Gas Industry Co.

Review of the Proposed Changes to Schedule 1 of the Gas Governance (Critical Contingency Management) Regulations 2008

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Revision History

Revision	Prepared By	Description	Date
0	Daniel Momich	Issued for Review	5/04/2022
1	D Faraj	Issued for Use	12/10/2023

Document Acceptance

Action	Name	Signed	Date
Prepared by	D Faraj		12/10/23
Reviewed by	A Smith		
Approved by	A Smith		

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1 SUMMARY

For the worst case (if a CCMP is accepted where the lowest pressure values in the proposed range are used), the proposed changes to Schedule 1 of the Gas Governance (Critical Contingency Management) Regulations 2008 may:

- Slightly decrease the response time available to the Critical Contingency Officer (CCO) to manage critical contingency events at some delivery points

The proposed changes may also:

- Slightly increase the response time at other delivery points
- Along with other changes to the transmission network, enable significant emissions reduction on the order of 6,000 tCO2/year by bypassing Rotowaro Compressor Station
- Enable further emissions reductions through optimisation of compression throughout the transmission network
- Reduce the compression cost barrier to entry of low or zero emissions fuels, e.g. the Reporoa biomethane project

The CCO is prepared to curtail gas more quickly to manage cases where the available response time has decreased.

It is recommended that submissions of changes to the Critical Contingency Management Plan (CCMP) be accompanied with detail of the practical limits on the minimum operating pressure (MinOP) at each delivery point through the transmission network to ensure these limits are respected in the CCMP.

Consideration should also be given to the scenario of regulator failure of one stream at a delivery point coincident with peak demand as the Critical Contingency alerts currently do not capture the potential loss of distribution network pressure in this scenario at several locations.

If accepted, the proposed Schedule 1 forces minimal changes to the current CCMP. The reduced minimum operating pressure (MinOP) at Westfield and Cambridge could be compensated for by increasing the threshold time to MinOP to produce a CCMP that is functionally very similar to the current CCMP. The proposed Schedule 1 could be modified to enable a similar change at Waitangirua, where the time to MinOP is at the maximum specified in the current Schedule 1. More significant changes to the CCMP and hence the operation of the transmission network also require approval by the governing regulatory body and allow for detailed review of the specific changes within the approval timeframe.

It is recommended to accept the proposed changes to Schedule 1, given:

- The minor impact on most response times available to the CCO;
- The CCMP review and approval process;
- The potential to reduce emissions;
- The potential to enable (or reduce the barrier to entry for) low/no fossil gases.

2 GLOSSARY

Abbreviations and symbols used in this report are listed below:

Term	Definition
AUP	Ammonia Urea Plant
DP	Delivery Point / Gas Gate / Sales Gate
CCMP	Critical Contingency Management Plan
CCO	Critical Contingency Officer
CS	Compressor Station
KGTP	Kapuni Gas Treatment Plant
MinOP	Minimum Operating Pressure
SCADA	Supervisory Control And Data Acquisition

3 INTRODUCTION

First Gas, the owner of the New Zealand gas transmission systems has proposed changes to Schedule 1 of the Gas Governance (Critical Contingency Management) Regulations 2008. In the opinion of First Gas, these changes will enable more stable and efficient operation of the network, provide flexibility for First Gas to respond to changes in the energy environment including enabling development of biomethane injection. The letter from First Gas proposing the changes is attached in Appendix A.

3.1 IMPACT AND REGULATORY CONTEXT OF SCHEDULE 1

Schedule 1 specifies the limits on the time to minimum operating pressure (MinOP) calculation used in the Critical Contingency Management Plan (CCMP). The CCMP is prepared and periodically reviewed by First Gas. Various consulting and reviewing steps are required before a CCMP (or amendment to a CCMP) is approved, including:

1. The transmission system owner must consult with and consider suggestions from persons that the transmission system owner considers are representative of the interests of persons likely to be substantially affected by the proposed CCMP.
2. The industry body must appoint an expert adviser to review the proposed CCMP
3. The expert adviser must consult with the Critical Contingency Operator (CCO). The CCO may provide a report to the expert adviser.
4. The expert adviser must review the CCMP regarding reports and submissions noted above and recommend whether the industry body should approve or decline the CCMP
5. The industry body must approve (or decline) the CCMP based on the expert adviser's recommendation and whether the CCMP complies with regulation 25 of the Gas Governance (Critical Contingency management) Regulations and gives effect to the purpose of these regulations

The specified time and MinOP in the CCMP are the triggers for intervention by the CCO to oversee the operation of the transmission system and curtail demands as required. All delivery points with SCADA telemetry have their pressure trace monitored and forecast to determine if the time & pressure thresholds specified in the CCMP are breached. For example, were the pressure trend at Waitangirua to indicate that in 10 hours or less, pressure would be lower than the threshold MinOP of 37 barg (the current threshold), the Critical Contingency Operator would be alerted and take action to reduce the impacts of this potential loss of gas pressure at Waitangirua. Such mitigation actions may include dictating operational changes to the pipeline (e.g. increase compression upstream at KGTP and Kaitoke) and curtailments of gas demand (at Waitangirua or at other delivery points) through a series of bands that categorise gas users.

One particular aim of the CCO is to avoid a loss of gas pressure to residential gas users on the distribution network, thus reducing the time required to return to normal operation after the issue on the transmission network has been resolved. Maintaining sufficient gas pressure to domestic customers is important as significant work is required before normal operation can resume if pressure is lost to such a large number of customers.

With regards to the proposed changes being reviewed, it should be noted that for the CCMP, "the minimum operating pressure means the minimum pressure that is required to maintain the supply of gas across the relevant part or parts of the transmission system and to avoid disruption of distribution systems connected to the transmission system". This requirement places a second restriction on the MinOP that the transmission system operator may propose in an amended CCMP. In short, the MinOP in any CCMP must be:

1. Within the MinOP range specified in Schedule 1 of the Gas Governance (Critical Contingency Management) Regulations (the regulatory MinOP limit), and
2. At least the pressure required to maintain the supply of gas without disruption to the connected distribution systems (the practical MinOP).

The CCO's understand that, all other things being equal, a reduction in the MinOP for the Critical Contingency trigger will mean that less gas is available in the transmission network at the time the CCO is alerted and may therefore require a more rapid response (e.g. curtailing gas use for more bands of gas users in a rapid time frame). This may result in situations where a quick drop in pressure at a delivery point triggers a Critical Contingency and multiple gas user bands are curtailed rapidly in response. It may turn out that the triggering event was simply a spike in gas demand or an error in pressure monitoring, but with less of a buffer the CCO is not afforded the opportunity to make small interventions and wait to see if pressures recover.

3.2 PROPOSED CHANGES TO SCHEDULE 1

Currently, Schedule 1 is as follows:

Table 1: Current Schedule 1 of the Gas Governance (Critical Contingency Management) Regulations 2008

Pipeline	Maximum time before minimum operating pressure is reached	Minimum time before minimum operating pressure is reached	Minimum operating pressure range	Point of measurement
Maui Pipeline				
Rotowaro	5 hours	2 hours	32 (±2.5) barg	Rotowaro Compressor Station
Vector Pipeline				
South	10 hours	3 hours	35 (±2.5) barg	Waitangirua WTG06910
Hawkes Bay lateral	6 hours	3 hours	30 (±2.5) barg	Hastings HST05210
Frankley Rd To Kapuni	6 hours	3 hours	35 (±2.5) barg	Kapuni (GTP) KAP09612
Bay of Plenty	6 hours	3 hours	30 (±2.5) barg	Gisborne GIS07810
Bay of Plenty	6 hours	3 hours	30 (±2.5) barg	Taupo TAU07001
Bay of Plenty	6 hours	3 hours	30 (±2.5) barg	Tauranga TRG07701
Bay of Plenty	6 hours	3 hours	30 (±2.5) barg	Whakatane WHK32101
Morrinsville lateral	6 hours	3 hours	30 (±2.5) barg	Cambridge CAM17201
Central (North)	6 hours	3 hours	40 (±2.5) barg	Westfield WST03610
North	6 hours	3 hours	25 (±2.5) barg	Whangarei WHG07501
For any other gas gate on the Maui or Vector pipeline	6 hours	3 hours	30 (±2.5) barg	Gas gate not specified elsewhere

The proposed changes to Schedule 1 are provided in Appendix A with First Gas's rationale for the changes. For the purpose of this review, the proposed Schedule 1 has been interpreted as the following:

Table 2: Proposed Schedule 1 (Interpreted)

Pipeline	Maximum time before minimum operating pressure is reached	Minimum time before minimum operating pressure is reached	Minimum operating pressure range	Point of measurement
Rotowaro	5 hours	2 hours	30 (±5) barg	Rotowaro Compressor Station
South	10 hours	3 hours	27.5 (±7.5) barg	Waitangirua WTG06910
Hawkes Bay lateral	6 hours	3 hours	25 (±5) barg	Hastings HST05210
Frankley Rd To Kapuni	6 hours	3 hours	35 (±2.5) barg	Kapuni (GTP) KAP09612
Bay of Plenty	6 hours	3 hours	25 (±5) barg	Gisborne GIS07810
Bay of Plenty	6 hours	3 hours	25 (±5) barg	Tauranga TRG07701
Bay of Plenty	6 hours	3 hours	25 (±5) barg	Whakatane WHK32101
Morrinsville lateral	6 hours	3 hours	25 (±5) barg	Cambridge CAM17201
Central (North)	6 hours	3 hours	27.5 (±7.5) barg	Westfield WST03610
North	6 hours	3 hours	25 (±5) barg	Whangarei WHG07501
For any other gas gate on the Maui or First Gas pipeline	6 hours	3 hours	25 (±5) barg	Any other gas gate*

*Excluding gas gates supplied by pipelines operated at distribution pressures (<20barg)

If the proposed Schedule 1 is accepted, the following minimum operating pressures specified in the current CCMP would exceed the maximum MinOP in Schedule 1:

Table 3: Required Changes to CCMP on Acceptance of Proposed Schedule 1

Delivery Point	Current MinOP in CCMP, barg	Proposed Maximum MinOP, barg
Westfield	42	35
Cambridge	32	30
Waitangirua	37	35

4 RESPONSE TIME IMPACT

In the event that damage to or a significant failure in the transmission pipeline system has occurred, the CCO has a limited time from when they are alerted to curtail gas demand with the goal of maintaining gas supply to the domestic (and as many other) customers for as long as possible – ideally until the issue is resolved and normal operation is resumed.

