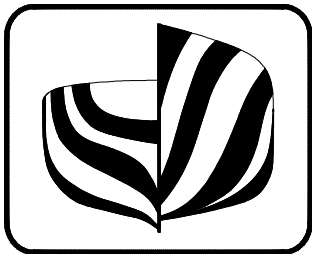
Sentinel Tug Requirements for Gulf of Alaska: Ship Drift Study

Project 215-067 Revision 1 May 4, 2016

Prepared for:

Prince William Sound Regional Citizens' Advisory Council
Anchorage, AK



Prepared by:

Robert Allan Ltd.
Naval Architects and Marine Engineers
230 - 1639 West 2nd Avenue
Vancouver, BC V6J 1H3 Canada

Sentinel Tug Requirements for Gulf of Alaska: Ship Drift Study

Document No.: RAL00704R-215-067-000

Prepared For:	*Client's Reference:*
Prince William Sound Regional Citizens' Advisory Council Anchorage, AK	**Contract 8010.15.01**
Prepared By: **Robert G. Allan, P. Eng.**	*Professional Engineer of Record:* **Robert G. Allan, P. Eng.**

Revision History

1	First Issue	RGA/MP	RGA	RGA	RGA	May 4, 16
DRAFT	For preliminary info only	RGA				Mar. 7, 16
Rev.	*Description*	*By*	*Checked*	*P. Eng. of Record*	*Approved*	*Issue Date*

Class Approval Status				**Client Acceptance Status**			
Rev.	*Approval Agency*	*Initials*	*Date*	*Rev.*	*Design Phase*	*Initials*	*Date*

Confidentiality: **Confidential**

Contents

* * *

Project 215-067
May 4, 2016
Rev. 1

EXECUTIVE SUMMARY

In 2012 Robert Allan Ltd conducted a study for the Prince William Sound Regional Citizen's Advisory Committee (PWSRCAC) on the technical requirements for a Sentinel Tug to be stationed at Hinchinbrook Entrance. One of the conclusions of that report [1] was the following;

- *It is recommended that a formal drift study be conducted, accounting for the precise influence of wind, waves and currents on a disabled tanker on a time domain basis to verify that 17 miles is the correct offshore tanker transit distance during which the Sentinel Tug should standby.*

In 2015 PWSRCAC contracted with Robert Allan Ltd to conduct this drift study in order to close this gap in the knowledge of ship behaviour and response capability within the study area. The drift study modelled both 125,000 DWT and 193,000 DWT tankers drifting from pre-determined start points in the shipping lanes, in the defined closure condition at Hinchinbrook Entrance of 45 knot winds and 15 ft. significant waves, as measured by the buoy at Seal Rocks. It is important to note that due to effects including wave sheltering, topographic sheltering, and buoy anemometer height, this closure condition is actually equivalent to approximately 57 knots of wind (at 10m elevation) and 20 ft. significant waves in the gulf areas offshore of Hinchinbrook, where a rescue tow of a disabled tanker would potentially take place.

The following are some of the key findings of this study, as well as a summary of the average drift times (for all vessel types and load states considered) for varying starting distances from Hinchinbrook:

1. Smaller, lighter vessels drift more quickly than do larger vessels
2. A vessel in ballast (or partly loaded) will draft faster than the same vessel fully laden
3. Vessels adrift before the peak of the closure condition tend to drift towards the north-west, towards Montague Island and Hinchinbrook Island
4. Vessels adrift at and after the peak of the closure condition tend towards the north-east.
5. Vessels adrift from the southern shipping lane reach shore on average 21% faster than do ships adrift in the eastern shipping lane

