Regenerate Seaweed Study

Special License Application

UPDATED August 11, 2016

Submitted to:
Kerry Allard, DMF Licensing
The Commonwealth of Massachusetts
Division of Marine Fisheries
251 Causeway St, Suite 400
Boston, MA
02114-2152

From:
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Location of site:
Town: Manchester, MA
County: Essex
Waterbody: Between Graves Island and Little Salt Rock

Additional description: West of Graves Island, East of Little Salt Rock and South of Eagle Head in Manchester

Type of culture: Suspended (gear in the water and/or on the bottom)

Name of species to be cultivated, common and scientific names:
Sugar Kelp (Saccharina latissima), Horsetail Kelp (Laminaria digitata), Winged Kelp (Alaria esculenta

Name and address of the source of seed stock, juveniles, smolts, etc., to be cultivated:
Inoculated lines will be purchased from Ocean Approved, LLC nursery- 188 Presumpscot Street, Portland, ME 04103

INTRODUCTION

Seaweed aquaculture represents approximately half of the world mariculture production with most commercial operations based in Asia. Seaweed has the potential to provide positive economic impacts to the local economy and marine ecology.

Regenerate Marine wants to champion economic development and ecological restoration initiatives in Gloucester and around the world by studying growth patterns of endemic species of seaweed in Cape Ann and with our partners in Melbourne, Australia.

Long Term Goals: Building a knowledge platform

By combining scientific excellence with industrial relevance, we will target successful and predictable production of high quality biomass. The project will provide the company with important tools, enabling key steps towards a cost-effective industrial cultivation of macroalgae. The projects primary objective is to establish an interdisciplinary knowledge platform on fundamental production biology and technology for cultivation

- Increase the principal knowledge on biological performance and environmental requirements for optimized chemical composition and biomass production
- Obtain technological specifications and to develop generic models and simulation tools for farm systems and biomass production
- Create a thriving and regenerative kelp market in Gloucester
- Commercial production in waters of Massachusetts and beyond
- Create downstream products with local seaweed including but not limited to green chemistry
- Drive circular economy value
- Deliver raw and finished kelp products to the market
- Purchase seaweed from local cultivators
- Grow and harvest highly restorative resource
- North Shore as hub for ecological restoration initiatives

Supporting Objectives

- Joint Venture with AquaTrophic in Melbourne AUS
- Educational opportunities with the Gloucester Maritime Heritage Center
- Economic Development and Ecological Restoration co-benefits

Economic Opportunity

- Seaweed aquaculture represents 24% of world marine aquaculture production (by weight)
- $5.7 billion food market (USD)
- Majority of seaweed aquaculture occurs in China, Korea and Japan
- Norway making a push into the commercial market
- Opportunity to create seaweed industry in US
- Revive fishing industry on east coast
- Job creation
- Establish new export market of sustainable products
- Establish entirely new market of goods, grown sustainably in coastal waters

Environmental Benefits

- Coastal ecology restoration

- Biodiversity enhancement
- Remove Nitrogen/Carbon from coastal ecosystems
- Mitigate nutrient flow from wastewater treatment facilities
- Remove harmful nutrients that promote algae blooms
- Create habitat for juvenile fish
- Filter and clean the water column
- Nutrient bioremediation
- Carbon sequestration
- Buffer to ocean acidification

Consideration

The company has letters of support from the following offices:

Manchester Harbormaster:
Bion Pike
Town Hall, First Floor
10 Central Street
Manchester, MA 01944
O: 978.526.7832
C: 978.473.2520
harbormaster@manchester.ma.us

Manchester Shellfish Constable
Tom Henderson
Town Hall, First Floor
10 Central Street
Manchester, MA 01944
H: 978-526-7451
C: 978.766.8686
No Email

Manchester Conservation Commission
Chris Bertoni
P: 978-921-0225
Town Hall, Second Floor
10 Central Street
Manchester, MA 01944
Phone: 978-526-4397
bertonic@manchester.ma.us