Gas network modelling has been used to quantify the differences in this response time the CCO has available between the current and proposed schedule 1. Conservatively and to compare the potential effects of the proposed change to Schedule 1, the CCMP has been assumed to use the lowest value in the range of minimum operating pressures and the minimum time before MinOP is reached. Upgrades would be required at several delivery points in order to use the lowest values for MinOP where the practical requirements are not currently met.

The modelling was performed using DNVGL's Synergi Gas version 4.9.3

4.1 MODEL DESCRIPTION, ASSUMPTIONS AND SET-UP

The latest, validated transmission models from First Gas were used with modifications for:

- The latest 2031 peak week demand forecast from First Gas
- Kaitoke CS upgrade
- 600 loop lines available (no Pressure Reduction Station required with Kaitoke upgrade)
- Simple modelling of Rotowaro CS
- Merging of the South & Central South models to accurately model KGTP CS failure amongst other contingency events
- Merging of the Maui, North and Central North models to accurately model Rotowaro and Maui CS failures amongst other contingency events

Further changes were made for the future scenario under the proposed Schedule 1 limits, where Rotowaro is not operating:

- Rotowaro CS bypassed
- 402 Lateral upgrade & one-way supply from both 200 & 400 lines (odorization required at tie in from 400 line)

The models were initialized with discharge pressures from compressor stations constant and very low. Discharge pressure was determined iteratively, so that in the 2031 peak week forecast, the pressure trend would just trigger a Critical Contingency using the lower values for MinOP and time to MinOP. Historically, it has not been common to operate this way, though there are cases where compression is unavailable or where a normal demand peak has breached a critical contingency threshold at, for example, Waitangirua. This mode of operation has been assumed for the purposes of the modelling as it is a reasonably conservative scenario.

Note that the Critical Contingency thresholds used in this modelling are the minimum under the current and proposed Schedule 1, not those in the currently approved CCMP which has higher thresholds than the current minimum specified in the regulations.

Table 4: Modelled Compressor Discharge Pressures

Compressor Station	Discharge Pressure (Current Sch. 1), Barg	Discharge Pressure (Proposed Sch 1), Barg
Henderson	N/A Compressors Bypassed	50.0
Rotowaro	74.0	N/A Compressors Bypassed
Pokuru	66.0	63.5
Mokau	45.0	58.0
Kapuni GTP	63.0	63.0
Kaitoke	77.25	66.5

Once initialised using the compressor discharge points tabulated above, the models are run with the catastrophic compressor station failure or pipeline damage included. The failure is conservatively timed to be coincident with the lowest system pressures. The catastrophic compressor station failure is modelled as no flow to or from the compressor e.g. as if the compressors, bypasses and main line valve were all closed such as in a fire on site. The pipe damage scenario is modelled to simulate damage to the pipeline with an equivalent area of a 100mm bore pipe.

4.2 MODEL RESULTS: COMPRESSOR STATION FAILURE

Results are presented below, comparing various failure states. No response has been assumed except for the scenario of KGTP CS failure, where Kaitoke CS is stopped 2 hours later to prevent a rapid loss of pressure at the New Plymouth DP.

Table 5: Time to nominal MinOP on catastrophic failure at compressor stations

Loss of Supply from	Time to MinOP (Current Sch 1)	Time to minOP (Proposed Sch 1)
Henderson	N/A Compression Offline	6.5 hrs @ Warkworth, 20 barg 15 hrs @ Kauri, 20 barg
Rotowaro	2 hrs @ Cambridge, 27.5 barg 4.5 hrs @ Westfield, 4.5 barg	N/A Compression Offline
Pokuru	2.25 hrs @ Mt Maunganui, 27.5 barg 3 hrs @ Tauranga, 27.5 barg	3.25 hrs @ Mt Maunganui, 20 barg 4.5 hrs @ Tauranga, 20 barg
Mokau	3.75 hrs @ Rotowaro, 29.5 barg 4.5 hrs @ Huntly PS, 27.5 barg	8 hrs @ Cambridge, 20 barg
Kapuni GTP	12.5 hrs @ New Plymouth, 27.5 barg 12 hrs @ Palmerston North, 27.5 barg	12.5 hrs @ New Plymouth, 20 barg 11.75 hrs @ Palmerston North, 20 barg
Kaitoke	11.25 hrs @ Palmerston North, 27.5 barg 9.75 hrs @ Waitangirua, 32.5 barg	10 hrs @ Palmerston North, 20 barg 11.25 hrs @ Waitangirua 20 barg

In many cases, with the reduction in MinOP, the time between a Critical Contingency threshold breach and a breach of the nominal MinOP increases.

Table 6: Time to loss of system pressure on catastrophic failure at compressor stations

Loss of Supply from	Time to Failure (Current Sch 1)	Time to Failure (Proposed Sch 1)
Henderson	N/A Compression Offline	27 hrs @ Warkworth
Rotowaro	5 hrs @ Cambridge	N/A Compression Offline
Pokuru	7 hrs @ Mt Maunganui	6.5 hrs @ Mt Maunganui
Mokau	12.5 hrs @ Huntly PS	10 hrs @ Huntly PS
Kapuni GTP	13.75 hrs @ Palmerston North	12.5 hrs @ Palmerston North
Kaitoke	13.5 hrs @ Palmerston North	11.75 hrs @ Palmerston North

Time to loss of pressure in the transmission system is reduced as starting pressure (and hence the starting line-pack) of the scenario is reduced.

Table 7: Time to current practical MinOP (2 working regulator streams) at select delivery points on catastrophic failure at compressor stations

Loss of Supply from	Time to practical minoOP(Current Sch 1)	Time to practical minOP (Proposed Sch 1)
Henderson	N/A Compression Offline	4 hrs @ Warkworth, 22.1 barg
Rotowaro	3.25 hrs @ Cambridge, 18.9 barg	N/A Compression Offline
Pokuru	5.7 hrs @ Mt Maunganui, 18.8 barg	4.5 hrs @ Mt Maunganui, 18.8 barg
Mokau		6 hrs @ Cambridge, 18.9 barg
Kapuni GTP	12.5 hrs @ Palmerston North	11 hrs @ Palmerston North
Kaitoke	11.75 hrs @ Palmerston North, 23.6 barg 14.75 hrs @ Waitangirua, 19.4 barg	7.75 hrs @ Palmerston North, 23.6 barg 11.25 hrs @ Waitangirua, 19.4 barg

Practical MinOP is the current minimum supply pressure to a delivery point where peak demand flow can be met without regulator droop (reduced pressure to the distribution network). Table 7 presents this comparison using the optimistic version of this practical limit to the MinOP: where both regulator streams are operational. Note that some of these are above the lower range of the MinOP in the proposed Schedule 1.

There are many delivery points in the network where the delivery point may be operated at or near peak demand with insufficient pressure to meet this demand from the transmission network without any system failure or Critical Contingency alert raised in these scenarios. When considering both regulator streams as being in good working order, this number is reduced. These are tabulated below based on the information provided by First Gas.

Table 8: Delivery Points operating below practical MinOP before Critical Contingency is declared

When considering one stream non-operational	When considering both streams operational
Dannevirke	-
Inglewood	-
Kairanga	Kairanga (only with proposed Schedule 1)
Lake Alice (only with proposed Schedule 1)	-
Oroua Downs	-
Palmerston North (only with proposed Schedule 1	-
Patea	-
Pukekohe (only with proposed Schedule 1)	-
Warkworth (only with proposed Schedule 1)	-

Table 8 does not include DPs where the calculation of the practical MinOP appeared to be in error.

4.3 MODEL RESULTS: PIPELINE DAMAGE

The pipeline damage modelling results are tabulated below:

Table 9: Time to MinOP in the event of damage to the pipeline equivalent to a 100mm bore hole

Pipe damage near	Time to MinOP (current sch 1)	Time to MinOP (proposed sch 1)
Ruakaka	<0.25 hrs	<0.25 hrs
Alfriston	0.75 hrs	0.75 hrs
Morrinsville	<0.25 hrs	<0.25 hrs
Tauriko	<0.25 hrs	0.25 hrs
Otorohanga	12 hrs	MinOP not breached
New Plymouth	<0.25 hrs	<0.25 hrs
Takapau	<0.25 hrs	0.375 hrs
Paraparaumu	1 hr	1 hr

For the tested locations, there is no significant difference between time to MinOP in the event of pipeline damage equivalent to a 100mm bore hole, except for Otorohanga. It is likely that the same pipe damage located anywhere on the 400 line between Mokau and Rotowaro would give similar results. In the proposed operating configuration, Mokau discharge pressure is required to be higher to supply gas to Northland and the Morrinsville Lateral without compression at Rotowaro, hence the significant difference here.

4.4 FURTHER DISCUSSION

Given the high discharge pressure required from Mokau to maintain sufficient pressure at Cambridge and other gas gates off the 402 lateral, it is likely that further improvements to the network are required before Rotowaro compression can be bypassed year round. A likely additional improvement is upgrading or looping the 402 lateral from the 200 line (and 400 line tie-in) to Te Rapa.

4.4.1 RESPONSE TIME

Response times will be impacted if minimum operating pressures are reduced to the lower limit in the proposed Schedule 1.