Start Location			Time to Shore[1]	Mean Time	Drift Velocity[3]	Mean Drift Velocity	Typical End Location Landmark
Number	Radius	Location	Hours	Hours	Knot	Knot	
1	50 NM	Eastern Shipping Lane	10.77	11.97	2.12	2.36	Copper River Estuary
2	50 NM		13.17		2.59		
3	50 NM	Southern Shipping Lane	15.06	14.93	2.36	2.33	Southern Montague Island Wooded Islets
4	50 NM		14.79		2.30		
5	25 NM	Eastern Shipping Lane	6.44	6.95	2.31	2.35	Eastern Hinchinbrook Island
6	25 NM		7.46		2.39		
7	25 NM	Southern Shipping Lane	9.21	8.67	2.38	2.34	Central Montague Island
8	25 NM		8.12		2.29		
9	17 NM	Eastern Shipping Lane	4.52	4.75	2.06	2.16	Western Hinchinbrook Island
10	17 NM		4.98		2.27		
11	17 NM	Southern Shipping Lane	6.52	6.19	2.27	2.26	Northern Montague Island Seal Rocks
12	17 NM		5.85		2.25		

The updated B.A.T. analysis for the Sentinel Tug [2] affirms that the minimum required BP for the Sentinel Tug is 185 tonnes BP in order to satisfy a zero drift criteria, and as such some allowance must be made for the fact that even the PRT class of tugs, which are the most powerful in the current SERVS fleet, would be losing ground in the defined closure conditions, at least until the storm conditions begin to abate or until a second tug arrives to provide additional assistance with the tow.

Given this, and considering the drift rates identified by the drift study (summarized in table above), and probable Sentinel Tug response speeds, *it is recommended that the requirements for the Sentinel Tug as defined in the VERP be modified to require a response to at least 30 nautical miles from Hinchinbrook, as follows*:

> *"Hinchinbrook Tug – A vessel (PWS, PRT, or Theriot Class) capable of ocean escort and rescue service. The vessel is stationed in the vicinity of Hinchinbrook Entrance to provide assistance as a Sentinel escort for tankers in ballast transiting Hinchinbrook Entrance, and laden tankers transiting into or out of the Gulf of Alaska to* ***30 miles of Cape Hinchinbrook****. This vessel may also be utilized as a close escort for laden tankers transiting through Hinchinbrook Entrance."*

* * *

Project 215-067
May 4, 2016
Rev. 1

Sentinel Tug Requirements for Gulf of Alaska: Ship Drift Study

For: Prince William Sound Regional Citizens' Advisory Council
Anchorage, AK

1.0 BACKGROUND

In 2012 Robert Allan Ltd conducted a study for the Prince William Sound Regional Citizen's Advisory Committee (PWSRCAC) on the technical requirements for a Sentinel Tug to be stationed at Hinchinbrook Entrance. One of the conclusions of that report [1] was the following:

- *It is recommended that a formal drift study be conducted, accounting for the precise influence of wind, waves and currents on a disabled tanker on a time domain basis to verify that 17 miles is the correct offshore tanker transit distance during which the Sentinel Tug should standby*

In 2015 PWSRCAC contracted with Robert Allan Ltd to conduct this drift study in order to close this gap in the knowledge of ship behaviour and response capability within the study area.

2.0 TERMS OF REFERENCE

The terms of reference given to Robert Allan Ltd for this work were the following:

(a) Review the Mission requirements for the Sentinel Tug and address any apparent deficiencies/discrepancies.
(b) Review the current regulatory requirements and standing orders for the Sentinel Tug(s).
(c) Conduct a computer based drift study, using the sub-contracted services of Tetra Tech Consulting Group (www.tetratech.com), *a well-respected consulting group with whom Robert Allan Ltd. are currently working on a very similar drift study. The study will be based on the following parameters:*

- Met-Ocean Conditions:
  - the simulation period will be selected as the one that best represents the occurrence of the defined closure conditions of 45 knot winds and app. 15 ft. H_s (approximately equivalent to the 99th percentile of prevailing local conditions)

- the drift model will make use of the best available gridded data. These are:
  - Winds: Alaska Experimental Forecast Facility (AEFF), University of Alaska, WRF archived forecast data, provided courtesy of AEFF. Backup data source is the Alaska Ocean Observing System (AOOS) ROMS model, Prince William Sound
  - Waves: Wave Watch III, Alaskan Waters. Backup data source is SWAN Wave Simulation (AOOS), Prince William Sound
  - Currents: AOOS ROMS model, Prince William Sound. Backup data source is the AOOS HYCOM model, Global Forecast
- Two charted courses (regulated/monitored shipping channels) (as per Annex A attached)
- Two tanker sizes: 125,000 t DWT and 193,000 t DWT
- Two Load Conditions: Full load and ballast
- Geographic Area: Hinchinbrook Entrance to the 200 n. mile limit of US waters
- Start Points of Tanker Drift (from Hinchinbrook Entrance): 17 n. miles; 25 miles, 50 miles

(d) Compare the predicted tanker drift rates to the response speed of the tug from the point of separation.
(e) Update the Sentinel Tug report to incorporate the results of this study.