Manchester-by-the-Sea Public Hearing Thursday, March 3

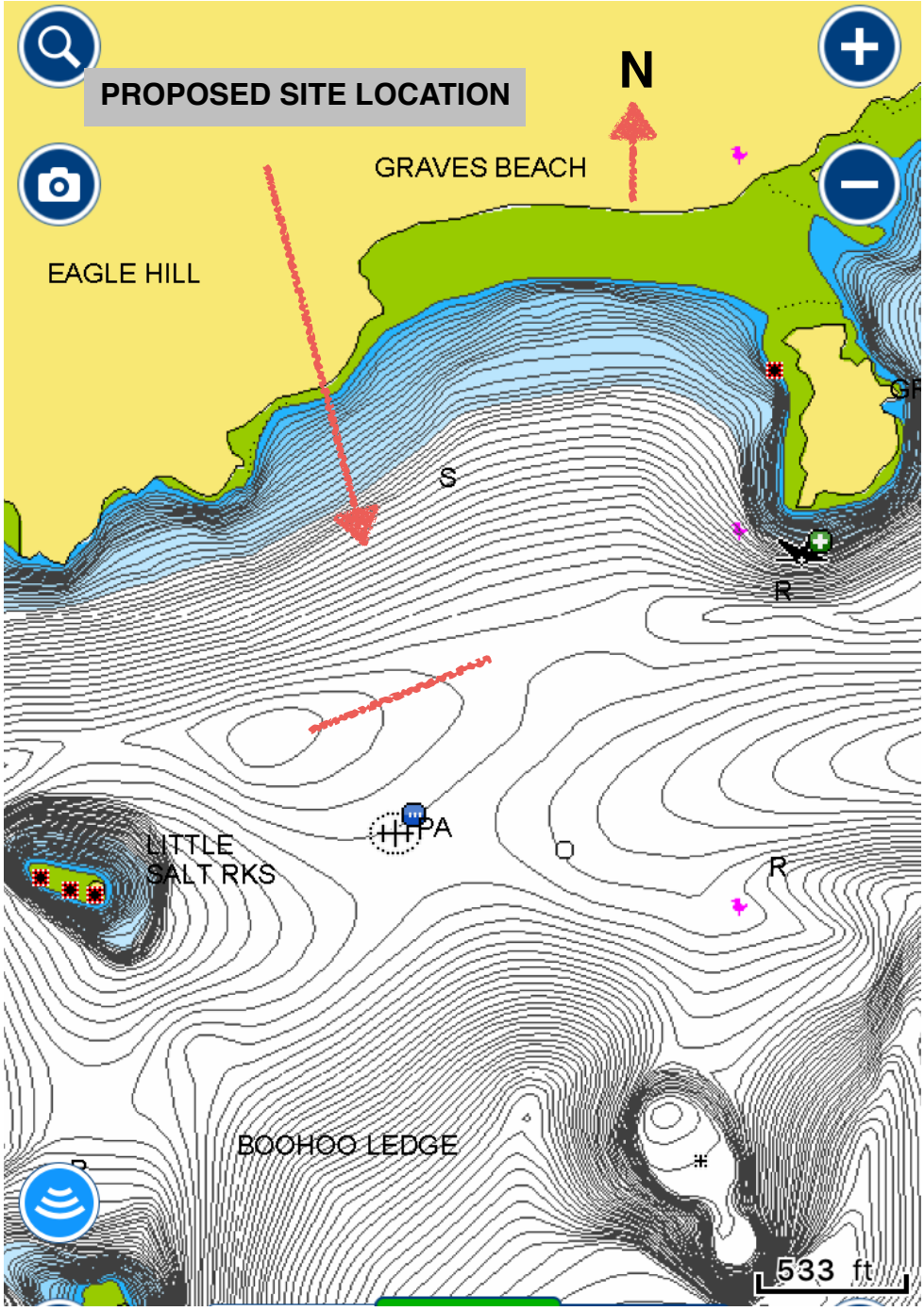
Measure & Verification

- Regenerate Marine will measure and verify the samples bi monthly in winter months and weekly in summer months
- Regenerate Marine will follow Ocean Approved Methodology (See Appendix 2)
- Regenerate Marine will hire Cape Ann Marine to install system
- Regenerate Marine will monitor tackle
- Regenerate Marine will take photographs and monitor cultivation activities on the site

- Regenerate Marine will provide research report at the end of the year with results

1. Location of Proposed Research Site

A. Vicinity Map



NAVIONICS Map

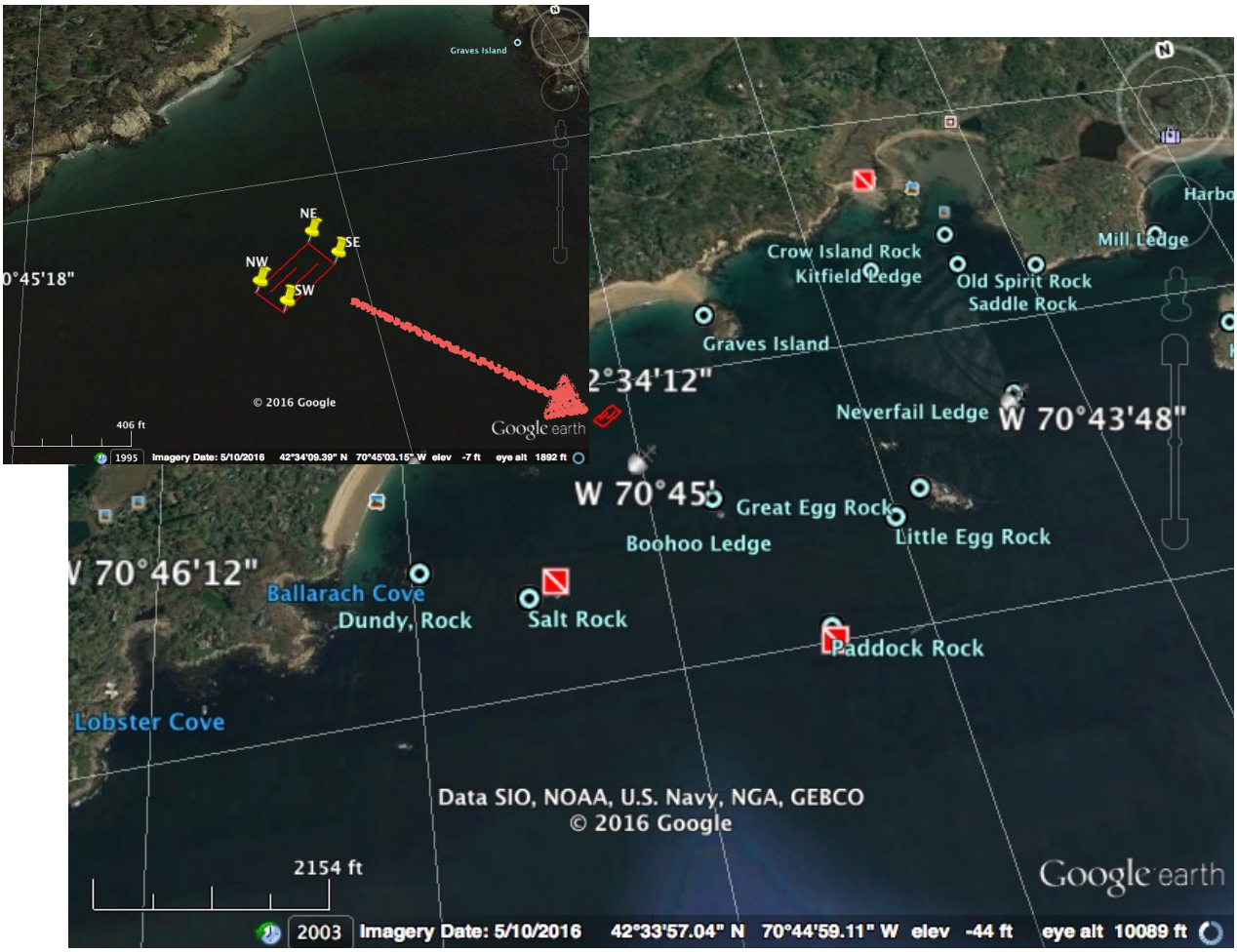
B. Boundary Description

This proposed lease site composes two 150 ft sections that are 120 feet in width. . The northern end of the site is south of Eagle Head in Manchester to the east of Little Salt Rock and west of Graves Island. The proposed lease site is in sub tidal waters. These waters are unrestricted.

