

# **Snowy 2.0 Main Works Modification 2 (SSI-9687)**

## **Comments and Questions from the National Parks Association of NSW**

19 September 2023

### **Summary**

Tunnel boring machine (TBM) Florence has excavated 146 metres of the Snowy 2.0 headrace tunnel (16 kilometres) during the eighteen months since her commissioning on 22 March 2022. Since December 2022 she has been stuck beneath a five metre deep sinkhole she caused.

The [Snowy 2.0 Main Works Modification 2](#) seeks an extension of the approved construction envelope at Tantangara to enable works to be carried out to free Florence and rectify the environmental damage. It was expected that the modification request would also address measures to avoid further environmental damage from tunnelling – it doesn't.

The Modification Report ('Report'):

- reveals that Snowy Hydro's reporting of Florence's predicament has been misleading, failing to describe the magnitude of problems and extent of damage to Kosciuszko National Park
- establishes that the exploratory borehole drilling failed to detect the adverse soil conditions at the start of the headrace adit tunnel
- establishes that, inexplicably, Florence was not fitted for closed mode operation (slurry plant) to handle soft ground at the outset - it wasn't till January 2023 that such plant started to be installed, taking six months to complete
- provides no information on the environmental impacts of the grouting operations undertaken to attempt to free Florence nor of the expected impacts of further grouting
- expects the risk of further sinkholes to be unlikely, but fails to provide evidence
- most importantly, fails to provide a rigorous process to detect further problems and undertake measures to avoid further environmental damage, a fundamental requirement for the Report set by the Department of Planning and Environment (DPE) and National Parks and Wildlife Service (NPWS)
- provides no information on the required scope of the modification application
- triggers a question as to whether the 'approved construction envelope' is appropriate for tunnelling and may need to be amended, requiring another modification request

DPE should engage independent experts to review the adequacy of the measures proposed in the Report both to address the current problems and to foresee and avoid future problems and further environmental damage.

The Florence debacle is causing additional unexpected environmental damage to Kosciuszko National Park and costing hundreds of millions of dollars.

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*"Snowy 2.0 is the largest committed renewable energy project in Australia"*

This misleading statement is made in the Report and throughout all Snowy 2.0 documents.

Snowy 2.0 may well be the largest committed energy project in Australia (and the most expensive), but it is not renewable (whereas conventional hydro is). Pumped hydro is simply a water battery, and a very inefficient battery at that, losing over 25% of energy in the pumping/generation cycle.

In this Paper:

*Text in italics* are extracts from the Modification Report or Snowy Hydro media releases

Numbered sentences are questions/comments

## 1 What's happened to Florence

The Modification Report ('Report') covers in detail the problems encountered by Florence with unstable ground conditions since her commissioning on 22 March 2022. Florence has excavated just 146 metres in the ensuing 18 months, and since December 2022 has been stuck beneath a 5 metre deep sinkhole she caused.

*"At Tantangara, tunnelling via TBM commenced excavation of the head race tunnel (HRT) adit portal in March 2022. Around May 2022, the TBM began encountering adverse geological conditions, which can be broadly characterised as unstable sub-surface materials. In December 2022, a sinkhole formed at the surface near the adit portal and TBM operations were suspended. The TBM cutting head is approximately 35 m directly below the sinkhole and 140 m horizontally from the HRT adit portal. The sinkhole is located outside of the approved construction envelope for Snowy 2.0.*

*Since February 2023, FGJV has also undertaken a range of geotechnical investigations around the TBM and the HRT adit portal. This was done through four surface boreholes including a sub-horizontal borehole aligned to the alignment of the Tantangara HRT adit. In addition to these boreholes, geophysical surveys around and in front of the TBM were completed.*

*Since March 2023, FGJV has been undertaking ground consolidation works around the cutting head of the TBM by grouting the sub-surface materials. The aim of these works is to stabilise the soil matrix sufficiently so that material will not fall into the TBM cutting head. These ground stabilisation works have been undertaken from the surface inside the approved construction envelope and from within the TBM. However, depending on the outcome of the works, further ground consolidation may also be required to be undertaken from the surface outside the construction envelope directly above the TBM cutting head."*

### 1.1 Misleading/untruthful spin by Snowy Hydro

The Report provides a very different account of what has happened compared to previous upbeat public statements by Snowy Hydro.

