

PRELIMINARY RECONNAISSANCE REPORT ON THE 2003 TOKACHI-OKI EARTHQUAKE

INVESTIGATION DETAILS

- Date: September 27 and 28, 2003
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- Route: Obihiro Airport - Hiroo (Tokachi Port) - Toyokoro - Urakoro - Kushiro - Onbetsu – Moiwa - Ootsu - Kushiro Airport

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GENERAL COMMENTS

The largest damage was inflicted to lifelines, embankments and roads. Large ground displacements and related damage occurred mostly in man-made earth structures, reclaimed soils and artificial fills. Most of the ground-related damage can be attributed to soil liquefaction.

Large settlement of the crest, longitudinal fissures and ground distortion associated with lateral movement of the embankment slopes were observed almost continuously along the embankments of Tokachi River. The largest damage to the embankment was found in the vicinity of Ootsu Sewerage Treatment Facility where partial collapse of the embankment took place along two sections, each with a length of about 150-250 m. Clear signs of liquefaction including sand boils were observed at several locations of the embankments.

In Moiwa, Onbetsu and Ootsu, collapse with subsidence of the road/pavement as large as 40-50 cm was observed along the route of buried pipelines. Several man-holes were up-lifted as much as 1.2-1.8 m above the ground surface. Signs of liquefaction were evident along the collapsed ground over buried pipelines and near uplifted man-holes.

Damage to buildings and houses was very light. Non-structural elements of two buildings were damaged; a couple of old/abandoned houses collapsed, and in several cases cracked walls and damage due to failure of foundations or/and differential settlement was observed. Damage due to liquefaction of foundation soils is reported herein.

A couple of bridges were found damaged and out of use on September 27 and 28. The eastward section of Tokachigawa Bridge moved laterally as much as 50-60 cm. Sinusoidal pattern of movement and tilting of distribution poles of electric power lines were also found in the vicinity of this location. The roads in the vicinity of Tokachi River were extensively damaged including partial collapse of some sections.

The inspection team was predominantly interested in the geotechnical aspects and related damage. This preliminary report serves to provide quick release of first-hand information and images from the area affected by the quake.

BURIED PIPELINES AND MAN-HOLES



Moiwa: Cracks on asphalt surface and settlement of the road along buried pipelines (D-2)



Kushiro: Differential vertical displacement of man-holes on the order of 10-20 cm; part of the movement can be attributed to uplift of the man-hole whereas part is due to settlement of the surrounding ground; the same man-holes were uplifted during the 1993 Kushiro earthquake (A-3)



Onbetsu: Huge uplift of a man-hole at Onbetsu, Kawahigashi Danchi; the top of the man-hole was approximately 170 cm above the ground surface; (B-1)



Onbetsu: Collapse of the pavement and subsidence of 30-50 cm was observed along a length of 200-300 m of the pipeline route; the collapsed portion has a width of about 1-1.2 m; (B-1)



Onbetsu: The fill soils are sandy soils; liquefaction of the relatively loose fills is considered to be the cause of the observed damage as above; (B-1)



Onbetsu: Additional two man-holes were uplifted as much as 1 m and 1.7 m above the ground level; (B-1)



Ootsu: Subsidence of road surface above buried pipelines and uplift of man-holes; the top of the man-hole shown on the right was about 180 cm above the ground level; (B-1)



Ootsu: The maximum subsidence was about 40-50 cm; sand boils were seen at the contact zone of the asphalt and ground clearly indicating that the fill soils liquefied; (B-1)

EMBANKMENTS ALONG TOKACHI RIVER



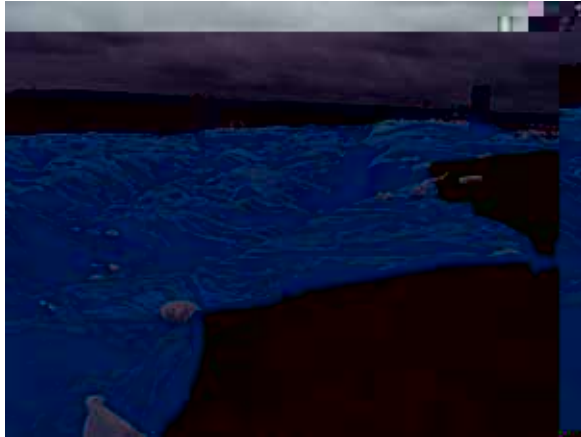
Tokachi River: The embankments along Tokachi River, from Toyokoro to Ootsu are about 20 km long; large longitudinal fissures along the crest and slopes were observed at numerous locations; (C-1)



