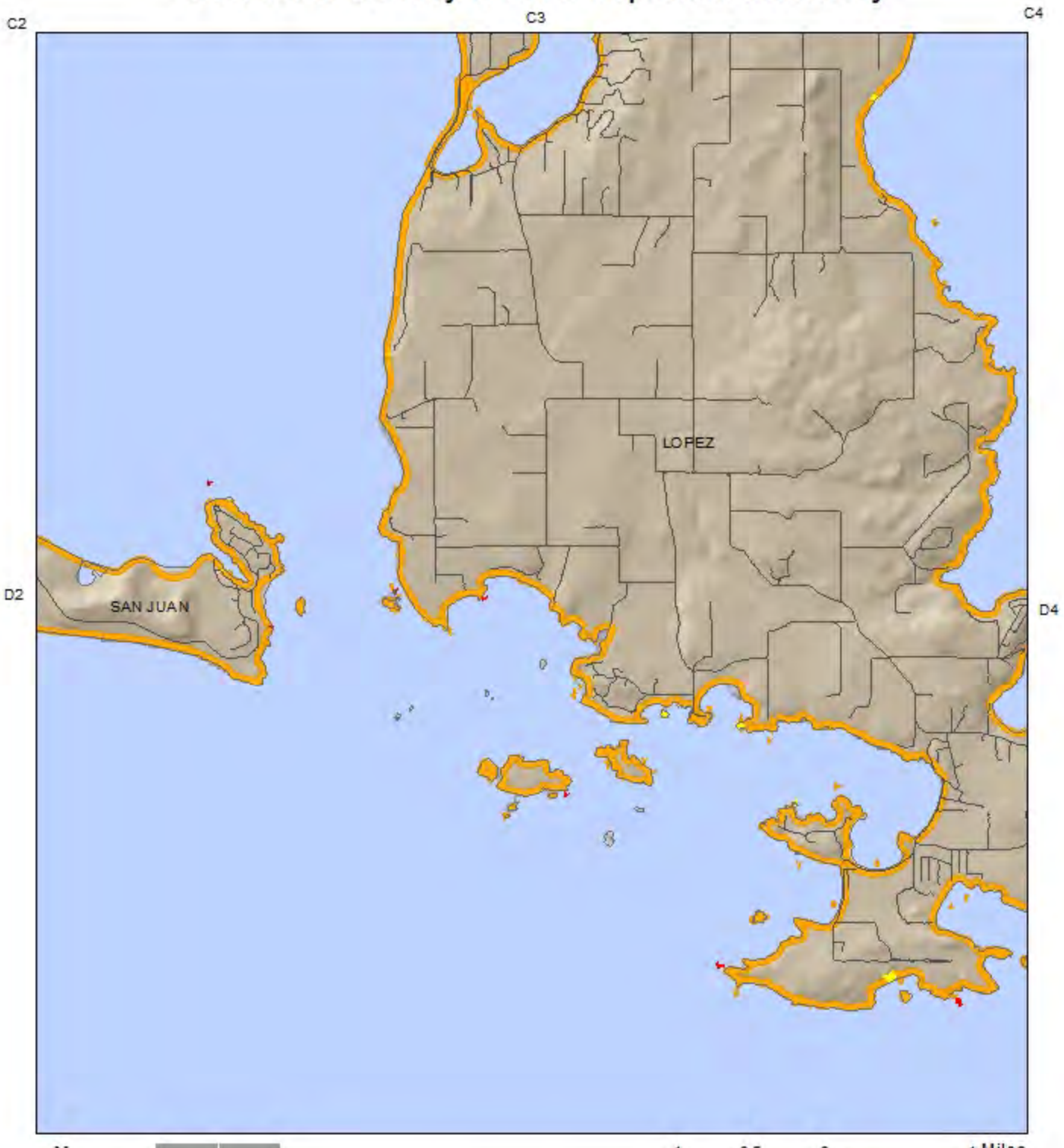
Shrub Class % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

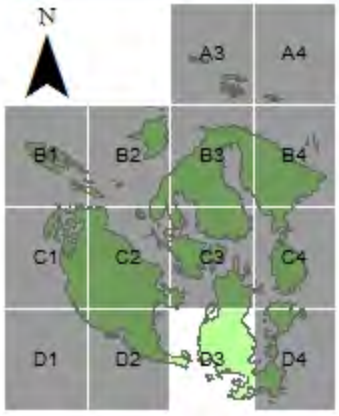
D2



San Juan County Marine Riparian Inventory



1 0.5 0 1 Miles



Shrub Class % of Coverage

Unit of Analysis:
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- 0 = No Coverage
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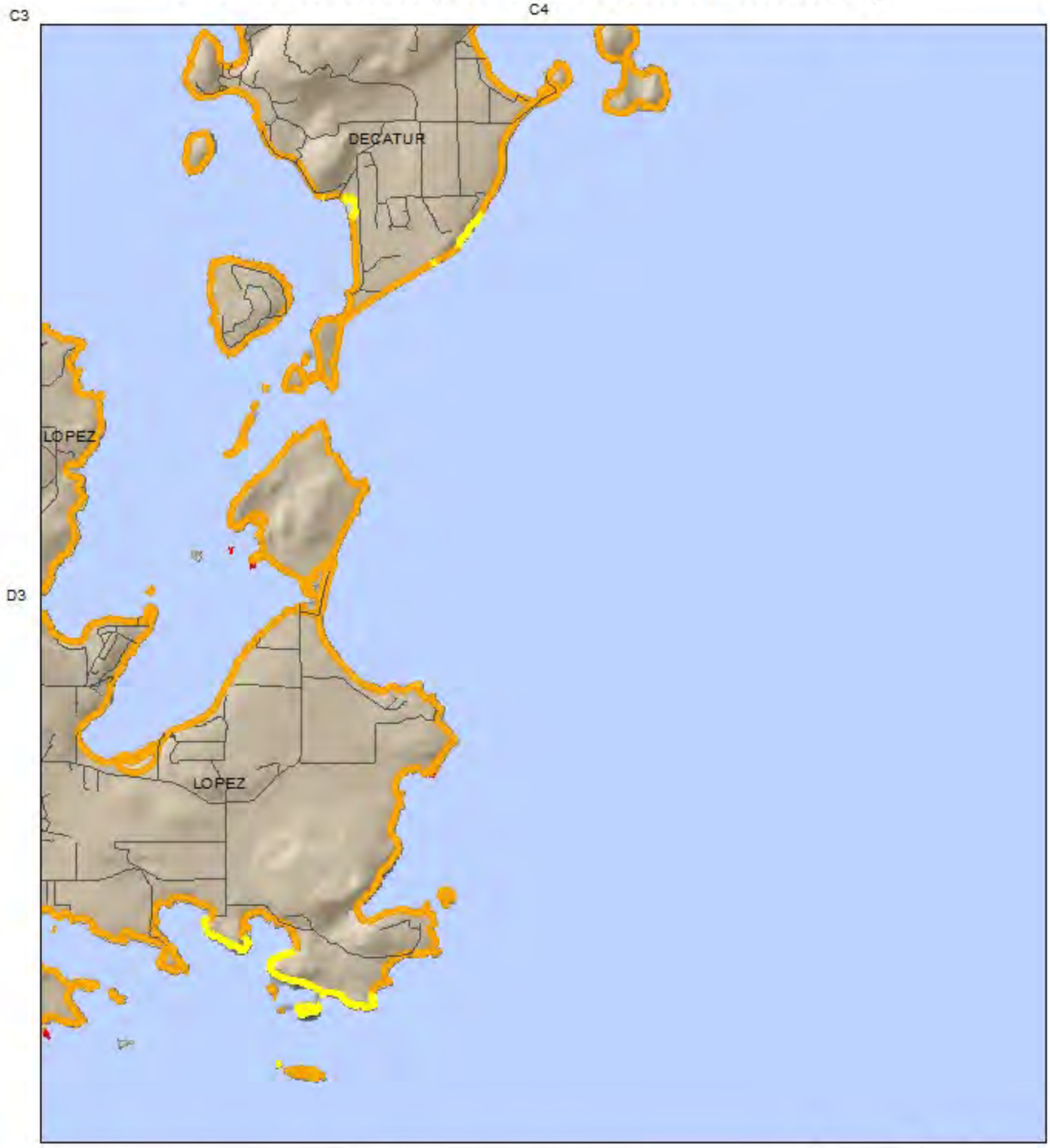
D3

San Juan County Marine Riparian Inventory



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0 = No Coverage
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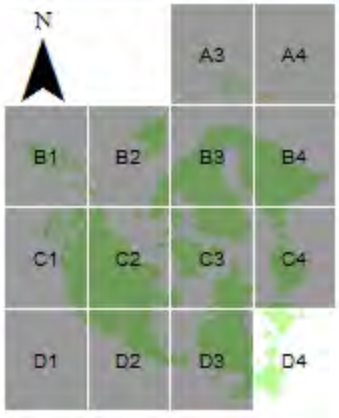
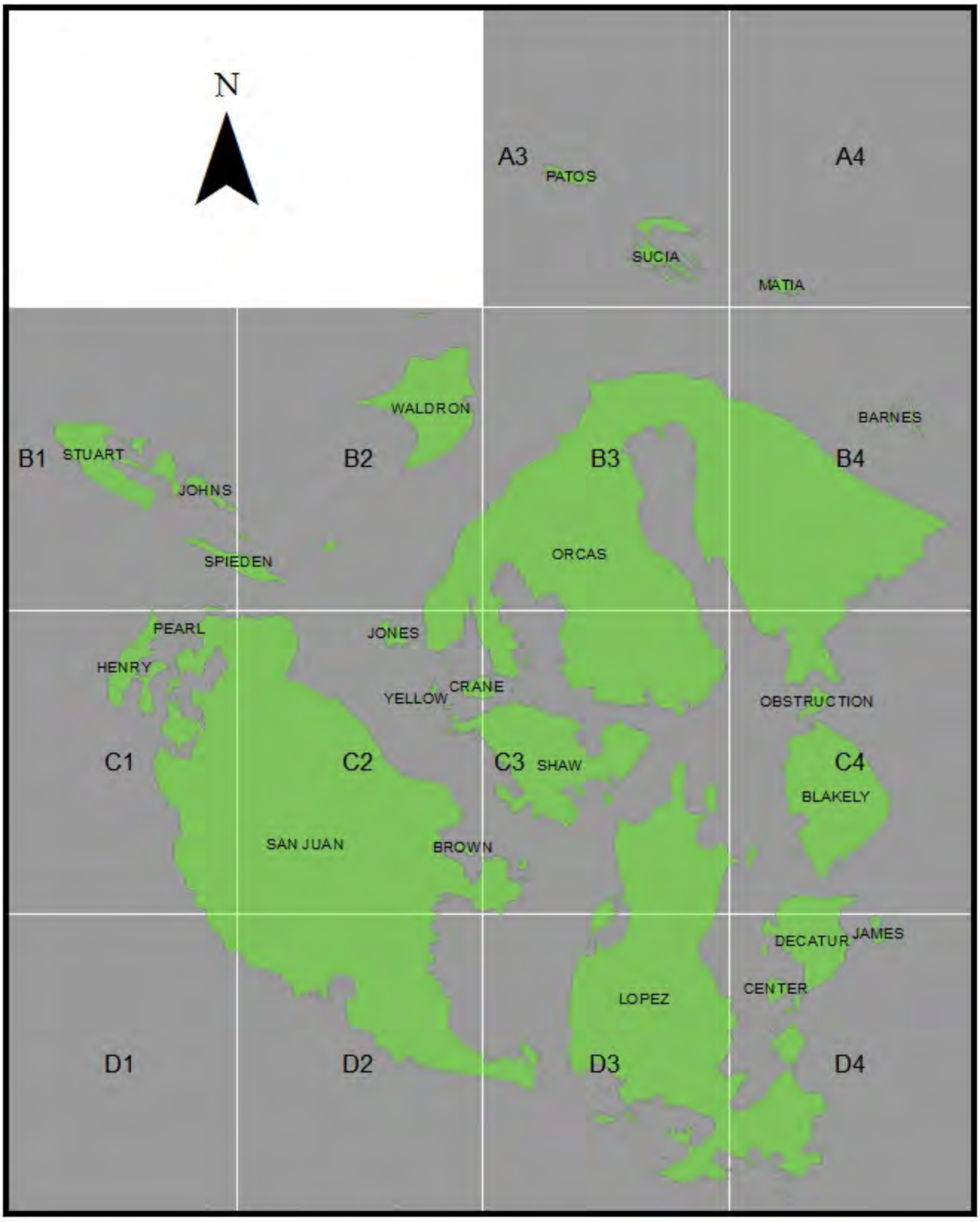
Shrub Class % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

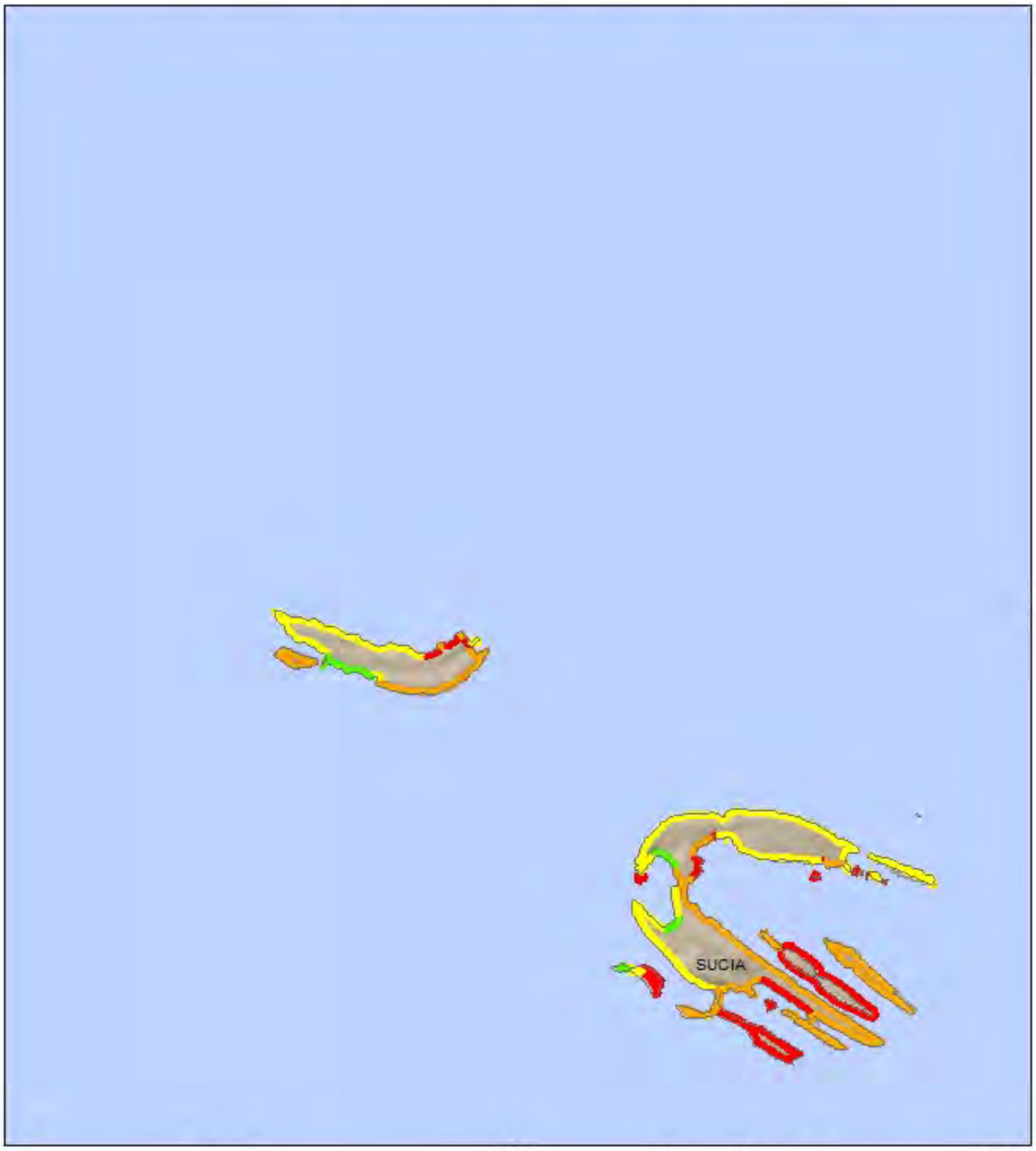
D4

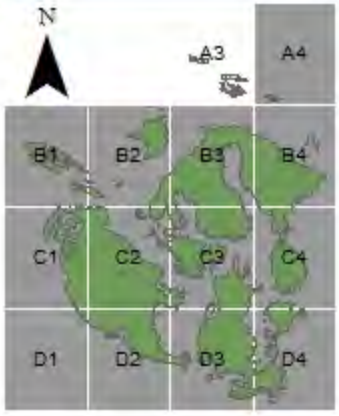




San Juan County
Marine Riparian Inventory Mapbook
Below 2 Ft. Vegetated Coverage Class