5 Oct 2022 - [Florence on the Move](#)

Tunnel boring machine (TBM) Florence **continues excavating** the Snowy 2.0 headrace tunnel at Tantangara following successful reinforcement works. **As anticipated**, the ground conditions encountered by the TBMs on Snowy 2.0 have been highly variable, ranging from soft, sandy ground to extremely hard rock. TBM Florence **has been specifically designed** to encounter these variable ground conditions.

16 Dec 2022 - [Snowy 2.0 update](#)

Snowy 2.0 teams are **monitoring a surface depression** that has emerged above the headrace tunnel at Tantangara. The integrity of the tunnel has not been compromised, and **tunnelling is continuing** while work to remediate the surface depression above tunnel boring machine (TBM) Florence is carried out. **As previously indicated**, the ground conditions encountered by the TBMs on Snowy 2.0 have been highly variable, ranging from very loose, sandy ground to extremely hard rock in fluctuating groundwater conditions. TBM Florence **is transitioning from soft material into harder rock conditions**.

12 Feb 2023 - [Response to ABC 7.30 report](#)

Across the project, and **as anticipated**, the ground conditions encountered by the Snowy 2.0 TBMs are highly variable, ranging from soft, sandy ground to extremely hard rock. TBM Florence at Tantangara has been traversing a section of soft ground and is **temporarily paused** while plans to remediate a

surface depression above the Tantangara adit (as reported on the [Snowy Hydro website](#) Snowy Hydro website in December) are finalised.

1 Mar 2023 - [Tunnelling Update](#)

TBM Florence has tunnelled about 150 metres and is currently located at a depth of approximately 30 metres below ground. A **surface depression** recently emerged in the ground above TBM Florence, which has **temporarily delayed progress** on this particular worksite. The project team has **paused the machine** until about 10-15m of weak material in front of it is stabilised, prior to striking hard rock, when we **expect normal tunnelling to resume**. FGJV is currently installing a slurry plant for the TBM that will mean the machine can switch from open excavation to a closed, pressurised mode. This will deliver stable excavation and efficient progress through the softer ground conditions, while enabling the TBM to switch back to open mode when in harder rock.

22 May 2023 - [Senate Estimates Mr Barnes](#)

*"The precondition for restarting [Florence] is to ensure that the area in front of the machine is strengthened, and we've all but completed that. The other precondition is the completion of the slurry plant, which essentially allows the tunnel-boring machine to move forward in a pressurised, liquefied sand mode. **That slurry plant is commissioning at the end of the month, and then we should be able to push forward with Florence shortly thereafter.**"*

Snowy Hydro has made numerous misleading and untrue statements about Florence:

- i) The *"highly variable ground conditions were anticipated"*  
Not true. As the Report states, *"The material that the TBM encountered was not expected based on the results of previous geotechnical investigations undertaken for Snowy 2.0"*. Presumably, if the variable ground conditions had been anticipated the slurry plant would have been installed at the outset.
- ii) Florence was *"specifically designed to encounter variable ground conditions"*  
Possibly so, but, inexplicably, she was not fitted with the slurry plant to be able to operate in closed mode.
- iii) The first public report of a problem was the emergence of a 'surface depression' in December 2022  
We now learn that Florence first encountered problems in May 2022, seven months earlier. Also, the surface depression is now called a sinkhole, a more apt description.
- iv) *"Tunnelling is continuing while work to remediate the surface depression above tunnel boring machine (TBM) Florence is carried out"*  
Not true. Florence was stuck unable to move and has remained stuck for nine months.
- v) Florence was said to be *"temporarily paused"* in March 2023 (three months later)  
This is a bit of an understatement as Florence was stuck and still is, a further six months later.
- vi) *"The project team has paused the machine until about 10-15m of weak material in front of it is stabilised, prior to striking hard rock, when we expect normal tunnelling to resume"*  
Not so. The Report states that *"The boreholes indicate that there is 50 m of soft unconsolidated ground ahead of the TBM followed by good quality rock mass"*.