The site is 1,300 ft off the coast.

NW
42°34'7.00"N
70°45'5.85"W

NE
42°34'8.76"N
70°45'2.61"W



SW:
42°34'6.00"N
70°45'4.64"W

SE:
42°34'7.66"N
70°45'1.40"W

2. Research Program and Application

Inoculated lines will be purchased from Ocean Approved, LLC nursery- 188 Presumpscot Street, Portland, ME 04103. We will follow their prescribed methodology.

Species of Interest: The company will focus on species endemic to New England waters including:

1. Saccharina latissima (sugar kelp)—A single-blade kelp with a long, thick stipe. e blade tastes a little like an early green bean; the stipe is slightly bitter. Generally found in areas of moderate current and low wave energy.
2. Laminaria digitata (horsetail)—A multi-blade kelp that resembles a horse tail when held upside down. Very mild in taste and a vibrant green color when cooked. Generally found in areas of high current and/or moderate wave energy.
3. Alaria esculenta (winged kelp)—A single-blade kelp with reproductive areas shaped like small wings attached to the stipe area just below the large main blade. e reproductive blades resemble dragon y wings when viewed underwater. Nutty in taste, this kelp is generally found in high wave energy zones and moderate to high current.

The farming calendar is dictated by the species one desires to cultivate, the weather, and the local water conditions. In general, nursery work takes place September through November, seeding takes place late October through November, and harvesting takes place March through May. A rule of thumb is to have the kelp farm seeded before December and then have it harvested before the water temperature rises to the point where biofouling starts to degrade the quality of the kelp, and phytoplankton starts to compete with the kelp for nutrients.

3. Methodology

A. The purpose and design of the study.

The purpose of this study is to determine the optimum growth environment, seeding and harvest periods through measurement of yields for native to Massachusetts species of kelp to aid in selecting a permanent kelp aquaculture site. Long lines will be seeded during late spring and fall. Growth rates will be monitored and wet weight yield per meter of long line will be calculated at harvest. Data from spring and fall plantings will be compared over a 1 to 3 year period—permit depending.

B. The species, amount and proposed source of the organisms to be grown

The company will purchase inoculated lines from Ocean Approved who have isolated and maintain native cultures of Sugar Kelp (Saccharina latissima), Horsetail Kelp (Laminaria digitata), Winged Kelp (Alaria esculenta). The amount to be grown will be the expected outcome of this study.

The source of the organisms will be spores harvested from native plants collected in the wild. The spores will be grown to 2.5mm sporelings in Ocean Approved's laboratory prior to being placed at the site. This technology was developed by Ocean Approved in 2010 and funded by NOAA.

C. Description of the culture and harvesting techniques to be used

1. Ocean Approved will isolate and maintain native cultures of Sugar Kelp (Saccharina latissima), Horsetail Kelp (Laminaria digitata), Winged Kelp (Alaria esculenta) to be used as "seed stock" for the production of young plants.

2. Sporophyte will be transferred to the site when they achieve 2.5mm in length. Seed string with sporelings will be applied to long lines.
3. The kelp will be harvested by lifting the long line to the surface and cutting the kelp at the intersection of the hold fast and the stipe, striping the kelp from the line
4. Yield wet weight per meter of seed string will be measured and compared to yields from other sites grown using identical rigs and techniques.
5. Harvest will be done by hand and knife
6. Gear will be checked weekly.

D. The expected length of the study.
The expected length of this study is 1 year at shortest and 3 years at longest. Three years will allow for up to 6 growing cycles.

E. Scientific OR commercial research and Development.

Commercial Research

4. Existing Uses

- There are no marked channels close to the proposed site
- Singing Beach is a public beach. Divers have been observed enjoying the local waters
- Graves Island is a private beach accessible at low tide. Graves island is a private beach and accessible only by adjacent landowners. During low tide, a sand bar extends from Graves Beach to Graves Island
- Lobster gear is prevalent in the area during lobster season
- Recreational fishermen are observed during summer and fall

5. Exclusive Use

The site structure design illustrated in section 10, will allow for recreational boaters to transit the site. We request that fishing both lobster and dragging be restricted from the site to minimize the risk of gear entanglement.

6. Description of Proposed Lease Site

A. Environmental Characterization

1. *Bottom Characteristics*- The bottom in the proposed site area is sand
2. *Approximate Depths*- Approximate depth at low tide is 30-40 feet. The approximate depth at high tide is 39.9-50 feet.
3. *Topography*- Gently sloping topography. The lease site follows the 38 foot contour line.
4. *Flora and Fauna*-There are areas of seaweed, lobster, crab. The presence of seaweed cultivation in this area will provide additional structure and shade for a diverse array of species including juvenile fish, small invertebrates, diving birds, etc. Seaweeds provide excellent shelter and juvenile habitat.
5. *Approximate Current Speed and Direction*- The current in the proposed lease site area runs in several directions during both ebb and flow due to the nature of the sand bar between Graves Island and Graves Beach to the north east at low tide and west towards Manchester Harbor. The current runs at flood at approximately 0 to 1 knot depending on the state of the tide.
6. *The General Shoreline and Upland Characteristics*- The proposed site is located wast of Graves Island and south of Eagle Head, Manchester and east of Little Salt Rock, Manchester. The granite shore is lightly developed— lined with private homes with no

water access for boats. Singing Beach is a public beack. Swimmers are restricted from swimming to the site. White Beach and Black beach are public access. Coolidge point is managed by the Trustees of Reservation.

