AA2018-2

AIRCRAFT ACCIDENT INVESTIGATION REPORT

Setouchi SEAPLANES Inc.

J A 0 2 T G

February 22, 2018

JTSB Japan Transport Safety Board

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board and with Annex 13 to the Convention on International Civil Aviation is to determine the causes of an accident and damage incidental to such an accident, thereby preventing future accidents and reducing damage. It is not the purpose of the investigation to apportion blame or liability.

Kazuhiro Nakahashi
Chairman,
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

AIRCRAFT ACCIDENT INVESTIGATION REPORT

SETOUCHI SEAPLANES, INC.
QUEST KODIAK 100 (AMPHIBIAN), JA02TG
AIRCRAFT DAMAGE DURING TAKEOFF RUN FROM WATER
AT THE SEA OFF BEPPU CITY, OITA PREFECTURE, JAPAN
AT AROUND 16:20 JST, MARCH 24, 2017

January 26, 2018
Adopted by the Japan Transport Safety Board

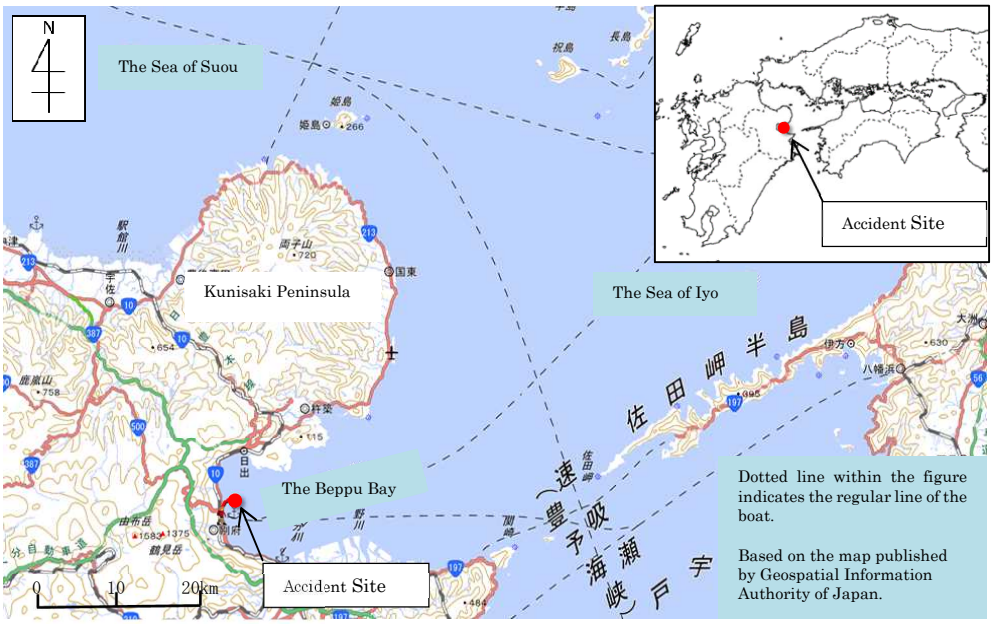
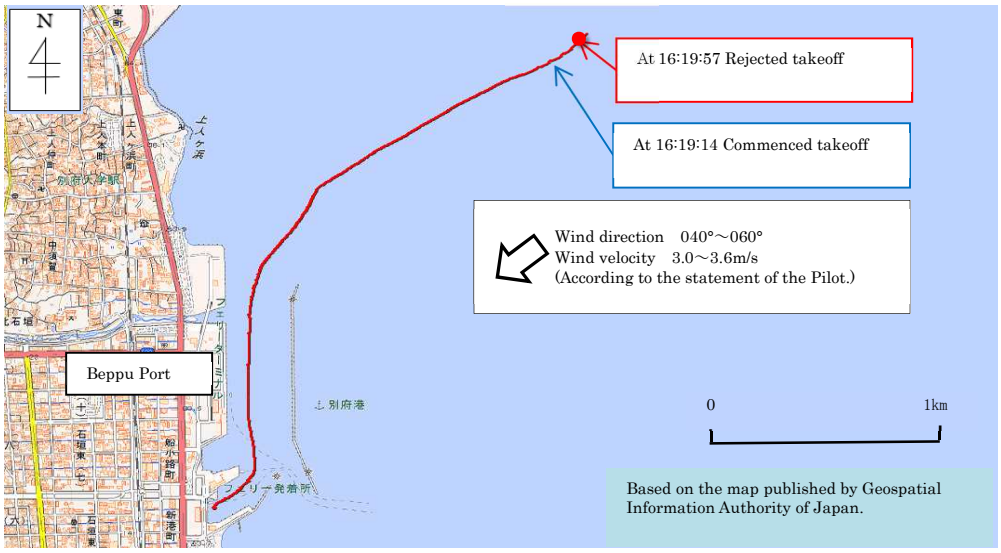
Chairman Kazuhiro Nakahashi
Member Toru Miyashita
Member Toshiyuki Ishikawa
Member Yuichi Marui
Member Keiji Tanaka
Member Miwa Nakanishi

1. PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Accident	On March 24(Friday), 2017, a Quest Kodiak 100, registered JA02TG, operated by Setouchi SEAPLANES, Inc. took bounces during the takeoff run from water and suffered damage to the aircraft when contacting water surface.
1.2 Outline of the Accident Investigation	On March 27, 2017, the Japan Transport Safety Board (JTSB), upon receiving the report of the accident occurrence, designated an investigator-in-charge and one other investigator to investigate this accident. An accredited representative of the United States of America, as the State of Design and Manufacture of the aircraft involved in this accident, participated in the investigation. Comments were invited from the parties relevant to the cause of the accident. Comments were invited from the participating State.

2. FACTUAL INFORMATION

2.1 History of the Flight	According to the statement of the Pilot and the Recordings of the flight data in the Integrated Instrument System (described later in 2.7 (8)), the history of the flight up to the accident is summarized below; On March 24, 2017, at around 15:59 Japan Standard Time (JST; UTC + 9hrs) a Quest Kodiak 100 registered JA02TG, operated by Setouchi SEAPLANES, Inc. (hereinafter referred to as "the Company") left the Beppu Port to return to its base at Sakai-ga-Hama in Onomichi City, Hiroshima Prefecture, with the Pilot and three other passengers onboard. The Pilot planned to takeoff from water by using the north area of Beppu Bay where the wind wave had less effects. The Aircraft taxied on water for about 20 minutes to a location to commence the takeoff from water and commenced the takeoff run from water at around 16:20. The Aircraft became to cross swell during the

	acceleration and bounced twice at about 23 kt and 38 kt of the airspeed. The second bounce was bigger than the first one and the Pilot decided to reject takeoff as receiving the strong impact at the second contact with water surface. The Aircraft bounced several times by swell during its deceleration after the rejected takeoff. Later, at around 16:57, the Aircraft returned to the Port by taxiing on water. At the subsequent aircraft inspection, damages on the fuselage, the float strut and others were found. During the takeoff run, there was no cruising of boat or ship in the vicinity of the Aircraft. This accident occurred at offshore approximately 2 km from Beppu City, Oita Prefecture, Japan (33°19'8"N, 131°31'15E) at around 16:20 on March 24, 2017.  **Figure 1 : Accident Site**  **Figure 2 : Estimated Taxi & Takeoff run Route**
2.2 Injuries to Persons	None

2.3 Damage to Aircraft	Extent of Damage : Substantial damage ① Lower parts of engine firewall; Deformed, Damaged ② Lower parts of the forward fuselage; Dent, Damaged ③ Engine mount frame; Damaged ④ Struts of left and right floats; Broken, Deformed, Damaged ⑤ Tie rods of left and right floats; Bent ⑥ Fairings of left and right floats; Damaged
2.4 Personnel Information	Pilot Male, Age 68 Airline transport pilot certificate (Airplane) January 6, 1974 Specific pilot competence certificate Expiration date of piloting capable period July 22, 2018 Type rating for Single Engine Airplane (Amphibian) March 24, 2016 Class 1 aviation medical certificate

