



AQUAFAC

**MARINE HYDROGRAPHIC SURVEY,
SOUTH OF ARKLOW, CO. WICKLOW**

JUNE JULY 2015

**Report to
Irish Mussel Seed Company Ltd.**

**Produced by
AQUAFAC International Services Ltd**

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1. Introduction

This document reports on the deployment of a recording current profiler for the measurement of water currents and tidal elevations at a site located south of Arklow, Co. Wicklow over a three week period. Wind measurements were also recorded during the same time period. These measurements were required to determine the water current that would be exerted on structures to be deployed at the proposed location as outlined in Figure 1.1.

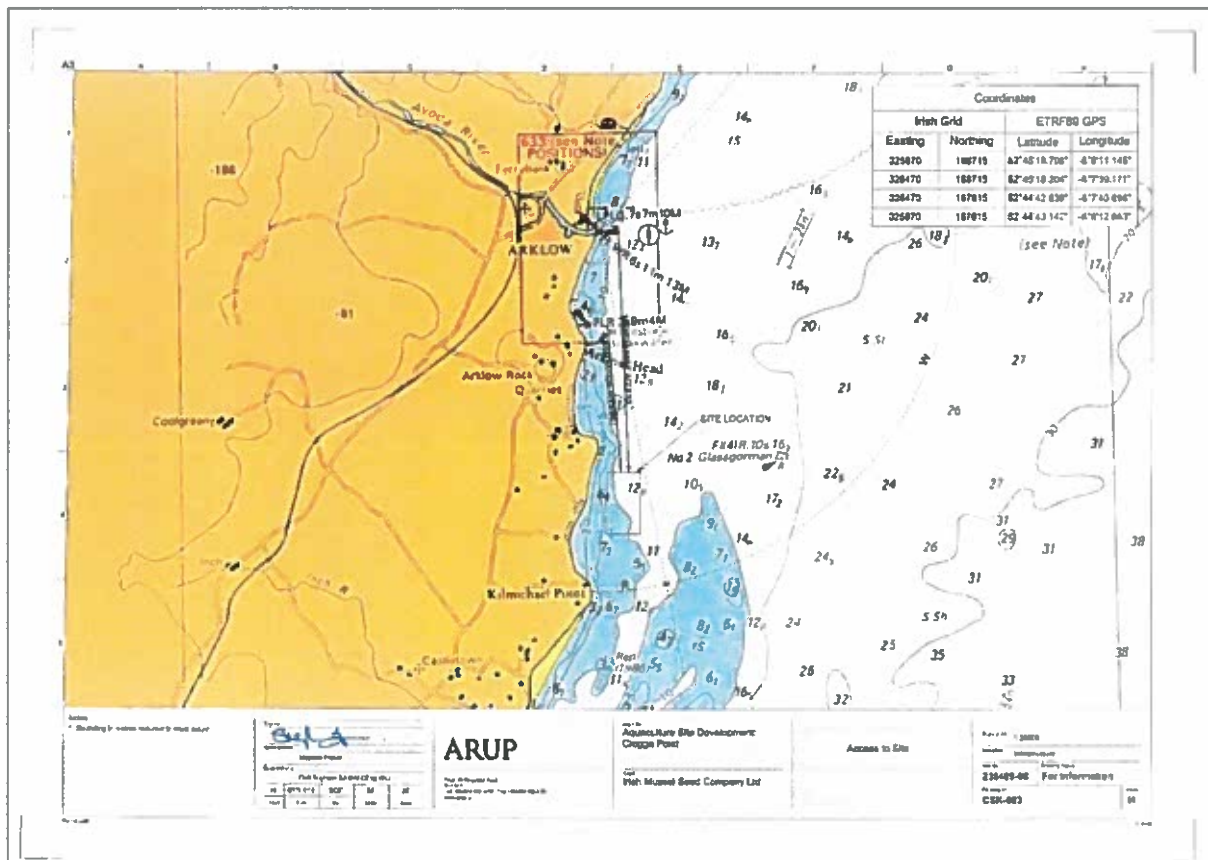


Figure 1-1 Location of the Marine Study Area Off South County Wicklow.

2. Methodology

2.1. Introduction

An Aquadopp 1MHz Acoustic Doppler Current Profilers (ADCP) with z cell was deployed south of Arklow on 25th July 2015 at 52.75129°N 6.13528°W. The location of the deployment site is presented in Figure 2-1. The meter was retrieved three weeks after deployment (14th July).



Figure 2-1 Location of the recording stations off the Wicklow Coast

The Aquadopp current profiler sits on its own mooring on the seafloor looking up into the water column and records current speed and direction at set distances above the transducer head. Prior to deployment the profiler was calibrated and set up to record currents in one meter bins above the transducer heads every ten minutes. The upright stable condition of the profiler was checked by diver following deployment and prior to retrieval. Water depth and tidal variations were recorded at each location with the internal pressure sensor that is inbuilt in the profilers.

A Windsonic anemometer was deployed on land close to the site to record wind data during the same time period.

3. Results

3.1. Introduction

All data recorded by the meter during the hydrographic survey south of Arklow are included as Excel files and accompany this report.

Visual inspection of the Aquadopp profiler prior to retrieval found that the meter was still in an upright state and in a similar condition as it was when inspected after deployment. All data records were of good quality.

3.2. Tidal Variation

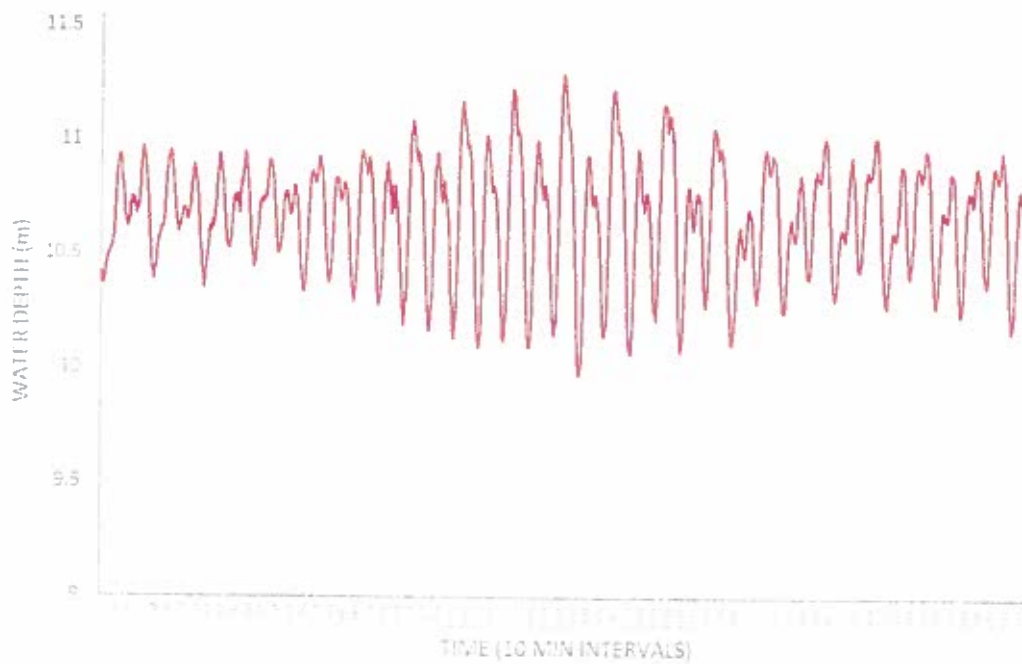


Figure 3-1 Tidal variation recorded by the Nortek Aquadopp, 25th June to 14th July 2015

The Aquadopp was located in approximately 10 m water depth and the tidal range recorded over the deployment period is presented in Figure 3-1. Maximum range during a spring tide was just over 1.2 m while the range during neaps was just under 0.3 m.

3.3. Currents

Current speed recorded at three depths from 25th June to 14th July 2015 are presented in Figure 3-2. Maximum current speeds recorded sub-surface, mid-water and off bottom were 1.08 ms^{-1} (2.16 knots), 0.97 ms^{-1} (1.94 knots) and 0.70 ms^{-1} (1.4 knots), respectively. Maximum currents were recorded during spring ebbing tides at all depths.

Horizontal current vector scatter plots from sub-surface, mid-water and off bottom (Figures 3-3) show a west-southwest to east-northeast directional trend at all depths.

Cumulative vector plots from sub-surface, mid-water and off bottom (Figures 3-4) indicate a residual flow to the southwest at all depths.

