Liquid Robotics, Inc.
Field Operations

MBARI SV3-011 “Tiny” BOG Timeseries Piloting Mission Plan

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instrument the ocean

Liquid Robotics – Field Operations
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1 EXECUTIVE SUMMARY

Client: MBARI

Mission Date Range: 01JUL2016 – 07JUL2016

21JUL2016-01AUG2016

Mission Point-of-Contact: Chris Wahl

Wave Glider Info: Qty 1 SV3-011, "Tiny"

Theater of Operations (UTC+/-#): Monterey Bay and nearby vicinity, UTC-7

Mission Description and Objectives: Run the BOG timeseries line (c1 to m1 to m2) while running science sensors

Special Operational Considerations: none, basic deployment

- ☒ Standard Piloting (pre-planned navigational/operational tasking), or
- ☐ Interactive Piloting (event-based navigational/operational tasking; non-standard device configuration / duty cycling regime [explain]

Operational Risk Assessment Summary: Client's mission involves risk inconsistent with LRI standard operating procedures that can only be partially mitigated. Client is aware of the following risks and is instructing LRI to proceed with Professional Services:

- Operations in known high vessel density areas (AIS and or non-AIS transmitting vessels) posing a risk to WG ops. There is recreational and fishing boat traffic in and around the Bay. Also, the offshore waypoints are near shipping lanes. Navigational aids (AIS, RTE, and visibility light) to be used to mitigate risk as best as possible.

	C1-M1-M2 line	Mitigation
• Navigational Authority	🟢	*see piloting tasks*
• Power Margin	🟢	
• Bathymetry	🟢	
• Vessel Traffic	🟡	
• Hazards to Navigation	🟢	
• Political Interests	🟢	

* Link to complete Operational Risk Assessment: *see* Appendix

Local Authorities & Permitting:

Request for publication in USCG-D11 Local Notice to Mariners submitted on 21JUN2016 for 27JUN2016 – 19AUG2016. See email attachment.

* Evidence of communications and or authorizations required: *see* Appendix

2 KEY STAKEHOLDERS

2.1 Points-Of-Contact

Client POC:	Chris Wahl Operations Engineer cwahl@mbari.org 831-775-1746	**Mission POC:**	Chris Wahl Operations Engineer cwahl@mbari.org 831-775-1746
Data QC:	Chris Wahl Operations Engineer cwahl@mbari.org 831-775-1746	**VP, Operations:**	Keith Kreider VP, Mission Services keith.kreider@liquidr.com +1 408 636 4277
Field Ops Eng./Tech:	Chris Wahl Operations Engineer cwahl@mbari.org 949-929-7598 (cell)	**WGOC Mgr:**	Marc Sallaberry Spvsr, Customer Support Operations marc.sallaberry@liquidr.com +1 408 636 4260
Acct Rep, or Channel Partner:	Chris Wahl Operations Engineer cwahl@mbari.org 831-775-1746	**WGOC:**	Pilot-in-Charge Mission Support Specialists opscenter@liquidr.com +1 408 636 4205

2.2 Roles and Responsibilities

Client Point-of-Contact: If deployment is on behalf of an external client, Client POC is the primary liaison to the Mission POC to coordinate mission objectives, and communicate deviations should they become required during fulfillment of mission objectives.

Mission Point-of-Contact: Primary liaison to client, and governing entity of the mission. Mission POC coordinates communications and personnel required to support the field deployment in conjunction with Field/Customer Support Operations. Mission POC authorization is required to affect mission objectives as well as manage any deviation requests subject to WGOC vetting for operational risk assessment.

Data QC: Ensures sensors and Wave Glider are properly integrated and operating consistent with mission objectives (prior to, and during field deployment).

Field Operations Manager: Coordinates and plans logistics of people, equipment, and vessels (responsibility may be fulfilled by Mission POC).

Field Operations Engineer/Technician: Personnel assigned to perform on-location work.

Wave Glider Operations Center Manager: Coordinates mission planning logistics, mission administration, and piloting operations of Wave Glider activities.

Account Representative/Channel Partner: Provides project oversight ensuring mission plan aligns with client's business needs.

Wave Glider Operations/Customer Support Call Center: Personnel assigned to perform shore-side piloting operations.