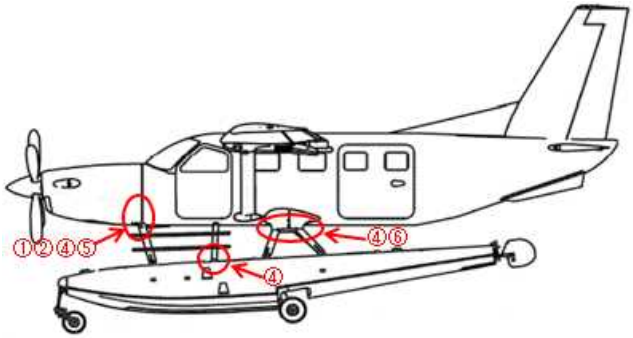


Figure 3 : Damaged parts at left side of the aircraft

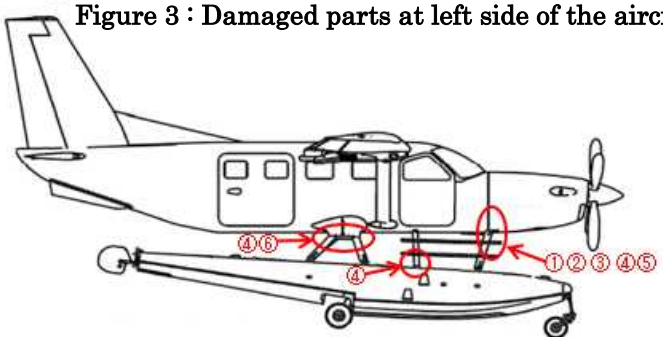


Figure 4 : Damaged parts at right side of the aircraft

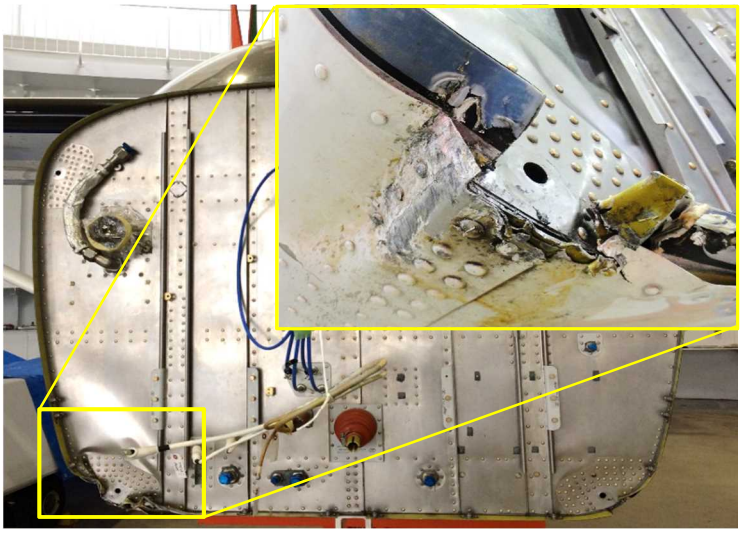


Photo 1 : Damaged area at the lower engine firewall (right-side)