San Juan County Marine Riparian Inventory





Below 2 Ft. Vegetated % of Coverage

Unit of Analysis:
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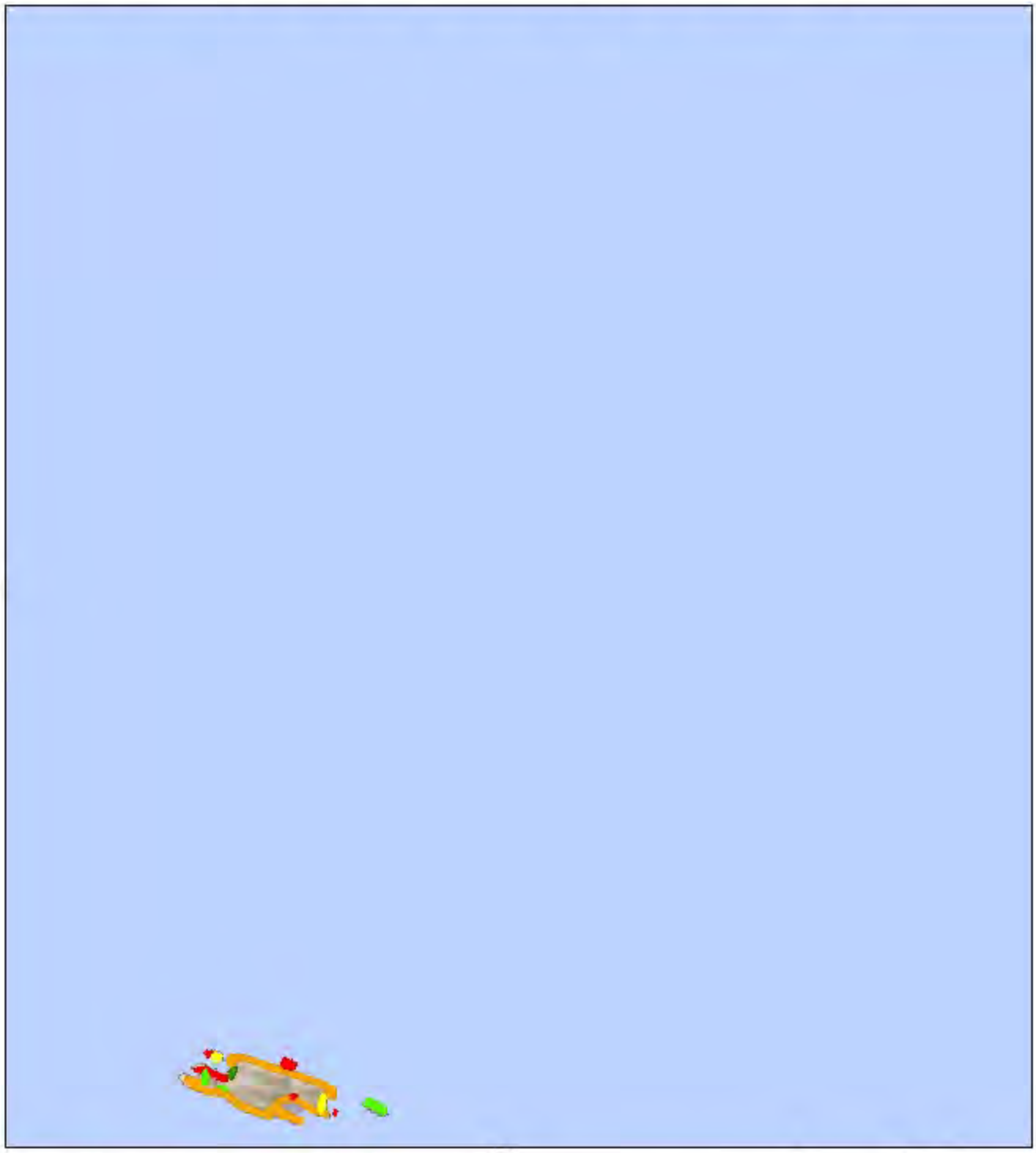
A3

San Juan County Marine Riparian Inventory



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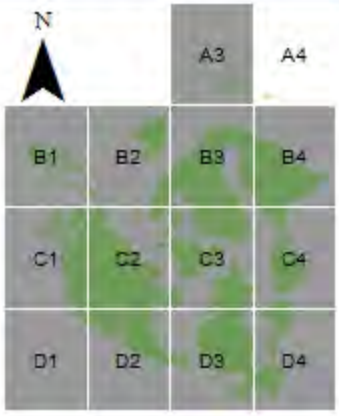
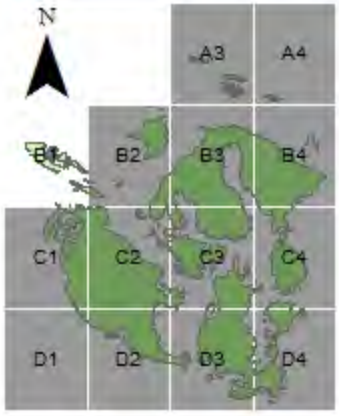
Below 2 Ft. Vegetated % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

A4



San Juan County Marine Riparian Inventory



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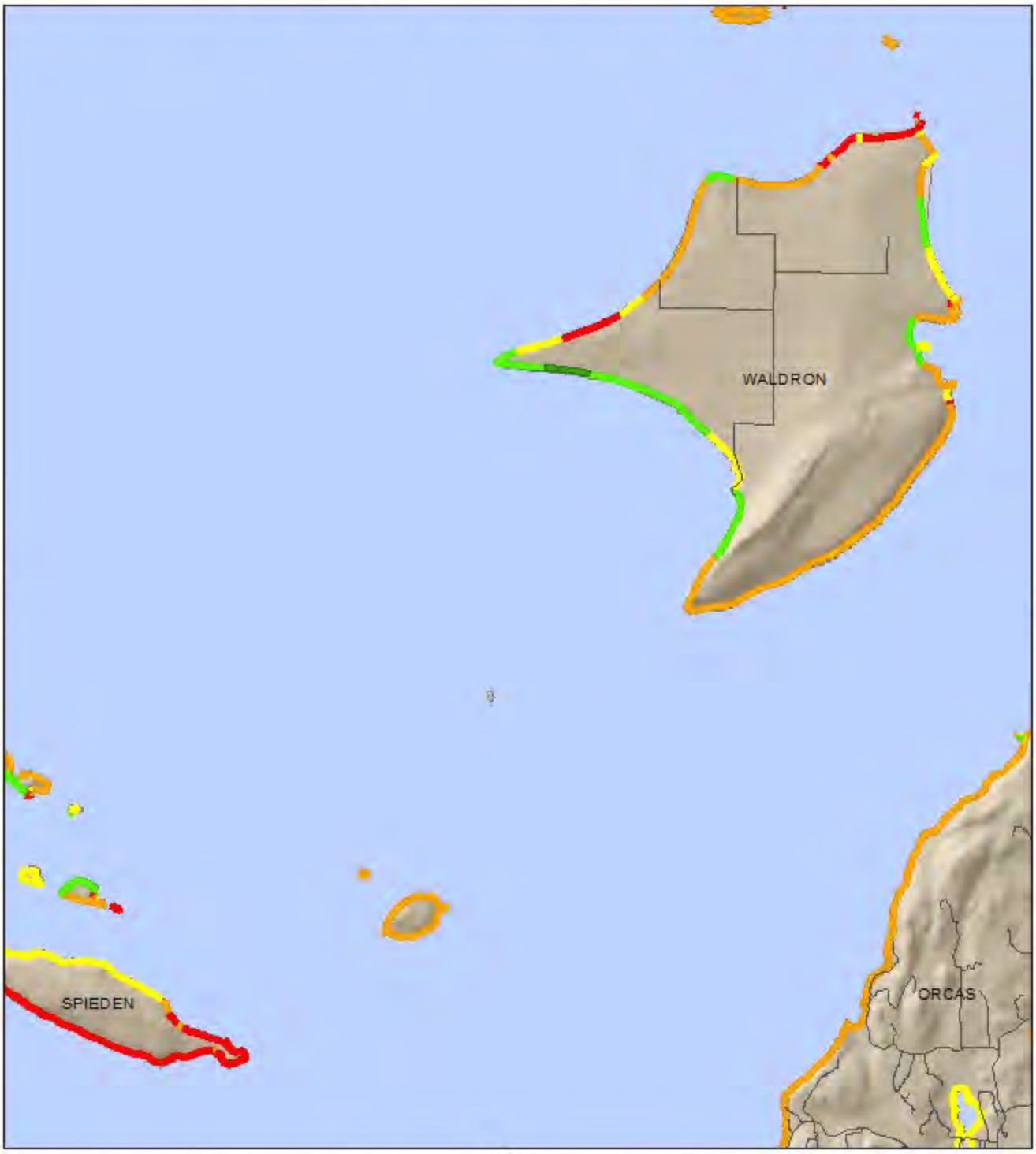
B1

San Juan County Marine Riparian Inventory



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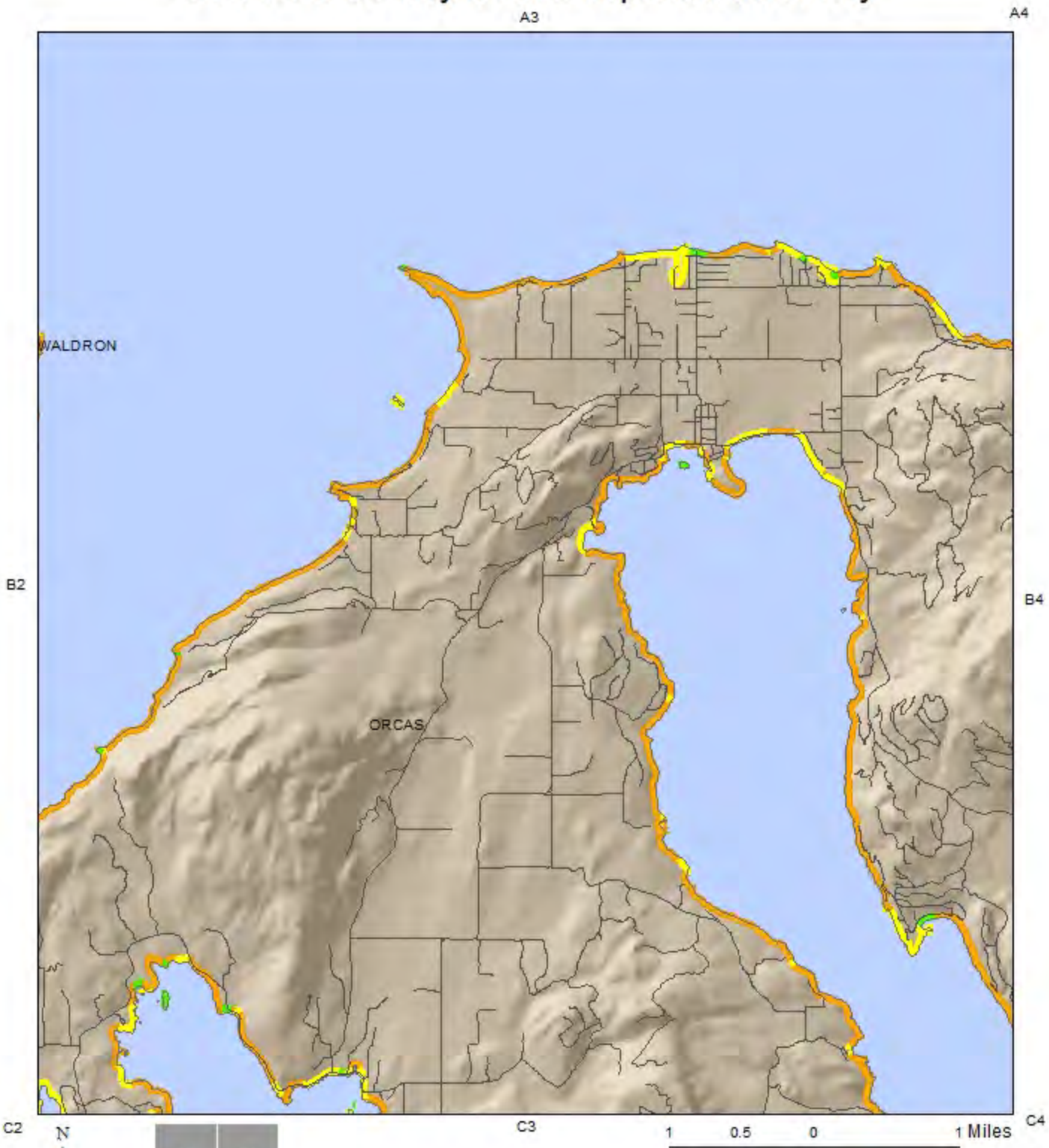
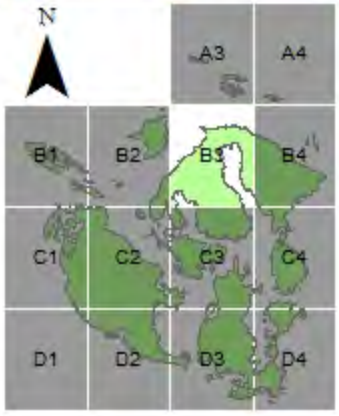
Below 2 Ft. Vegetated % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