7. *Presence and Extent of Submerged Aquatic Vegetation*- Observed aquatic vegetation. No dives have been performed to collect data on aquatic vegetation, presence of vegetation is confirmed

B. Environmental Impact

The Town of Manchester-by-the-Sea has closed Black Beach to swimming during summer months due to elevated levels of bacteria. On Saturday, August 24, 2013 testing at Black Beach, off Ocean Street, showed a bacteria count of 223. The state sets the allowable level for swimming at 104. The marsh adjacent to White and Black beach is lined by houses. Heavy use of recreational boaters could also add to the bacterial load. Green algae is prevalent on the ocean side of Kettle Cove, near the Ocean St. bridge — consistent with excess nitrogen in the local ecosystem.

Kelp cultivation can have a positive impact on the environment. As a sea plant, kelp consumes excess nitrogen and CO2 in the water and expresses O2, improving the water quality of the surrounding environment. In addition to improving the quality of the surrounding waters, kelp provides structure and shade for many marine organisms. It is an important habitat for juvenile fish and small invertebrates.

Kelp farm operations are low impact on the environment. Seeding is a relatively quick process accomplished from small skiffs. Seeding should require not more than 2 days each planting season for the proposed site (wind dependent). Seeding takes place in fall, winter, and spring.

Harvest is quick and efficient, and takes place in late fall and spring. It consists of bringing the long line onto the boat and removing the kelp with a small knife as the boat moves down the line. Husbandry for the site will include weekly or bi monthly trips to the site (season dependent) for plant sampling, data capture, and structure inspection/maintenance.

There are no Essential Wildlife Habitats, such as bald eagle nests surrounding Graves Island and White Beach

7. Quantity

- Regenerate Marine requests the permit for a two, 150 ft lines for research purposes.
- Term of the permit is for one (1) year with the potential to extend up to three (3) years pending annual review

8. Methods of Collection

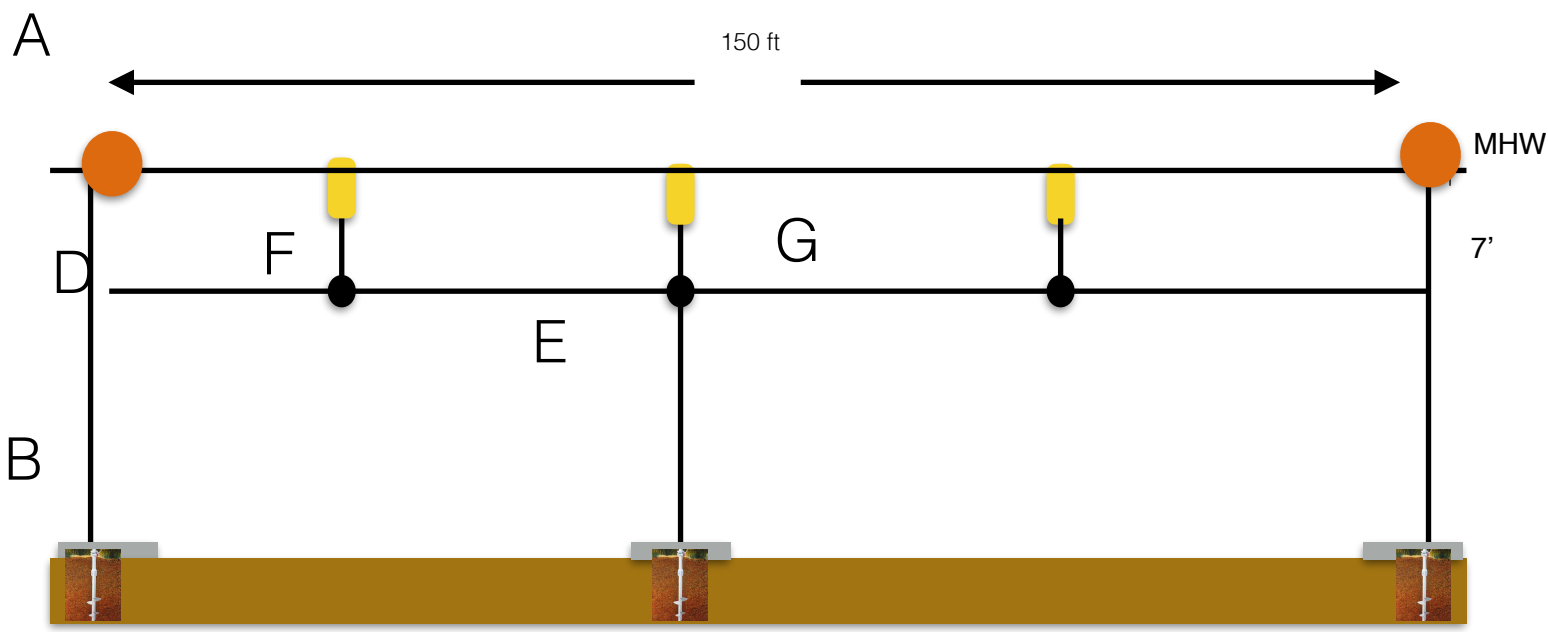
- Anchor inoculated lines of endemic species
- Seasonal rotation os species
- Harvest with knife off long lines

9. Final Disposition of Species Collected

Species collected will end up at Warner Babcock Laboratories for research purposes as well as Cedar Rock farm as organic fertilizer.