	Validity June 16, 2017 Total flight time 19,186 hours 40 minutes Flight time in the last 30 days 18 hours 20 minutes Total flight time on the type of aircraft 287 hours 50 minutes Flight time in the last 30 days 18 hours 20 minutes Flight time on other type of the aircraft 10 hours 42 minutes
2.5 Aircraft Information	(1) Type; Quest Kodiak 100 Serial number; 100-0156 Date of Manufacture; October 23, 2015 Airworthiness certificate; No. Dai-2016-398 Validity October 06,2017 Total flight time 320 hours 59 minutes (2) When the accident occurred, the weight and the position of the center of the gravity were within allowable range. (3) Length of float; approximately 8 m Height of float; approximately 90 cm
2.6 Meteorological / Sea States Information	Observation values; Oita Meteorological Office (Approximately 15 km southeast of the accident site) 15:00 North-Northeasterly wind at 2.4m/s, Temperature 12.2 ºC 16:00 Northeasterly wind at 2.0 m/s, Temperature 11.9 ºC Observation values; Kitsuki Regional Meteorological Observatory (Approximately 13 km Southeast of the accident site) 15:00 Easterly wind at 3.0 m/s, Temperature 11.6 ºC 16:00 Southeasterly wind at 3.3 m/s, Temperature 11.1 ºC Weather and Sea States acknowledged by the Pilot prior to the takeoff from water Wind direction 040 º to 060 º, Wind velocity 3.0 m/s to 3.6 m/s (6 to 7 kt) It was approximately 30 cm high in synthesized wave height of wind wave and swell, and swell from multiple direction crisscrossed inside the bay and formed irregular swell of approximately several meters in their wave length.
2.7 Additional Information	(1) Takeoff from water by Seaplane Regarding to the takeoff procedure from water for seaplane, Chapter 4 Seaplane Operation Preflight and Takeoffs of "SEAPLANE, SKIPLANE AND FLOAT/SKI EQUIPPED HELICOPTER OPERATIONS HANDBOOK (2004)" issued by Federal Aviation Administration of the United States has the following descriptions. The following is the summary of the description above mentioned with addition of Figure 6. ① Stage to take off from water a. Idling Position The engine is at idle rpm, the buoyancy of the floats supports the entire weight of the seaplane and it remains in an attitude similar to being at rest on the water. b. Plowing Position Commence to takeoff run from water as raising the seaplane's nose with the sterns sink farther into the water by setting the engine power for takeoff from water. The resistance at this moment reaches its

peak.

c. On the step Position

Because increase in hydrodynamic lift generated on floats by water current. Hydrodynamic lift support the weight of the seaplane, the float essentially clear of water, continues to accelerate at condition of decreased water resistance, increases of lift generated at wings lift the Aircraft off.

Figure 5 : Flow of Takeoff from water

② Takeoff from rough water surface

If the wavelength is less than half the length of the floats, the seaplane is always supported by at least two waves at a time. If the wavelength is longer than the floats, only one wave at a time supports the seaplane. This creates dangerous pitching motions, and takeoff should not be attempted in this situation.

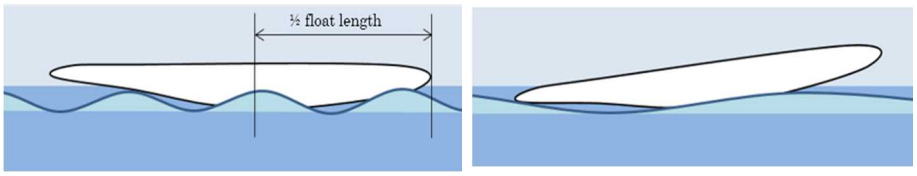


Figure 6 : Relation between waves and float

(2) Attitude during takeoff run from water

According to the instructor of the Company, standard pitch angle at each position of the Quest Kodiak 100 to takeoff from water are as follows. Furthermore, a pitch angle could be varied depending on the position of the center of gravity of aircraft.

① Idling position; + 6.5° to +7.5°

② Plowing position; + 12.5° to +15.0°

③ On the step position; + 7.5° to + 8.5°

(3) Speed to takeoff from water

4-5-1 NORMAL TAKEOFF of 4-5 TAKEOFF ON WATER of the training manual of the Company has the following description (excerpts);

(6) At 55kts, Slightly aileron & back press. Airplane fly off the water with one float. (lift off approximately 60kts)

(4) *Synthesized wave*

Regarding wave, the Japan Meteorological Agency homepage has the following descriptions;

http://www.data.jma.go.jp/gmd/kaiyou/db/wave/comment/elmknwl.html

(See 2017-11-01) the following are the excerpts and summary of the contents;

① *Synthesized wave height*

Wave height when multiple waves are mixed is estimated by the square root of the sum of the square of each wave height. It is called

"synthesized wave height". The synthesized wave height; Hc is expressed as Hc=$\sqrt{H_w^2 + H_S^2}$, when wind wave height is Hw and swell height is Hs.