B2

San Juan County Marine Riparian Inventory





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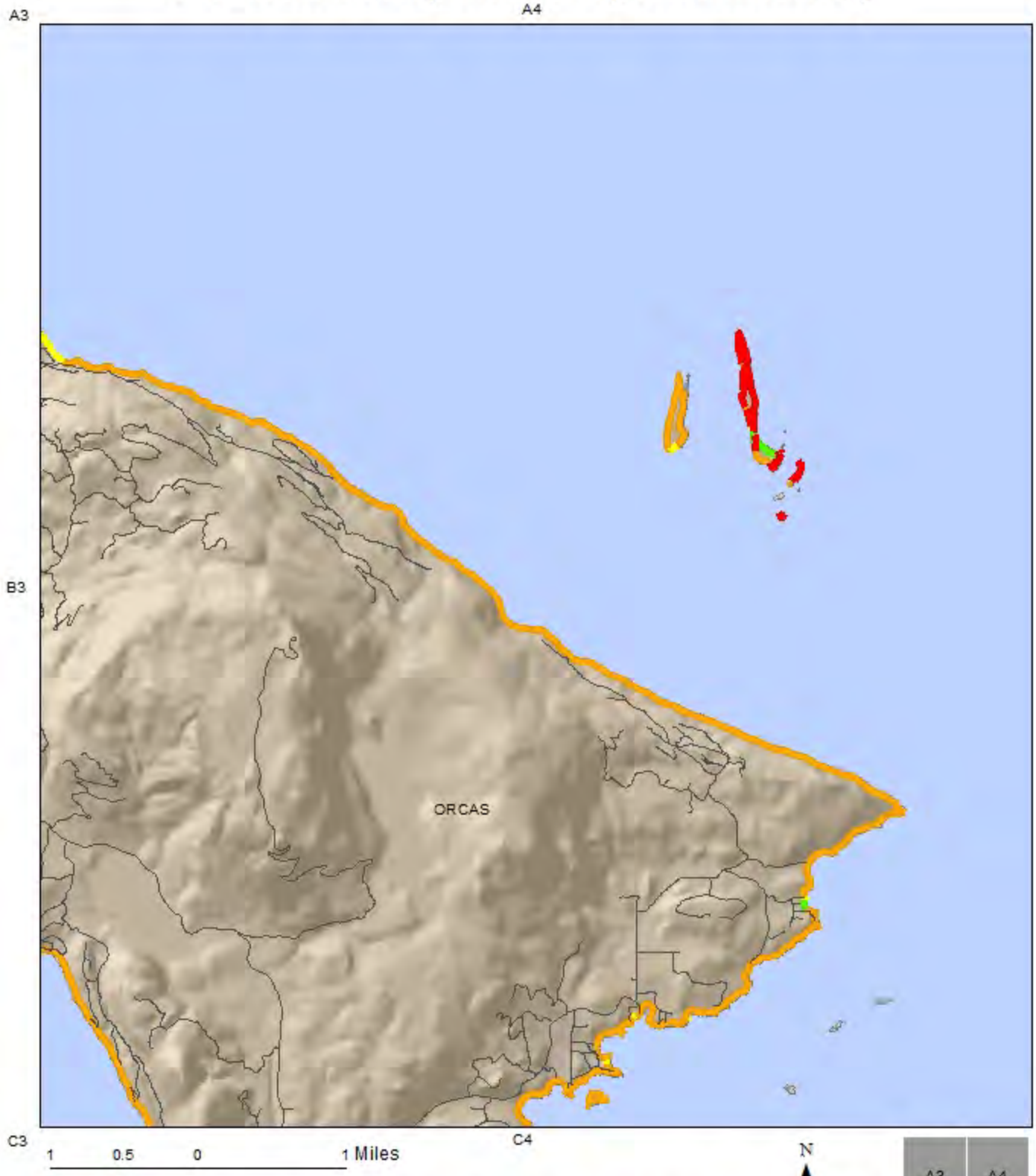
B3

San Juan County Marine Riparian Inventory



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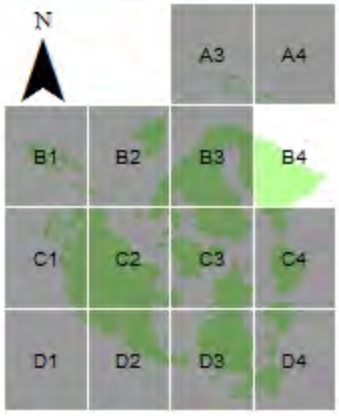
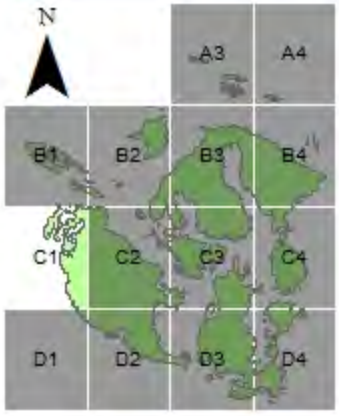
Below 2 Ft. Vegetated % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

B4



San Juan County Marine Riparian Inventory



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Unit of Analysis:
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- 0 = No Coverage
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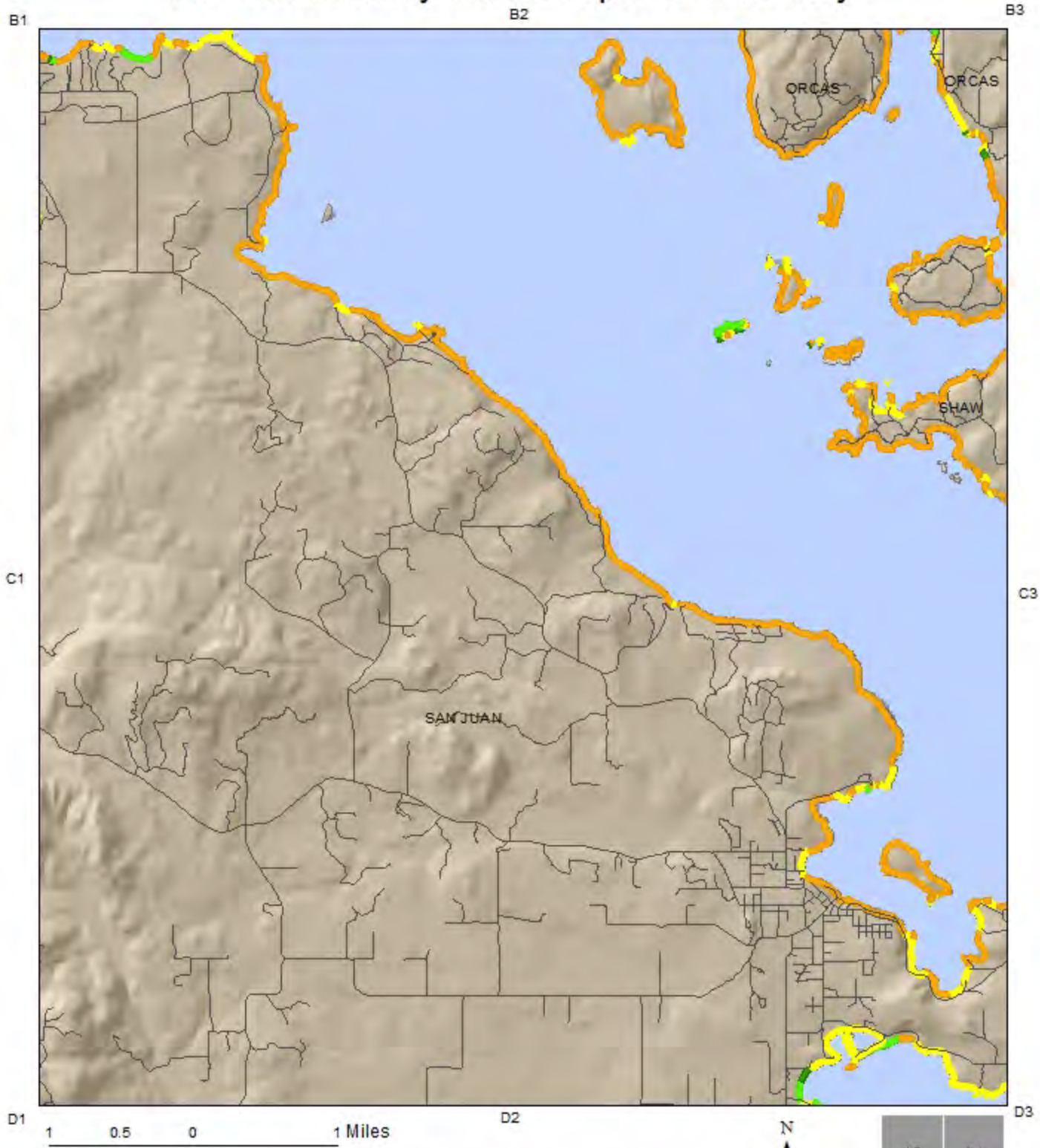
C1

San Juan County Marine Riparian Inventory



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Below 2 Ft. Vegetated % of Coverage

Unit of Analysis:
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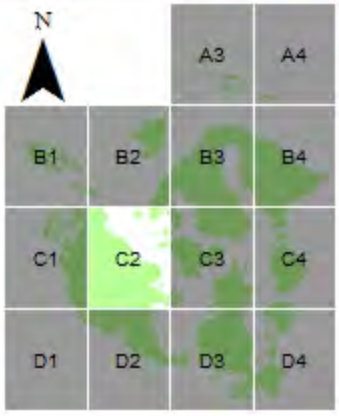
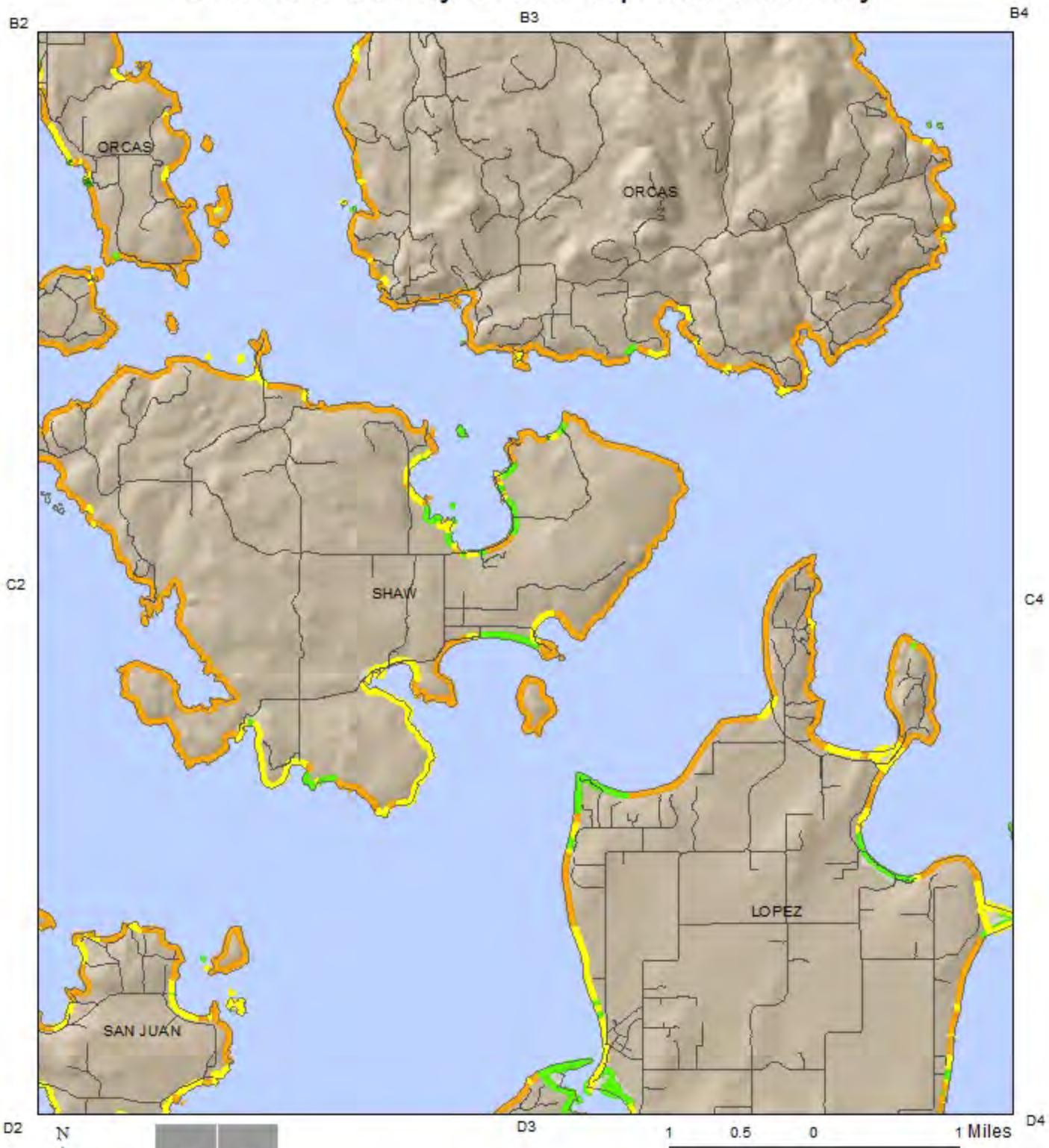
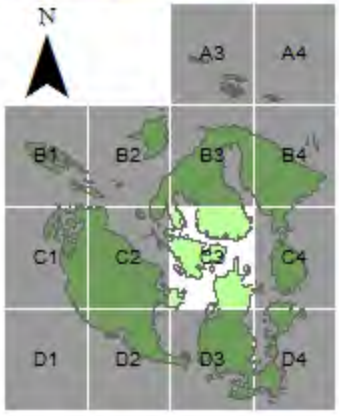
C2



San Juan County Marine Riparian Inventory





Below 2 Ft. Vegetated % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

- 0 = No Coverage
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C3

San Juan County Marine Riparian Inventory

0 = No Coverage
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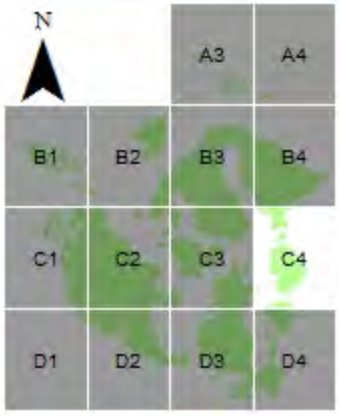
3 = 51-75%
4 = 76-100%

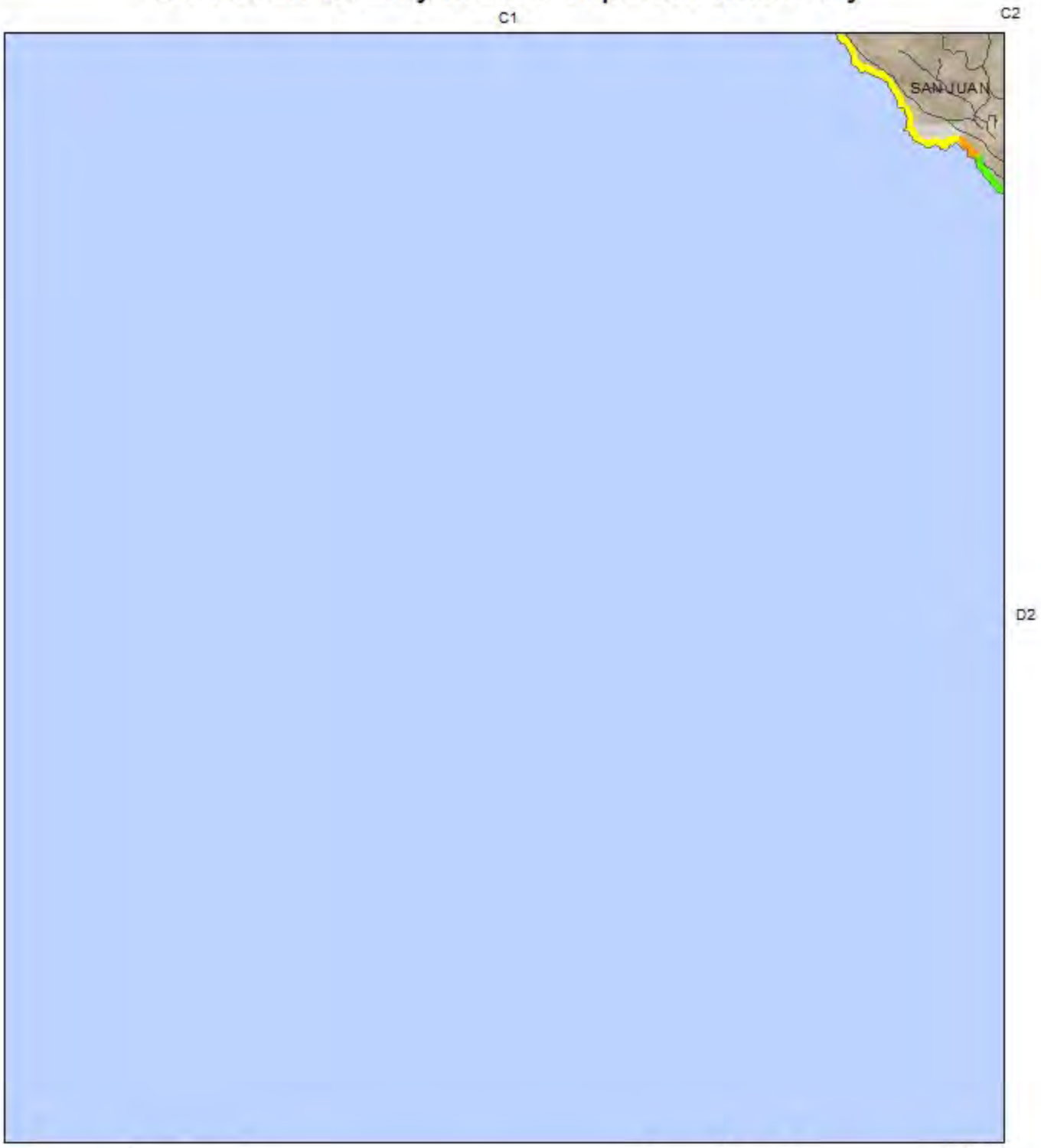
Below 2 Ft. Vegetated % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