For the modelled pipe damage cases, the response times are very limited, regardless of the operating conditions and MinOP, with most failures allowing less than 1 hour for demand curtailment. In these scenarios, it is not expected that the distribution network would be capable of supplying gas to the domestic customers long enough to resolve the issue. The exception is pipe damage on the 400 line north of Mokau CS, where sufficient compression from Mokau could sustain network pressures at the cost of continuous venting of gas through the damaged area. Due to the high flow and large line size, smaller damage to the 400 line may not be noticeable to Gas Control via SCADA telemetry, instead requiring notification from parties at the site of the damage to the line.

In the modelled catastrophic compressor station scenarios, the time to nominal MinOP often increased as the MinOP was reduced. This is not unexpected: operational pressures cannot decrease as much as MinOP decreases because frictional losses increase at lower operational pressure and demand spikes cause larger spikes in pressure, leading to breach of the Critical Contingency trigger earlier; a larger margin in terms of gas line-pack is required with the reduced MinOP, so this response time often increases.

By contrast, when considering fixed pressure failure points such as a complete loss of pressure at some point in the system or a breach of the current practical MinOP (where the current regulators will fail to maintain downstream pressure at peak flow), the response time decreases where a direct comparison is available. The reduction in response time appears unlikely to significantly hinder the ability of the CCO to respond appropriately to these contingency scenarios. The reconfiguration of the network enabled by the reduction in MinOP improves the response time at Cambridge significantly from 2 hours under the current compression configuration to 8 hours with gas supply from Mokau and with the additional supply from the 400 line at the 402 Lateral, providing a significantly larger volume of gas that can supply the 402 Lateral in this scenario. There remains a chance that a failure could prevent gas supply from Rotowaro, down the 200 line to the 402 Lateral, although much less likely and with supporting gas supply from the proposed tie in from the 400 line.

With the exception of KGTP CS failure, responses to declaration of the Critical Contingencies have not been modelled to simplify the models and allow an easier comparison between the calculated response times. Interventions such as curtailment of demand and increased compression (where available) can increase the available time until MinOP is reached. Interventions that decrease response times such as isolation of a pipeline segment or reduction in compression may be taken to reduce emissions of natural gas to the environment in the event of loss of containment.

The 300 and 400 lines between KGTP CS and Mokau CS have not been considered. Gas supply to this region is via multiple gas producers in the Taranaki region and pressure is typically maintained within the limits of the Taranaki Target Pressure of 42 – 48 barg. A single failure may have significant impact or very limited impact and is difficult to model in any meaningful way without a well defined scenario. Additionally, in the case of a production station trip, the gas producer may alert their customers to significantly reduce demand or arrange for alternative supply from other producers.

4.4.2 PRACTICAL MINOP

The modelling assumed that the practical limits to MinOP allow the use of the lower boundary on MinOP in Schedule 1. Presently, this condition is not met within the transmission network at a few delivery points at the current MinOP specified in the CCMP. From First Gas's calculation in Appendix E and excluding cases where the calculation appears to be in error, this is true at the following locations, depending on whether one or two regulator streams are available:

Table 10: Delivery Points Where CCMP Specified MinOP Appears to be Impractical

Delivery Point	Current MinOP in CCMP, barg	Current practical MinOP (1 stream), barg	Current practical MinOP (2 stream), barg
AUP (Ballance, fuel)	30	31.4	30.4
AUP (Ballance, process)	30	32.0	30.6
Broadlands	30	44.9	22.4
Dannevirke	30	46.5	24.2
Eltham	30	47.1	23.6
Foxton	30	30.6	15.3
Inglewood	30	63.9	32.4
Kairanga	30	93.1	47.7
Kinleith	30	33.6	19.8
Lake Alice	30	56.7	28.6
Longburn	30	37.2	18.7
Ngaruawahia	30	30.1	14.8
Okaiawa/Mania	30	44.4	22.2
Okato	30	33.3	16.4
Opotiki	30	39.1	21.8
Oroua Downs	30	64.7	32.8
Palmerston North	30	43.4	23.6
Patea	30	38.1	18.9
Pukekohe	30	47.9	24.7

Delivery Point	Current MinOP in CCMP, barg	Current practical MinOP (1 stream), barg	Current practical MinOP (2 stream), barg
Stratford	30	48.2	24.7
Takapau	30	34.5	18.2
Hamilton Te Kowhai	30	38.3	20.4
Waikeria	30	52.3	27.9
Waitara	30	47.6	24.7
Waitotara	30	48.2	24.2
Warkworth No.2	30	39.5	22.1

The number of delivery points where the CCMP MinOP is lower than the practical MinOP is greatly reduced where two regulator streams can count towards the station capacity. In normal operation this would be the case. Delivery points are not designed to operate with both regulator streams operating. Instead, a 'working stream' operates, while a 'standby stream' is available and will take over if pressure to the distribution network drops (e.g. if the working stream regulator gets blocked). Regulator failure does occur on occasion, with the station operating on the standby stream until maintenance activities return the other stream to service. It is unlikely that an event causing a critical contingency (e.g. pipeline damage, compressor issues) would occur while a delivery point is operating on only one regulator stream.

Under the assumed operating conditions used in the modelling, some Delivery Points would operate below their current practical limit to their MinOP without declaration of a Critical Contingency. Other DPs have practical MinOP for peak demand far greater than nominal MinOP, but other requirements for maintaining sufficient pressures throughout the network ensure sufficient supply to these delivery points. For example, if only one regulator stream is available at Eltham, the practical MinOP rises to 47.1 barg at peak demand while the supply pressure at Eltham would exceed this limit even under the proposed changes to Schedule 1 so long as New Plymouth DP has sufficient pressure that a Critical Contingency is not declared there.

Delivery Points such as these are vulnerable to insufficient supply if this is not considered when a significant change is made to the configuration of the transmission network. Continuing with the Eltham DP example, if the New Plymouth distribution network were to be supplied from multiple or alternative sources such as the New Plymouth Power Station DP (near the port, off the 400 line), the demand at the New Plymouth DP would reduce. With such a configuration, other pressures in the system may be reduced without triggering a Critical Contingency at New Plymouth DP, perhaps to the point where Eltham DP may be exposed to the risk of operating below its practical MinOP if only one regulator stream is available.

Various DPs supply IP20 networks at pressures up to 20 barg. Achieving a practical MinOP of 20 barg at these DPs may not be feasible without reconfiguration of the distribution network such as operating the IP20 piping as IP10 which may only be possible with significantly reduced demand, significant upgrades to the distribution network or additional gas supplies from within the network such as integrating production and storage of biomethane.

These concerns around the practical limits to MinOP should be considered in detail when reviewing proposed changes to a CCMP, ensuring that the MinOP specified in the CCMP is practical. Using the practical limit when considering only one regulator stream would be most conservative but more costly to achieve and technically challenging where high turndown is required. It would be prudent to carry out a risk assessment to determine if the risks are acceptably low to consider the practical limit to MinOP where both regulator streams are available to avoid over engineering.

5 EMISSIONS REDUCTION

The proposed Schedule 1 changes and various upgrades to delivery points to meet the practical requirements of reduced MinOP are part of a strategy to enable Rotowaro CS to be bypassed in normal operation, reducing emissions. The additional step of a one-way tie-in from the 400 line to the 402 lateral assumed in this modelling may not be the only approach to reconfiguring the transmission network to enable bypassing Rotowaro compression.

First Gas have presented figures of 6,220 tCO2/yr (theoretical required emissions at Rotowaro) and 9.900-11,650 tCO2/yr (based on actual fuel gas consumption operating the compressors at Rotowaro) in reduced emissions if Rotowaro Compression is removed from operation during normal circumstances. These are the emissions at Rotowaro CS itself and does not consider other effects:

- Increased compression at Mokau CS is required without Rotowaro CS operating
- Increased/required compression at Henderson CS without Rotowaro CS operating
- Reduced compression at KGTP CS, Kaitoke CS & Pokuru CS

Additionally, operating the transmission network at lower pressures may lower the barriers for emissions reduction technologies, for example:

- Biomethane or other non-fossil gas injection (lower injection costs)
- Hydrogen blending (lower injection costs, lower brittle fracture risk)

It is difficult to quantify the emissions savings that will directly result from the proposed change to Schedule 1 due to various factors:

- The transmission pipeline operator may retain compression similar to current levels, using the reduction in MinOP as an increase in security of supply or otherwise operate the transmission network such that reduced or no emissions savings occur
- Mokau CS may or may not be re-wheeled to operate more efficiently if Rotowaro is bypassed
- Further optimisation of compression enabled by lower pressure requirements may result in additional emissions savings
- Biomethane projects may proceed or fail regardless of compression costs for injection to the gas transmission system
- Hydrogen blending in the transmission system may not proceed

It must be noted that First Gas has a stronger incentive to reduce fuel gas use and hence emissions at Rotowaro and other compressor stations than it does at Mokau. Under the pricing methodology for gas transmission services, fuel gas costs at Mokau are 'pass – through' costs. The transmission pipeline operator is limited in how it can take advantage of this by the operational requirement to manage linepack north of Mokau in order to maintain Taranaki pressures within the 42 – 48 barg range

APPENDIX A PROPOSED SCHEDULE 1

Firstgas Group

22 November 2021

Grace Burtin
Tim Kerr
Caitlin Tromop van Dalen
Gas Industry Company
PO Box 10-646
WELLINGTON 6143

Dear Grace, Tim, and Caitlin:

Recommended Schedule 1 to CCM Regulations

Thank you for meeting with us recently to discuss the Critical Contingency Management Regulations (Regulations) and the need for flexibility that will enable us to respond more efficiently and effectively to the challenges posed by a rapidly evolving energy environment.

In that meeting, you asked us what we would recommend in terms of Schedule 1 thresholds, and I have attached our proposal as Appendix 1.