(5) Limitations

2-2 Operating Limits (3) of the Chapter 2 Limitations of Aircraft according to the FCOM (Flight Crew Operating Manual) provided by the Company has the following descriptions;

"Maximum Wave Height 16 inches (40 cm)

Note; it is a demonstrated value provided by the supplemental flight manual, and do not operate beyond this value."

(6) Company's Experience regarding operation and knowledge on swell

According to the Company, it did have the experiences to operate at an inland sea where ship generating wave exists, therefore, regarding the ship generated wave, and the Company realizes the risk and implements the training. On other hand, regarding swell, the Company has very few operating experience and knowledge, the training guideline was not provided for and educations for pilots and dispatchers were not sufficient.

According to the training manuals of the Company, during the training to obtain the type rating certificate for amphibian aircraft, pilots shall have 200 times or more experience to land on water in order for pilot to grasp the entire sea area for takeoff from water and landing on water and to develop ability to judge whether to takeoff or land on water could be done or not.

(7) Sea States at Beppu Bay

Because the Company did not have the operating experiences at the Beppu Bay, prior to the flight to the Bay, the company carried out the on-site investigation by using boat and obtained the following information.

① The Bay opens toward east, swell becomes higher with blows of east wind.

② When northerly wind blows strong, wind wave and swell becomes higher.

(8) Recordings of the flight data at the Integrated Instrument System

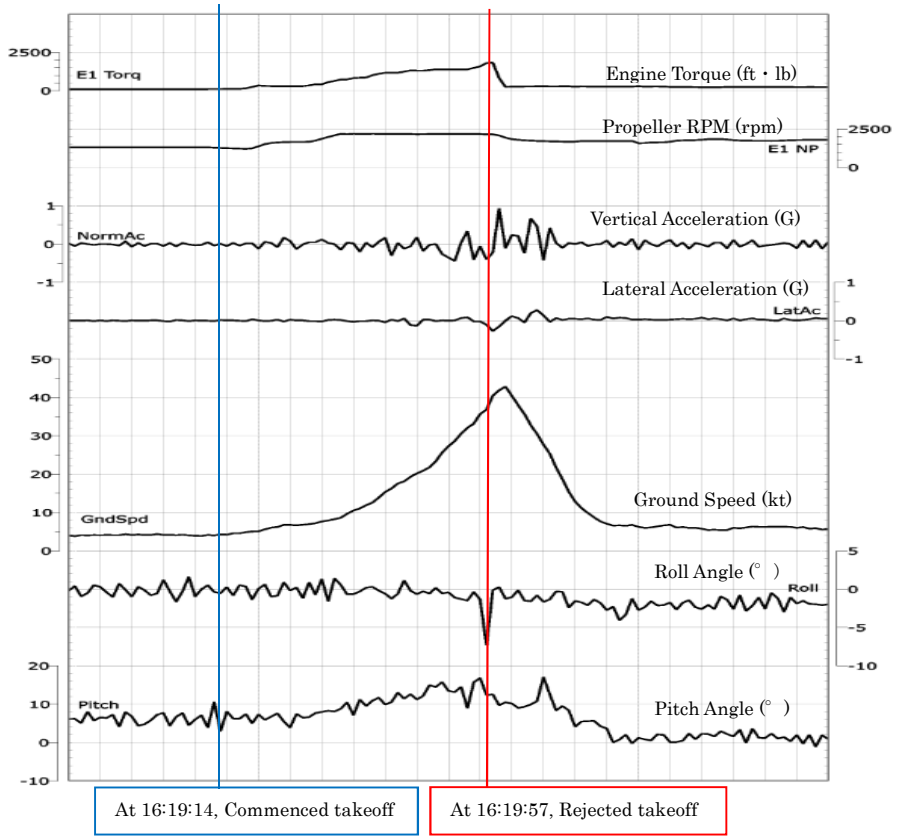
The aircraft is equipped with the Integrated Instrument System which could display various flight data and record it. The records of the flight data were shown below. Furthermore, the flight data were recorded every second.

① The engine power had reached the takeoff power from water, normally.