C4



San Juan County Marine Riparian Inventory



Below 2 Ft. Vegetated % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

- 0 = No Coverage
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D1

San Juan County Marine Riparian Inventory

1 0.5 0 1 Miles

0 = No Coverage
1 = .01-25%
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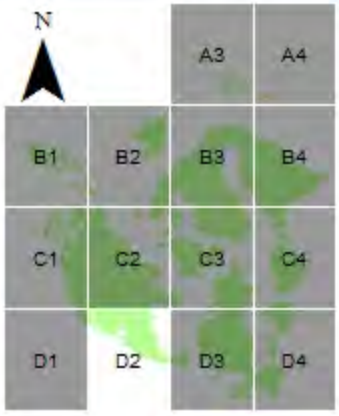
3 = 51-75%
4 = 76-100%

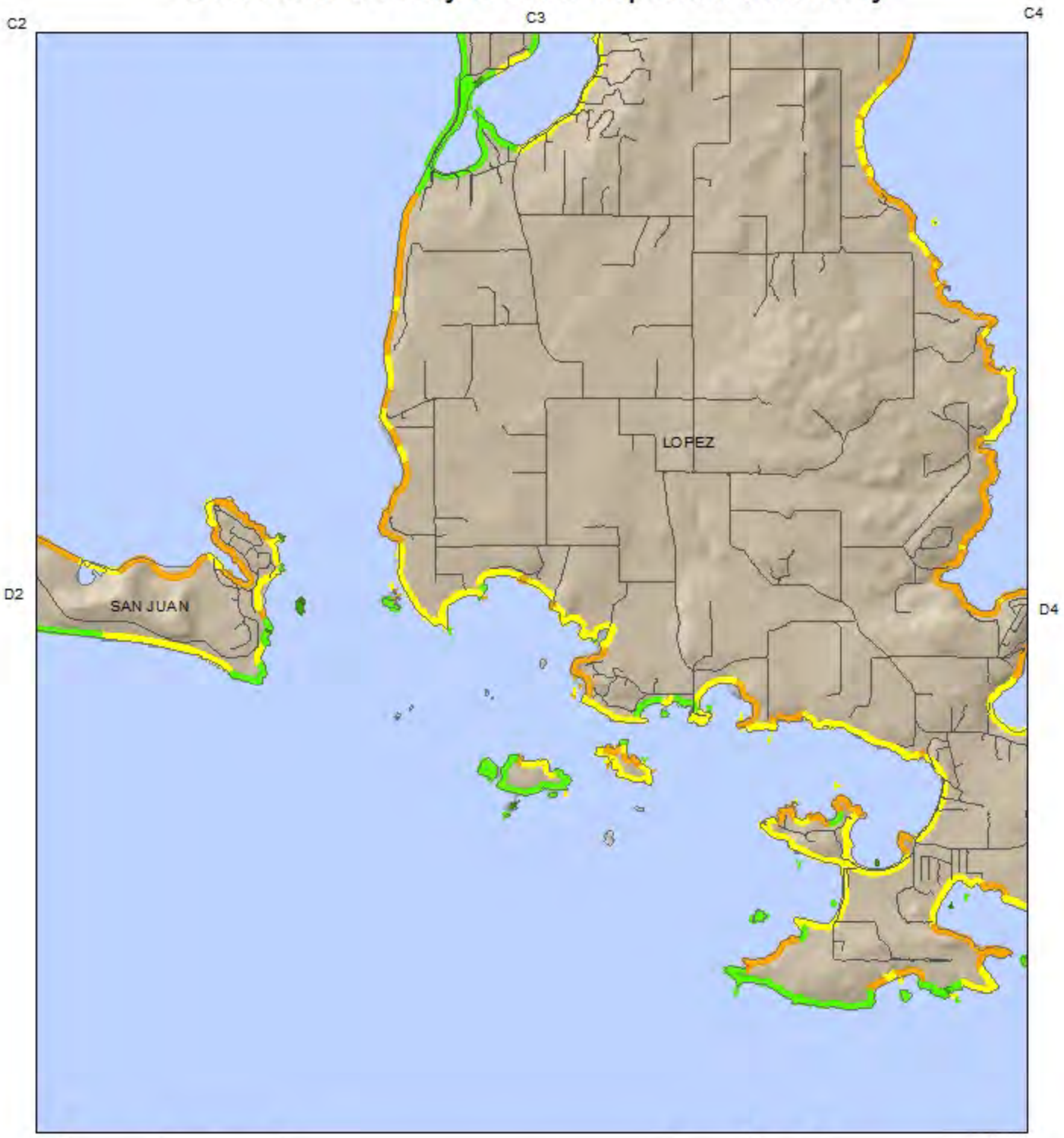
Below 2 Ft. Vegetated % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

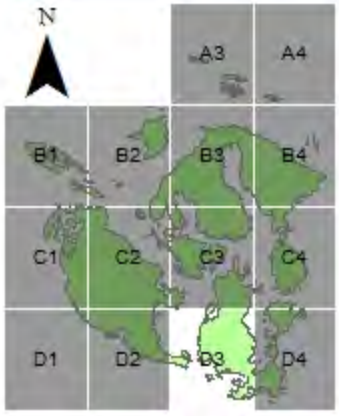
D2



San Juan County Marine Riparian Inventory



1 0.5 0 1 Miles



Below 2 Ft. Vegetated
% of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

- **0 = No Coverage**
- **1 = .01-25%**
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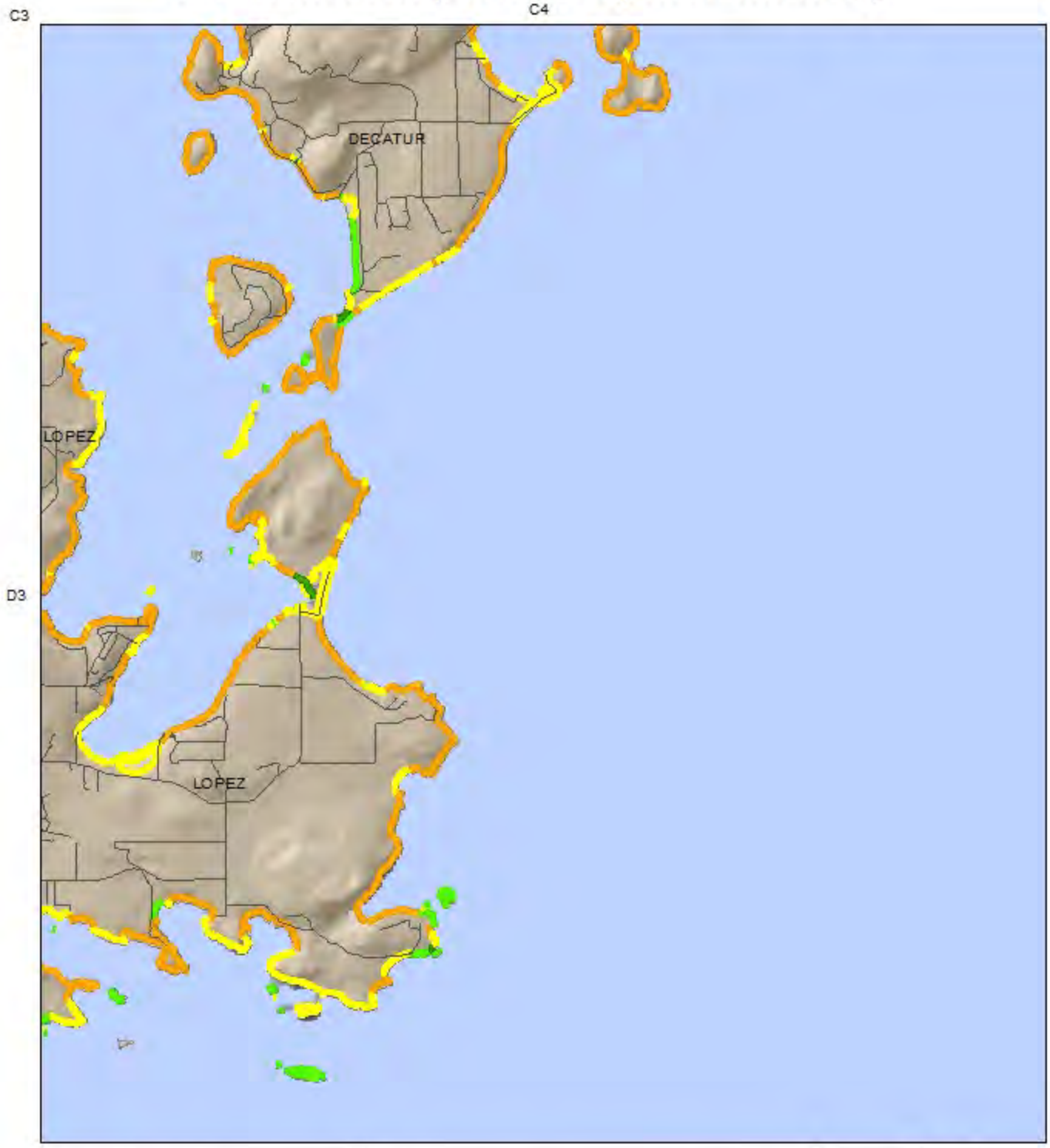
D3

San Juan County Marine Riparian Inventory



1 0.5 0 1 Miles

0 = No Coverage
1 = .01-25%
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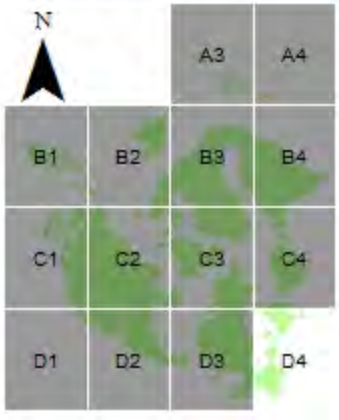
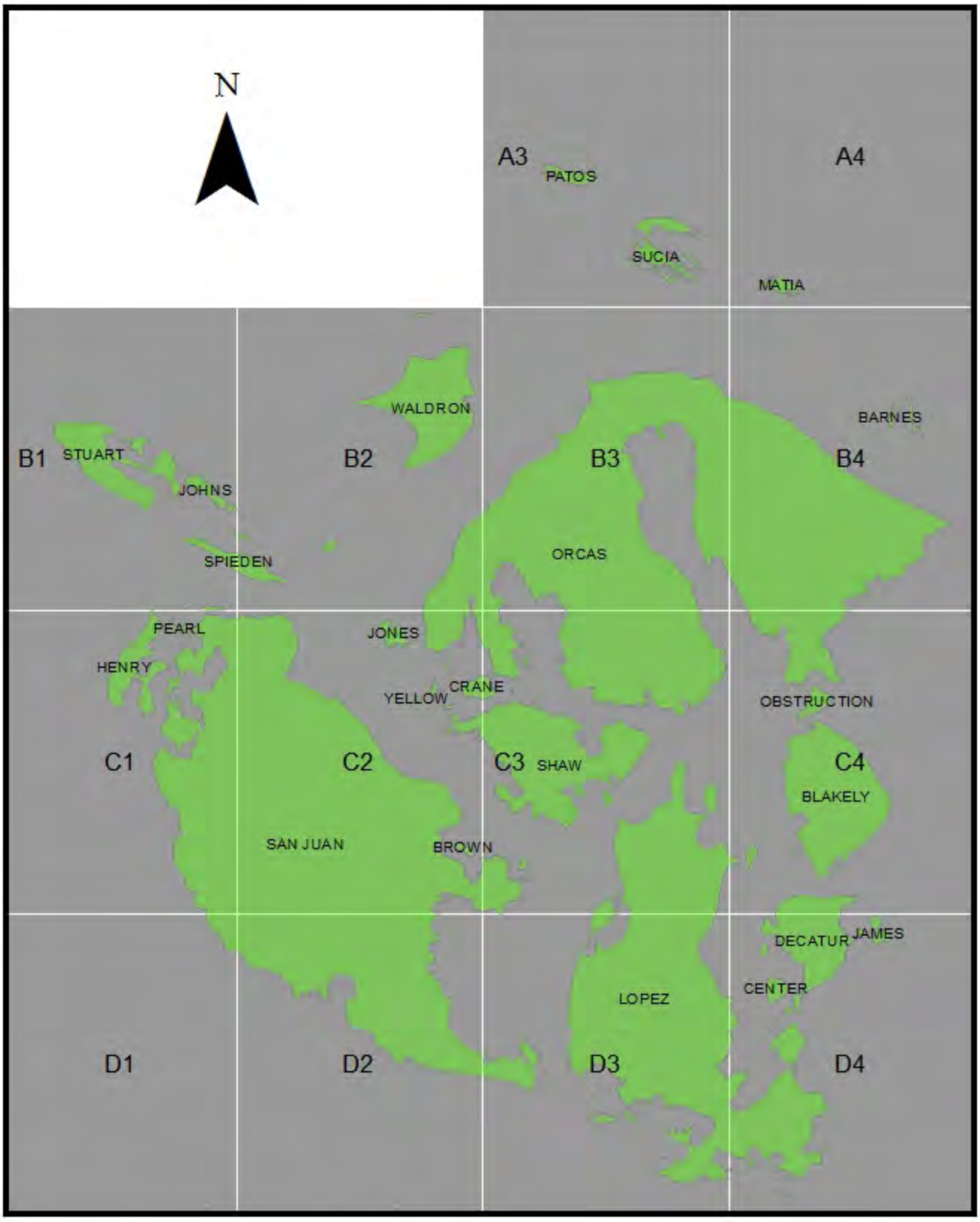
Below 2 Ft. Vegetated % of Coverage

Unit of Analysis:
Length: Geomorphic Shoreform, Width: 200 ft.