3 MISSION PLAN

3.1 Client Deliverables

Specific to Client PO (LR SO# ####)**; or Internal Demo/Test Plan**

Sortie 1: A successful mission will be achieved if we recover the vehicle in good condition and collect accurate data with science sensors on the BOG timeseries line

Device configurations: *see Device Configurations / Duty Cycling Regime*

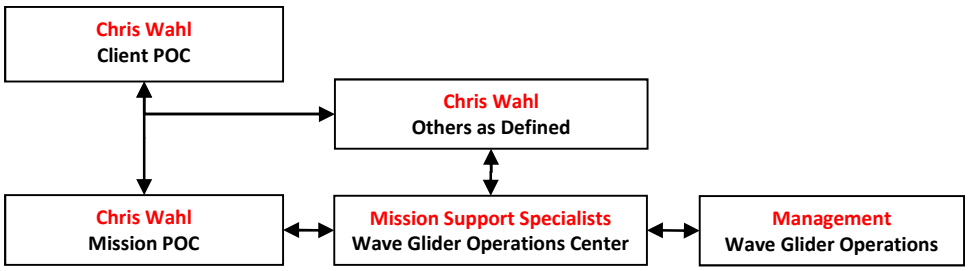
Professional Service: Piloting

Reports:

- Mission operations – **Not needed**
- Data delivery(if other than client accessible via WGMS)–**Not needed, if data server is online**
  - Raw data extraction (if required) harvested by [who] from vehicle devices post recovery operations [define what; format; method of delivery]

Communications:

- Mission plan deviations:
  - To be submitted and approved by Mission POC after vetting by the WGOC for operational risk assessment (and corresponding mitigating factors if applicable).
- Non-emergency:
  - Drift or evasive navigation causing breach of, and return to a defined survey area to be communicated to mission POC immediately.
  - Device duty-cycling in compliance with power management criteria and or Duty Cycling Regime to be to communicated to and authorized by Mission POC.
- Emergency:
  - Core system and or device malfunctions to be communicated to Mission POC.
- Escalation Interfaces:



3.2 Operations Logistics

Project Code:	?	**Field Ops Req:**	**Total days on location:** 0 days **Total days underway:** 0 days
Deployment Type:	01JUL2016 Small boat deployment	**Schedule (dates):**	**TBD**
Vessel:	R/V Paragon Chris Wahl 949-929-7598	**Client/ Vessel Required Certs:**	**Credentials required:** Over 18 yoa (TWIC, Security clearance, BOSIET/HUET or STCW-95, Diver certifications, CPR, 1st aid, Immunizations, physical examination
Port:	Moss Landing Harbor		

Moss Landing, CA 831-699-5417	records)

Vehicle Preparation: Performed by Chris Wahl at MBARI

Field Replaceable Units (FRUs/Spares) and Special Tools: All spares will be onshore and vehicle will be recovered early if there are any major problems.

Freight Forwarding Logistics: Not applicable.

Field Operations Accommodations: Not applicable.

Pre-Launch Validation: Core systems and subsystem calibration (pre-launch checklist) distributed to WGOC with detailed vehicle parameters. *see* Appendix

3.3 Vehicle Configuration & Operating System

Wave Glider Info:	**Vehicle, Tracker:** Tiny Tracker	**WGMS Org:**	mbari.wgms.com
		Access:	Submit request with user name, email, phone# (LR Acct. Rep. authorization required) to opscenter@liquidr.com
Float Devices:	S2 port GPCTD + DO S3 port pCO2 and pH G2 EcoPuck and VR2C	**WGMS, Dashboard Ready:**	01JUL2016
Sub Devices:			

3.4 Navigational / Operational Tasking

Mission Description, Objectives, and Theater of Operations: *see Executive Summary*

Sortie 1: *See Sec 3.1 for details*

Task 1: Run MBARI "BOG Timeseries line C1-M1-M2" (WGMS Waypoints 41 through 44).

- [01JUL2016, 1200, 36.797, -121.847 – task start]
- [07JUL2016, 1200, location unknown – task end]

Task 2: Run MBARI "BOG Timeseries line C1-M1-M2" (WGMS Waypoints 41 through 44).