② The pitch angle of the Aircraft was not stable from right after the commencement of takeoff, it accelerated with ups and downs motion of nose in approximately 4° amplitude, and the pitch-up attitude was recorded +16.84° when the speed reached approximately 36kts at around 16:19:55.

Roll angle was recorded at -7.34° (left wing down) right after then, the reject takeoff at around 16:19:56.

③ Vertical acceleration was slightly irregularly fluctuating from right after the commencement of takeoff run from water and was recorded +0.56 to +1.93 G at right after and right before the rejected takeoff from water. (According to the records of flight data shown in Figure 7, the vertical acceleration was displayed in plus or minus by the starting point of 1G as

	"zero".)  **Figure 7 : Recordings of Flight Data**

3. ANALYSIS

3.1 Involvement of Weather/Sea State	Yes
3.2 Involvement of Pilot	Yes
3.3 Involvement of Aircraft	None
3.4 Analysis of Findings	(1) Effects by the Weather/Sea States According to the statements of the Pilot, it is probable that the weather and the sea states before commencing the takeoff run for Beppu Bay are 3.0 to 3.6 m of Northeasterly wind, the water area for the takeoff from water had approximately 30 cm in synthesized wave height and these are within the operational limits described in the FCOM of the Company. On the other hand, as described in 2.6 and 2.7 (7), it is somewhat likely that there were swell in addition to the wind wave within Beppu Bay, and it is somewhat likely that the synthesized wave height when the Aircraft was commencing the takeoff run from water might exceed the operating limit provided by FCOM of the Company. (2) Situation at the time to takeoff from water According to the statements of the Pilot, it is probable that the Aircraft

	was facing the Northeasterly wind and performed the takeoff run from water by crossing the swell. Based on the records of the flight data, the pitch angle of the plane was unstable from the time to commence the takeoff run from water and was fluctuating at the range of approximately +10º to +16.84º, during the time to accelerate while continuing a pitching motion by 4º amplitude till the time to reach the speed of approximately 36 kt. It is somewhat likely that this pitching motion was caused by crossing the swell which wave length was longer than the float length as described in 2.7 (1)②. The roll angle of the Aircraft was recorded as -7.34º (the left wing down) right before the rejected takeoff. It is probable that this left wing down was caused because the right float was lifted by wind wave and swell. Based on these, it is probable that the amplitude of the Aircraft become larger along with the acceleration due to the generation of the ups and downs motion of the nose by the swell during the takeoff run from water. It is highly probable that when the speed reached the approximately 38 kt, the Aircraft bounced and suffered damage to the plane as receiving strong impact when contacting water surface. (3) Operation and determination whether to takeoff from water or not The training manual of the Company does not provide the training items concerning swell, therefore, it is probable that pilots did not receive sufficient training concerning the swell. Because of this, although the Pilot had recognized the influence caused by the swell, it is somewhat likely that because the knowledge was not sufficient, he executed the takeoff run from water across the swell by judging it was within the operational limit.

4. PROBABLE CAUSES

It is highly probable that because the Aircraft bounced during the takeoff run from water and received strong impact when contacting water surface, and suffered damage to the Aircraft.

Regarding the Aircraft bounced during the takeoff run from water, it is probable that because the Pilot conducted the takeoff run from water across the swell at the sea area existing the wind wave and swell, pitching motion was generated and the amplitude become larger along with the acceleration.

5. SAFETY ACTION

Safety action taken by the Company

(1) The Company invited the instructor from the seaplane operating company in United States of America and provided the seminar concerning the operation on rough water like the swell and others to pilots and dispatcher.

(2) Issued the in-house document (Operation on the rough water like the swell and others) reflecting the contents of this seminar and had all pilots and dispatchers in the company know.

(3) Regarding the selection of new water area, investigate the possibility to have an occurrence of swell and the meteorological conditions and other to generate the swell in more details than before.

(4) When the takeoff area faces the open ocean, carefully check the condition of the swell.

Does not operate when the swell occurs as basic.

(5) Revise the Training Manual and implement the classroom lecture regarding the swell.

(6) The Pilot surely obtains information about the possibilities of the swell prior to departure, Dispatcher shall support it.