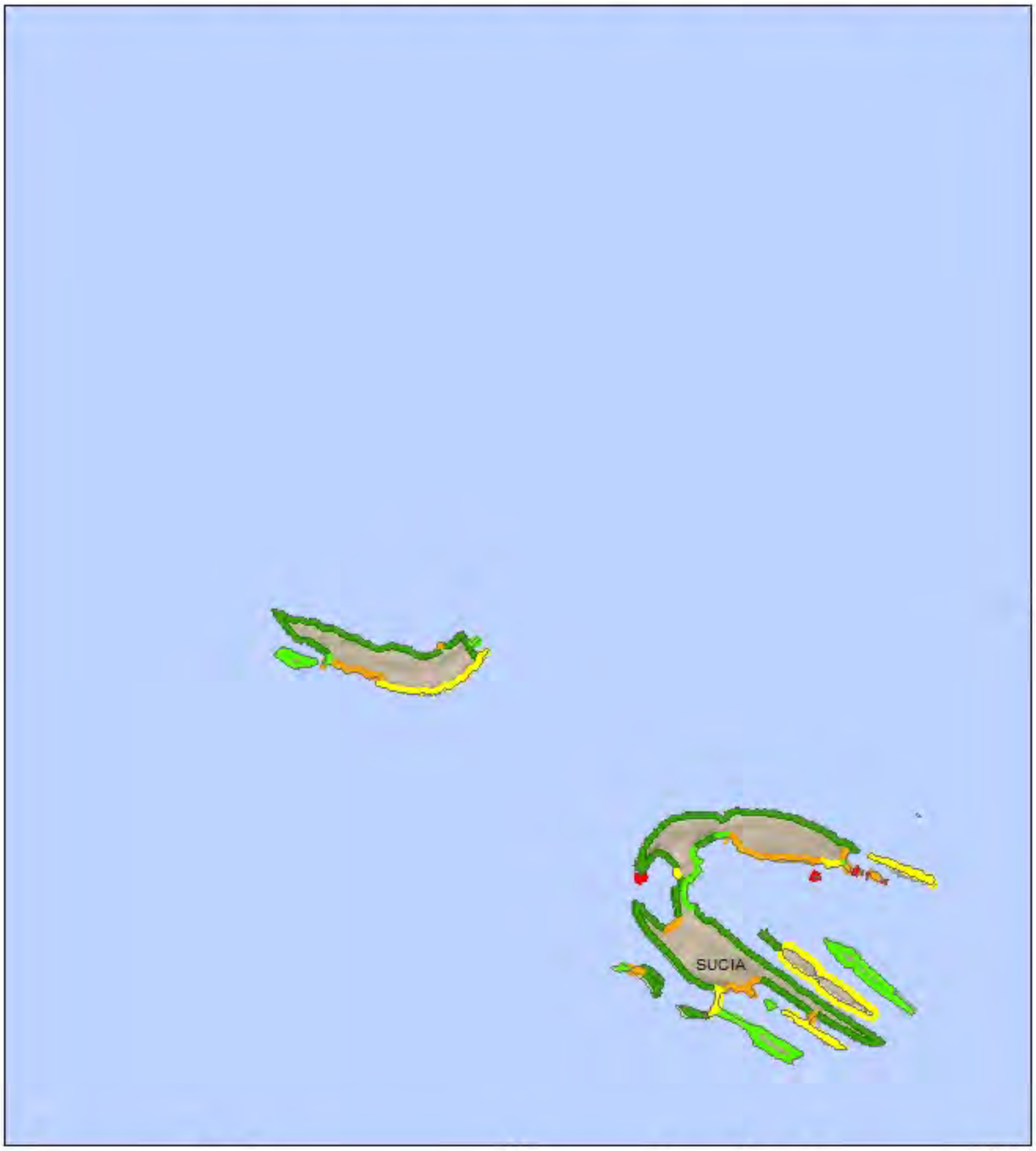
D4

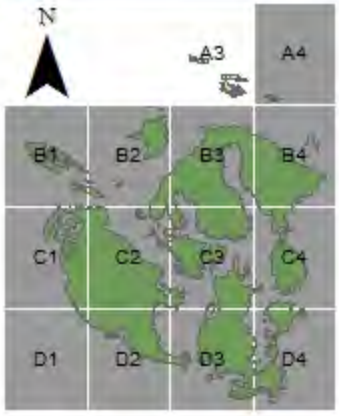




San Juan County
Marine Riparian Inventory Mapbook
Overhanging Vegetation Coverage Class

San Juan County Marine Riparian Inventory





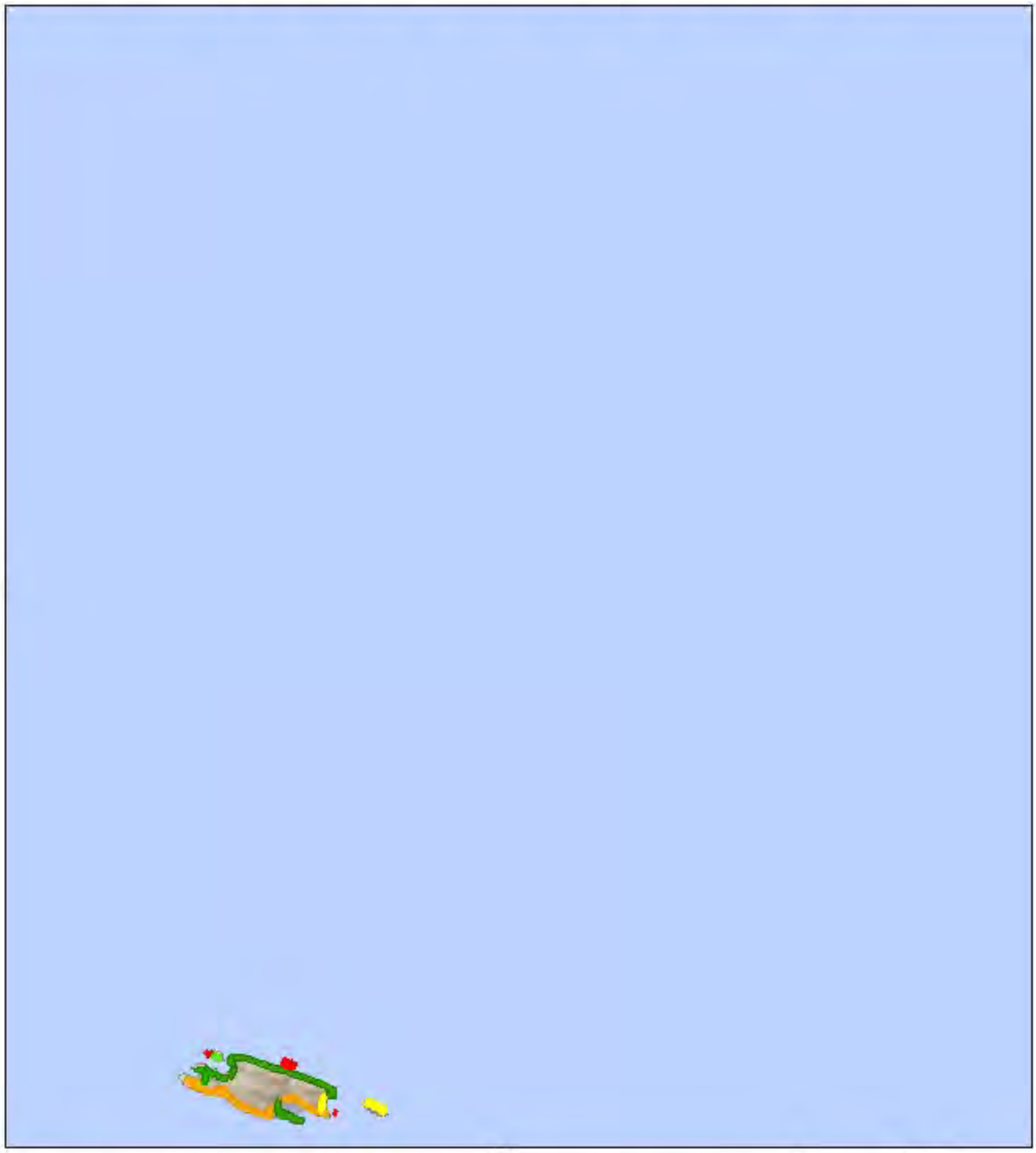
Overhanging Vegetation % of Coverage at Shoreline

Unit of Analysis:
Geomorphic Shoreform

- 0 = No Coverage
- 1 = .01-25%
- 2 = 26-50%
- 3 = 51-75%
- 4 = 76-100%

A3

San Juan County Marine Riparian Inventory



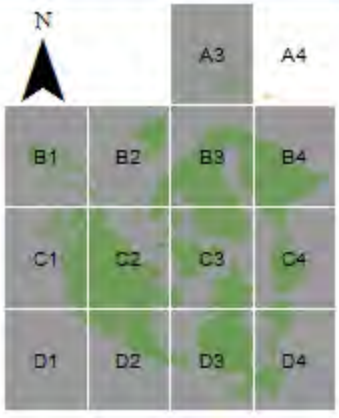
1 0.5 0 1 Miles

0 = No Coverage
1 = .01-25%
2 = 26-50%
3 = 51-75%
4 = 76-100%

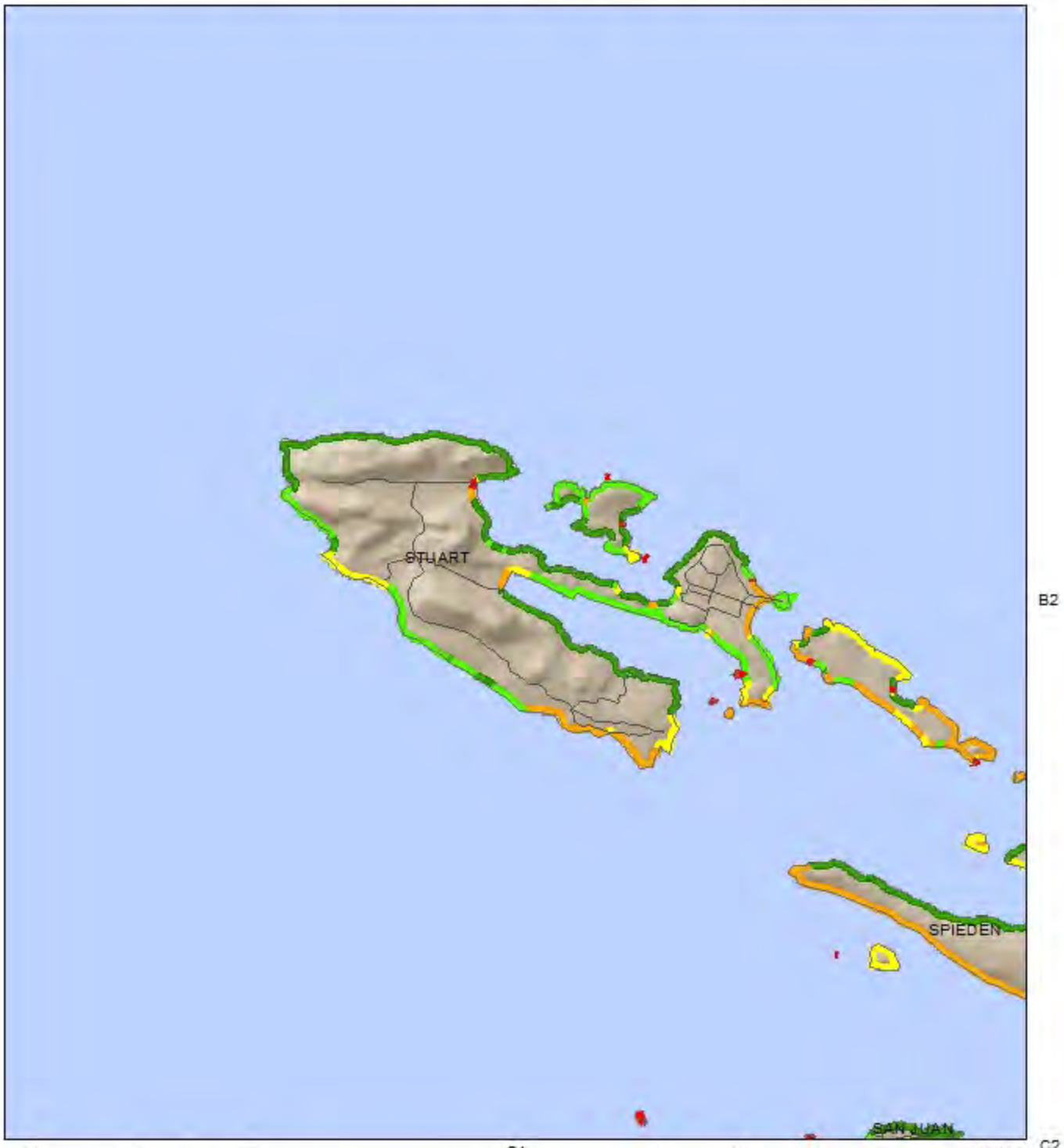
Overhanging Vegetation % of Coverage at Shoreline

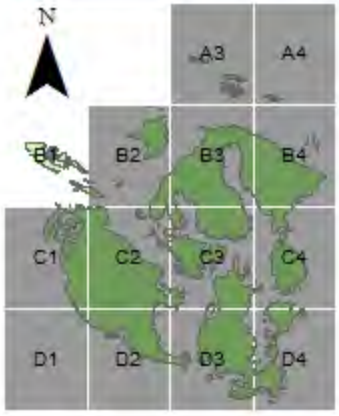
Unit of Analysis:
Geomorphic Shoreform

A4



San Juan County Marine Riparian Inventory





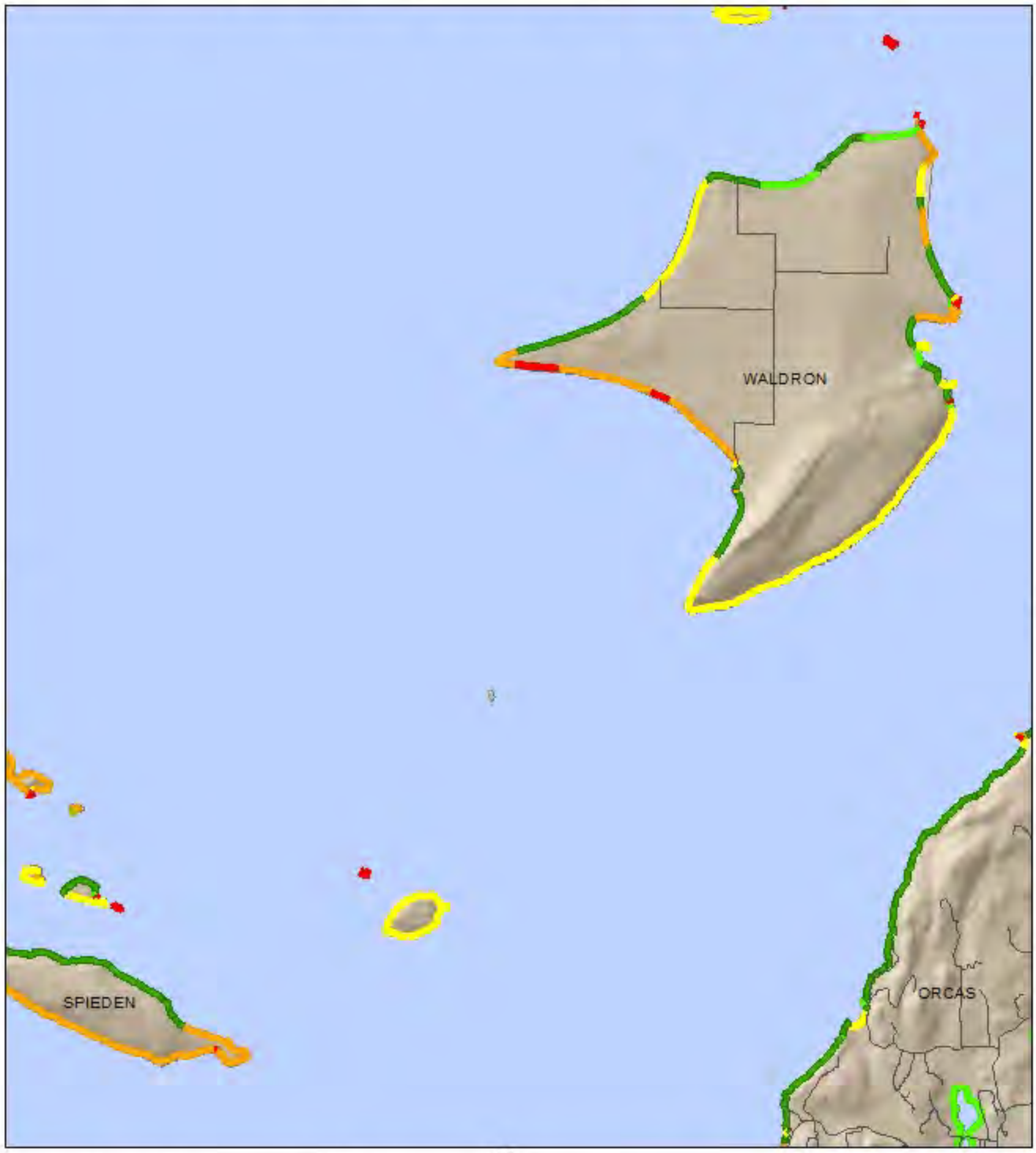
Overhanging Vegetation % of Coverage at Shoreline