The specific changes proposed are:

- **Widen the P_{min} bands**, which will enable more efficient and reliable operation of the network for the anticipated changes over the next 5 years;
- **Remove Taupo as a specific point of measurement and add a note excluding any gas gate supplied by pipelines operated at distribution pressures**, which will enable the biomethane gas injection project at Reporoa to proceed, an important first step in the decarbonisation journey;
- **Retain Westfield as the measurement point in Auckland**: Firstgas had previously recommended changing this point to Henderson Compressor Station. With the loss of the significant Refining NZ load, Westfield is now considered the appropriate measurement point.

Implementing these proposals will allow Firstgas greater flexibility in determining appropriate thresholds in its Critical Contingency Management Plan under section 25(1) of the Regulations and address the current constraints that we are experiencing in developing solutions to optimising the safe, efficient, and reliable operation of the transmission system.

As we discussed, we remain of the opinion that the best way to address changing gas consumption patterns and changing energy policy considerations would be to eliminate Schedule 1 from the Regulations. We believe that the steps required by the Regulations in updating a Critical Contingency Management Plan ensure that any threshold change is subject to robust independent scrutiny before being implemented. Schedule 1 has provided an added layer of oversight that worked well when pipeline conditions and energy policy settings were relatively stable, but we consider that, as a part of the Regulations, Schedule 1 is not nimble enough to respond to future changes.

I would be happy to discuss our recommendation further with you. If you have any questions or need further information, please contact me on [redacted]

Please feel free to share this letter with interested government departments.

Yours sincerely

[redacted]

Appendix 1 – Proposed Schedule 1

Pipeline Name	Point of Measurement	P_{min} (barg)
Maui	Rotowaro	30 +/- 5
South	Waitangirua	27.5 +/- 7.5
Hawkes Bay Lateral	Hastings	25 +/- 5
Frankley Road to KGTP	KGTP	35 +/- 2.5
Bay of Plenty	Gisborne	25 +/- 5
~~Bay of Plenty~~	~~Taupo~~	(Removed)
Bay of Plenty	Tauranga	25 +/- 5
Bay of Plenty	Whakatane	25 +/- 5
Morrinsville Lateral	Cambridge	25 +/- 5
Central (North)	Westfield	27.5 +/- 7.5
North	Whangarei	25 +/- 5
First Gas and Maui Pipeline	Any other gas gate*	25 +/- 5

*Excluding gas gates supplied by pipelines operated at distribution pressures (<20barg)

APPENDIX B CURRENT SCHEDULE 1

Schedule 1
Critical contingency threshold limits

r 25

In accordance with regulation 25(1)(a), the permissible limits for the thresholds specified in a critical contingency management plan that apply to the following parts of the transmission system (as identified on the map published in accordance with regulation 10) are:

Pipeline	Maximum time before minimum operating pressure is reached	Minimum time before minimum operating pressure is reached	Minimum operating pressure range	Point of measurement*
Maui pipeline				
Rotowaro	5 hours	2 hours	32 (±2.5) bar g	Rotowaro Compressor Station
Vector pipeline				
South	10 hours	3 hours	35 (±2.5) bar g	Waitangirua WTG06910
Hawkes Bay lateral	6 hours	3 hours	30 (±2.5) bar g	Hastings HST05210
Frankley Rd to Kapuni	6 hours	3 hours	35 (±2.5) bar g	Kapuni (GTP) KAP09612
Bay of Plenty	6 hours	3 hours	30 (±2.5) bar g	Gisborne GIS07810
Bay of Plenty	6 hours	3 hours	30 (±2.5) bar g	Taupo TAU07001
Bay of Plenty	6 hours	3 hours	30 (±2.5) bar g	Tauranga TRG07701
Bay of Plenty	6 hours	3 hours	30 (±2.5) bar g	Whakatane WHK32101
Morrinsville lateral	6 hours	3 hours	30 (±2.5) bar g	Cambridge CAM17201
Central (North)	6 hours	3 hours	40 (±2.5) bar g	Westfield WST03610
North	6 hours	3 hours	25 (±2.5) bar g	Whangarei WHG07501
For any other gas gate on the Maui or Vector pipeline	6 hours	3 hours	30 (±2.5) bar g	Gas gate not specified elsewhere

*The codes specified in the fifth column of this table refer to the gas gate codes determined under the Gas (Switching Arrangements) Rules 2008.

APPENDIX C NOTE ON ROTOWARO FUEL GAS

NOTE | Rotowaro Emissions

Date: 25 Feb 2022
Author: Tim Gray

1. Current Emissions

Rotowaro is currently used to compress all gas consumed in Auckland, as well as through the 402 lateral, from Te Rapa to Cambridge.

Due to operational limitations of the existing compressors, multiple units are used to compress the gas, resulting in inefficiencies to the operation, driving emissions higher and higher. If we look at the theoretical compression case and ignore the operational limitations, we see emissions of the below:

Flow Average 1800e3 Scm/Day
Average Inlet Pressure: 52barg
Average Outlet Pressure: 75barg
Approximate Compression Power required: 1095kW
Engine Efficiency 30%
Average CV: 39.54 Mj/M3
Fuel Gas required per day: 315GJ/d
Tonnes Co2/GJ: 0.0541
TCo2/yr = 6,220

As noted above this is a highly conservative estimate of the emissions typical for this location, due to operational considerations and assumes only the most efficient units are ever run (i.e. if the turbines are never run). This contrasts to actual current fuel gas consumption average of 500-590GJ/d which equites to 9900-11,650tCo2/yr, however this is skewed greatly higher than the theoretical case by the poor efficiency of the existing turbine units.

Smaller savings could be made if the units at Rotowaro were replaced with appropriately sized units for the current flow and pressure requirements, but given these flow and pressure requirements can be meet elsewhere, and result in a higher reduction in emissions any further development of the Rotowaro compression system is not currently under consideration.

For transparency, it should be noted if the compressors at Rotowaro are turned off, the supply pressure will likely be increased slightly by increasing the amount of upstream compression, as well as the requirement to run Henderson compression to support the 430 System. Due to optimized selection of the upstream compression system and Henderson operating with small electric drive compressors, there should be little to no transfer of emissions from shutting down Rotowaro to other compression locations.

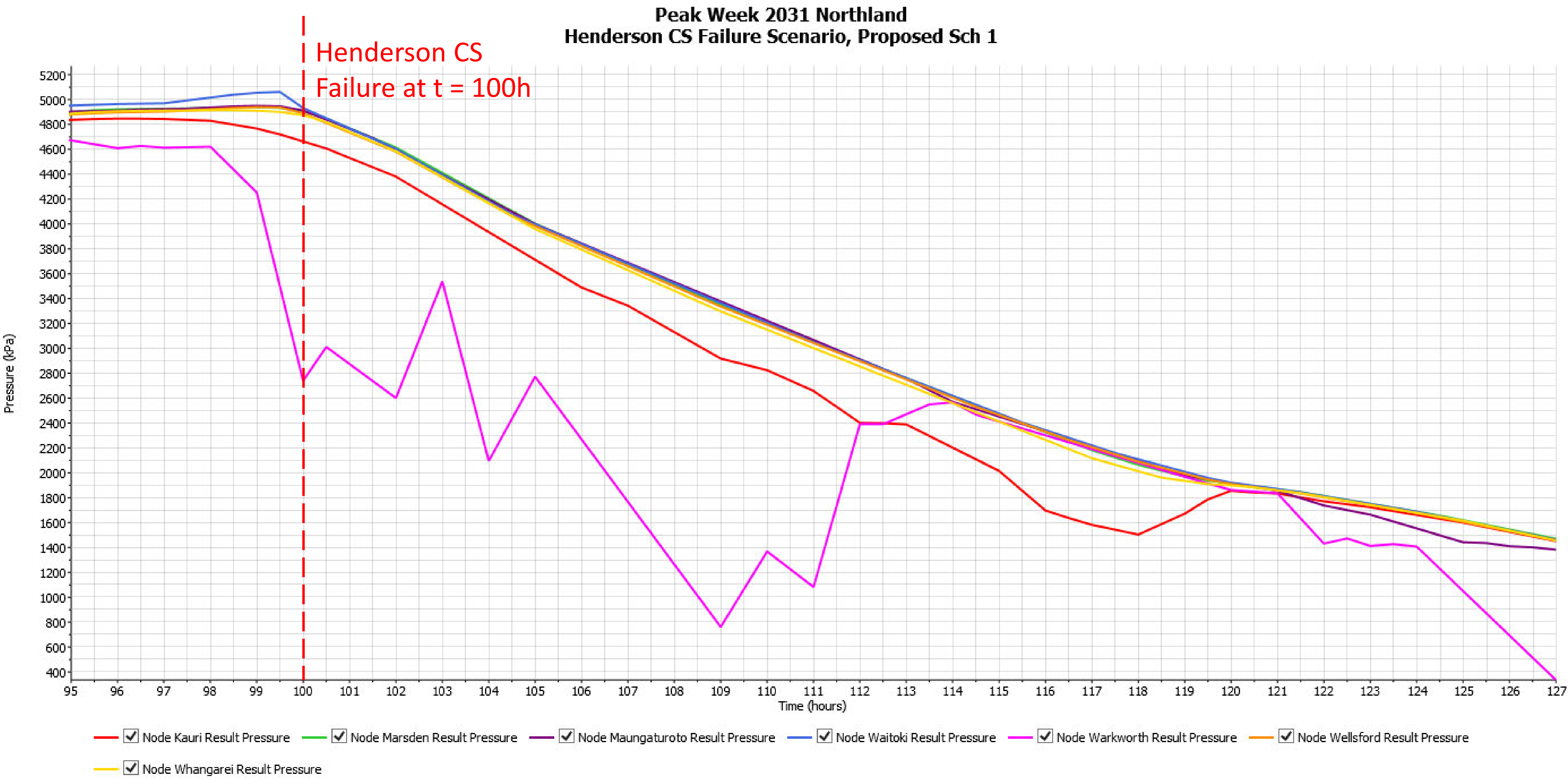
Note this also excludes fugitive emissions which occur due to leakage seals and shutdowns of the compressor. These are considered relatively minor compared to the emissions from fuelling the units so have been excluded.