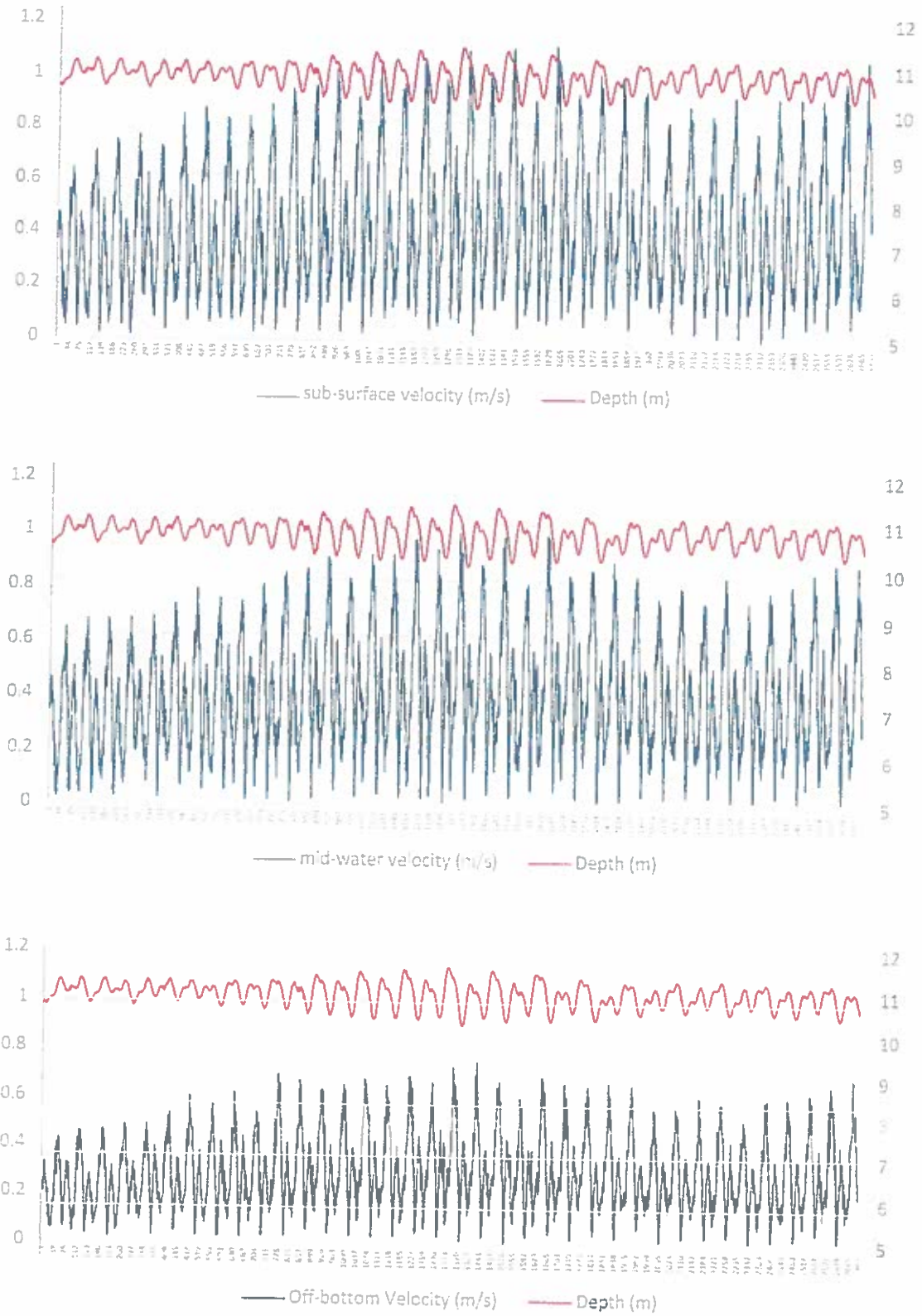


Figure 3-2 Current speed recorded at three depths, 25th June – 14th July 2015

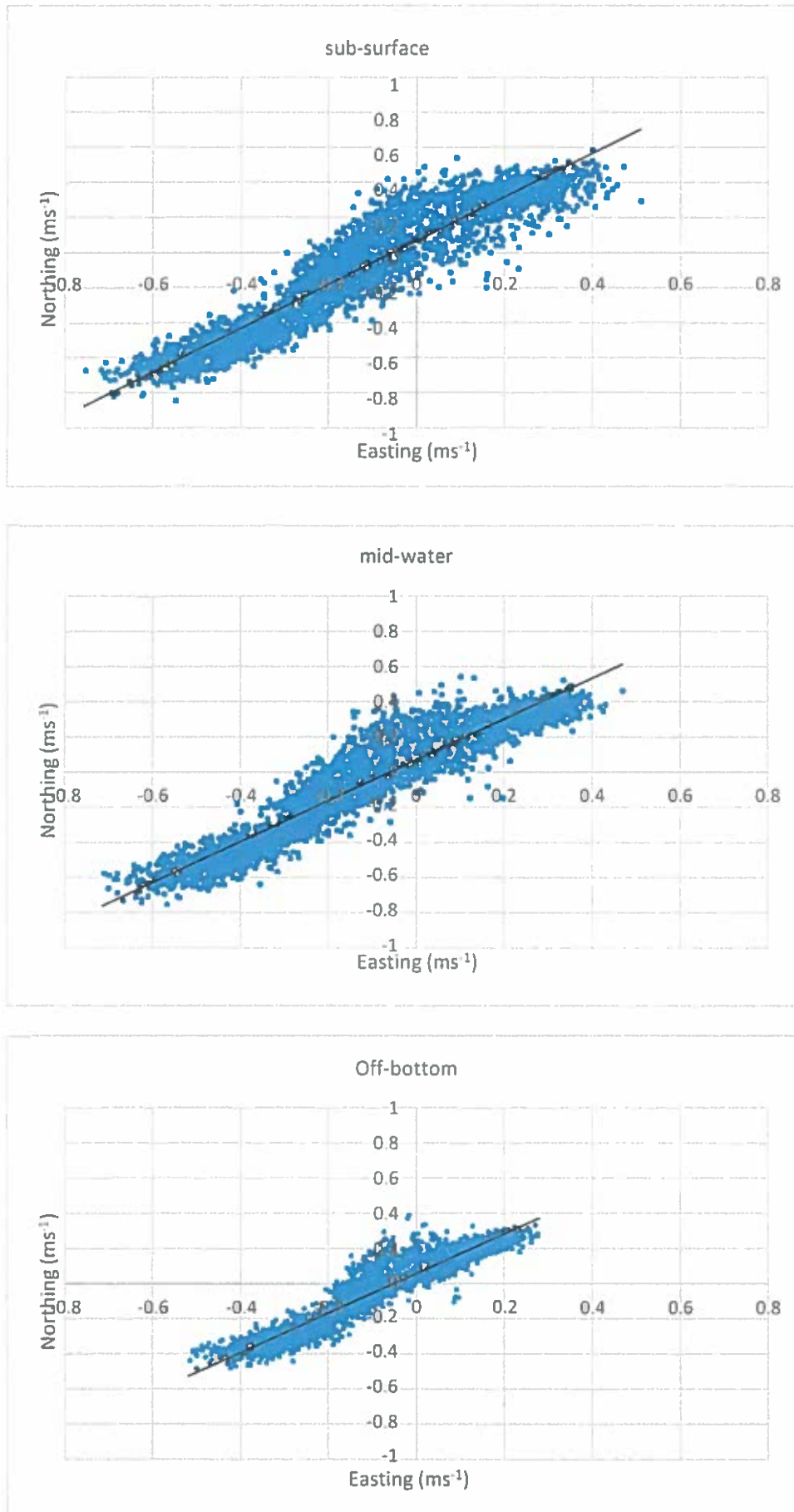


Figure 3-3 Water current vector scatter plot, 25th June – 14th July 2015

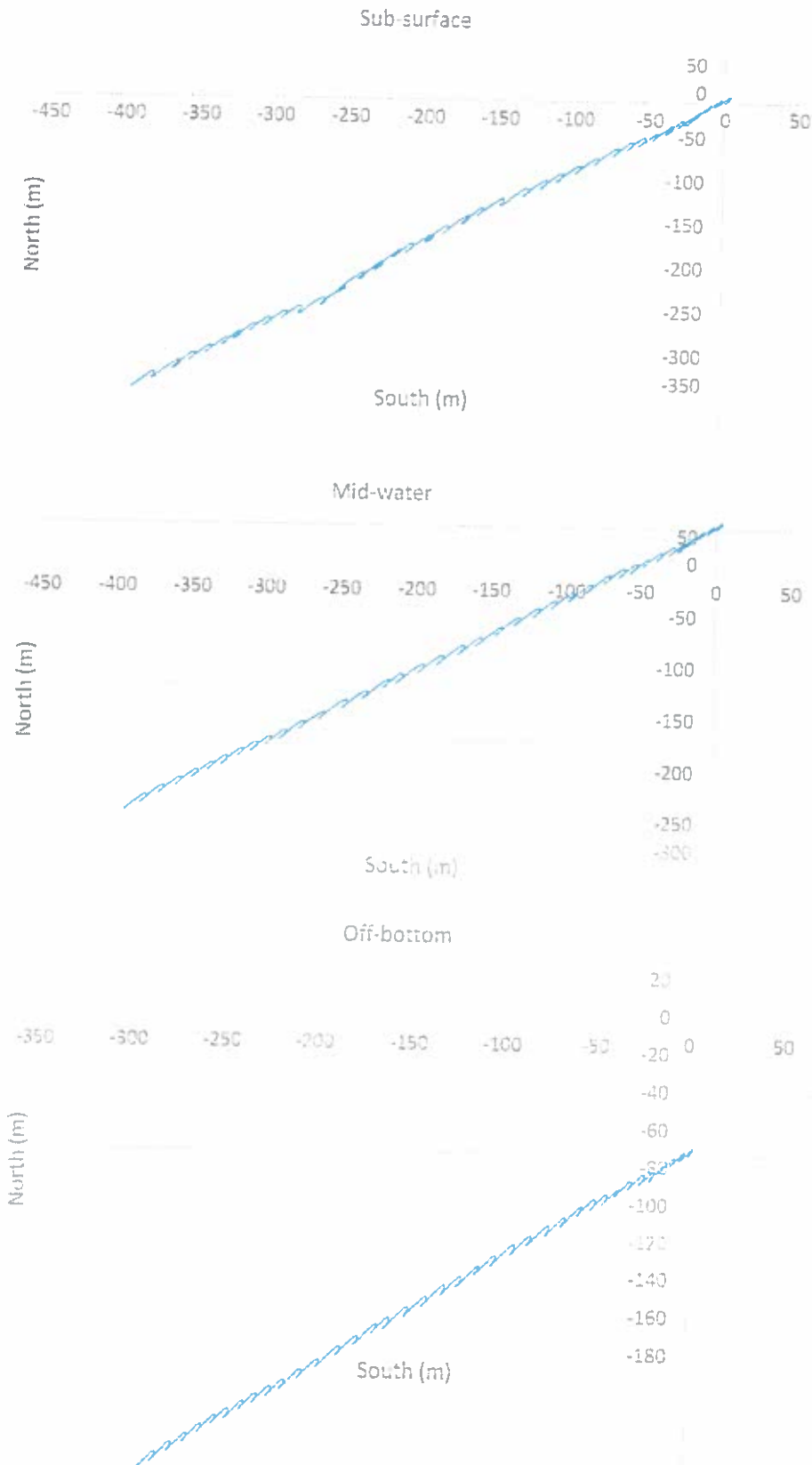


Figure 3-4 Current cumulative vector plot for three depths, 25th June – 14th July 2015.

A summary of current velocity and direction from sub-surface, mid-water and