1. Why was the public information previously provided by Snowy Hydro untruthful and so much at variance with the actual situation now described in the Report? Snowy Hydro has had ample opportunity to correct the misinformation in its public statements.

## 1.2 Varying dimensions of sinkhole size and Florence's depth

There has been varying information on the size of the sinkhole and Florence's depth.

*"The sinkhole is at an angle of 65°–70° from TBM Florence and is located 35 m vertically above the TBM cutting head. It has a diameter of approximately 8 m and is 5 m deep. It is estimated to have a volume of approximately 250 to 300 m<sup>3</sup>." (Report)*

*"TBM Florence has tunnelled about 150 metres and is currently located at a depth of approximately 30 metres below ground. A surface depression recently emerged in the ground above TBM Florence, which has temporarily delayed progress on this particular worksite. The depression is approximately nine (9) metres deep and continues to be monitored." (1 Mar 2023 - [Tunnelling Update](#))*

2. How deep is Florence – 30 or 35 metres?
3. How deep is the sinkhole ('surface depression') – 5 or 9 metres?

## 1.3 Sinkhole location at 140m or 146m

Throughout the Report two distances are quoted for Florence's progress - 140m and 146m. Also, as noted above, Snowy Hydro reported in March 2023 that Florence has tunnelled 150 metres.

*"The sinkhole is located approximately 10 m outside the approved construction envelope and disturbance boundary and 140 m horizontally from the Tantangara HRT adit portal." The TBM cutting head is approximately 35 m directly below the sinkhole and 140 m horizontally from the HRT adit portal."*

*"In December 2022, the TBM passed into a fault zone and encountered sandy material with no apparent cohesion at approximately tunnel length 146 m."*

*"Due to this increased quantity of spoil entering the excavation chamber at Tunnel Length 145.8 m the excavation was stopped due to ground loss resulting in the sinkhole formation."*

4. How far has Florence bored?

## 1.4 What are the below-ground impacts

No information has been provided on the grouting works over the past 18 months to try to stabilise the ground for Florence to progress.

5. What has been the extent of grouting operations over the past 18 months and the volumes of materials injected into the ground?
6. What has been the impacts of these injections to the environment in the vicinity of Florence and beyond?

## 2 Why did Florence get stuck

### 2.1 Inadequate borehole testing

Snowy Hydro's CEO has stated that \$100 million was spent on exploratory borehole drilling prior to the start of tunnelling. Even so, it is apparent that the soil conditions at the start of the headrace tunnel were not identified.

The Geotechnical Report noted that (only) 19 boreholes were drilled along the 27 kilometres of water tunnels, two of which were near the start of the headrace tunnel.

*"The geotechnical investigations outlined above, including geomorphological assessments, boreholes, and seismic surveys, indicate differences in rock conditions in the Tantangara area when compared to the GBR."*

7. Why weren't the adverse soil conditions at the start of Florence's journey detected in the Geotechnical Baseline Report?
8. Why weren't adverse conditions detected by advance drilling ahead of Florence?
9. Why did Florence keep on excavating as the sinkhole developed and until such a large amount of soil was displaced?
10. Shouldn't additional boreholes be drilled to better know the soil conditions ahead of Florence?

### 2.2 Florence not initially fitted with slurry plant, inexplicably

Despite being designed to operate in both open and closed modes, Florence was not fitted with its closed mode (slurry) plant. Clearly, it was envisaged that Florence would need to be operated in closed mode for the sections of tunnel that have soft rock and naturally occurring asbestos (seven kilometres inside the headrace tunnel).