10. Structures

Little Salt Rock Research Site
Cross Section View: Not to Scale



A= Mooring Ball
B= 3/4" Mooring chain
C=1,000 lb mooring OR Helix Anchor
D= 3/4 line hold fast shackled to mooring chain
E=7/16" controlled depth long line
F=7" depth control line with buoy and weight

Maximum Depth= 39.9"

Moorings

- Moorings will be Helio Anchors
- Flexible anchor rhodes
- Site application is for 3 years subject to annual review
- Moorings will be left at the site for the duration of the study
- Moorings will be removed at the conclusion of the study
- Suspended lines will not have any impact on fish runs— they actually provide habitat for juvenile fish

Mooring Materials

Thee farm design is made up of three components:

1. Moorings and ground tackle
2. Long lines
3. Depth maintenance systems (droppers)

Mooring systems consist of 1,000-lb. high density concrete blocks with a 1.5- inch chain holdfast set in the concrete (Figure 1.5). A shackle and 3⁄4-inch mooring chain was attached to the

holdfast in the concrete. To the other end of the mooring chain a 200-lb. (or greater) displacement buoy was attached. Also shackled to the mooring chain was a length of 3⁄4-inch line with an eye splice at the end to act as a holdfast for the long line. Thee length of the holdfast should be at least equal to the depth at which it is shackled to the mooring chain. This will allow for attaching the long line to the mooring system from the surface. For example, if the long lines are set at a 7-foot depth, the holdfasts should be 8 to 10 feet long.

Long Lines
Long lines consist of 7/16-inch poly line cut into 150-foot lengths. Lines are on large spool for easy transport and deployment during seeding.

Dropper Materials
- 10 feet of 5/16-inch poly line
- 14-lb. displacement lobster buoy with 1-inch ID spindle hole · Two spindle washers
- 10-lb. weight with holdfast
- 7 feet of 1-inch PVC pipe

Site Access
- Access to the site will be undertaken by boat/research vessel
- No beach access is required
- The site 1,300 feet offshore from land

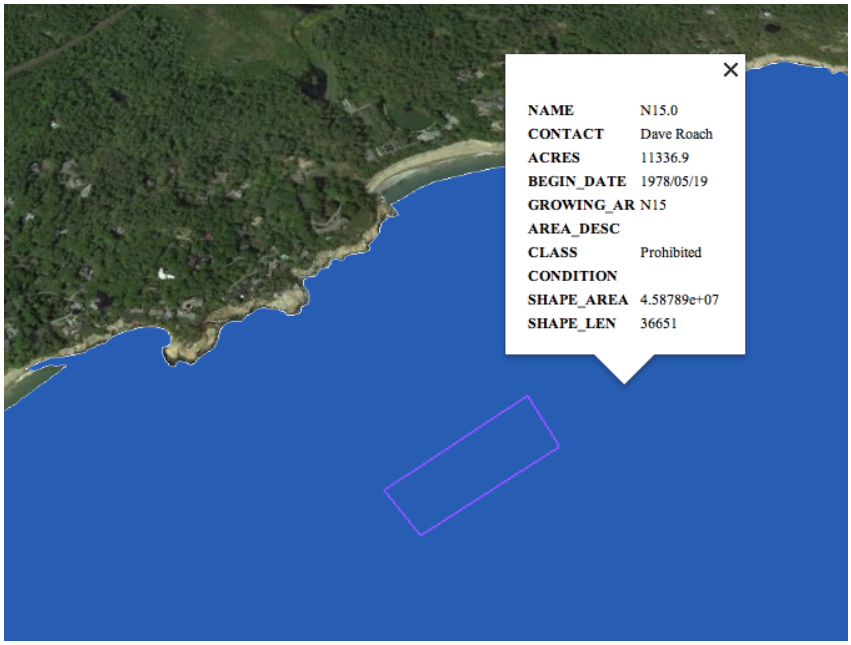
12. Competing Uses

A. Eelgrass

No eelgrass growth within the zone.

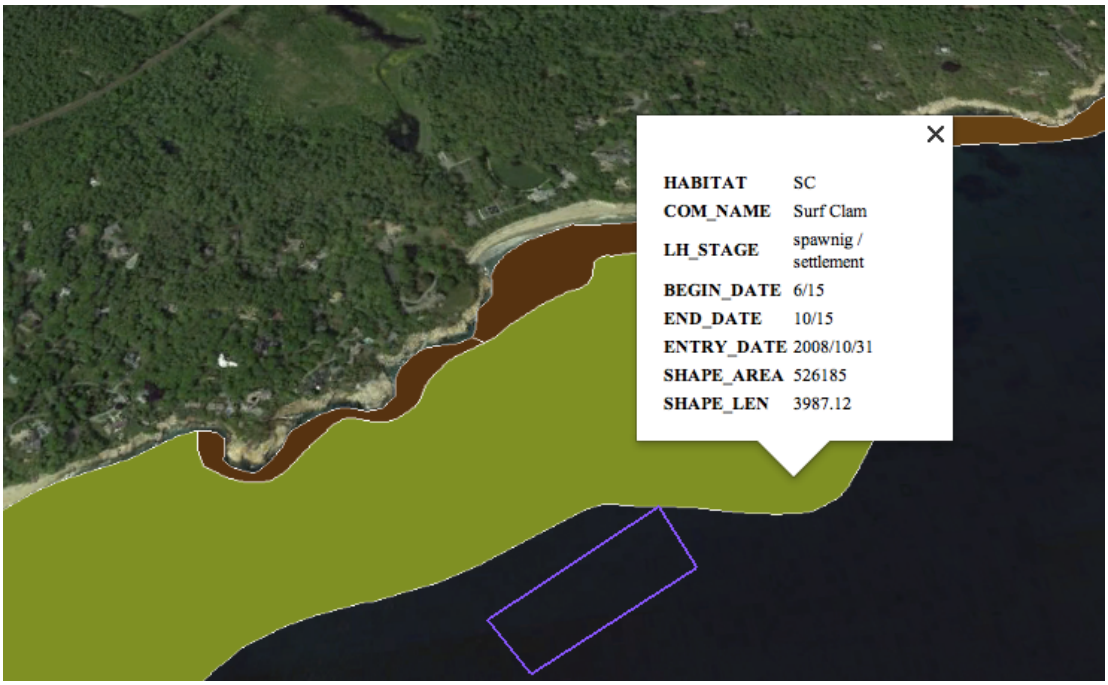
B. Designated Shellfish Growing Areas

Shell fish growing area status: prohibited as of 05/19/1978.