off-bottom are presented in the following three roses. Current direction is to the direction shown. It is clear that the predominant current is to the southwest at all depths.

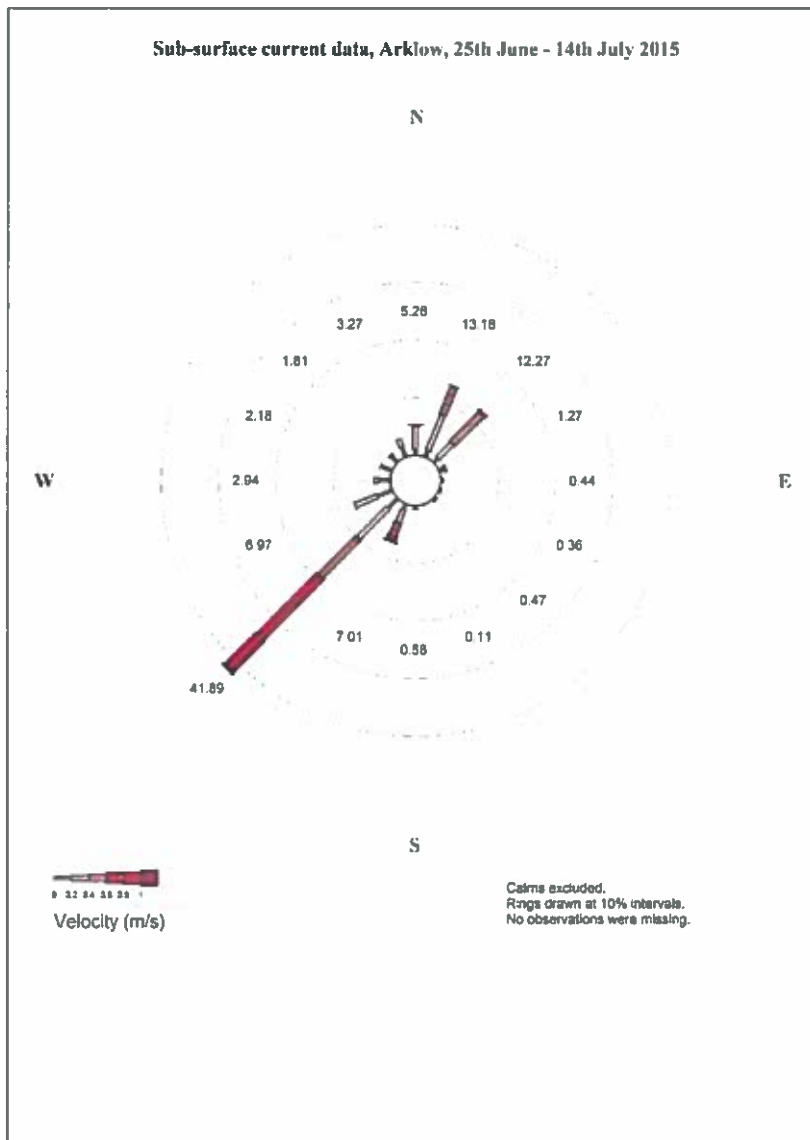


Figure 3-5 Sub-surface current velocity and direction recorded from 25th June to 14th July 2015.

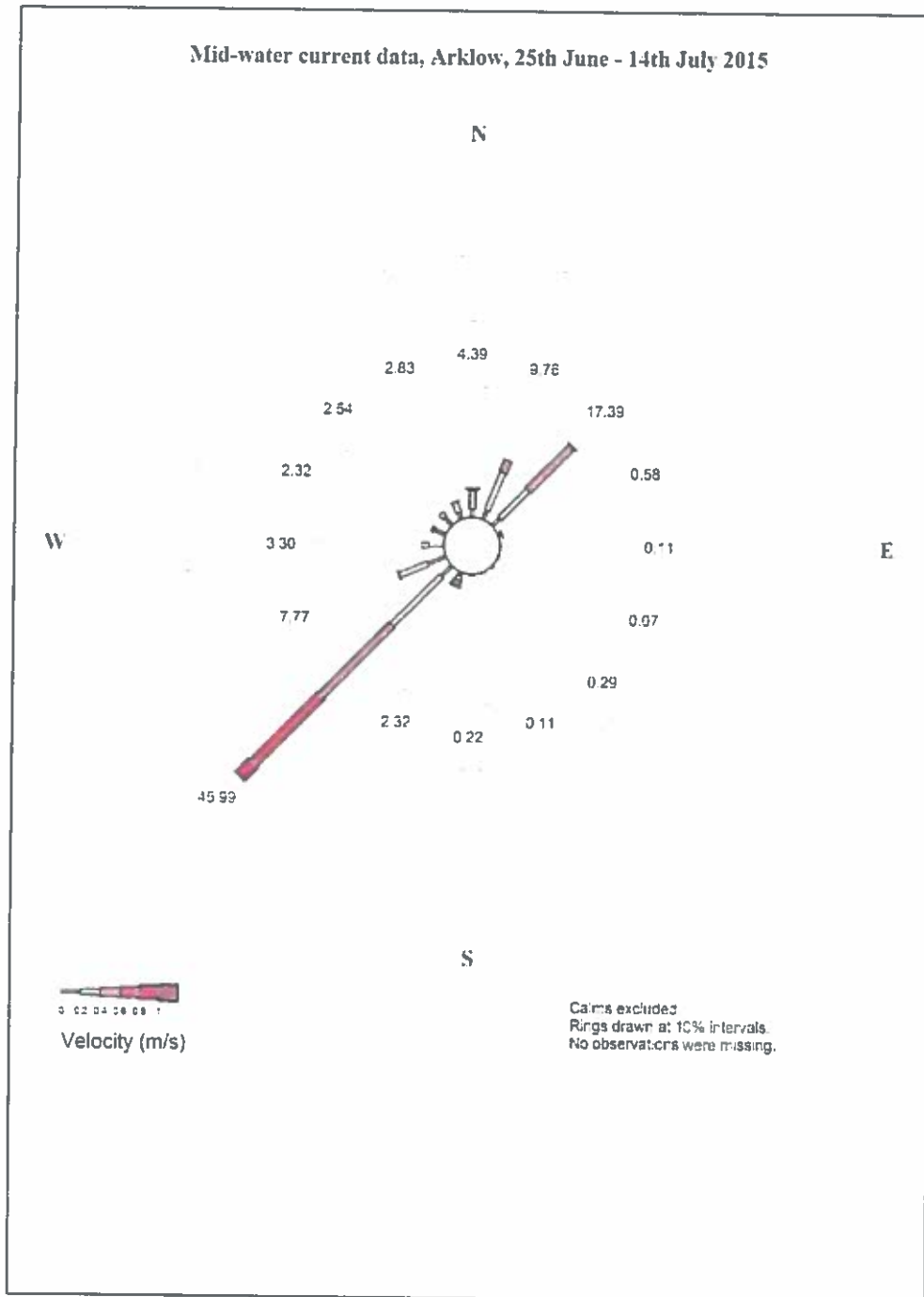


Figure 3-6 Mid-water current velocity and direction recorded from 25th June to 14th July 2015.