Unit of Analysis:
Geomorphic Shoreform

- 0 = No Coverage
- 1 = .01-25%
- 2 = 26-50%
- 3 = 51-75%
- 4 = 76-100%

B1

San Juan County Marine Riparian Inventory



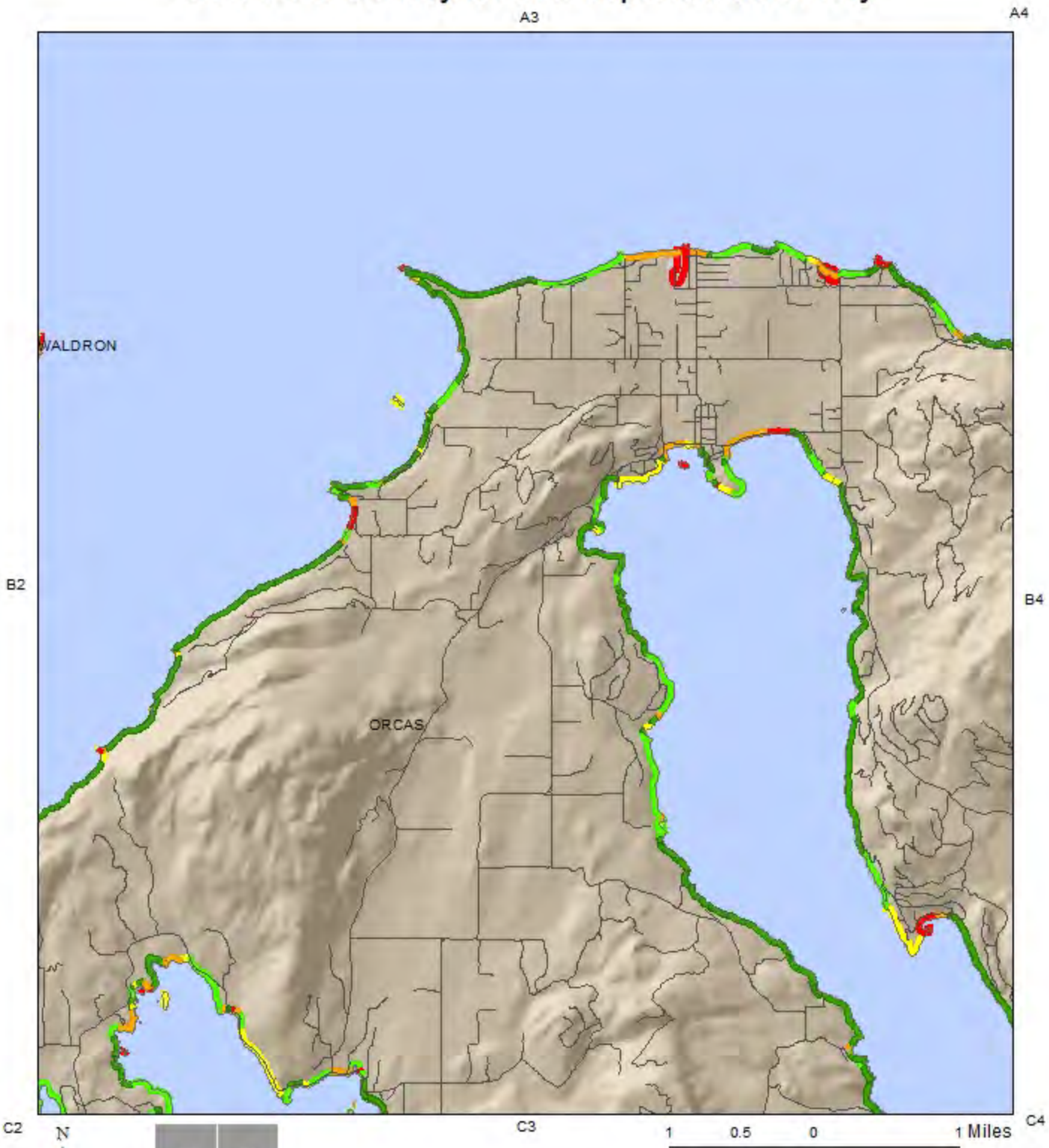
0 = No Coverage
1 = .01-25%
2 = 26-50%
3 = 51-75%
4 = 76-100%

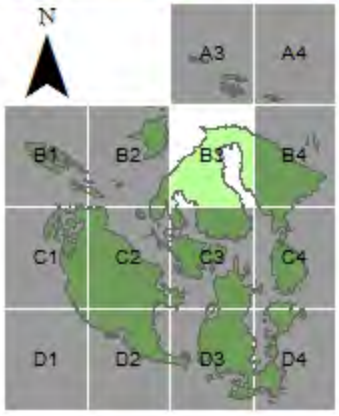
Overhanging Vegetation
% of Coverage at Shoreline

Unit of Analysis:
Geomorphic Shoreform

B2

San Juan County Marine Riparian Inventory





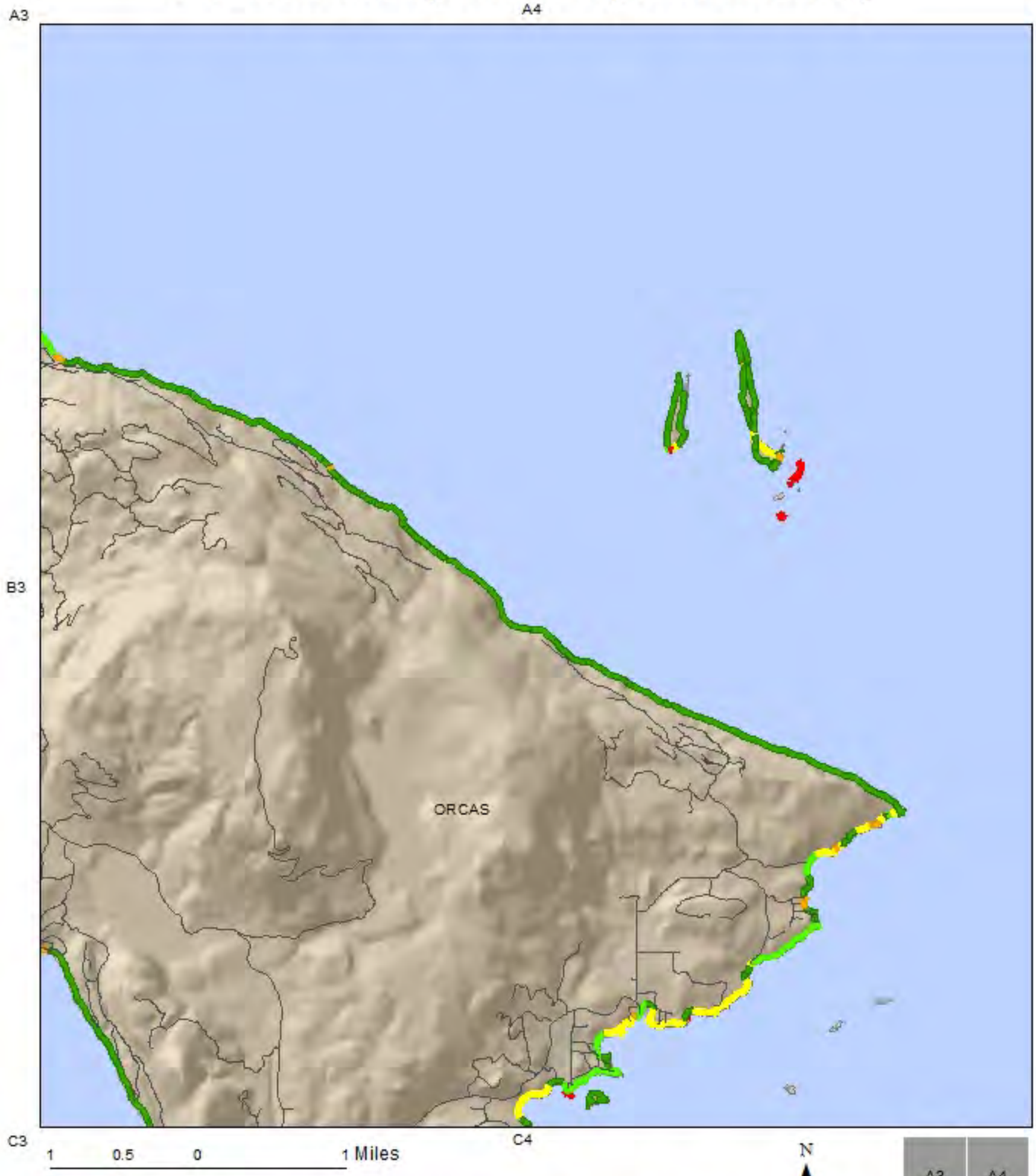
Overhanging Vegetation % of Coverage at Shoreline

Unit of Analysis:
Geomorphic Shoreform

- 0 = No Coverage
- 1 = .01-25%
- 2 = 26-50%
- 3 = 51-75%
- 4 = 76-100%

B3

San Juan County Marine Riparian Inventory

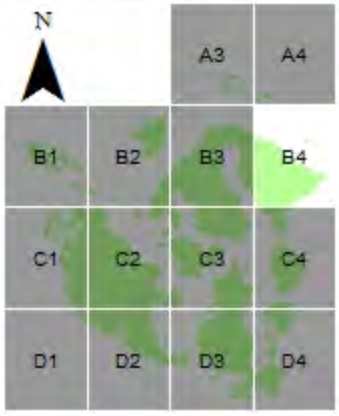


0 = No Coverage
1 = .01-25%
2 = 26-50%
3 = 51-75%
4 = 76-100%

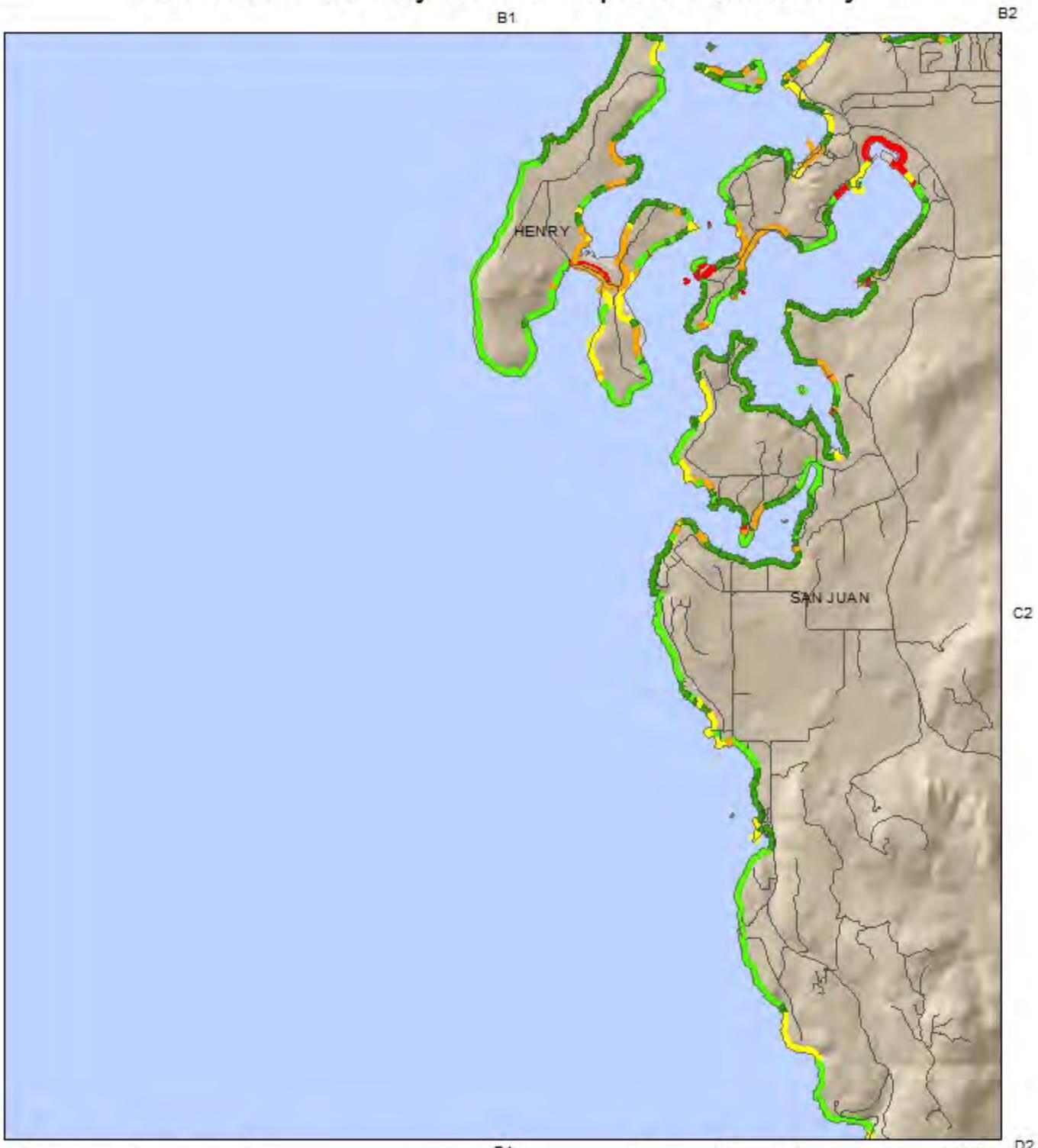
Overhanging Vegetation
% of Coverage at Shoreline