*"TBM Florence was designed to operate in two modes – open and closed. Open mode is its normal operational mode and will be mainly used to tunnel through normal competent rock conditions. In closed mode, which is also known as slurry mode, the TBM can tunnel through incohesive sandy conditions encountered at the Tantangara HRT adit. Tunnelling of the Tantangara HRT adit commenced in open mode. FGJV are in the process of installing the required additional support plants to convert the TBM from open mode to closed mode if required."*

*"The report confirmed the respective alignment consisted of Naturally Occurring Asbestos (NOA) approximately 7 km inside the Tantangara HRT Tunnel (HRT02) and an unlikely occurrence of fault affected zone / weak material, karst phenomena. The design included a single shield TBM capable of operating in two different modes: open mode and closed mode (slurry mode). Open mode is the main mode for excavation and will be used to tunnel through the rock conditions where asbestos contaminated rock is not present. However, open mode excavation is not able to excavate in unconsolidated, soil like material. The closed mode (slurry mode) is a mode able to excavate through asbestos containing material and unconsolidated, soil like material. Slurry mode involves modifying the TBM to enable safe excavation through NOA material."*

11. When was it expected that the slurry plant would have been installed?
12. Was the slurry plant delivered to site at the same time as Florence?
13. Why wasn't the slurry plant installed before Florence was commissioned, or at least when the unstable soil conditions were encountered in May 2022?

### 3 Need for modification raises questions on construction envelope

The Report makes it clear that the sinkhole is just outside the approved construction envelope at Tantangara, and hence the need for the modification application.

*“Since March 2023, FGJV has been undertaking ground consolidation works around the cutting head of the TBM by grouting the sub-surface materials. The aim of these works is to stabilise the soil matrix sufficiently so that material will not fall into the TBM cutting head. These ground stabilisation works have been undertaken from the surface inside the approved construction envelope and from within the TBM. However, depending on the outcome of the works, further ground consolidation may also be required to be undertaken from the surface outside the construction envelope directly above the TBM cutting head.*

*Snowy Hydro proposes to modify the Snowy 2.0 Main Works infrastructure approval under Section 5.25 of the EP&A Act to facilitate the rehabilitation of the sinkhole and undertake the ground consolidation works from the surface, if required. These works would be undertaken outside the approved construction envelope for Snowy 2.0.”*

The explanation for the need for the modification is limited to rehabilitation of the sinkhole and ground consolidation works from the surface outside the approved construction envelope. There is no mention of proposed actions to ensure this doesn't happen again, as required by DPE (see later).

#### 3.1 The construction envelope has already been breached

The sinkhole is outside the approved construction envelope, as are the below-ground stabilisation works undertaken from within the TBM in advance of the cutter head.

14. Does the creation of the sinkhole outside the approved construction envelope constitute a breach and if so, what penalties will be levied?
15. Have the stabilisation works and injection of foreign materials also breached the construction envelope?
16. Did Snowy Hydro obtain approval for these stabilisation works and if so, can that be released?

#### 3.2 Is there an approved construction envelope for the under-ground tunnelling works

Tunnelling doesn't appear to be included in the approved construction envelope.

17. Does the approved construction envelope include the headrace and other tunnels?
  - if not, is that an oversight?
  - if so, what is the width of the construction envelope for the tunnel and have the stabilisation works gone beyond the envelope?

#### 3.3 Is another modification application needed for a tunnelling construction envelope

Shouldn't Snowy Hydro seek approval for additional surface and below-ground works along the route of Florence for borehole drilling and potential ground consolidation due to the environmental impacts.

18. If a construction envelope hasn't been approved for tunnelling, or is not wide enough, will a modification application be sought before the proposed works in front of Florence can proceed?



## 4 Report focusses on getting Florence moving, with scant attention to further problems

### 4.1 Initial DPE/NPWS expectations of Modification Report

It is clear that DPE and the National Parks and Wildlife Service (NPWS) were expecting the Report to cover both the existing problems at Tantangara and potential problems across the rest of the tunnel project, rightly so.

*"We are working closely with the EPA, Planning and Assessment Compliance, SHL and Future Gen Joint Venture to assess the upcoming process for protection and rehabilitation of the site and to assess the potential for future issues. We have ascertained that no threatened species or Threatened Environmental Communities were impacted by the subsidence. Boring has been stopped while further considerations are made.*

*As you can imagine this is quite a fluid process of understanding how and why this occurred, what is to be done to rectify the issue and how we can be assured this will not occur in the future or that no further impacts occur on park."* Communication from NPWS to NPA, 8 January 2023

*"The NSW Department of Planning and Environment (DPE) told the ABC in February it was investigating the incident and has now placed further environmental conditions on the boring operation.*