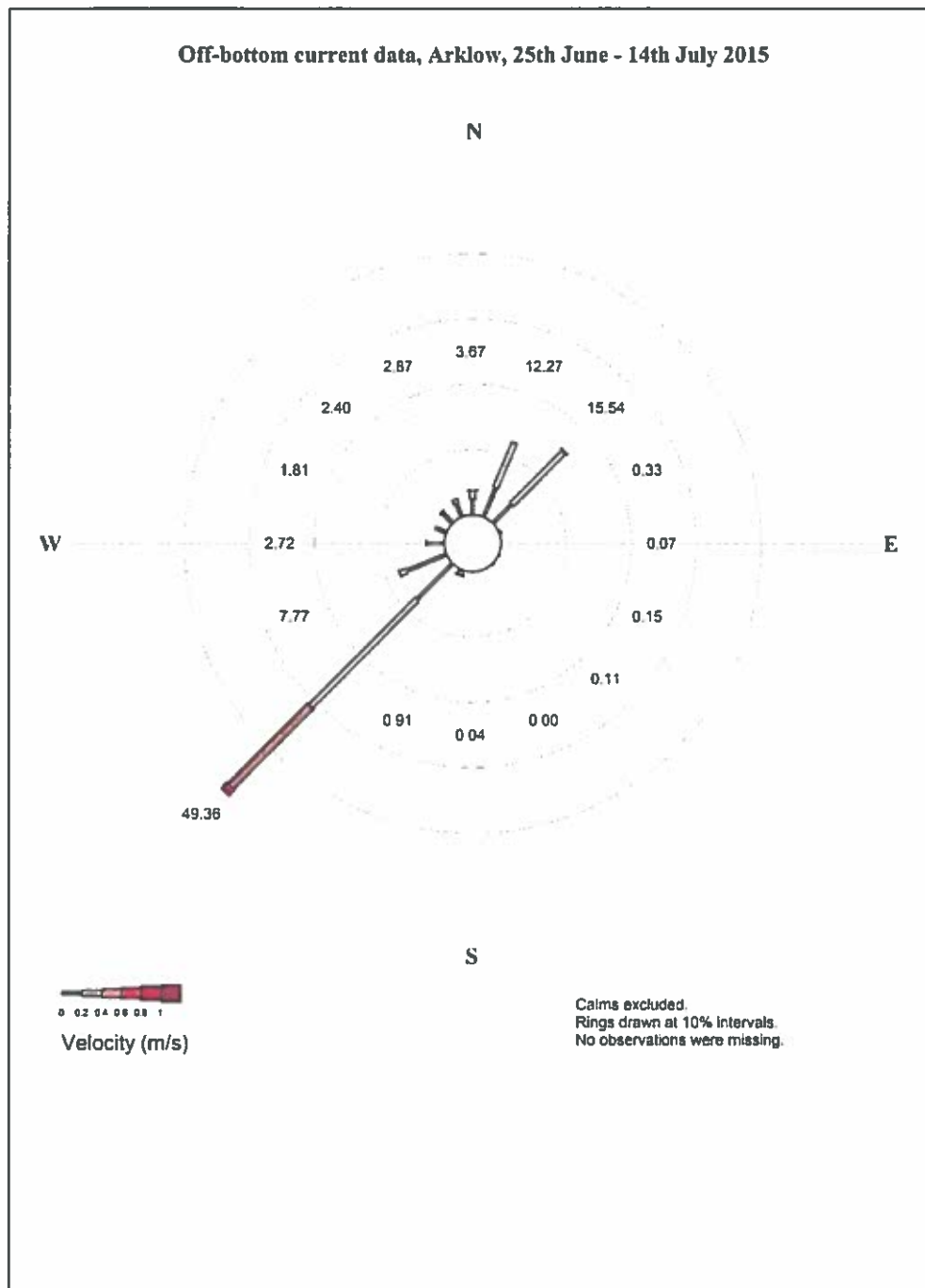


Figure 3-7 Off-bottom current velocity and direction recorded from 25th June to 14th July 2015.

3.4. Wind Data

Figure 3.8 presents a wind rose outlining wind speed and direction recorded during the water current study (25th June – 14th July 2015). In general, the wind was from the west at less than 10 kmh⁻¹. Analysis of the current data as detailed above would indicate that wind had little impact on direction or velocity of the tidal currents. Note: unlike water current roses, the direction of the wind is from the direction shown.

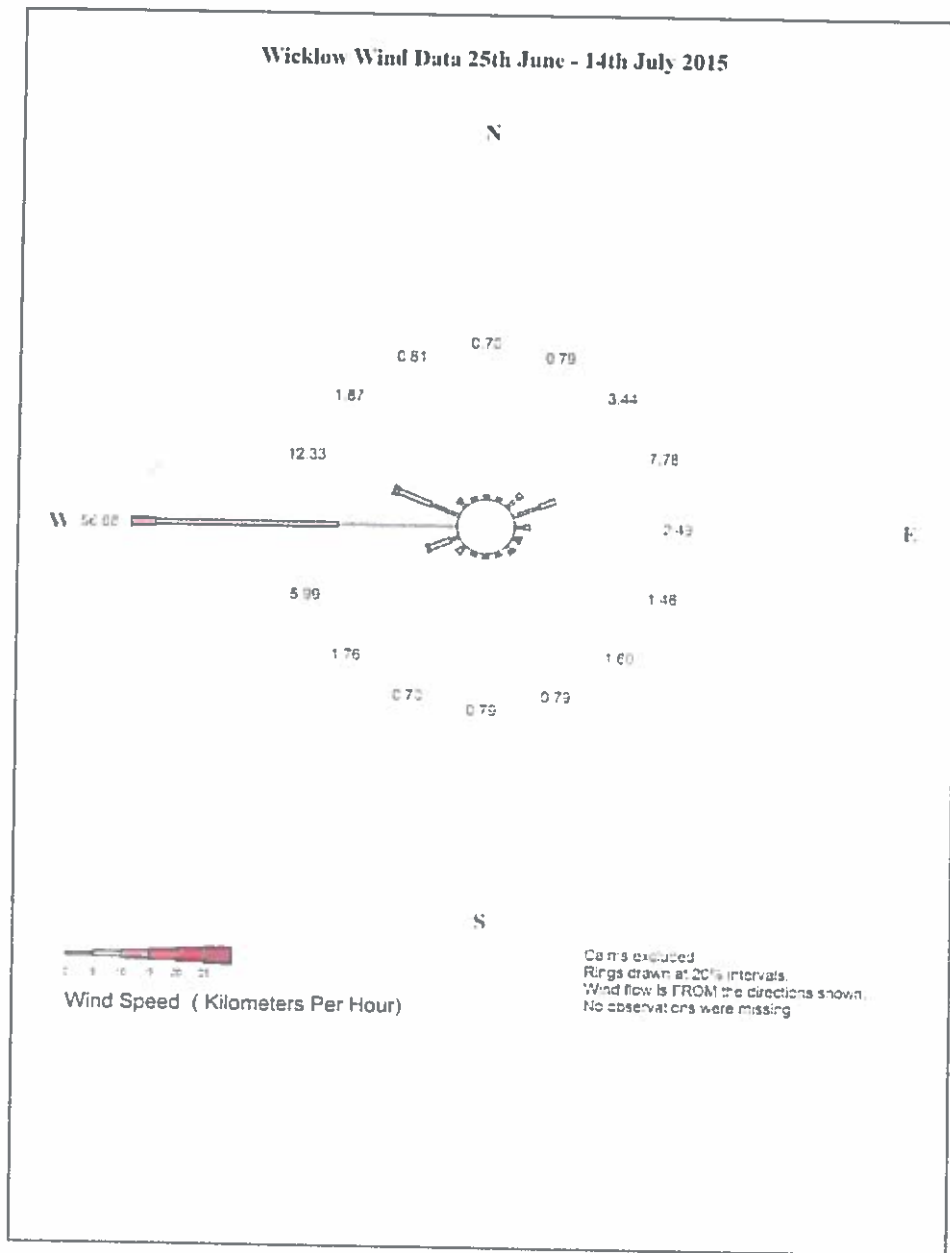


Figure 3-8 Wicklow wind speed and direction recorded from 25th June to 14th July 2015.

9.

Installation and Operation Procedure



IMSC – T32/27

2/20/2018

Installation

The system being employed by IMSC is the New Zealand continuous long line system. This system has been designed to withstand hurricanes. It does so by semi-submerging with extreme force and is industry standard across the globe. Ireland has existing sites using this method. Once the force is reduced the buoyancy allows the long-line back to the surface.

The element specifications are contained in the equipment list. This document will not break down the installation into lengths of time as this would require a fixed date of ordering equipment and is licence dependent. The average build time is 6-8 months.

IMSC will be hiring equipment from the UK (Offshore Shellfish Limited, use the same anchors) to install anchors. Fielder Marine consultants install all anchors on site. IMSC provide a suitable vessel with skipper and deck hand. Hydraulic power (50L/min 2000psi), GPS with farm co-ordinates loaded, Anchor Ropes and Floats. Full anchor installation will take a total of 21 days to include two days for boat loading and set up.

Ropes will be supplied by Quality Equipment Limited and will arrive in Ireland in Containers to Dublin Port. It is the responsibility of IMSC from that point. They will be transported by road and contents will be unloaded and stored securely by IMSC ready for installation.

Floats will be supplied by Gem Plastics Limited and delivered to IMSC at Arklow harbour.