- [21JUL2016, 1200, location unknown – task start]
- [01AUG2016, 1200, location unknown – task end]

3.5 Piloting Tasks

Observations:	Probable Response:	When to Escalate:
Events	• **Navigate** (threat evasion; drift management) • **Observe power management criteria** • **Take corrective action** • **Record accordingly**	• Unsafe operation conditions • Mission deviation required

Power Management	SV2 criteria (increase thresholds by 200wh for SV3):
	• **Light**: Launch/recover/threat evasion use only
	  ○ *Night use requires local authority authorization*
	• **Radar Target Enhancer**: Near shore; high traffic areas; off at 200wh
	• **Telemetry**: 5min nominal; 10-15min (200wh auto)
	  ○ *AIS notification diminished at TRR >5min*
	• **Water Speed Sensor**: < 400wh, use as needed
	• **Payloads**: Duty cycle at 300wh (off at 200wh)
	  ○ *G2 - Eco Puck and VR2C(off at 300wh)*
	  ○ *S2 - GPCTD + DO(off at 300wh)*
	  ○ *S3 - pCO2 and pH(off at 300wh)*
	  ○ *P? - Weather Station (use as needed for Alt GPS)*
	• **AIS**: Off at 100wh
	  ○ *Consider glider position (no vessel awareness aides, and risk of power loss)*
	• **Move to Safe Harbor**: At 50wh
	• **Power Restoration**: In reverse order +25wh
	  ○ *Increase thresholds by 100Wh when entering periods of deteriorating weather forecasts)*
		• Notify Mission POC at 300Wh
		• If course change required

SV3 Operational Notes	• **Thruster:** < 400wh, emergency use only • **Cell Modem & Ethernet Switch**: Off at 300wh	

3.6 Device Configurations / Duty Cycling Regime

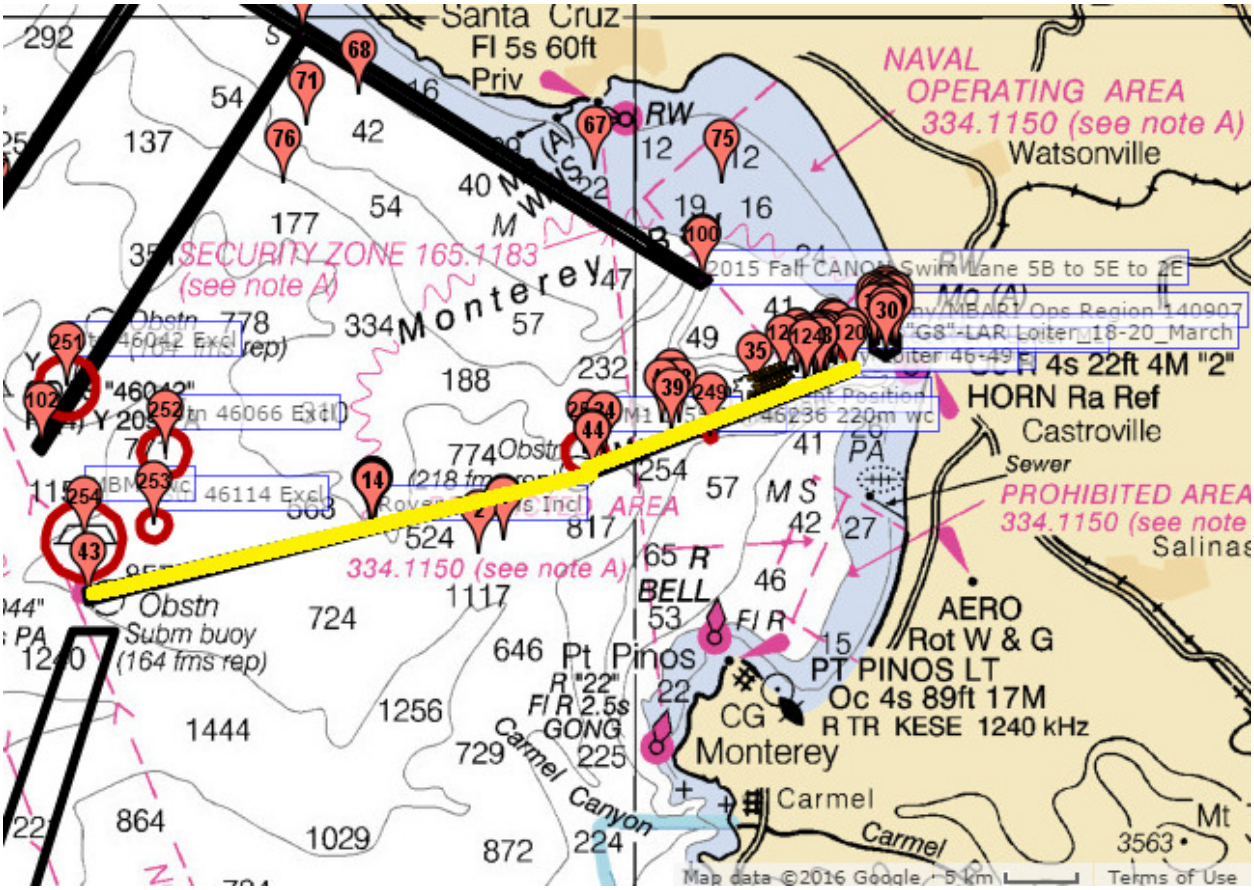
Instrument (SV#)	Data Rate	Effective Duty Cycle	Notes
Core Systems SV3	Continuous	100%	NAL 9603; Ublox GPS; Torpedo GPS; VMC; AMPS; thrudder
Core Systems SV2	Continuous	100%	NAL 9602; C&C electronics; rudder
Cell/Ethernet	Continuous	As needed	SV3 only
Ethernet	Continuous	As needed	PL dependent (i.e., USSI, Leopard camera)
AIS	Continuous	100%	Data acquisition reported to shore at same interval as telemetry rate. • Manual duty-cycling capable
Weather Station PB200, 200WX	1 ensemble/ 10 min.	100%	600 1Hz samples per avg'd ensemble; reported to shore every 10 minutes. • Manual duty-cycling capable
Water Speed Sensor	Continuous	100%	Measurement reported with telemetry. • Manual duty-cycling capable