2. Summary

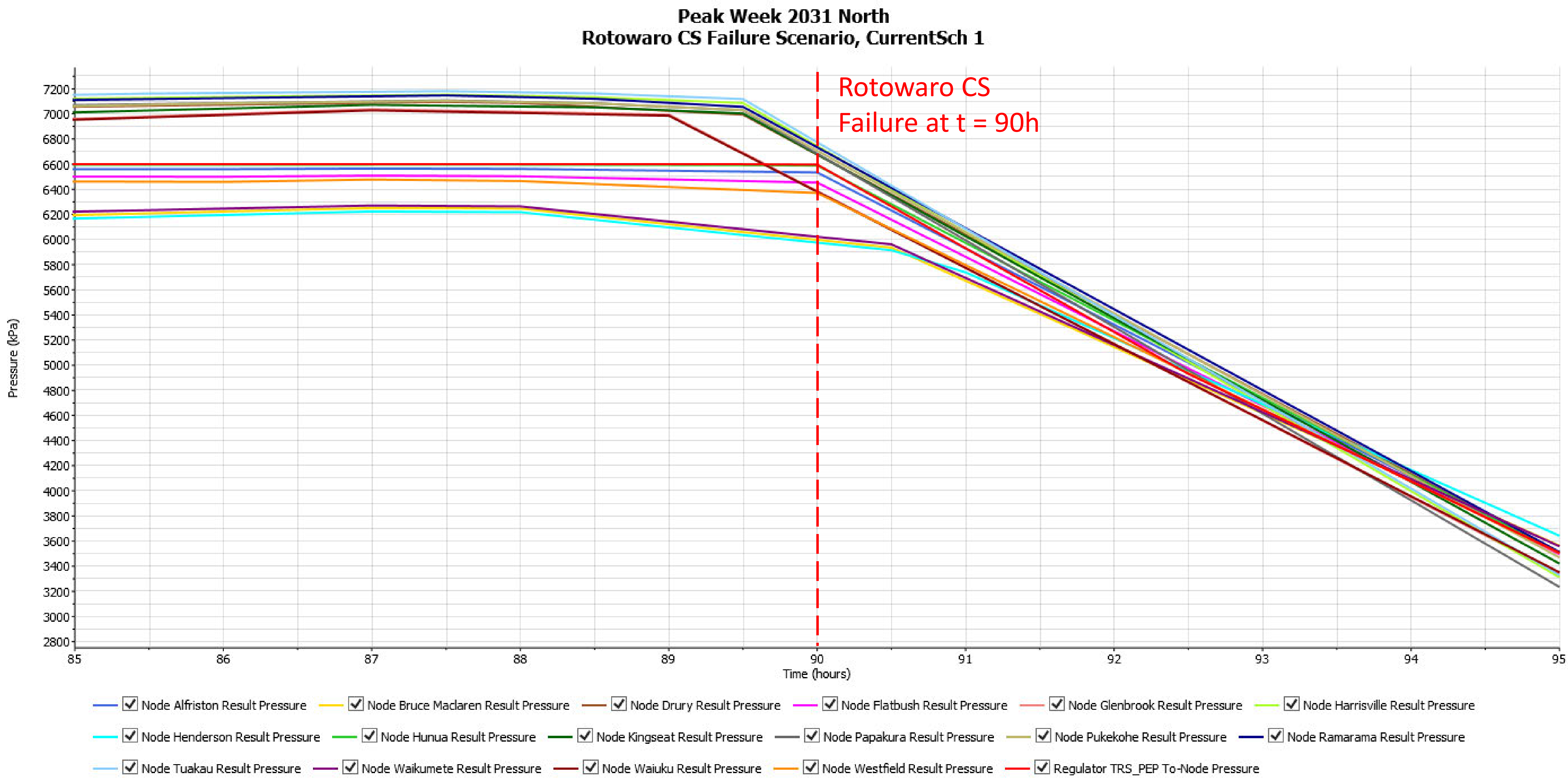
Current FGL total emissions are estimated at 32,000TCO2/annum from Fuel Gas usage, so the cessation of compression at Rotowaro is likely to result in at least a 19.4% of total CO2 emissions from Fuel consumption, and potential result in a saving of up to 35% based on the current operational limitations of the equipment installed.

APPENDIX D SYNERGI GAS MODELLING RESULTS

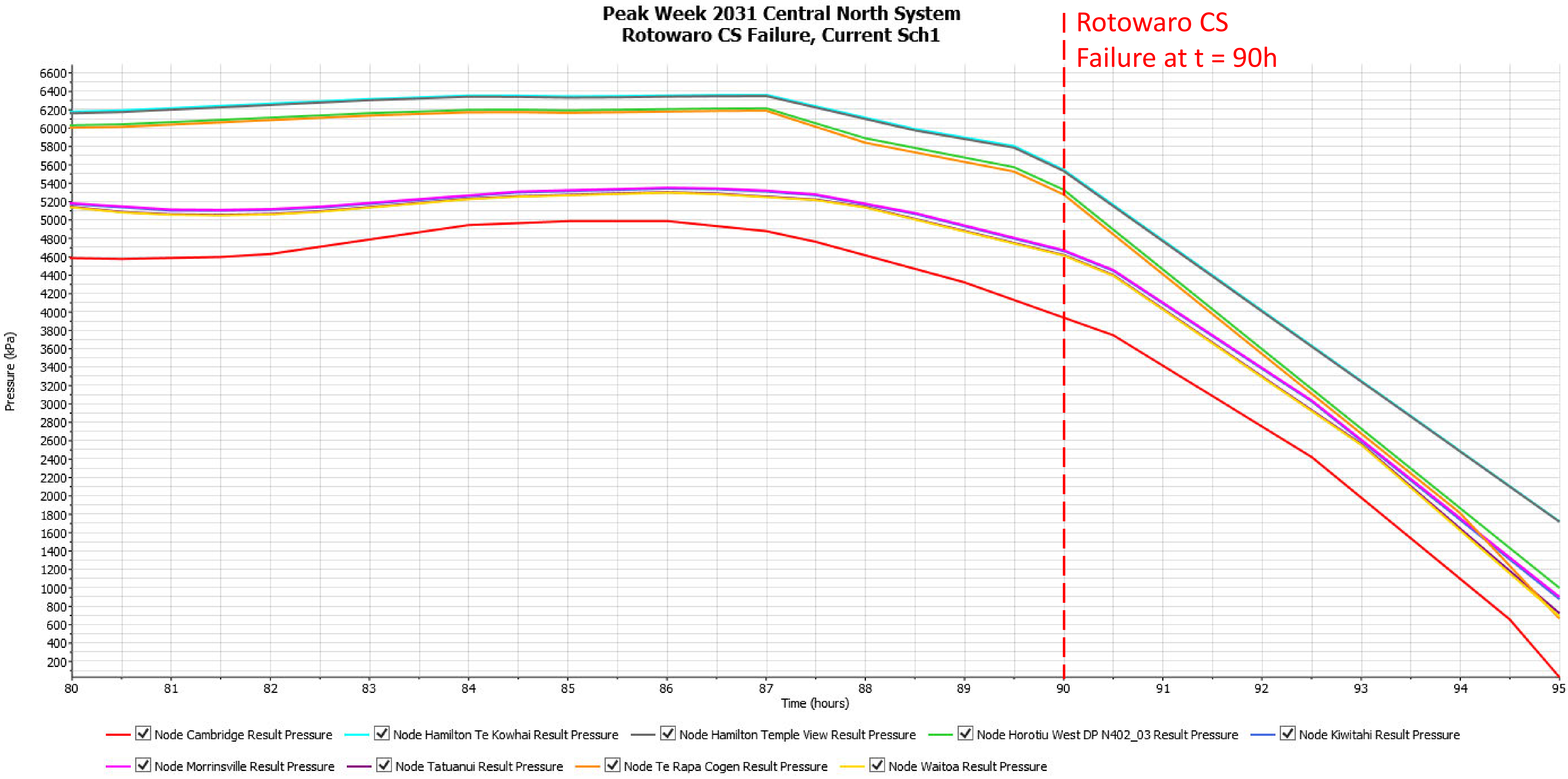
Catastrophic failure at Henderson Compressor Station has not been modelled for the current Schedule 1 scenario. With Refining NZ off, northland demand is low enough that Henderson CS does not need to run for the forecast 2031 peak week demand.