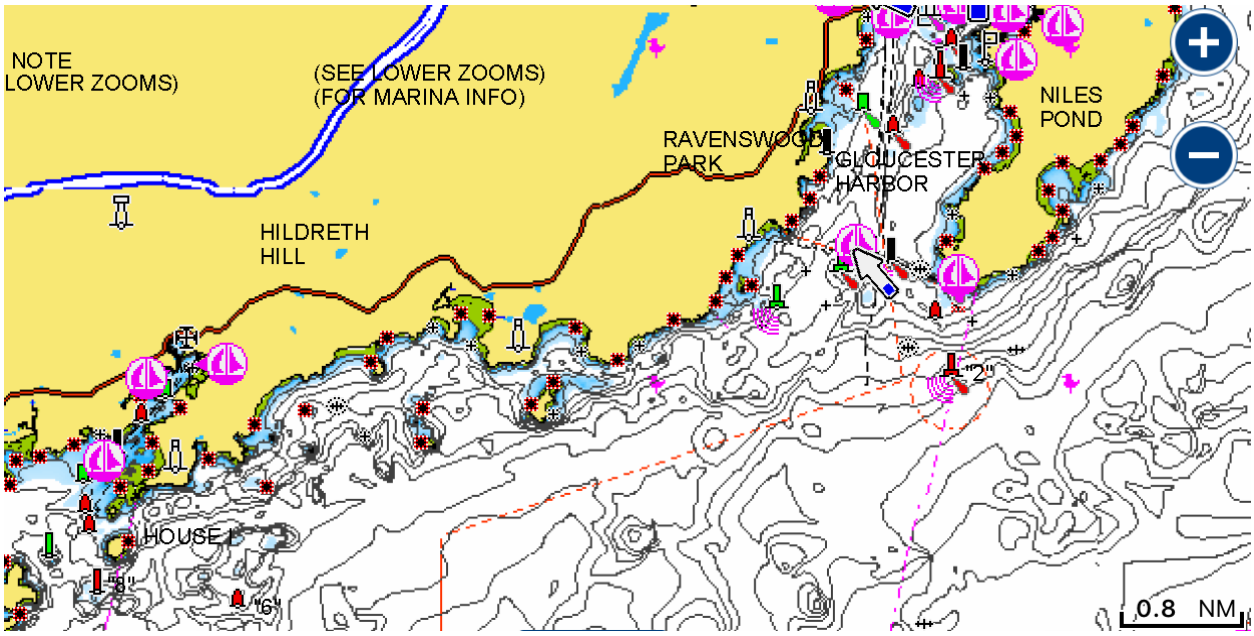
C. Shellfish Suitability

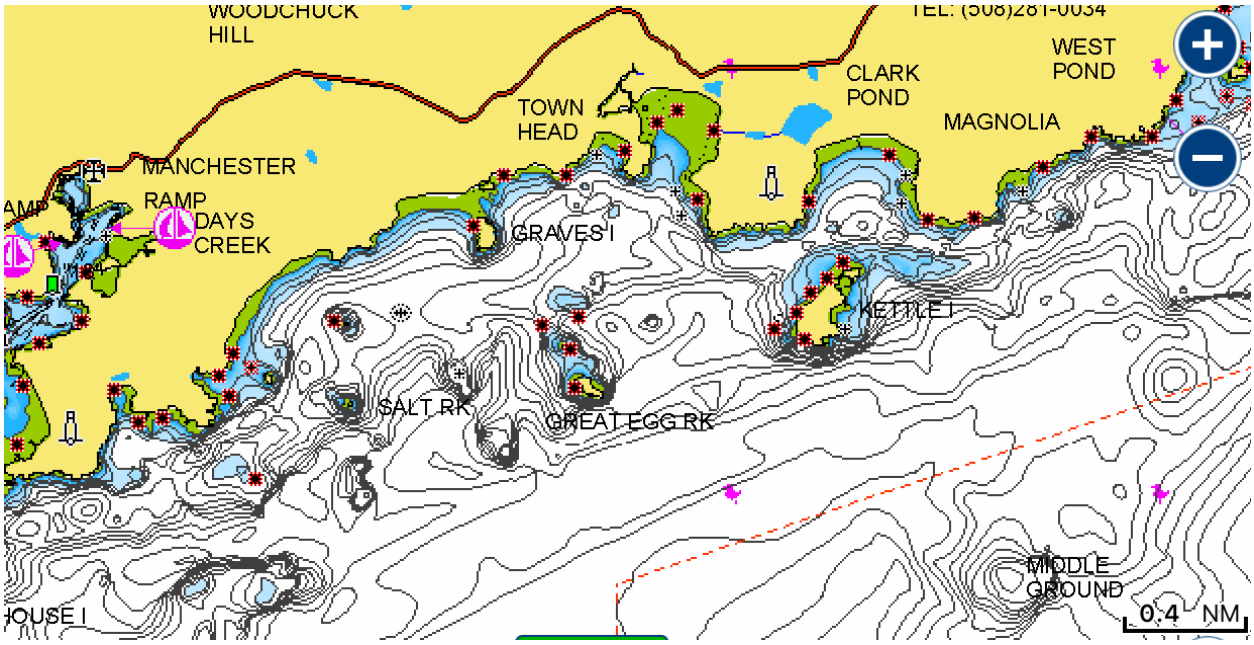
Surf clam spawning/settlement between 6/15 and 10/16 close to site. We can move the site south and west to ensure no overlap.