Tokachi River: At this location, massive sand boils were found at the top of the embankment; the approach road shown in the upper-right picture moved laterally; the fissures created by the large lateral movement are seen in-filled with sand-boils and water in the lower images; (C-1)



Tokachi River: The largest damage of the embankment occurred near the Ootsu Sewerage Treatment Facility; along two sections with approximate lengths of 150-250 m, the lower body of the embankment completely collapsed; the foundation soil beneath the embankment seen on the left side in the lower images was extremely soft and soaked in water; these images show the first of the two collapsed sections; (C-4)



Tokachi River: The second section of the collapsed lower embankment is located just in front of the Ootsu Sewerage Treatment Facility; most of the ground surface was covered with protective sheets and therefore the features of ground distortion were not fully visible; excessive lateral movement of large masses of soil and collapse of the lower body of the embankment were evident; (C-4)



Tokachi River: These pictures show the other slope of the embankment (the one toward the banks of Tokachi River) at the Ootsu Sewerage Treatment Facility; longitudinal cracks and fissures in the lower body of the embankment were observed; these type of cracks and fissures were found in the foot of the embankment and also in the original soil deposit to a distance of about 20-30 m from the embankment; there were clear signs of liquefaction in the soil deposit at the foot of the embankment; (C-4)

LIQUEFACTION AT TOKACHI PORT (HIROO)



Tokachi Port: Massive sand boils were observed in reclaimed fills; (G-1)



Tokachi Port: Sand boils; (G-1)



Tokachi Port: Massive sand boils and sand littered on the road surface; (G-1)



Tokachi Port: According to the observed gaps between the concrete blocks, it is estimated that the quay walls moved seaward about 10 cm; small settlement was observed behind the quay walls in accordance with the lateral seaward movement of the walls; (G-1)

LIQUEFACTION IN RESIDENTIAL AREA IN OOTSU



Ootsu: Liquefaction of foundation soils in the residential area occurred; there were clear signs of liquefaction including sand boils and uplift of a man-hole of about 15 cm just in front of the affected house; inside the garage shown in the lower-left picture, the parked truck sunk into the liquefied ground; (south of C-4)

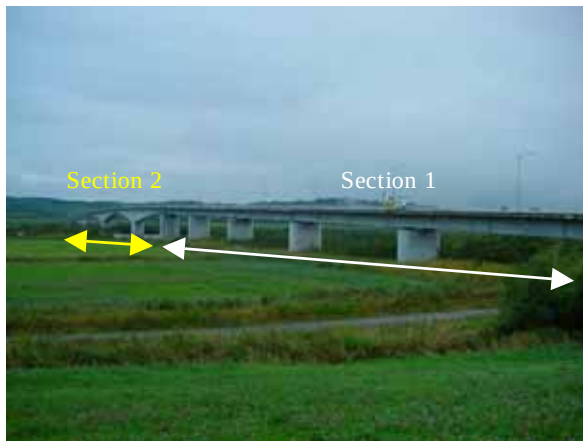


Ootsu: Fissuring of the ground around the foundation of the nearby house and uplift of a pipe about 30-40 cm above the ground were observed; (south of C-4)



Ootsu: Cracks in the walls and damage due to non-uniform settlements; (south of C-4)

TOKACHIGAWA BRIDGE



Tokachigawa Bridge: The bridge has two structural systems (Section 1 and Section 2); The upper deck of Section 1 moved laterally towards the right in the picture (NW), about 60 cm, as seen in the image on the left: view from the abutment; (C-2)



Tokachigawa Bridge: View from the abutment side and detail of the support at the abutment; (C-2)



Tokachigawa Bridge: At the connection of two bridge sections: pier at the connection of Sections 1 and 2; View from Section 1 towards Section 2; Section 1 is seen displaced laterally about 60 cm; (C-2)



Tokachigawa Bridge: Damage details at the connection of Sections 1 and 2; (C-2)

OTHER DAMAGES



Tabikorai: The road running along the embankment from Moiwa to Ootsu was heavily damaged or collapsed at numerous locations; (C-3)



Between Tabikorai and Ootsu: Tilting of distribution poles of electric power lines; sinusoidal wave pattern of tilting was observed with the poles on both sides of the road showing similar pattern of movement; there was no such horizontal wave-pattern in the deformation of the road, which was without damage at this section; (C-3)



Shinyoshino: Differential settlement and tilting of silo; (C-1)