3.0 METHODOLOGY

As the drift analysis technology is an area of study outside the realm of the professional practise of Robert Allan Ltd. as naval architects, this part of the work was sub-contracted to Tetra Tech EBA Inc. of Vancouver, B.C. The process of the analysis is described in detail in their report, attached as Annex A.

The results of this analysis were then used by Robert Allan Ltd to identify the recommended deployment of a so-called "Sentinel Tug".

4.0 ANALYSIS

The drift analysis process is fully described in Annex A.

5.0 RESULTS

In the defined closure conditions at Hinchinbrook Entrance (45 knots, 15 ft. H_s), the analysis reveals the following:

1. Smaller, lighter vessels drift more quickly than do larger vessels.
2. A vessel in ballast (or partly loaded) will draft faster than the same vessel fully laden
3. Vessels adrift before the peak of the closure condition tend to drift towards the north-west, towards Montague Island and Hinchinbrook Island
4. Vessels adrift at and after the peak of the closure condition tend towards the north-east.
5. Vessels adrift from the southern shipping lane reach shore on average 21% faster than do ships adrift in the eastern shipping lane

The average drift times (for all vessel types and load states considered) for varying starting distances from Hinchinbrook are shown in Table 1 below (Ref. Table 6-8 of Annex A):

Start Location			Time to Shore[1]	Mean Time	Drift Velocity[3]	Mean Drift Velocity	Typical End Location Landmark
Number	Radius	Location	Hours	Hours	Knot	Knot	
1	50 NM	Eastern Shipping Lane	10.77	11.97	2.12	2.36	Copper River Estuary
2	50 NM		13.17		2.59		
3	50 NM	Southern Shipping Lane	15.06	14.93	2.36	2.33	Southern Montague Island Wooded Islets
4	50 NM		14.79		2.30		
5	25 NM	Eastern Shipping Lane	6.44	6.95	2.31	2.35	Eastern Hinchinbrook Island
6	25 NM		7.46		2.39		
7	25 NM	Southern Shipping Lane	9.21	8.67	2.38	2.34	Central Montague Island
8	25 NM		8.12		2.29		
9	17 NM	Eastern Shipping Lane	4.52	4.75	2.06	2.16	Western Hinchinbrook Island
10	17 NM		4.98		2.27		
11	17 NM	Southern Shipping Lane	6.52	6.19	2.27	2.26	Northern Montague Island Seal Rocks
12	17 NM		5.85		2.25		

Rather obviously, the closer a vessel is to shore at the time of drift initiation, the shorter the time to grounding. The least time indicated in the analysis was 3.2 hours; the maximum 29.3 hours.

6.0 CONCLUSIONS

The critical operative criteria for a Sentinel Tug, in the context of this study, is the ability to respond to an emergency aboard a disabled ship anywhere in the given response area in sufficient time to render effective assistance and prevent a grounding. It must be borne in mind that the closure conditions for the tankers as defined in this study are severe, and much more so for a tugboat, (even a large one of over 40 metres length), than for any of the much larger tankers considered.

The tug must be able to make headway in those conditions at a reasonable response speed, then manoeuvre and make a safe towing connection to the ship, and then at the very least slow its drift to as close to zero speed as possible until the storm conditions abate to the point where the tug can make headway with the ship in tow. The updated B.A.T. analysis for the Sentinel Tug [2] affirms that the minimum required BP for the Sentinel Tug is 185 tonnes BP in order to satisfy a zero drift criteria, and as such some allowance must be made for the fact that even the PRT class of tugs, which are the most powerful in the current SERVS fleet, would be losing ground in the defined closure conditions, at least until the storm conditions begin to abate or until a second tug arrives to provide additional assistance with the tow.