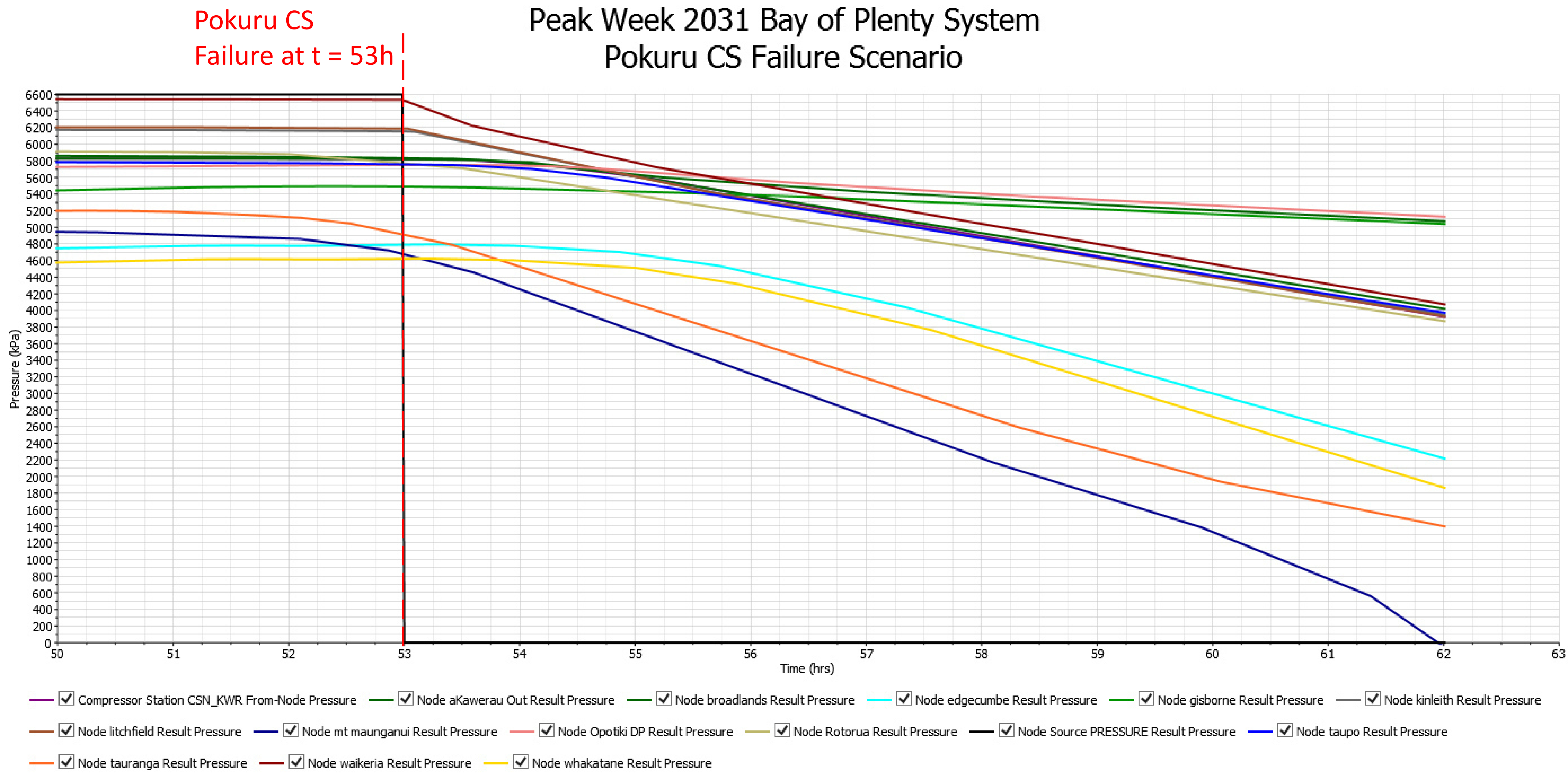
Peak Week 2031 Northland
Henderson CS Failure Scenario, Proposed Sch 1
Henderson CS
Failure at t = 100h
Pressure (kPa)
Time (hours)
Node Kauri Result Pressure
Node Marsden Result Pressure
Node Maungaturoto Result Pressure
Node Waitoki Result Pressure
Node Warkworth Result Pressure
Node Wellsford Result Pressure
Node Whangarei Result Pressure



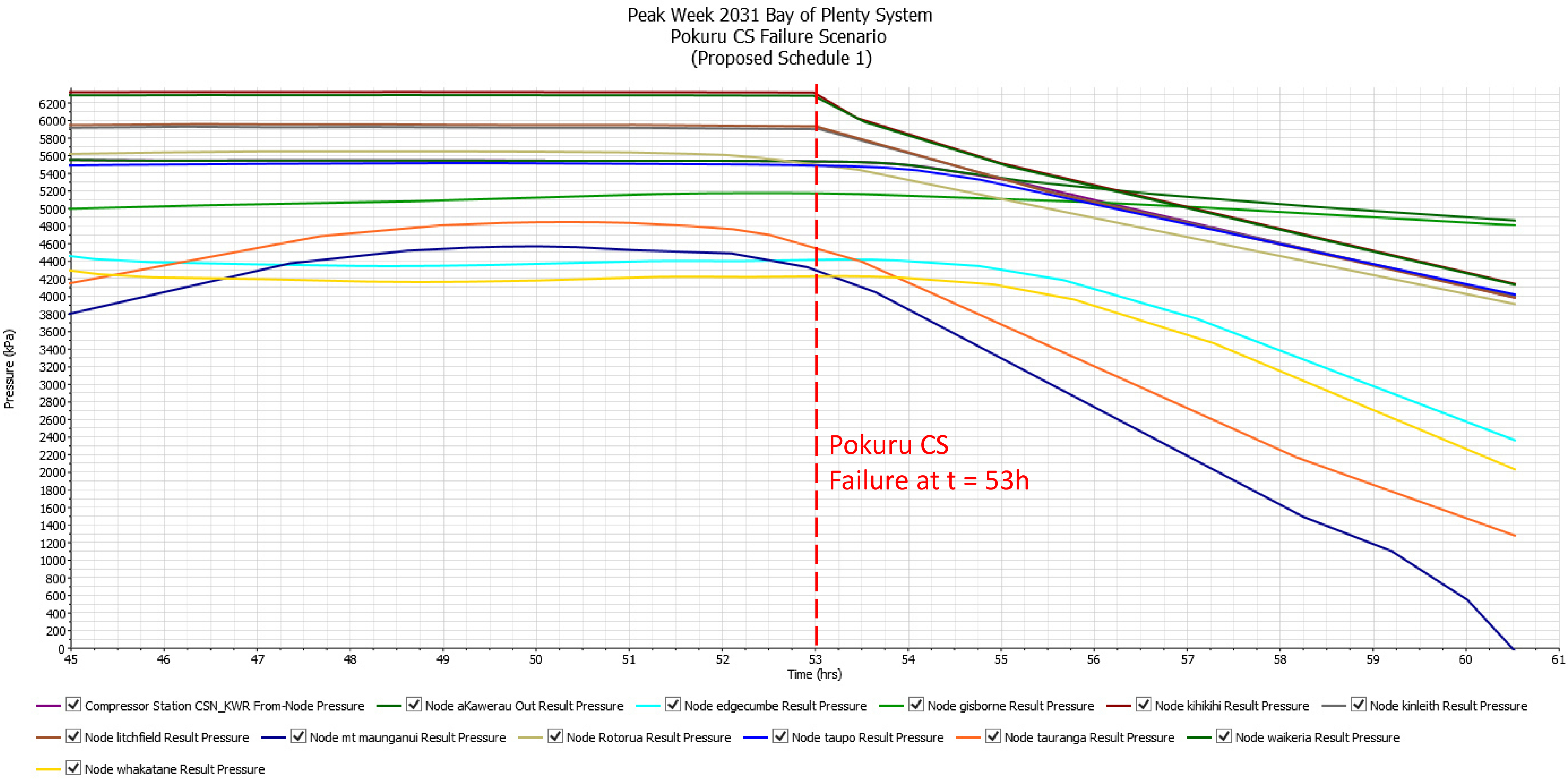
Peak Week 2031 North
Rotowaro CS Failure Scenario, CurrentSch 1
Rotowaro CS
Failure at t = 90h
Pressure (kPa)
7200
7000
6800
6600
6400
6200
6000
5800
5600
5400
5200
5000
4800
4600
4400
4200
4000
3800
3600
3400
3200
3000
2800
85
86
87
88
89
90
91
92
93
94
95
Time (hours)
Node Alfriston Result Pressure
Node Bruce Maclaren Result Pressure
Node Drury Result Pressure
Node Flatbush Result Pressure
Node Glenbrook Result Pressure
Node Harrisville Result Pressure
Node Henderson Result Pressure
Node Hunua Result Pressure
Node Kingseat Result Pressure
Node Papakura Result Pressure
Node Pukekohe Result Pressure
Node Ramarama Result Pressure
Node Tuakau Result Pressure
Node Waikumete Result Pressure
Node Waiuku Result Pressure
Node Westfield Result Pressure
Regulator TRS_PEP To-Node Pressure