*"Snowy Hydro must prepare a modification report that demonstrates how the project can safely progress without further environmental damage," the department said in a statement.*

[Major Snowy 2.0 tunnelling operation on hold after NSW government intervenes, ABC 11 May 2023](#)

19. What were the 'further environmental conditions' placed on the boring operations?

### 4.2 Requirements for Report not provided

*"Snowy Hydro met with representatives from DPE on 23 December 2022 and 2 February 2023 to discuss the sinkhole, temporary cessation of TBM operations and need for the proposed works. At the meeting in February, it was agreed that a modification to the Main Works approval would be required for the proposed works. It was also agreed that Snowy Hydro would prepare and submit a scoping letter to DPE setting out the proposed works and the scope of environmental assessments that would be undertaken to support a modification report.*

*A scoping letter was submitted to DPE on 3 April 2023. On 14 April 2023, DPE wrote to Snowy Hydro confirming that a modification to the Main Works approval would be required and set out requirements for the modification report (this report)."*

20. Contrary to the need for the modification application, why has Snowy Hydro repeatedly stated that there was no need for it to seek a modification, but it will do so of its own volition?
21. Can the scoping letter and DPE requirements be publicly released?
22. Did the requirements encompass both the existing problem and steps to be taken to avoid similar problems recurring as originally stated by DPE and NPWS?
23. If not, the requirements should be revised and reissued and a further Report requested.



## 5 Report must be augmented to address avoiding further problems

### 5.1 What is basis for considering further sinkholes unlikely

The Report considers the potential for further sinkholes to be unlikely. No doubt, the emergence of the current sinkhole was considered unlikely too – in fact there was no mention of any such possibility in the Main Works EIS.

*“Due to the hard rock conditions following the unconsolidated zone and the progressively increasing cover from the tunnel level to surface, the potential risk of a sinkhole as a result of tunnelling becomes increasingly rare.”*

*“Based on this as built information, at this stage, the Slurry Mode configuration may be required for the next 50m of excavation only. Moreover, tunnel alignment is going deeper into better rock condition and with the increase of rock cover thickness above the TBM tunnel, the risk of depression at the surface will be unlikely.”*

*“while the lowest point is at ch.2+500 close to the Nungar creek where the cover is about 115 m. About this particular case, the BH2103, closest available borehole, the at the tunnel depth shows competent rockmass: “META SANDSTONE: fine grained, grey, massive, occasional minor quartz veins, siltstone beds and clasts up to 100 mm, occasional quartz veins up to 15 mm”, even if the degree of fracturation is more dispersed than what is found in the BH2102 on the other side of the creek. In the described high-cover conditions, the formation of a sinkhole is unlikely”*

24. What assurances can be given that no further sinkholes will emerge?
25. What would be the impact of a sinkhole emerging under Nungar Creek or any other waterway?
26. What actions will be taken if further sinkholes emerge?

### 5.2 Where is the peer review report

*“A report which assesses the potential for subsidence and subsidence related impacts from continuing TBM operation has been prepared by FGJV and peer reviewed by SYSTRA Bamser. The geotechnical report can be found in Appendix A.”*

27. Can the SYSTRA Bamser peer review report be publicly released?

### 5.3 Water drawdown predictions

Clearly, significant changes to surface and underground water flows are anticipated from the tunnels.

*“Groundwater modelling predicted localised watertable drawdown in the vicinity of the Main Works project area, throughout construction and operation. Watertable drawdown was predicted to extend approximately 1.5 km north and south of main works project within the plateau area, east of the Snowy Mountains Highway, once the main works project had advanced into year 5 of construction and into operations. Watertable drawdown across the ravine area (west of the Snowy Mountains Highway) was predicted to be less extensive and restricted to less than 100 m from the Snowy 2.0 Main Works project infrastructure.*

*Based on the model, watertable drawdown was predicted to affect terrestrial, aquatic and subterranean groundwater dependent ecosystems (GDEs), and reduce groundwater availability for baseflow to rivers and creeks. The modelled reduction in baseflow was predicted to have the greatest effect to Gooandra Creek and the upper reaches of the Eucumbene River. The predicted effects would be localised to the area directly overlying the drawdown zone and are not predicted to significantly affect downstream reaches of these watercourses.”*