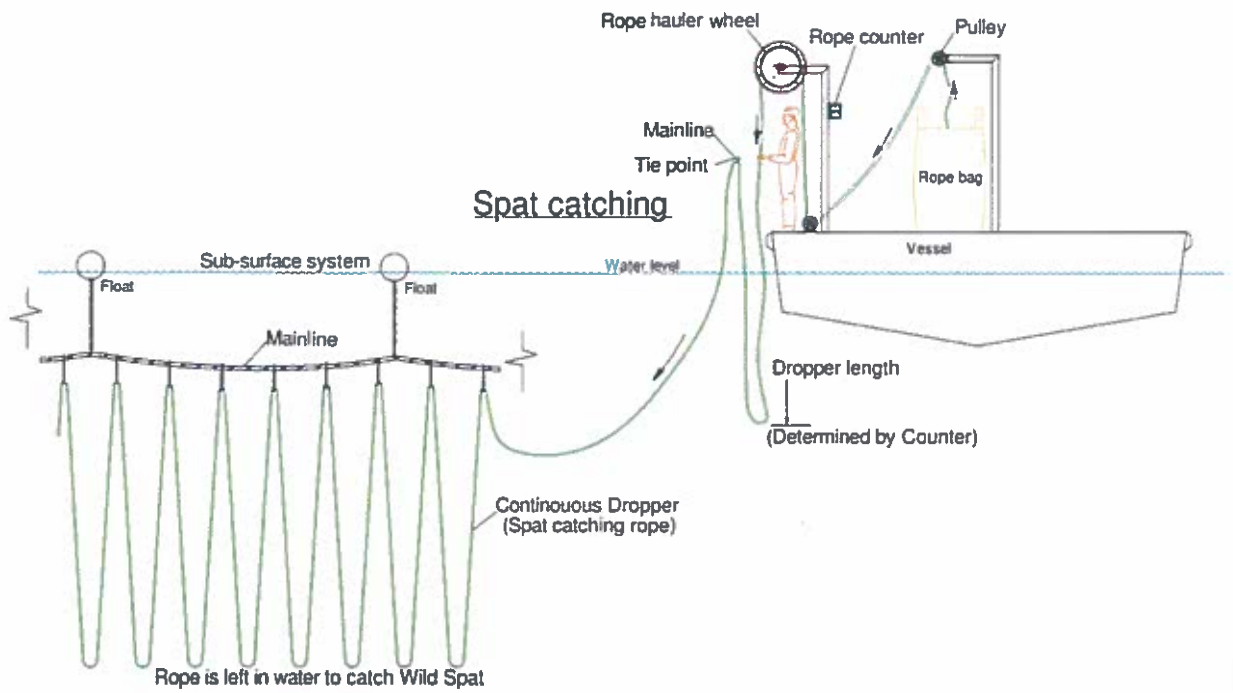
Navigational Buoys will be provided by (JSL Limited) and delivered to Arklow harbour.

IMSC will purchase a vessel which is fit for purpose and retrofit with all new equipment. The exact vessel specifications are not set out because availability of vessels are continuously changing and will not be identified until the licence is granted. Anasco Limited will retrofit the vessel and have provided an example of the layout of equipment. IMSC have a preferred design of vessel and will overtime aim to replace our original vessel with a purpose built one. The specifications of all equipment being sourced from Anasco Limited are contained in the equipment list.

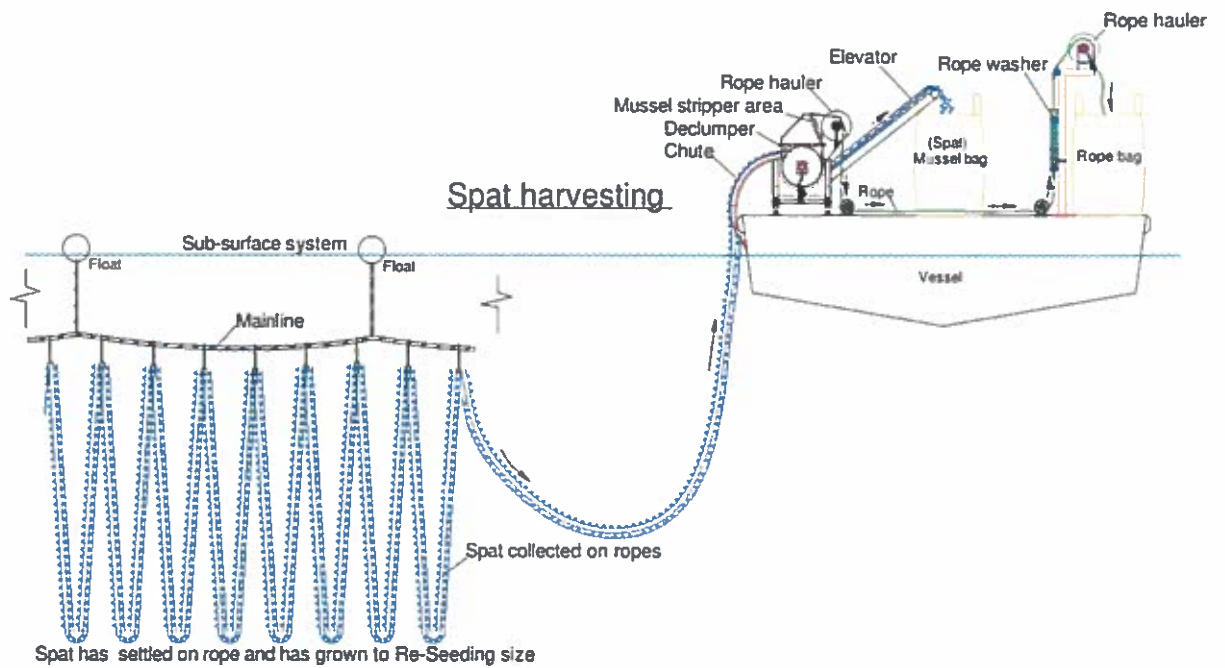
Once the anchors and anchor warp are installed the backbone (head rope) and buoys are attached and await spat collector ropes. Spat collector ropes are only in the water for the spat settlement period (end of March/start of April) and remain until harvest in October/November of that same year. Once the spat collector rope is harvested it is cleaned, brushed and bagged for maintenance on land. Regular maintenance checks of the area will be undertaken. Checks are undertaken to ensure security of the high economic investment in the structures. (Maintenance is discussed further in the Code of Practice)

The following diagrams simply describe the process of putting out spat collectors and harvesting;

System of putting spat collectors onto the mainline.



System of Spat harvesting.



Site for storage and maintenance on land

IMSC is currently in negotiation with Wicklow County council with regard to possible sites for storage and maintenance of equipment. This is dependent on the success of this licence application.

Aquaculture Consultant

IMSC will employ the expertise of Fielder Marine in anchor installation but also the installation of ropes, buoys and running of the farm for the first two years. This will then be reviewed and extended if necessary. IMSC will second an experienced member of the Fielder Marine Team to Ireland for this period of time.

Background to Fielder Marine

Fielder Marine Services Ltd, formerly Coromandel Dive, has been operational in New Zealand for 16 years. The primary focus of the company is in servicing the Aquaculture Industry. Our core businesses are Screw Anchor installations, farm design, consultancy, underwater maintenance and commercial diving. Fielder Marine Services have also installed marine farms in Australia and Europe and provide our clients with ongoing advice and developmental support. Graham Fielder, one of the directors of the company, has an honours degree in Marine /Mechanical Engineering and brings a wealth of international experience to the business. Graham began working in the English Royal Navy (RCNC), then as a construction diver and a Field Engineer within the oil industry, before moving to New Zealand and concentrating on Aquaculture.

Screw Anchors and Rock Anchors

Screw anchors are a proven technology that has been used in the anchoring of marine farms for many years now. Not only are the anchors cost effective, they also provide an environmentally friendly mooring system which minimizes disruption to the seabed.

Fielder Marine Services Ltd has developed and hold patents in an underwater screw anchor system, in which the entire drilling rig is portable. This enables installations to be carried out from most vessels currently used in the aquaculture industry without the use of divers and gives our clients the option of using their own vessels. FMS have also developed and patented a rock anchoring system, we can now offer the same benefits as screw anchors in ground consisting of rock.

All anchors/moorings are positioned using a Trimble differential GPS system, giving sub meter real time accuracy.

Installing the FMS system has allowed our clients to re-evaluate how they have traditionally worked their farms.

FMS provide and install around 95% of all Mussel farming anchors in the North Island of New Zealand, with over 3000 anchors currently holding Mussel Lines, Pearl lines and ship moorings.

Underwater Maintenance

The company services and maintains the majority of the marine farm underwater structures in the Coromandel, with the emphasis being placed on preventative rather than reactive maintenance. FMS's 'asset protection' service minimize crop loss and line breakages, ensuring that the Aquaculture farmers get the maximum harvest possible. Our underwater profiling survey's, help the Farmers to understand the underwater stresses on their farms, and work out effective management systems to ensure maximum productivity.

Commercial diving

FMS carry out commercial diving contracts for a number of Councils and Companies.