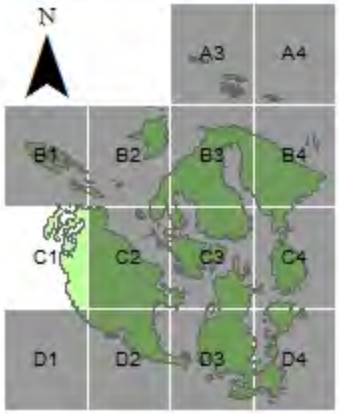
Unit of Analysis:
Geomorphic Shoreform

B4



San Juan County Marine Riparian Inventory





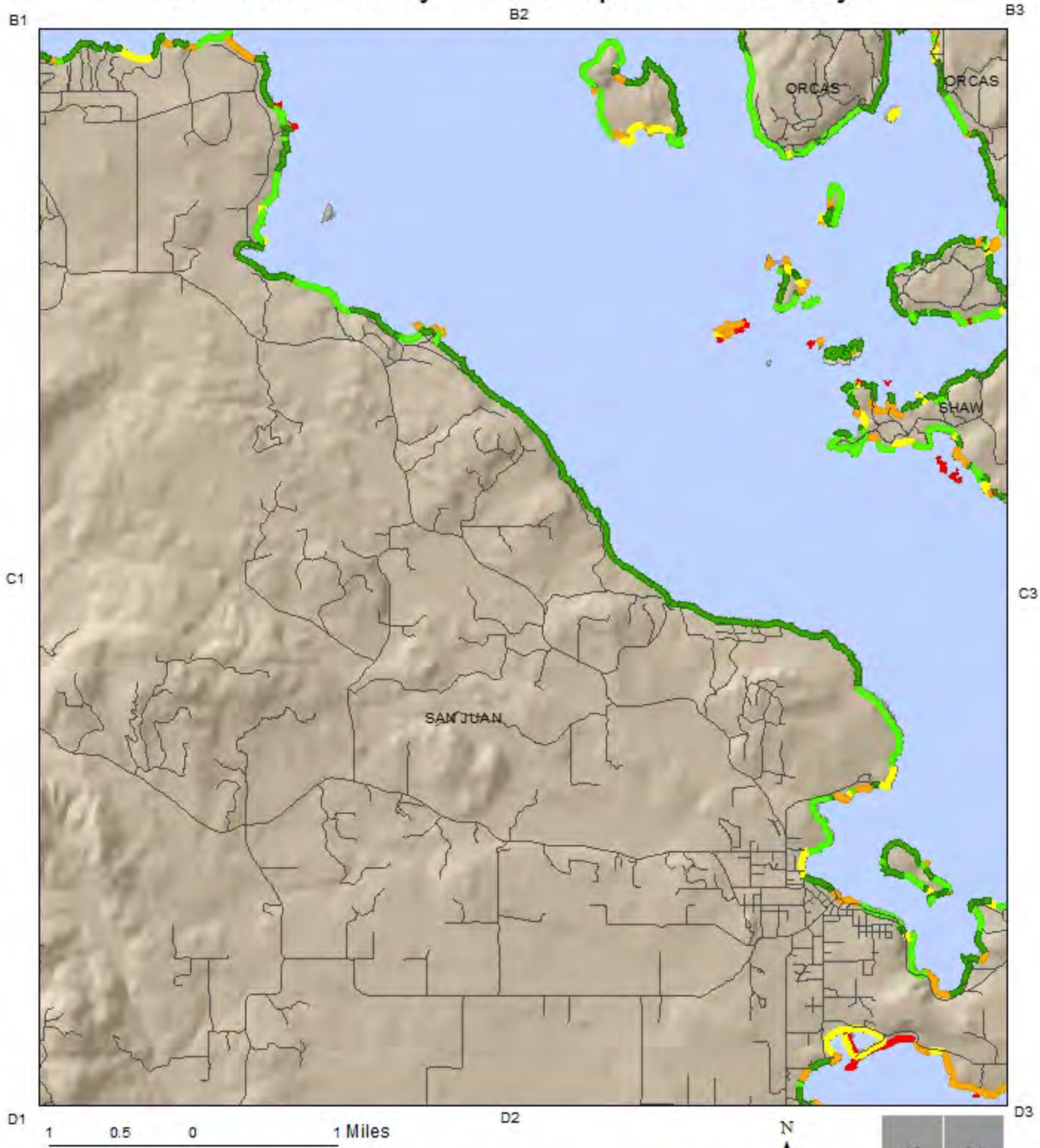
Overhanging Vegetation
% of Coverage at Shoreline

Unit of Analysis:
Geomorphic Shoreform

0 = No Coverage
1 = .01-25%
2 = 26-50%
3 = 51-75%
4 = 76-100%

C1

San Juan County Marine Riparian Inventory



0 = No Coverage
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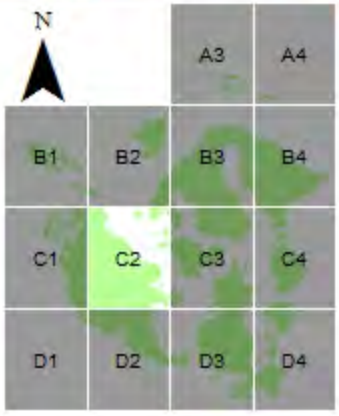
2 = 26-50%
3 = 51-75%
4 = 76-100%

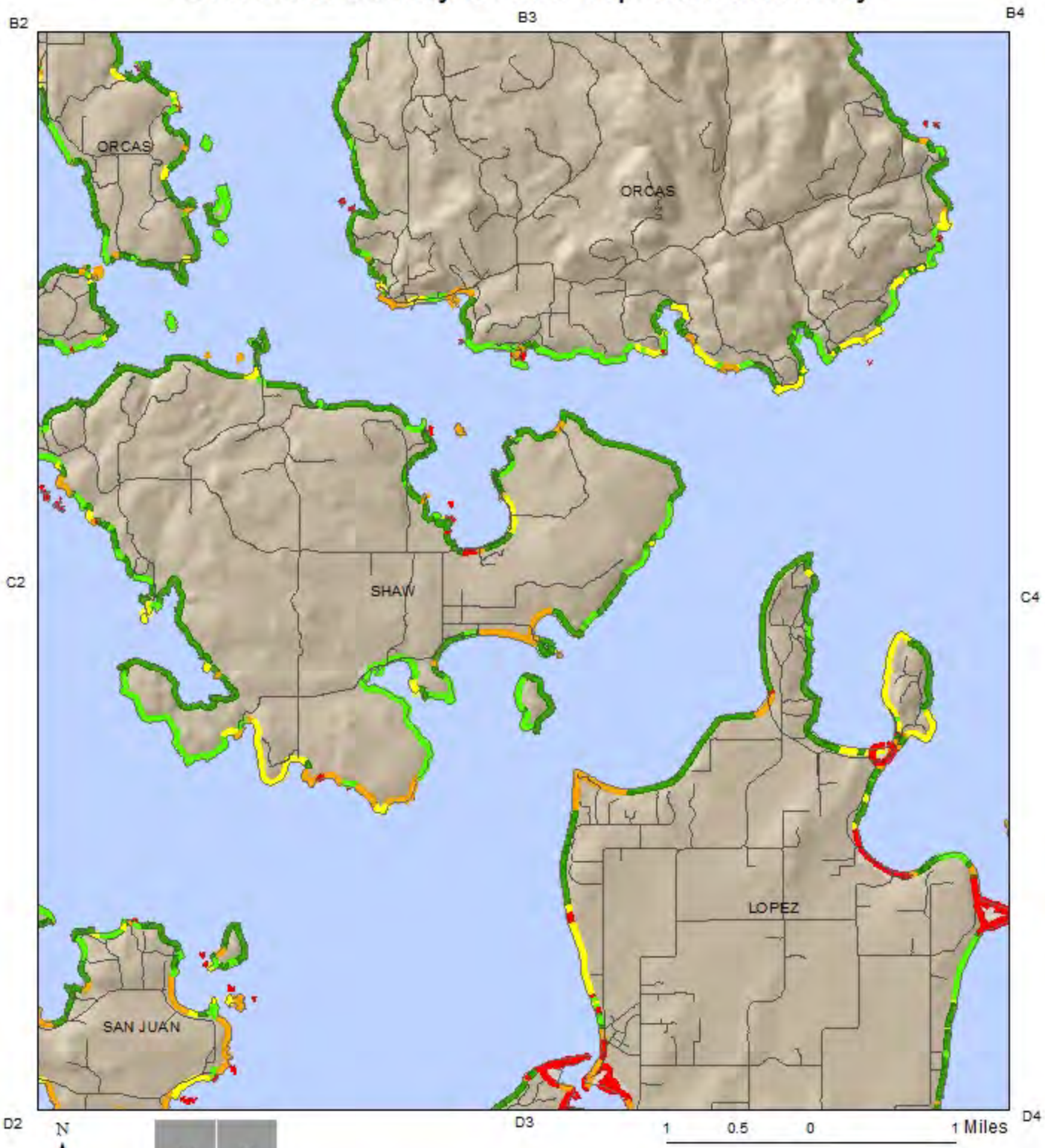
Overhanging Vegetation
% of Coverage at Shoreline

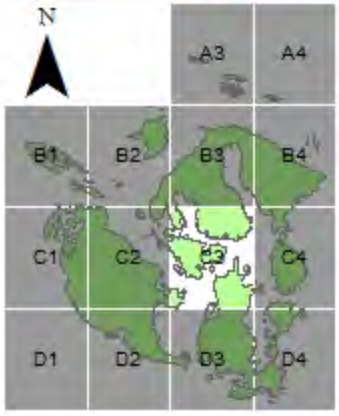
Unit of Analysis:
Geomorphic Shoreform

C2



San Juan County Marine Riparian Inventory





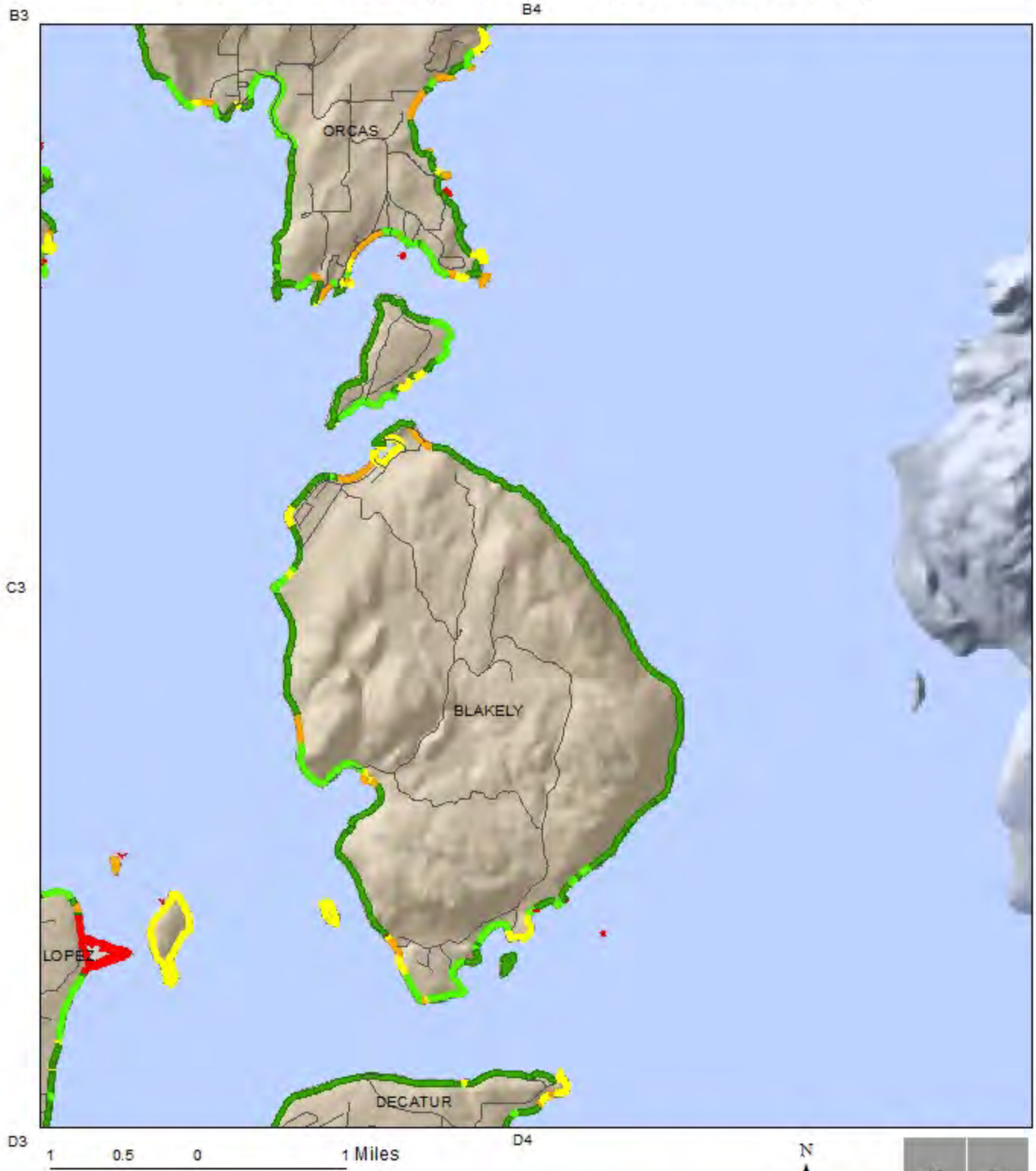
Overhanging Vegetation
% of Coverage at Shoreline

Unit of Analysis:
Geomorphic Shoreform

- 0 = No Coverage
- 1 = .01-25%
- 2 = 26-50%
- 3 = 51-75%
- 4 = 76-100%

C3

San Juan County Marine Riparian Inventory



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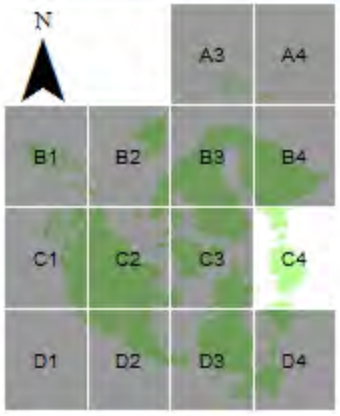
2 = 26-50%
3 = 51-75%
4 = 76-100%

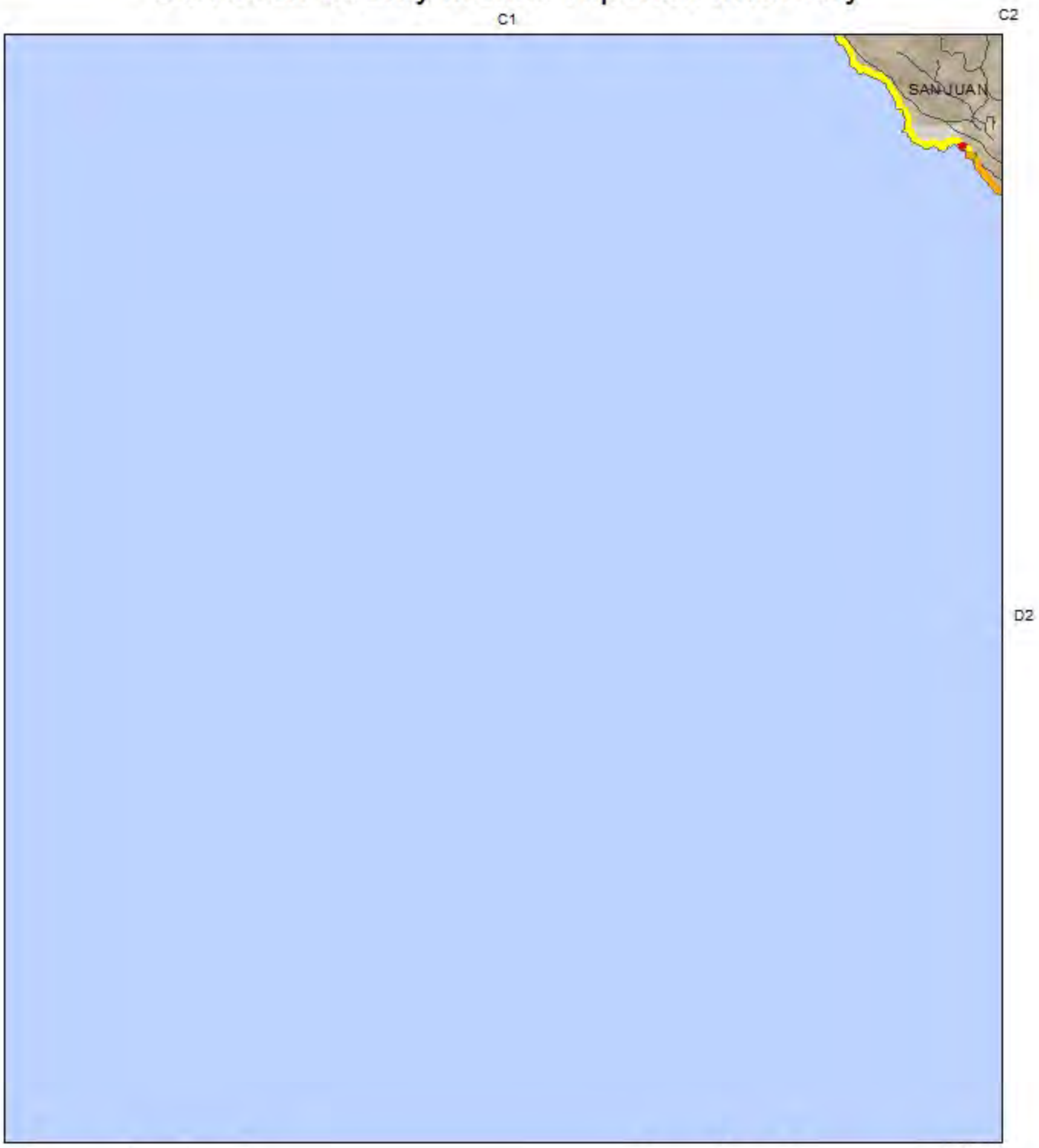
Overhanging Vegetation % of Coverage at Shoreline