*“With respect to the works directly adjacent to Tantangara Reservoir and in the vicinity of the MOD2 project area, the following predictions are noted:*

- Within two years of construction, significant (>2 m) watertable drawdown is predicted between Tantangara Reservoir and Nungar Creek; associated with the construction of the headrace tunnel and Tantangara Adit. The model simulates the geological unit (Kellys Plain Volcanics) intercepted by MOD2 at this location to have a much higher permeability (consistent with values estimated from field assessments).*
- After three years of construction the drawdown footprint associated with the Kellys Plains Volcanics (KPV) increases to approximately one (1) km north and south of the HRT and expands immediately above the HRT to over 50 m from the HRT alignment. After five years of construction the KPV drawdown is predicted to further expand to approximately 1.5 km north and south of the HRT alignment.”*

*“It is noted that Snowy Hydro are currently in the process of reviewing the wider groundwater monitoring program for Snowy 2.0, with a focus on increasing the density of monitoring sites in areas characterised as high risk, from a groundwater drawdown perspective. Any changes to the proposed groundwater monitoring program and therefore the Groundwater Management Plan (FGJV 2020c) will be undertaken in consultation with DPE-Water and the NSW Environment Protection Authority (EPA). The intent of changes to the monitoring program will be to enable both FGJV and Snowy Hydro greater visibility over groundwater drawdown impacts in proximity to identified sensitive receptors across the plateau area and sensitive watercourses (Eucumbene Creek, Gooandra Creek and Tantangara Creek). Exceedances of approved groundwater level trigger limits prompt dynamic adaptive management measures through the use of groundwater inflow management (i.e. pre-grouting, post grouting) to limit groundwater drawdown and therefore indirect impacts to sensitive environmental receptors.”*

28. Have the unexpected issues with Florence and the sinkhole changed the expectations in the Main Works EIS with respect to impacts on surface water flows and water table drawdown?

#### **5.4 What is to be done to avoid further sinkholes and other problems**

The Report only assesses the surface or near-surface impacts in the vicinity of the sinkhole and the means of getting Florence moving to as far as the junction with the headrace tunnel, at 900 metres in.

The Biodiversity Development Assessment Report (BDAR) focusses on the ‘study area’, the 0.63 hectares around the sinkhole.

*“Around May 2022 the TBM began encountering adverse geological conditions which hindered its advancement. As a result, a sinkhole formed above the TBM. To allow the TBM to continue operating, Snowy Hydro and FGJV will need to undertake remediation and possible ground consolidation works. The ground consolidation works will be carried out only if the present consolidation works carried out from inside the construction boundary are not sufficient for the TBM to move forward. The remediation works will involve filling the sink hole with material to get it back to its original levels. The ground consolidation works will involve grouting (i.e. digging a series of holes and filling with cement like material) in front of the TBM  
All vegetation within the remediation and possible ground consolidation works areas will be removed as a result of the Project. This BDAR assumes a conservative disturbance area of 0.63 hectares (ha) (study area).”*

There is scant mention of potential problems occurring beyond that point over the other 26 kilometres of tunnelling.

No mention is made of the actions to be taken in areas of naturally occurring asbestos.

29. The Report needs to be augmented to address *“how we can be assured this will not occur in the future or that no further impacts occur on park”* (NPWS) and *“how the project can safely progress without further environmental damage”* (DPE).

At the very least, one would think it essential for constant borehole drilling ahead of Florence to know exactly the composition of the ground ahead.

30. Shouldn't Snowy Hydro be required to drill exploratory boreholes ahead of Florence's path to better anticipate conditions that may cause surface and water flow impacts and other problems?

## 6 Need for independent expert advice

One of the lessons from the Snowy 2.0 project is that advice from Snowy Hydro is invariably incorrect and optimistic.

31. Has DPIE sought independent advice to review the Report?

- if not, why not – such independent review is essential in view of the damage already caused to Kosciuszko National Park and the damage that may be caused
- if so, the independent expert reports should be publicly released