Fielder Marine Services and Eastern Sea Farms

First true offshore mussel farm

Location 6miles east of New Zealand, open ocean, 9m swells. Depth 45-55m

Fielder Marine Services were approached to install the initial 10 screw anchors (5 lines) for Eastern Sea Farms as well as being involved in the design and orientation of the initial farm.

Lines were installed Oct 2010 each line is 500m anchor to anchor with 250m of backbone on each line and around 3000-4000m of spat catching rope hung out on each of the lines. We set the lines as semi subsurface with the backbone 4m below the surface.

It soon became apparent that without ongoing involvement by FMS the aims of proving the feasibility of an offshore farm were not going to be achieved. With Graham Fielder's experience of practical marine farming, we were asked to take on the day to day operation for the Eastern Sea Farms, as well as consultancy on the practical application of 'Open Water Farming' and development of new techniques and products to deal with this exposed open water environment.

FMS carried out the work on the farm for the next four years before turning over a working model to the owners.

Now in 2016 we have 48 lines in the water with a further 96 planned for later this year

The lines have performed very well over the last 6 years with storm seas up to 8m annually, FMS have worked on improving the design, learning more about the mussel cycle offshore and working on minimising wear and tear on the structure.

Offshore Shellfish LTD South Coast UK

Location 12miles from Weymouth 3-5 miles Offshore English Channel depth 24-28m. Fielder Marine Services were approached by John Holmyard from Offshore Shellfish ltd in around 2010. After initial consultation and legislative work we installed the first trial lines in 2013, despite some of the worst winter storms for over 100 years lashing the south coast they have had no line damage. Offshore shellfish currently have around 60 lines installed with a further 150 planned for this summer. Each line is moored with one FMS aquaculture anchor each end and carries on the knowledge acquired from Eastern Sea Farms.

Paspaley Pearling Intl Ltd Australia depth 12-45m

Location Northern Territory and Western Australia. FMS have worked with Paspaley for nearly 8 years, with over 10,000 lines in the water in 2008 spread over some of the most hostile and remote coastline in Australia they needed a reliable way to anchor their farms and to Cyclone proof them.

FMS have provided the anchors, the drilling equipment plus the expertise to start a systematic overhaul of their farm structures, starting with the traditional 100m lines and now installing 800m plus lines the FMS aquaculture anchors plus FMS rock anchors have brought increases in efficiency and cyclone proofing never before achievable.

Catalina Sea Ranch USA

Location 3miles offshore Los Angeles California depth 55m. FMS are working with Catalina Sea Ranch to install the first Open Ocean Mussel farm in the USA. With the anchors arriving on site in May 2016 once their Mussel farming Vessel is completed the first Offshore Farm in the USA will be installed using FMS aquaculture anchors.

END

Equipment List - IMSC



T32/27

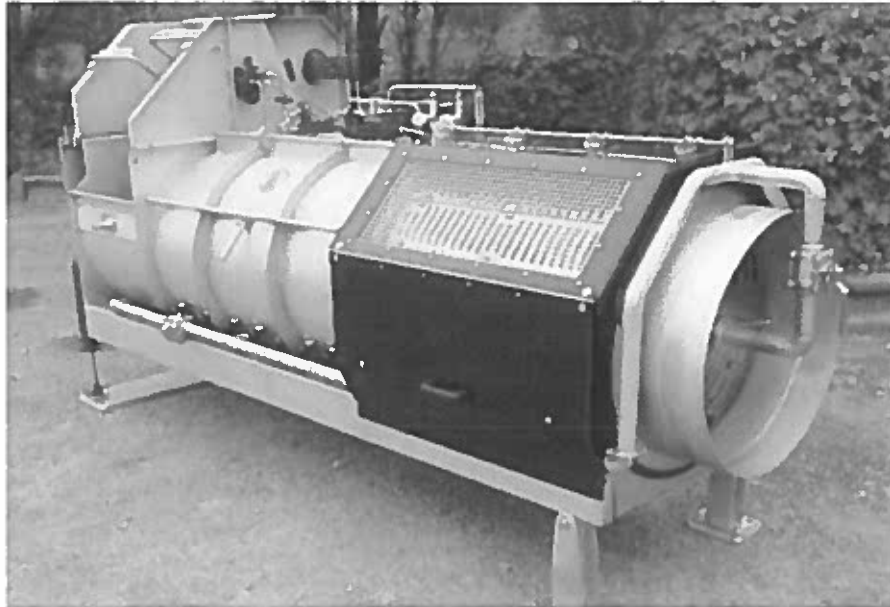
This document describes the equipment which will
be operated by IMSC

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Winch Davit	Error! Bookmark not defined.
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The purpose of this document is to outline the equipment used by Irish Mussel Seed Company in relation to application T32/27. Each piece of equipment will be maintained in accordance with usage and manufacturers guidelines.

Declumper AND 750



Includes:

- 10 to 12 ton/hr capacity
- Ø750mm De-clumping drum
- 950mm long Washing screen
- 1x bolt-on perforated adjustable screen (2mm to 15mm)
- 3x drive motors (De-clumping drum, Screen & Hauling wheel)
- Independent screen drive
- Stainless Steel Hauling wheel with rope stripper
- 25mm thick rubber rope strippers
- Three cleaning access doors with safety isolator
- Hydraulic plumbing & controls with SS fittings
- Manual leg tilting system (standard) Hydraulic option as per above
- 3x water control valves
- Mounting plates to weld to deck for legs
- Hydraulic requirements: 110 litres/min @ 60 bar

Declumper Infeed Chute



Includes:

- Stainless steel construction
- Hinging mounting brackets
- Lifting handles

Declumper / Bag Elevator



Includes:

- Stainless steel construction
- 500mm wide belt x 3300mm long
- Bag filling height range from 550mm to 1700mm
- Plastic modular belt with 75mm high upstands
- Hydraulic drive motor & hydraulic controls
- Lifting ram with hydraulic controls (access both sides of conveyor)
- Pivot mounting plate (for manual pivot only)
- Hydraulic price based on pressure compensated system
- Hydraulic requirements: 8 litres/min @ 1500psi

Grader Elevator



Includes:

- Stainless steel construction
- 400mm wide belt
- PVC heavy duty belt with bolt on Uhmwpe flights
- Hydraulic drive motor & hydraulic controls
- Mussel spreader chute on to grader

Rope Washer Hauler Post



Includes:

- Galvanised steel construction
- 2x Idler wheels -SS Hauler wheels
- Rope peeler knife
- 30 cube hydraulic motor
- Hydraulic plumbing (flow control & ball valve)
- Adjustable bag frame -Alloy / mild steel weld on doubling plate

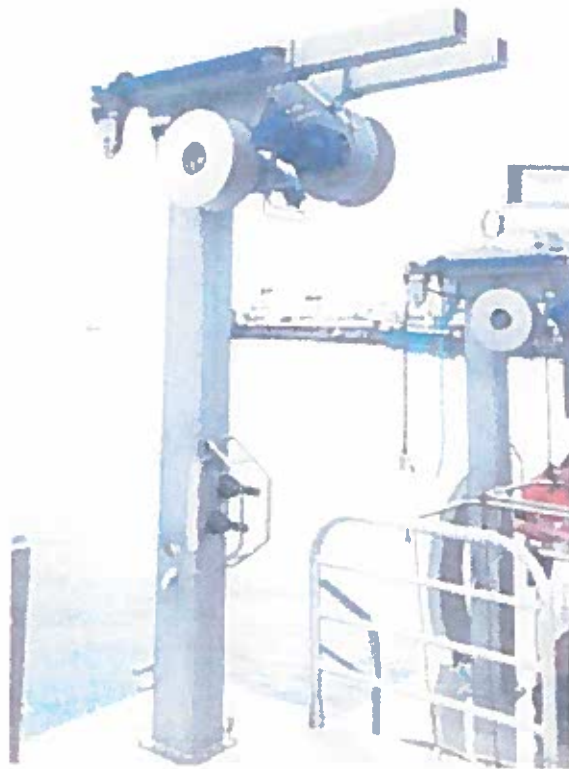
Seeder ANS650



Includes:

- Stainless steel construction
- Hopper volume = 0.65m^3
- Mechanical counter for dropper length
- Hydraulic plumbing & controls
- Marinised hydraulic motors
- To suit 75, 90 & 110mm PVC pipes
- Hinging Drive wheel bracket (for storage & access)
- Fully adjustable PVC pipe support bracket
- Quick release system for PVC pipes
- Hydraulic plumbing is priced for Pressure compensated pump
- Hydraulic plumbing for Fixed pump

Winch Davit



Includes:

- Brevini braked gearbox with 200cc hydraulic motor
- Certified design 1500 kg SWL per arm -Galvanised steel construction
- 250x250mm SHS posts -Twin winch drums
- Twin 800mm telescopic extension (hydraulic)
- Stainless steel deck mounting flange with steel doubling plate
- Rope tie off hooks
- Hydraulic hose work inside davit post.
- Hydraulic hoses to the rams and motors (SS tube work shown in photo)
- Hydraulic control valve

Mussel Floats

Description:

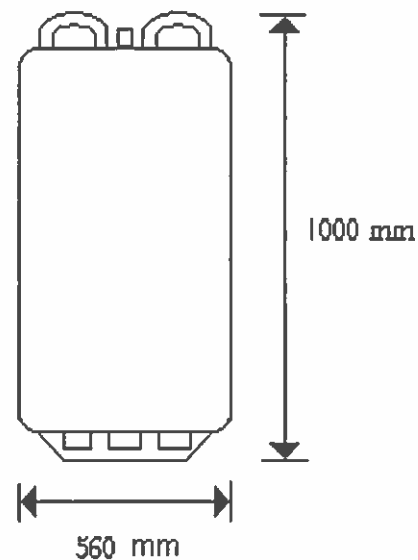
Aquaculture 'Mussel' Float (200 Series)

Method of Fabrication:

Extrusion Blow moulded.