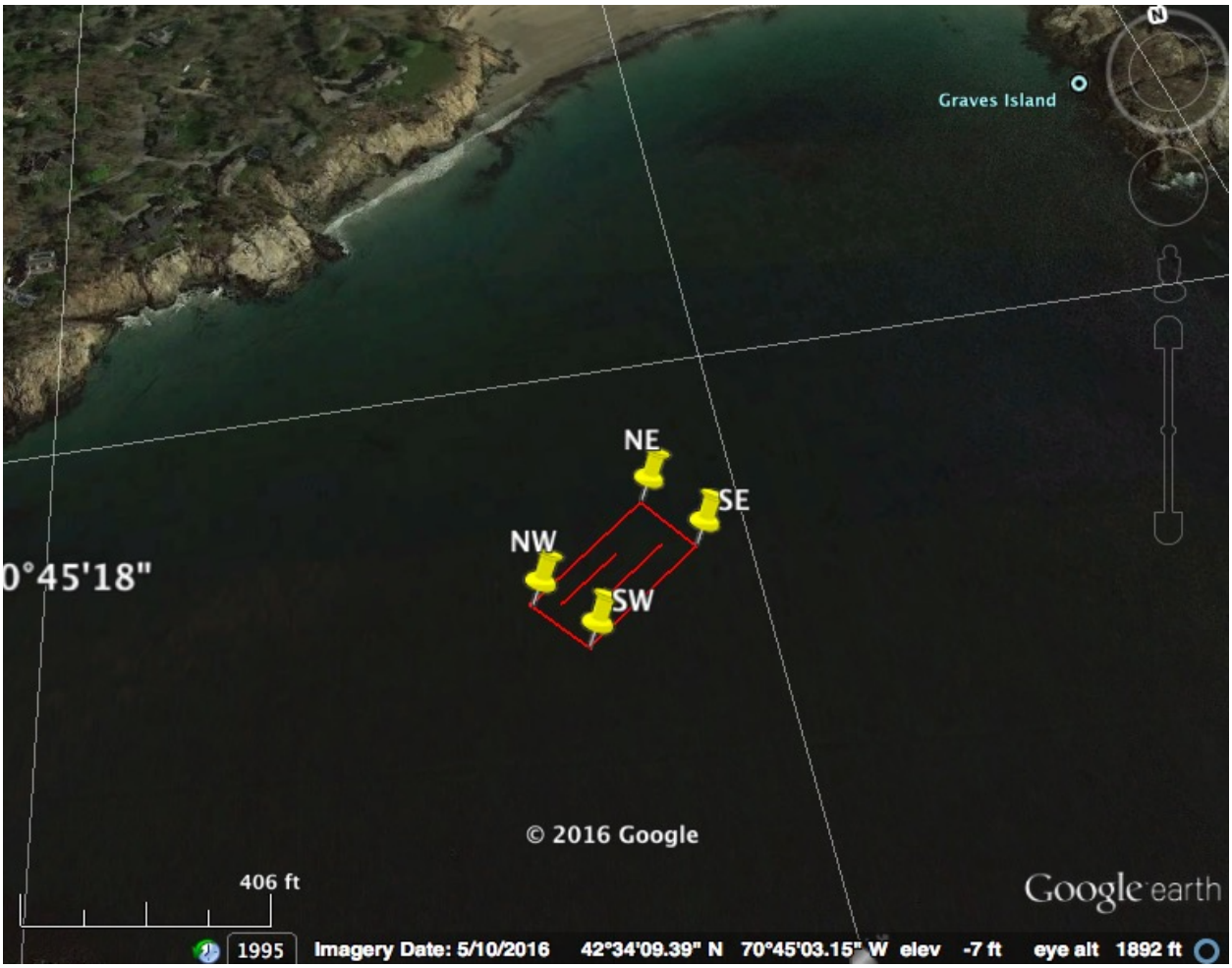


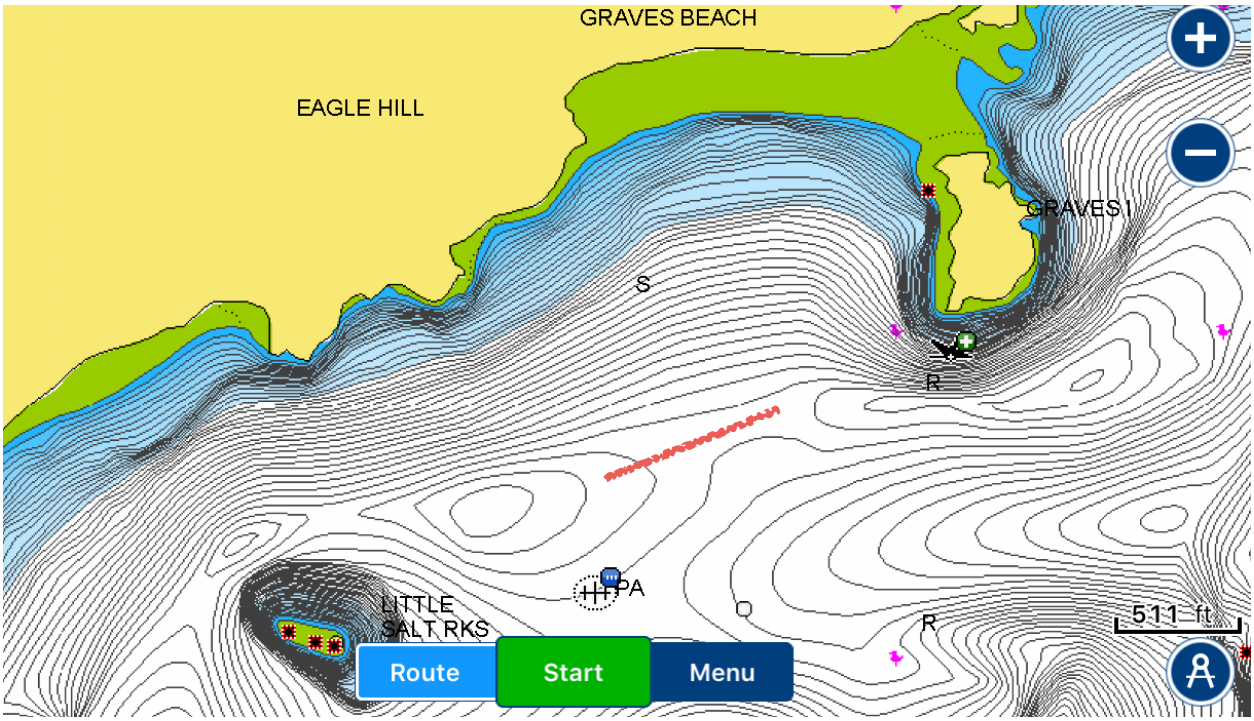
All Layers

13. Geograph


NOTE
LOWER ZOOMS)
(SEE LOWER ZOOMS)
(FOR MARINA INFO)
RAVENSWOOD
PARK
GLOUCESTER
HARBOR
NILES
POND
HILDRETH
HILL
HOUSE I
0.8 NM


WOODCHUCK
HILL
WEST
POND
CLARK
POND
TOWN
HEAD
MAGNOLIA
MANCHESTER
RAMP
DAYS
CREEK
GRAVES I
KETTLE I
SALT RK
GREAT EGG RK
MIDDLE
GROUND
0.4 NM


Graves Island
NE
SE
NW
SW
0°45'18"
© 2016 Google
406 ft
Google earth
1995
Imagery Date: 5/10/2016
42°34'09.39" N 70°45'03.15" W elev -7 ft
eye alt 1892 ft


GRAVES BEACH
EAGLE HILL
GRAVES I
S
R
PA
LITTLE
SALT RKS
R
511 ft
Route
Start
Menu

APPENDIX 1— Team

Archie Kasnet

Archie uses systems thinking to drive regenerative solutions. He identifies and scales net-positive solutions to sustainability challenges with a deep commitment to protecting global biodiversity. He is President of StratLeade Sustainability Education, Vice President Sustainability at Altenex and serves as a Trustee for the Intentional Endowments Network. Archie wrote a position paper on energy security to inform Vice President Joseph Biden's energy platform and was a contributing author on Healthy Solutions for the Low Carbon Economy published through Harvard Medical School. He holds a Master of Strategic Leadership toward Sustainability from Blekinge Institute of Technology in Karlskrona, Sweden, and a B.A. in Environmental Studies and Latin American Studies from Gettysburg College.

Robert Lovett

Robert Lovett runs the venture capital practice at Medina Capital, with a focus on seed and early stage investments in companies in the health and education market. He is a non-executive director at Investbridge Capital (IBC), a merchant bank based in the Middle East; there, he is a principal advisor to US companies looking to find key partners in frontier markets. Previously, he was Chairman of Landmark Advisory, a consulting firm that provides market intelligence, research reports, feasibility studies, and strategic planning services to government related entities, developers and financial services companies in the Middle East & North Africa (MENA) and other emerging markets. He has consulted on over US $25 billion in global master development projects. Mr. Lovett is a Partner at MIT's Center for Real Estate and divides his time between Boston and Dubai.

Dr. Scott Grierson