Radar Target Enhancer	Continuous	100%	Passive device activates when painted by radar. • Manual duty-cycling capable
Visibility Light	Off	As needed	Auto activation for SV3 with collision detection systems. Manual activation for SV2.
SMC (EcoPuck and VR2C)	Continuous	100%	Sensor Management Computer (EcoPuck and VR2C) connected to port G2, turn on G2 integrator payload, wait 10 min for startup, then issue a "StartEcoPuck" run shell command on the G2 payload interface. The VR2C sensor should start running automatically with G2 port power up.
CTD+DO	1 ensemble/ 10 min.	10%	8 samples at 10 sec interval reporting once every 10 min. Connected to Port S2, with board id 2049. Power up port S2, issue ctd-r write console script command to board id 2049 to start sampling
pCO2 + pH	pCO2 samples once an hr, pH once every 10 min	100%	These devices will start sampling and returning data automatically when the S3 port is powered.

3.7 Course Architecture

Overall Operating Area; Close-Ups (tasks, other points-of-interest):

Figure 1. The route for this mission is shown in yellow and the waypoints are already loaded in WGMS BOG timerseries line C1-M1-M2 (WGMS Waypoint 41 thru 44)



3.8 Emergency Equipment Retrieval

If escalation warrants emergency retrieval of a Wave Glider, please contact Chris Wahl at MBARI and I will coordinate a recovery effort during the period of 01JUL2016 to 07JUL2016. For the second period 21JUL2016-01AUG2016, please contact Jared Figurski jared@mbari.org 831-818-2769 to coordinate retrieval.

3.9 Authorizations

Client POC: Chris Wahl	**Spvsr, WGOC:** Marc Sallaberry
Mission POC: Chris Wahl	**VP, Mission Services:** Keith Kreider
Account Representative: Chris Wahl	

4 APPENDIX

4.1 Operational Risk Assessment

4.2 Evidence of Communications with Local Authorities & Permitting

4.3 Vehicle Pre-launch Validation & Detailed Vehicle Parameters

4.4 Mission Debrief

- **Satisfaction of deliverables (results/details)**
- **Client Perception**
- **Budget vs. actual**
- **Recognition**
- **Continuous Improvement Initiatives**
  a. **Opportunities**
     i. **Plan to leverage successes**
     ii. **Plan to address issues**