Using the data from the table above, the response times and positions for a tug to make contact with a disabled ship have been calculated as shown in Table 2 below. Although the tug response speeds are shown ranging from 8 to 12 knots, it is considered that in these sea conditions 8 knots is likely a reasonable average speed. Note that since drifts are generally towards Hinchinbrook entrance, tug response times are actually reduced from what they would be in calm conditions.

Start Location from shore (n.m.)	Location	Minimum time to 1 n.m. offshore (hours)	Tanker Drift Velocity	Response Time to Tug Arrival at Tanker, at Average Tug Speed (knots)			Tanker Position at Time of Tug Arrival (n.m. from shore)		
				8	10	12	8	10	12
50	Eastern Shipping lane	10.77	2.12	4.9	4.1	3.5	39.5	41.3	42.5
50	Southern Shipping lane	14.79	2.30	4.9	4.1	3.5	38.8	40.7	42.0
25	Eastern Shipping lane	6.44	2.31	2.4	2.0	1.7	19.4	20.3	21.0
25	Southern Shipping lane	8.12	2.29	2.4	2.0	1.7	19.4	20.3	21.0
17	Eastern Shipping lane	4.52	2.06	1.7	1.4	1.2	13.5	14.1	14.5
17	Southern Shipping lane	5.85	2.25	1.7	1.4	1.2	13.3	13.9	14.3

The challenge then is to determine how much time or distance is appropriate for a tug response in these critical situations. The rendezvous takes place at the positions indicated above, but then the two vessels will continue to drift at the tanker drift rate for the time it takes to make the towing connection, which must be assumed to be at least 1 hour, and could indeed be more. In a worst case scenario (similar to the Kulluk incident), there could be a towline failure and then the tow connection must be remade, which could easily take 2 hours, in addition to the initial 1 hour connection period. That further reduces the margin of error.

If the initial response range for a tanker in the southern shipping lane is only 17 miles, and one assumes that only 1 re-connection must be allowed for, then by the time the tug is reconnected it is a further 7 miles towards the beach (3 hours at approx. 2.25 knots), leaving only 6.5 miles to the beach. Since the stated closure conditions have a defined peak endurance of 4-6 hours (Ref. Sec.3.3 of Annex A) there can be zero tolerance for any final drifting of the tanker once connected. Starting at a distance of 6.5 miles from the beach, a 1 knot drift rate after tow connection for 6 hours would see the tanker within the 1 mile "margin line" from the beach used in this analysis…a potentially unacceptable condition. For that reason, it is recommended that the requirements for the Sentinel Tug as defined in the VERP be modified to require a response to at least 30 nautical miles from Hinchinbrook, as follows:

"Hinchinbrook Tug – A vessel (PWS, PRT, or Theriot Class) capable of ocean escort and rescue service. The vessel is stationed in the vicinity of Hinchinbrook Entrance to provide assistance as a Sentinel escort for tankers in ballast transiting Hinchinbrook Entrance, and laden tankers transiting into or out of the Gulf of Alaska to ***30 miles of Cape Hinchinbrook****. This vessel may also be utilized as a close escort for laden tankers transiting through Hinchinbrook Entrance."*

The extra margin afforded by an additional 13 miles of offshore distance is sufficient to allow a closure condition storm to abate and thus enable the tug to start making headway.

for **ROBERT ALLAN LTD.**

Robert G. Allan, P. Eng.
Executive Chairman of the Board

RGA/MP:da

REFERENCES

[1] *A Review of Best Available Technology in Tanker Escort Tugs*; for PWSRCAC, Robert Allan Ltd., Project 212-090, Revision 1, November, 2013.

[2] *A Review of Best Available Technology in Tanker Escort Tugs*; for PWSRCAC, Robert Allan Ltd., Project 212-090, Revision 2, April, 2016.

* * *

Annex A

Tetra Tech Report: *Gulf of Alaska, Ship Drift Study*