Scott Grierson is an entrepreneur, research commercialisation, consulting engineering and management professional currently living in Melbourne, Australia, with a background in biotechnology, sustainability, renewable energy and environmental science. He holds a PhD in Environmental Science from Macquarie University, where his research work focused on the thermochemical properties of biomass, most notably algae. Scott is the Managing Director of aquatic biotechnology start-up, AquaTrophic, which was recently the recipient of the 2015 Small Business Victoria Sustainability Award and is variously engaged in pre-commercial research with the University of Melbourne, Monash and Deakin in relation to integrated multi-trophic

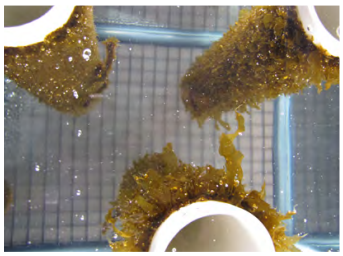
aquaculture operations. Scott has considerable experience in applied research and in 2014/15 co-ordinated a program at Deakin University (where he is currently an Associate Professor – Adjunct in the School of Life and Environmental Sciences) focused on carotenogenesis in microalgae. In 2013/14, Scott managed the Industry Engagement program for SMEs on behalf of the Advanced Manufacturing Co-operative Research Centre (AMCRC), focusing on additive manufacturing research and application. Until the end of March 2013, Scott was Chief Technology Manager - Research & Development for algae biotech aspirant, MBD Energy Limited. During this period he was based at James Cook University in Townsville (as a Principal Research Fellow - Adjunct) where he was responsible for strategic direction and day-to-day management of a multi-disciplinary, three-part research program developed in partnership with the University under the auspices of the AMCRC. This was a $25m, 6-year program primarily focused on bridging the gap between scientific research and commercial reality for a promising new biomass resource (algae and to a limited extent, bacteria), with a heavy emphasis on developing the contingent science and biotechnology. As such, Scott has a solid understanding of the structure and operation of complex, multi-disciplinary research programs, included budgeting, project management, reporting, contract scheduling, publications, strategy, staffing needs and management of intellectual property (IP).

APPENDIX 2: Ocean Approved Manual

http://static1.squarespace.com/static/52f23e95e4b0a96c7b53ad7c/t/52f78b0de4b0374e6a0a4da8/1391954701750/OceanApproved_KelpManualLowRez.pdf

Kelp Farming Manual

A Guide *to the* Processes, Techniques, and Equipment for Farming Kelp in New England Waters



Katie Flavin
Nick Flavin
Bill Flahive, PhD

Ocean APPROVED
FARMING THE NORTH ATLANTIC

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archie@regenerate.is