Materials:

Body	High Density Polyethylene
Closure	Brass valve with Stainless Steel screw stud
Gasket	EPDM



Colour: Grey ref. 17736

Dimensions in mm:

Overall Height	1000 mm +/- 20 mm
Float Diameter	560 mm +/- 20 mm

Tare Weight: 10 kg

Nominal Capacity:

220 Litres

Pressure

0.2 Bar is introduced by Gem Plastics Limited prior to dispatch.
It is recommended that this pressure be maintained during the working life of the float.

Sub Sea Floats

Lines are set up with a combination of surface floats and smaller subsea heavy-duty PPE floats. These floats are either hard tied, or short dropper tied to the anchor warp for the purpose of providing tension should it be required. PPE floats are heavy walled, injection moulded with various working depths from 40mtrs to 100mtrs depending on the size. Eyes or lugs in these injection moulded floats are solid plastic, offering very strong rope supports and extremely long life. These can be seen on the single long-line layout drawing.



Farm Ropes, Anchor Warps and Mainlines

Spat Catching Rope

- Spat Catching Rope extra heavy duty, Loop or cut.6L x 2000mtrs
- Cut Loop Spat Extra Heavy Duty. 5L, or 6L.
- Cut Loop Spat Catching,
- 18mm core x 2000mtr Carbon Black, 55-65mm de-waxed cut trims,
- PVC coated wires as required in core.



Dewaxed highly fibrillated fibres, formed in a net like structure, simulating natural algae environments.

Maintenance

After harvest the Spat catching ropes and harvest ropes are washed and brushed. The ropes will be inspected, and where necessary old lashing and or fouling is removed. The ropes are transferred from one bulk bag to another allowing the operator to visually inspect the ropes and to make sure it has not acquired any torque from the harvesting process. Brushing has the added advantage of re vitalizing the cut or loop trims to ensure the best presentation to the mussels when re deployed.

Anchor Rope and Mainlines

- UV treated. HI Fib De wax
- Durashield 32mm, Hard lay, Carbon black, 32mtrs x 175mtrs
- 32mm x 220mtr Medium or Hard Lay Carbon Black or Std Colours,
- B/load 16800kg, weight 106.05g



Lashing Ropes for Droppers

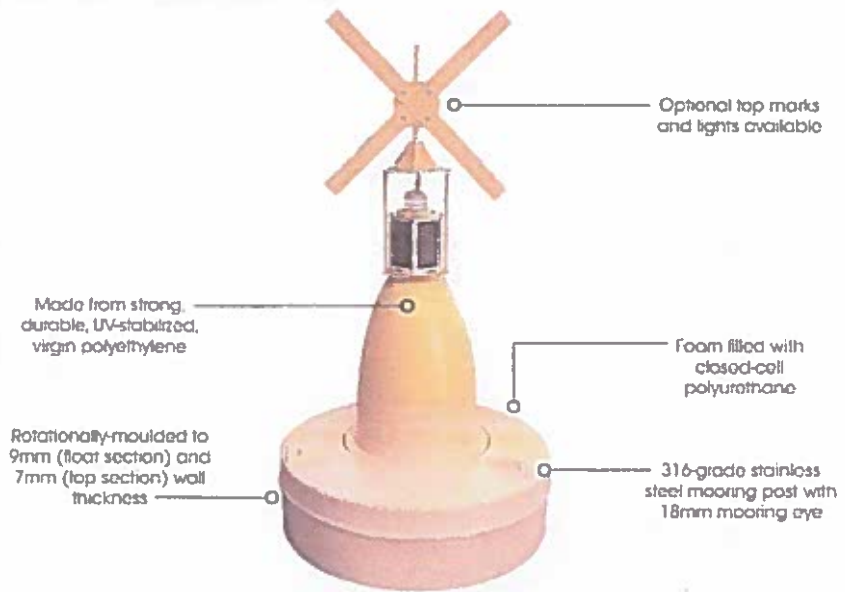
Danlash, 5mm x 500mtr Soft Carbon Black with Red fleck B/load 465kg,
weight 5.50kg



Navigational Buoys

SL-B1 250

Sealite have a range of mooring chains & accessories - ask your representative today how we can supply your complete mooring solution



The Sealite Advantage

- Single piece float
- Complete unit - ready for immediate installation
- High visibility red, green, white or yellow as per IALA recommendations
- 316-grade stainless steel eye bolt for strong mooring chain attachment point
- Excellent buoyancy & stability

The SL-B1250, 1250mm dia. Navigation Buoy, has proven its superior performance in many parts of Australia and around the world for long-range river and sea navigation.

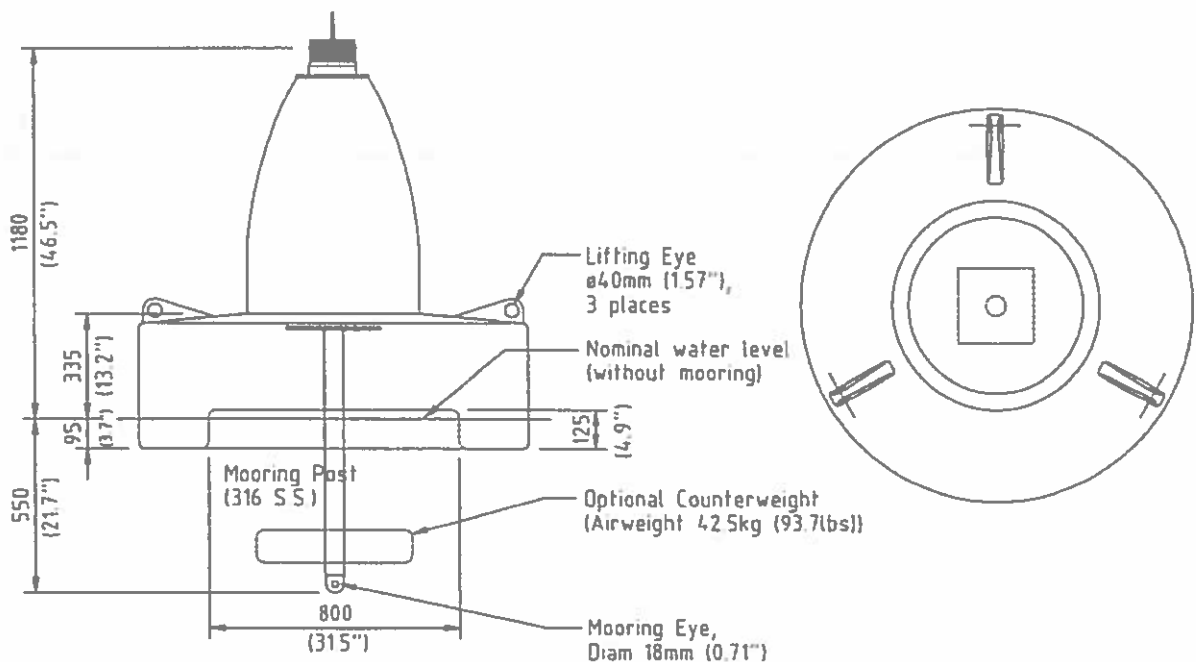
The base is moulded in one-piece, strong, coloured, durable polyethylene - filled with closed-cell polyurethane and UV-stabilized for resistance to sunlight

The strong, lightweight polyethylene buoy top is moulded in standard IALA high visibility colours and shapes to suit a range of installation requirements.

For superior night visibility, the SL-B1 250 navigation buoy may be fitted with a range of Sealite solar LED mono lanterns up to 5NM+.

Brass inserts provide a secure mounting for top, tower and signs. A 316-grade stainless steel eyebolt passes through the base providing a strong mooring chain attachment point

In addition, all hardware and fittings are 316-grade stainless steel.