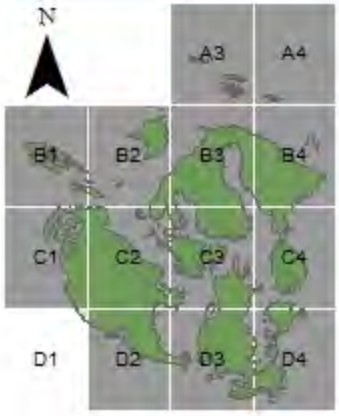
Unit of Analysis:
Geomorphic Shoreform

C4



San Juan County Marine Riparian Inventory





1 0.5 0 1 Miles

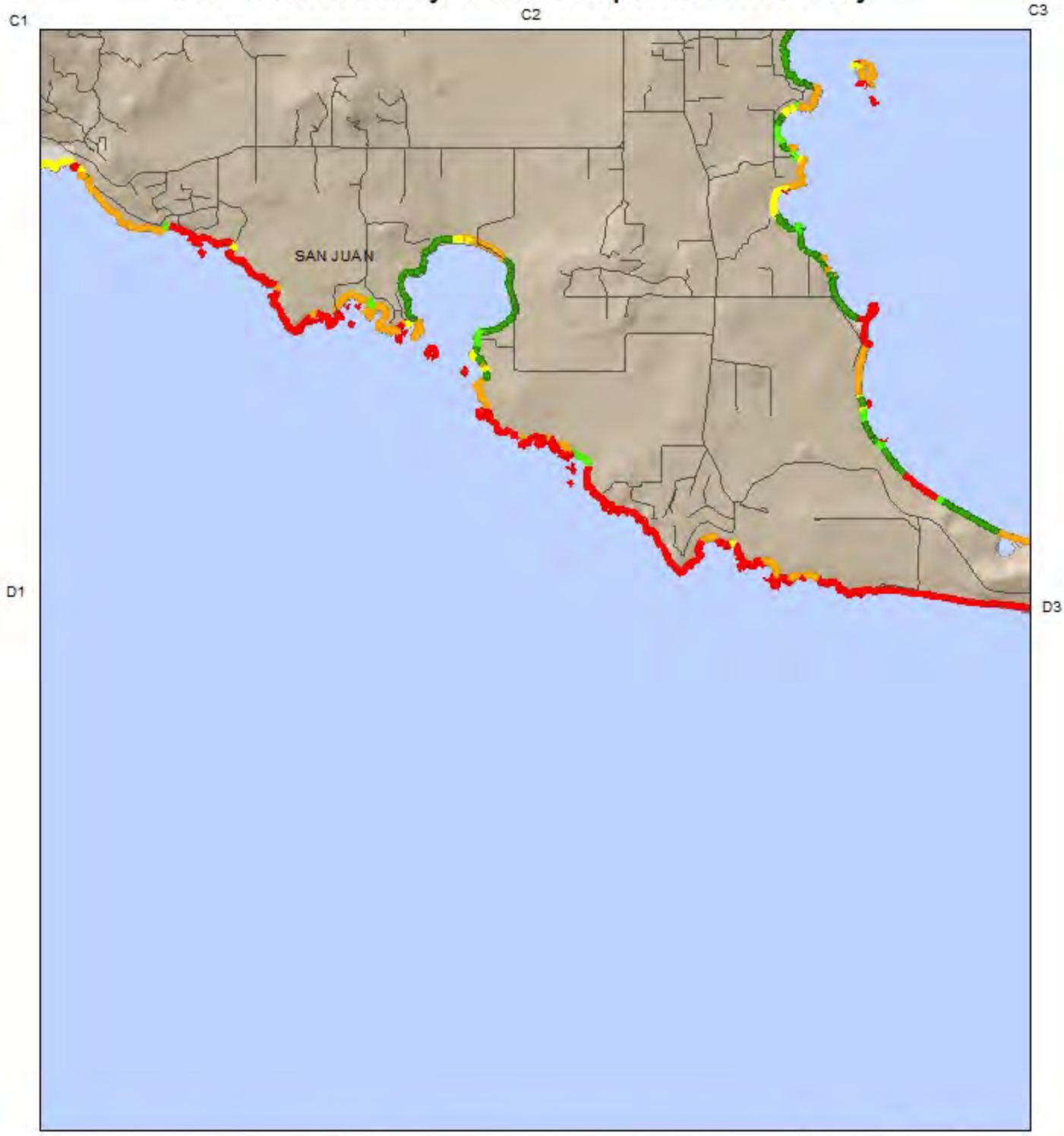
Overhanging Vegetation % of Coverage at Shoreline

Unit of Analysis:
Geomorphic Shoreform

0 = No Coverage
1 = .01-25%
2 = 26-50%
3 = 51-75%
4 = 76-100%

D1

San Juan County Marine Riparian Inventory



1 0.5 0 1 Miles

0 = No Coverage
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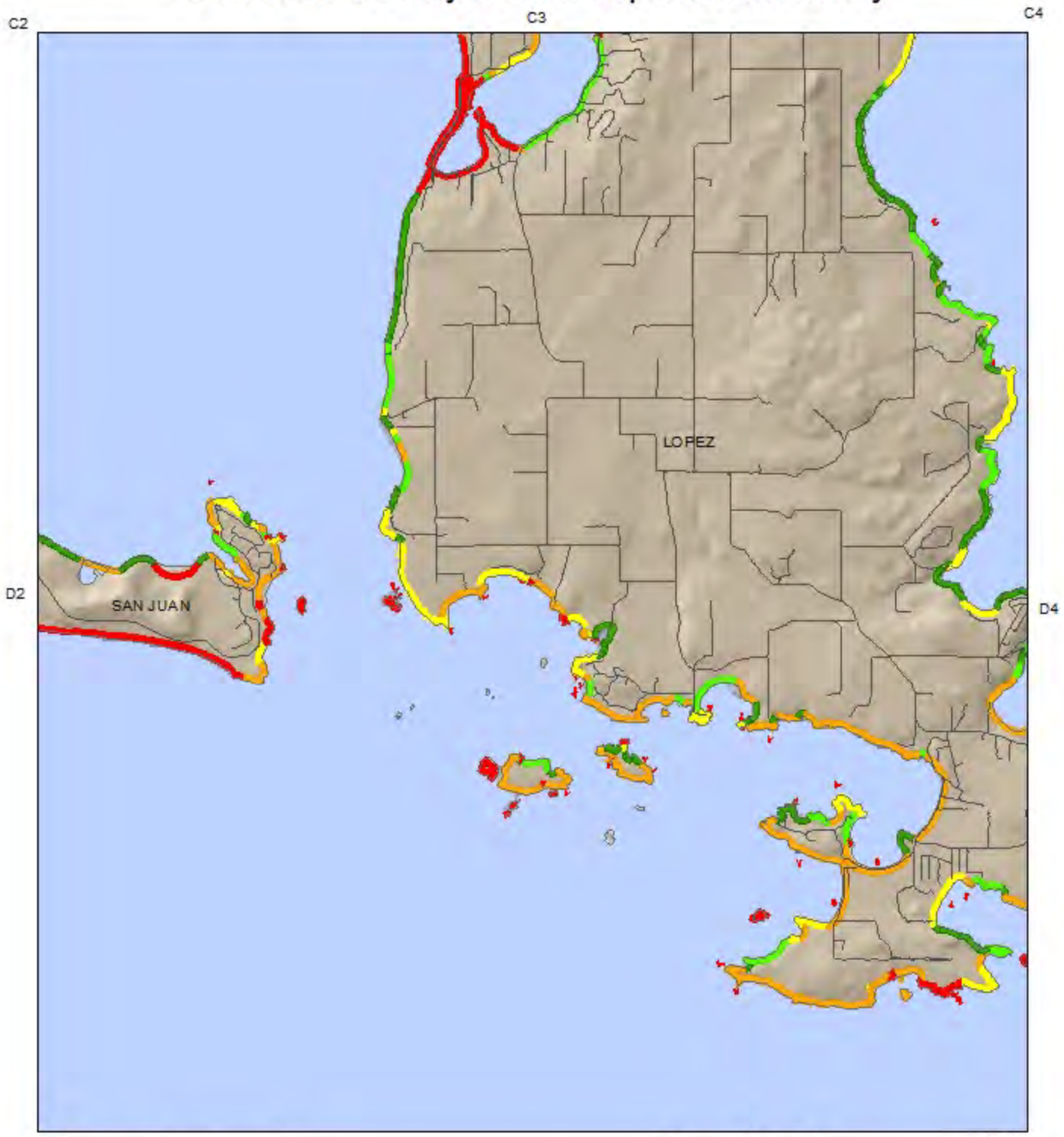
4 = 76-100%

Overhanging Vegetation
% of Coverage at Shoreline

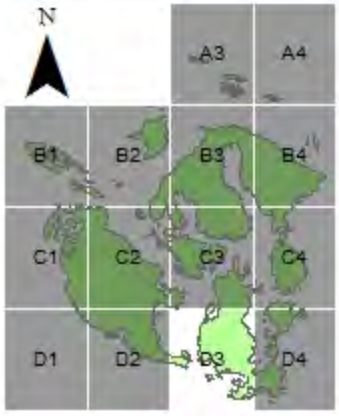
Unit of Analysis:
Geomorphic Shoreform

D2

San Juan County Marine Riparian Inventory



1 0.5 0 1 Miles



Overhanging Vegetation % of Coverage at Shoreline

Unit of Analysis:
Geomorphic Shoreform

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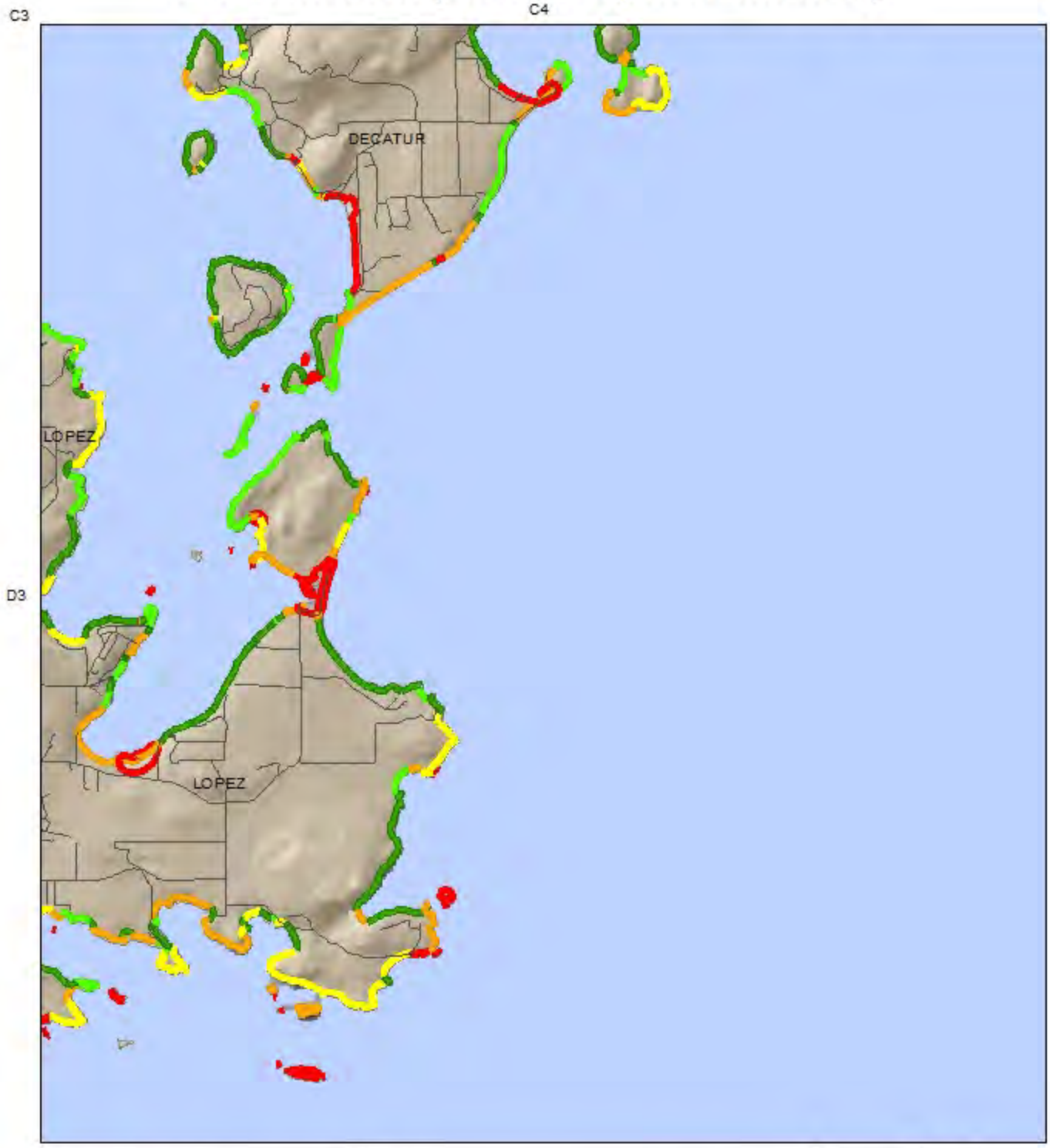
D3

San Juan County Marine Riparian Inventory



1 0.5 0 1 Miles

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1 = .01-25%
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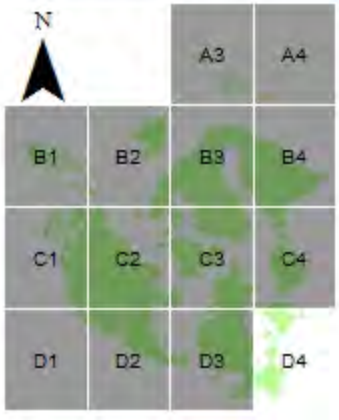
Overhanging Vegetation % of Coverage at Shoreline

Unit of Analysis:
Geomorphic Shoreform

D4