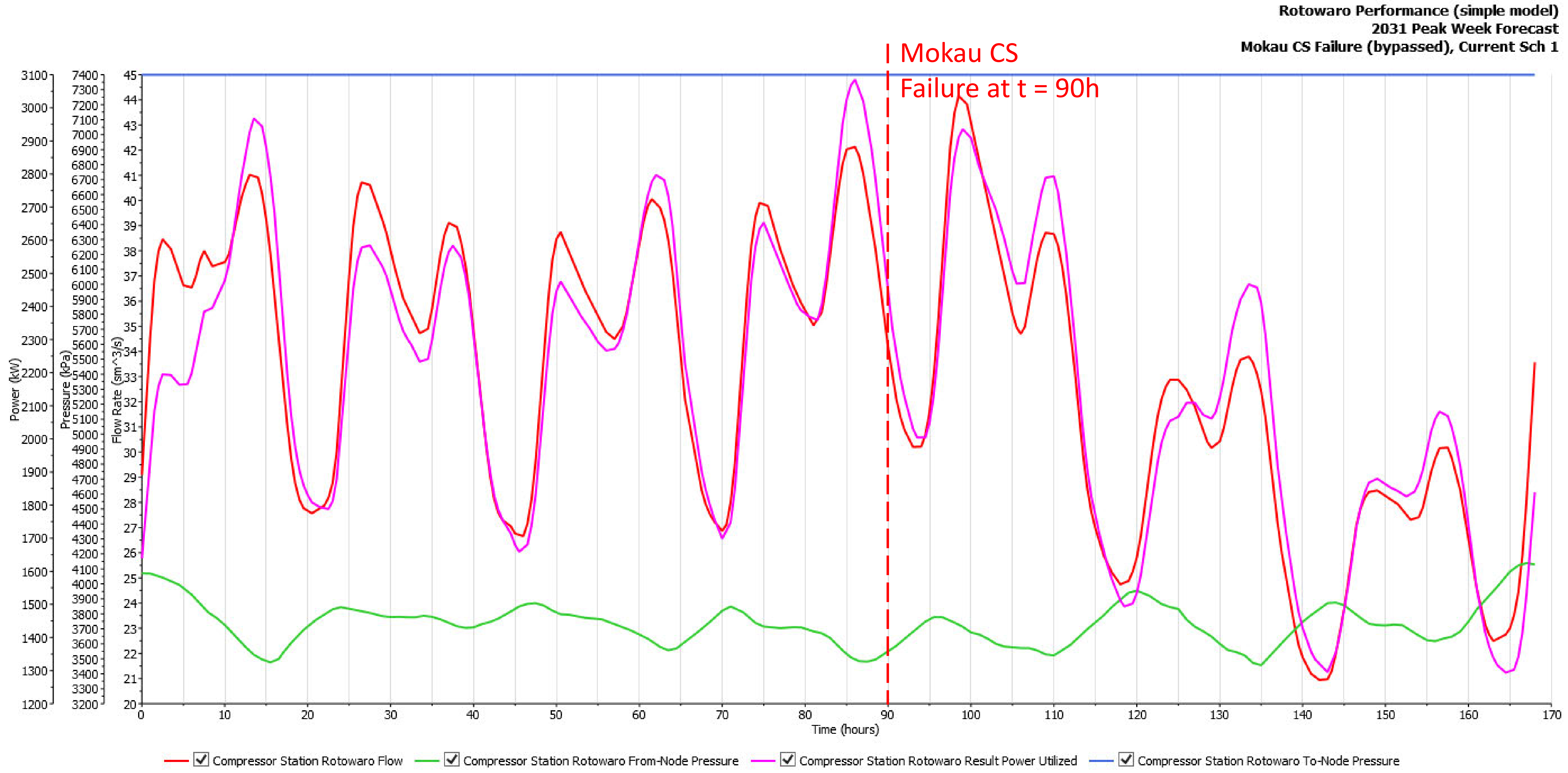

Peak Week 2031 Central North System
Rotowaro CS Failure, Current Sch1
Rotowaro CS
Failure at t = 90h
Pressure (kPa)
Time (hours)
Node Cambridge Result Pressure
Node Hamilton Te Kowhai Result Pressure
Node Hamilton Temple View Result Pressure
Node Horotiu West DP N402_03 Result Pressure
Node Kiwitahi Result Pressure
Node Morrinsville Result Pressure
Node Tatuanui Result Pressure
Node Te Rapa Cogen Result Pressure
Node Waitoa Result Pressure

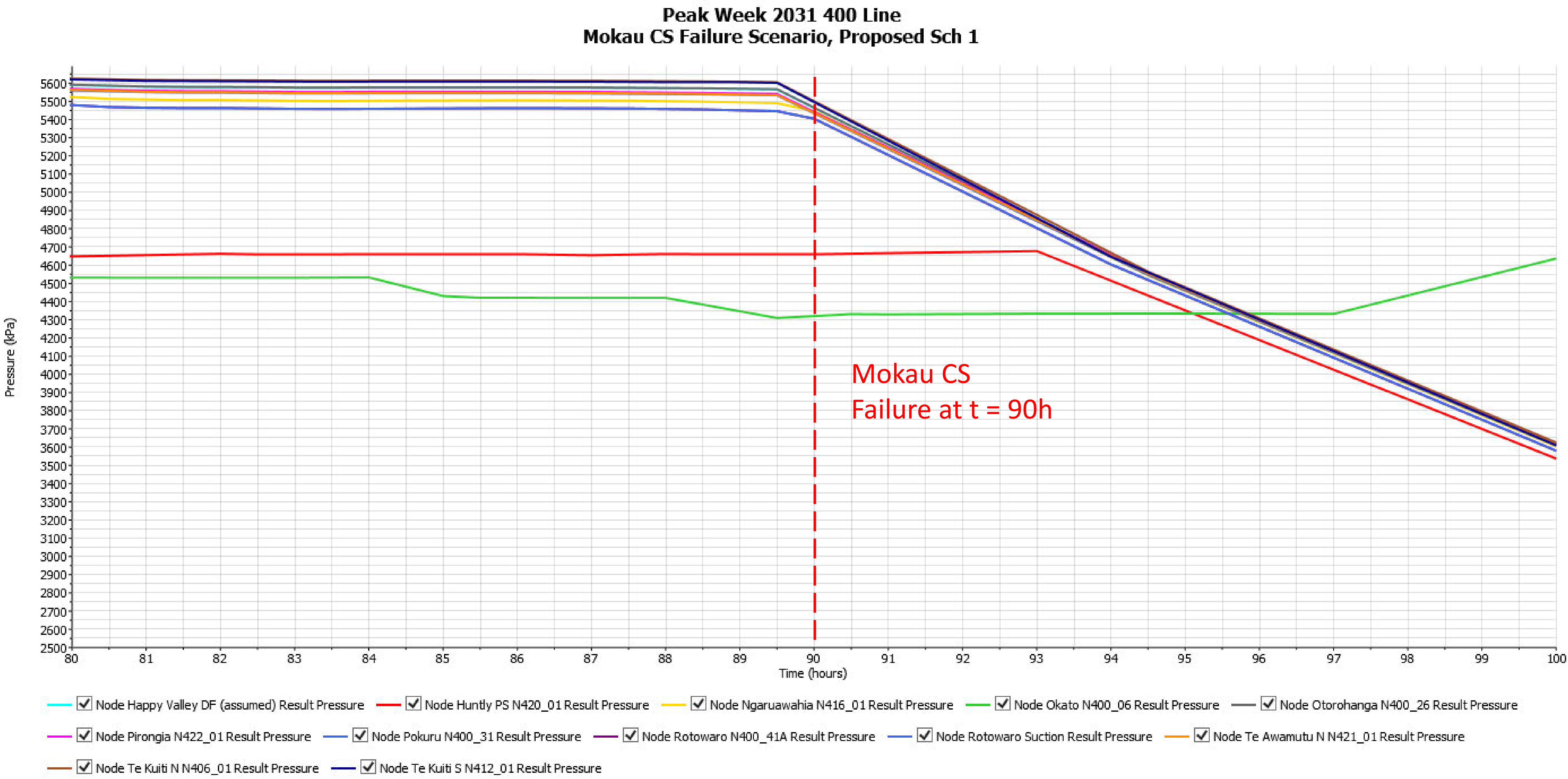
Catastrophic failure at Rotowaro Compressor Station has not been modelled for the proposed Schedule 1 scenario. With sufficient compression at Mokau CS, Rotowaro CS does not need to run for the forecast 2031 peak week demand.



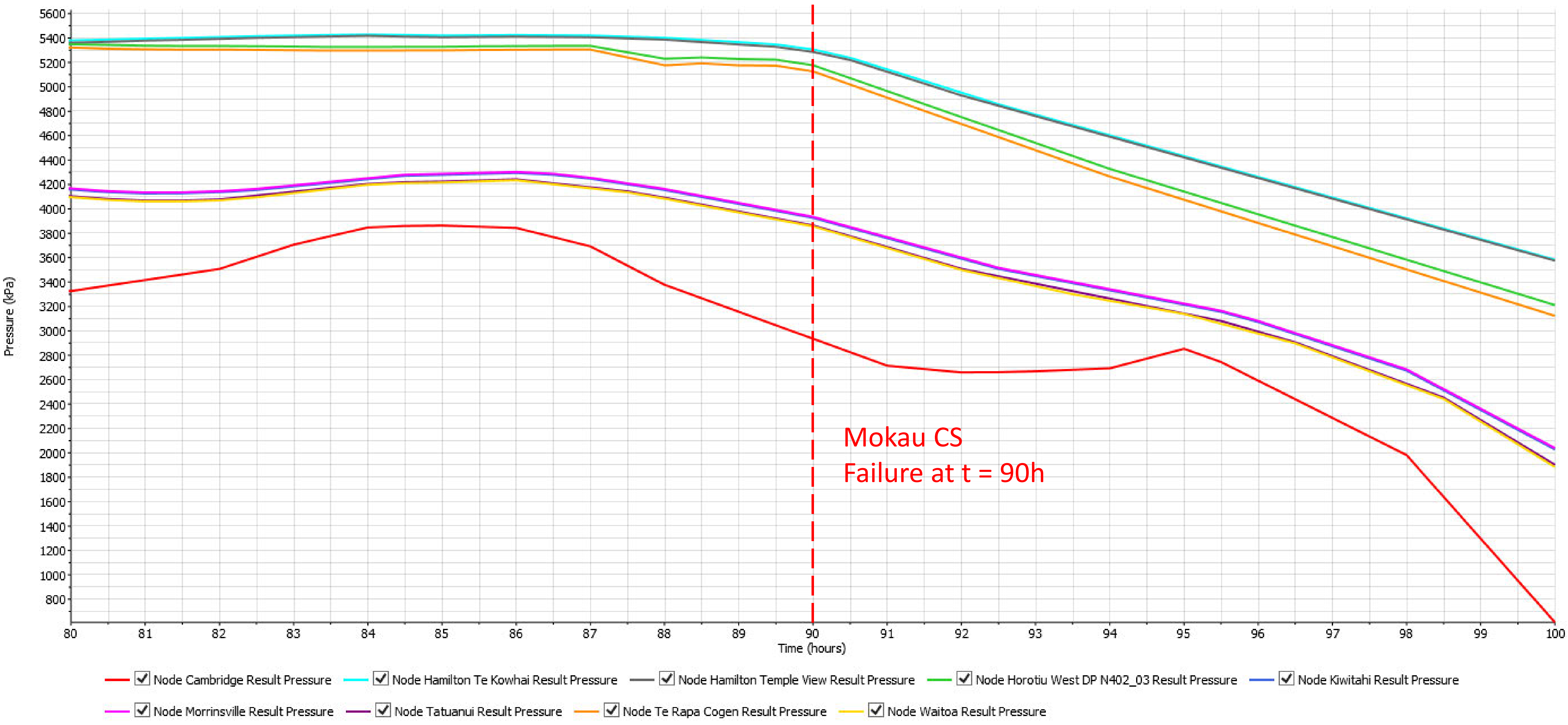
Pokuru CS
Failure at t = 53h
Peak Week 2031 Bay of Plenty System
Pokuru CS Failure Scenario
Pressure (kPa)
Time (hrs)
Compressor Station CSN_KWR From-Node Pressure
Node aKawerau Out Result Pressure
Node broadlands Result Pressure
Node edgecumbe Result Pressure
Node gisborne Result Pressure
Node kinleith Result Pressure
Node litchfield Result Pressure
Node mt maunganui Result Pressure
Node Opotiki DP Result Pressure
Node Rotorua Result Pressure
Node Source PRESSURE Result Pressure
Node taupo Result Pressure
Node tauranga Result Pressure
Node waikeria Result Pressure
Node whakatane Result Pressure