SPECIFICATIONS ** SL-B1250

General Characteristics

Available Colours	Red, Green, White, Yellow as per IALA Recommendations
Focal Plane Height (mm/inches)	1180 / 46 ¹ / ₂
Total Float Volume (ltrs/US gallon)	610 / 161
Nominal Freeboard (mm/inches)	335 / 13 ¹ / ₈
Nominal Draft (mm/inches)	550 / 21 ² / ₃
Reserve Buoyancy (kgs/lbs)	155 / 342
Maximum Mooring Load (kgs/lbs)	155 / 342
Draft, Maximum (mm/inches)	675 / 26 ² / ₃
Freeboard, Minimum (mm/inches)	210 / 8 ¹ / ₃
Submergence (kg/cm, lb/inches)	12.5 / 70
Visual Area (m ² /ft ²)	0.8 / 8.6

Physical Characteristics

Material

Rotationally-moulded UV stabilized virgin polyethylene,
316 grade stainless steel mooring pole

Wall Thickness (mm/inches)

9 / ³/₈ (float section), 7 / ¹/₄ (top section)

Ballast (kg/lbs)

30 / 66 external counter weight (optional)

Filling

Closed-cell polyurethane foam (float section)

Height (mm/inches)

1180 / 46¹/₂

Width (mm/inches)

1250 / 49¹/₄

Mass (kg/lbs)

70 / 154

Product Life Expectancy

Up to 12 years

Certifications

Quality Assurance

ISO9001:2008

Intellectual Property

Trademarks

SEALITE® is a registered trademark of Sealite Pty Ltd

Warranty *

1 year

Lantern Options

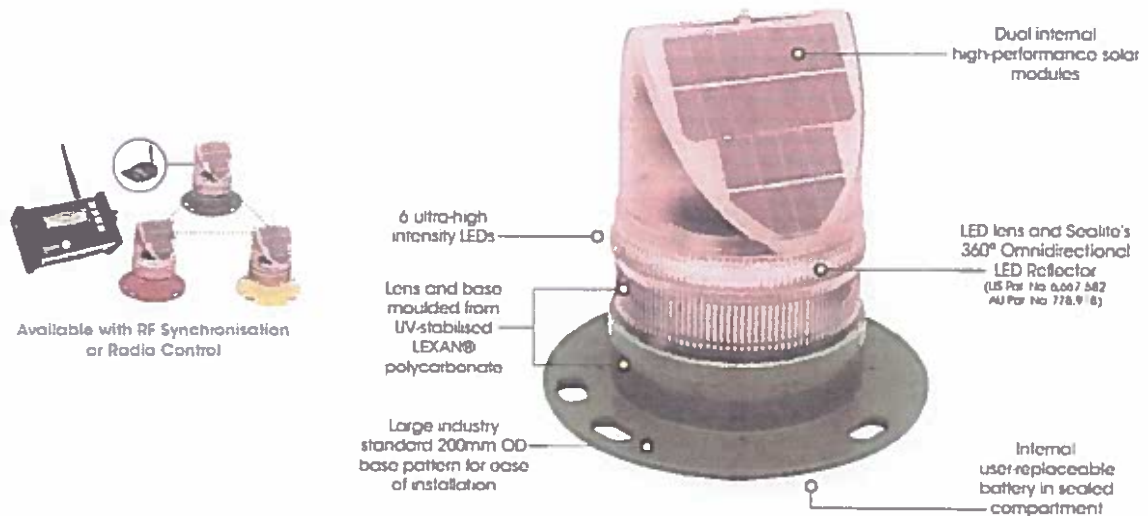
Sealite SL-15, SL-60, SL-70 or SL-C310 lantern

Options Available

- Mould-in graphics
- Sealite IALA recommended top marks
- External ballast
- Radar reflector

Marine Lantern

SL70



The Sealite SL70 is exceptional in its unique ability to be able to 'track the sun' and operate reliably in low sunlight conditions. The SL70 has been proven to operate as a 2-3+ nautical mile compact buoy lantern in various low sunlight environments such as Britain, Canada and Europe.

Made from tough, durable polycarbonate and using the latest high intensity LEDs, the SL70 lantern boasts dual high-performance solar modules incorporated into Sealite's world-first Solar Collection Lens. These solar modules are angled to obtain maximum sunlight capture, allowing the unit to operate reliably in a range of low sunlight environments.

The SL70 can be installed in minutes and requires no operator intervention. The flash characters are easily adjusted onsite by the user, and the lantern has a permanent ON/OFF switch for easy storage. Sealite's SL70 solar marine light has been awarded the prestigious Australian DesignMark® at the Australian Design Awards, a testament of Sealite's commitment to the ongoing development of state-of-the-art products.

Optional RF Synchronisation

The SL70 is available with optional short-range RF Synchronisation. Two (2) or more lights can be synchronised to flash in unison via an internal RF module. When lanterns flash in synchronisation they can be clearly distinguished from other navoids and confusing background lighting - ideal for rivers, marina entrances, channel marking and aquaculture.

Optional Radio Control System

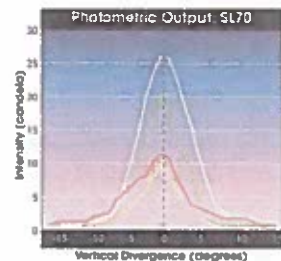
Radio control may be fitted to the SL70 model enabling users to remotely modify the setup of their lantern via handheld radio controller.

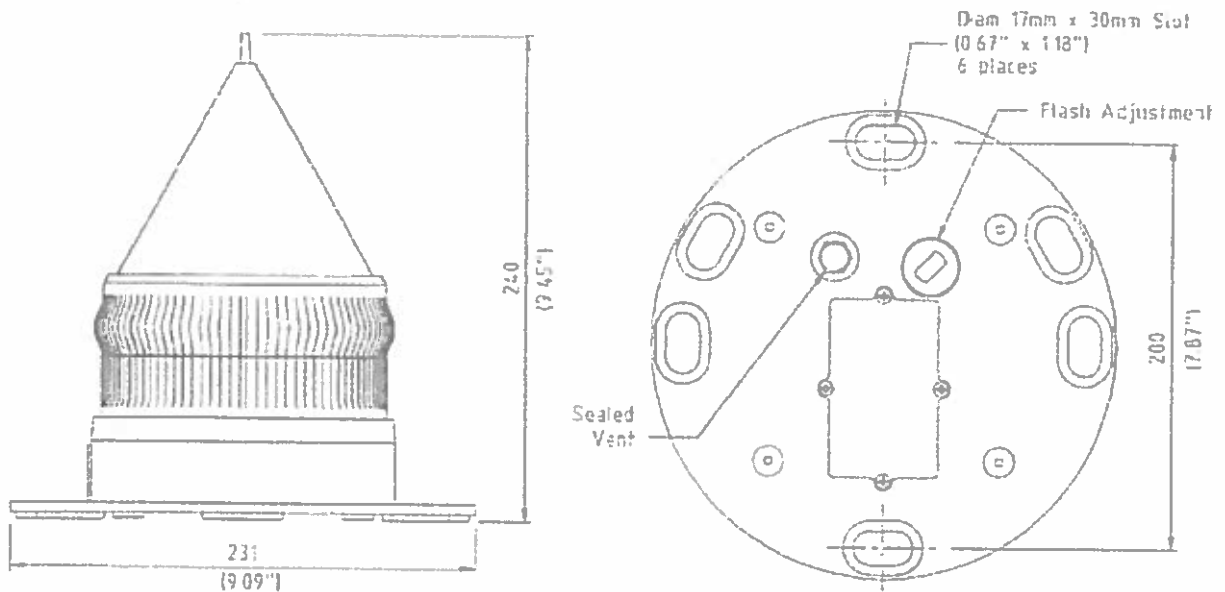
Optional 12 LED Light Configuration

In high sunlight regions the SL70 may be fitted with 12 LEDs and appropriate intensity settings to provide a range of >3 nautical miles (colour dependant).

Optional Larger Battery Pack

In regions where additional autonomy is required, the SL70 can be supplied with a larger 16Ah battery pack - this greatly extends the operational autonomy.





Light Characteristics

Light Source	6 ultra-high intensity LEDs
Available Colours	Red, Green, White, Yellow, Blue
Maximum Available Intensity (cd)†	Red - 11.4 Green - 20.0 White - 25.0 Yellow - 10.0
Visible Range (nm)	2-3+
Horizontal Output (degrees)	360
Vertical Divergence (degrees)	9
Reflector Type	Unidirectional 360° LED Reflector (US Pat. No. 6,667,582 AU Pat. No. 778,918)
Available Flash Characteristics	Up to 256 IALA recommended (user adjustable)
Intensity Adjustments	Adjustable in 25% increments
LED Life Expectancy (hours)	>100,000

Electrical Characteristics

Current Draw (mA)	Refer to Sealite Power Calculator
Circuit Protection	Integrated
Nominal Voltage (v)	3.6
Autonomy (days)	>30 (14 hour darkness, 12.5% duty cycle)
Temperature Range	-40 to 80°C

Solar Characteristics

Solar Module Type	Multicrystalline
Output (watts)	2.5 (2 x 1.25watt)
Solar Module Efficiency (%)	14
Charging Regulation	Micromicroprocessor controlled

Power Supply

Battery Type	High grade NiMH - Environmentally friendly
Battery Capacity (Ah)	8
Nominal Voltage (v)	3.6
Battery Service Life	Average 5 years

Physical Characteristics

Body Material	LEXAN® Polycarbonate - UV stabilised
Lens Material	LEXAN® Polycarbonate - UV stabilised
Lens Diameter (mm/inches)	150 / 5 7/8
Lens Design	External optics with interior flute design
Mounting	200mm OD base pattern
Height (mm/inches)	240 / 9 1/2
Width (mm/inches)	231 / 9 1/8
Mass (kg/lbs)	1.4 / 3 1/8 (SL70/16Ah 1.6 / 3 1/2)
Product Life Expectancy	Up to 12 years

Certifications

CE	EN61000-6-3:1997, EN61000-6-1:1997
Quality Assurance	ISO9001:2008
Waterproof	IP68