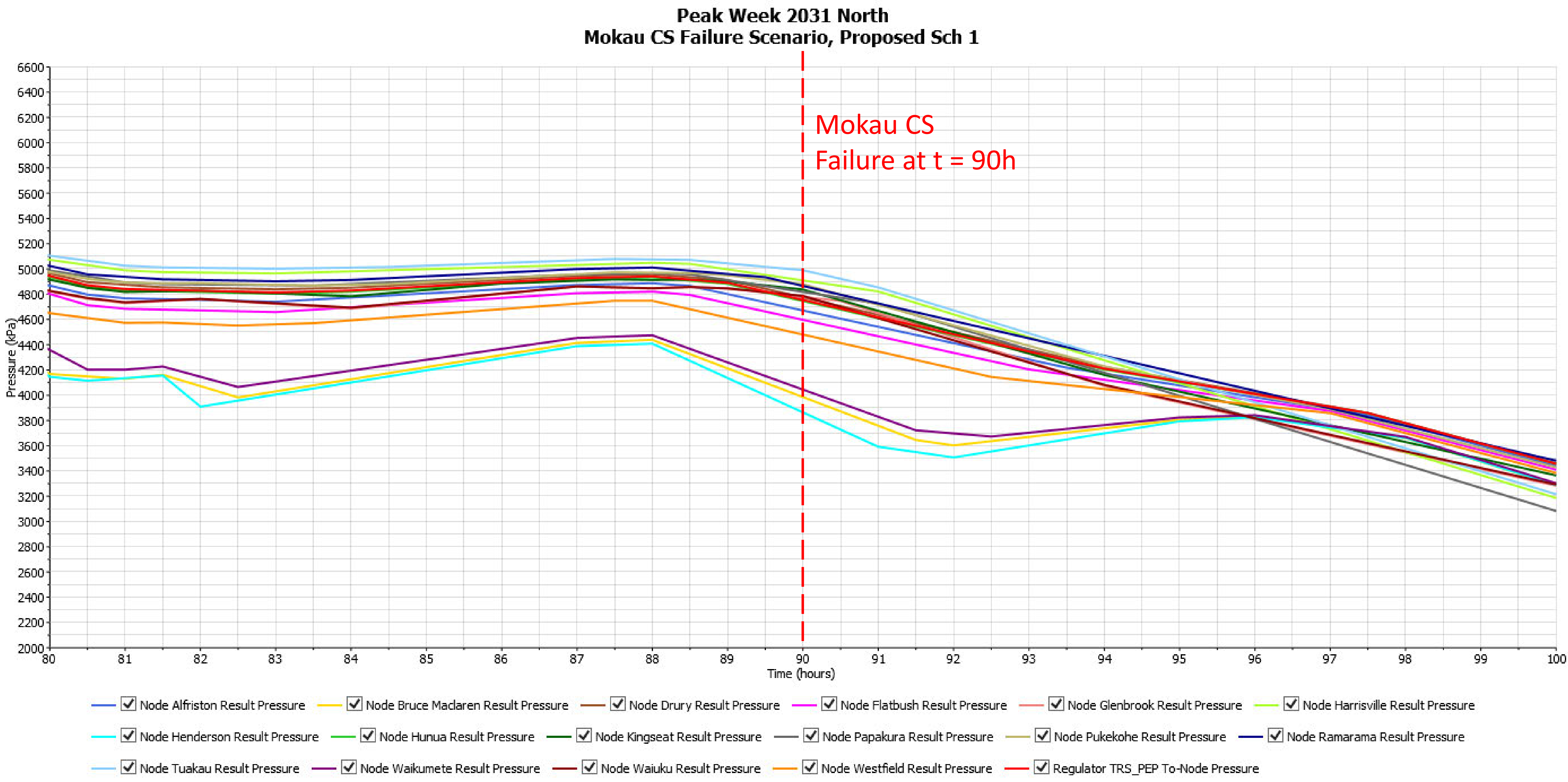

Peak Week 2031 Bay of Plenty System
Pokuru CS Failure Scenario
(Proposed Schedule 1)
Pressure (kPa)
Time (hrs)
Pokuru CS
Failure at t = 53h
Compressor Station CSN_KWR From-Node Pressure
Node aKawerau Out Result Pressure
Node edgecumbe Result Pressure
Node gisborne Result Pressure
Node kihikihi Result Pressure
Node kinleith Result Pressure
Node litchfield Result Pressure
Node mt maunganui Result Pressure
Node Rotorua Result Pressure
Node taupo Result Pressure
Node tauranga Result Pressure
Node waikeria Result Pressure
Node whakatane Result Pressure


Rotowaro Performance (simple model)
2031 Peak Week Forecast
Mokau CS Failure (bypassed), Current Sch 1
Mokau CS
Failure at t = 90h
Power (kW)
Pressure (kPa)
Flow Rate (sm^3/s)
Time (hours)
Compressor Station Rotowaro Flow
Compressor Station Rotowaro From-Node Pressure
Compressor Station Rotowaro Result Power Utilized
Compressor Station Rotowaro To-Node Pressure

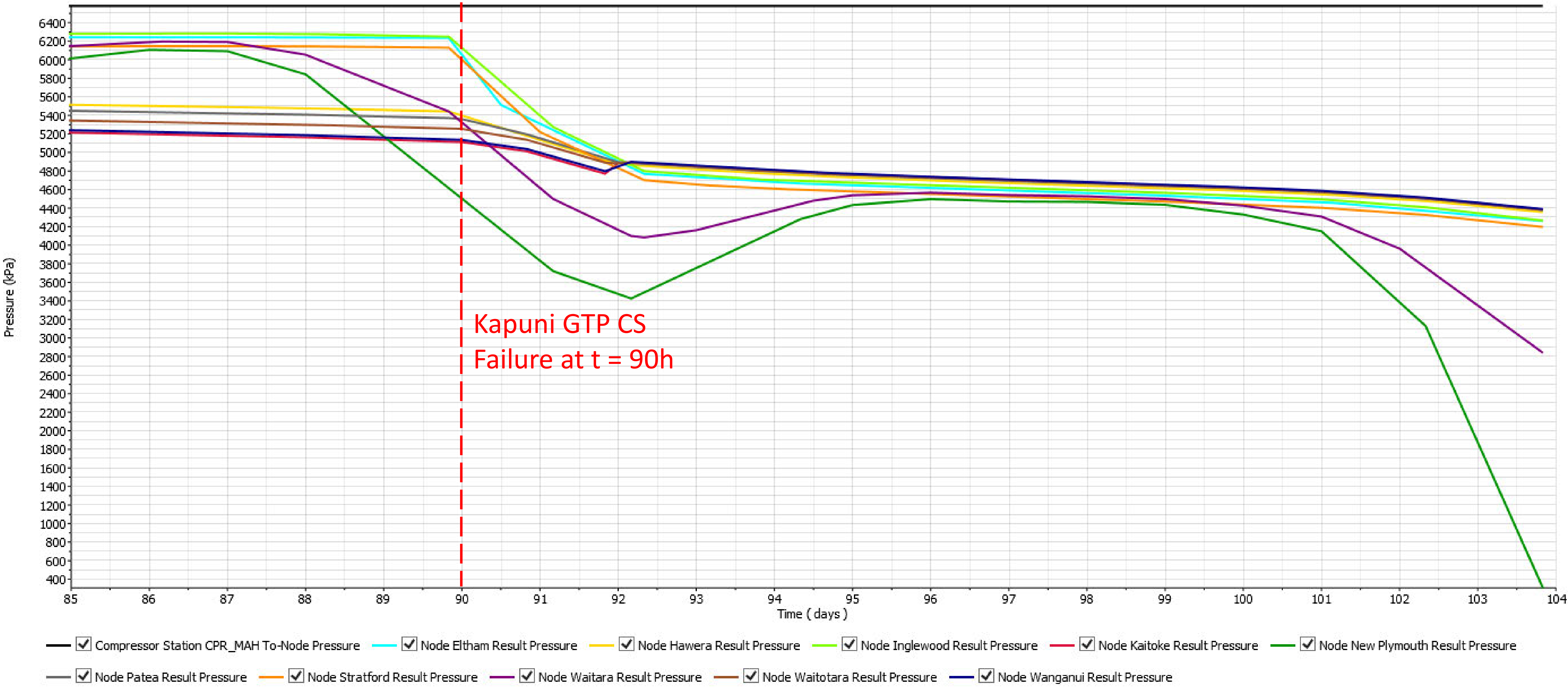

Peak Week 2031 400 Line
Mokau CS Failure Scenario, Proposed Sch 1
Pressure (kPa)
5600
5500
5400
5300
5200
5100
5000
4900
4800
4700
4600
4500
4400
4300
4200
4100
4000
3900
3800
3700
3600
3500
3400
3300
3200
3100
3000
2900
2800
2700
2600
2500
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
Time (hours)
Mokau CS
Failure at t = 90h
Node Happy Valley DF (assumed) Result Pressure
Node Huntly PS N420_01 Result Pressure
Node Ngaruawahia N416_01 Result Pressure
Node Okato N400_06 Result Pressure
Node Otorohanga N400_26 Result Pressure
Node Pirongia N422_01 Result Pressure
Node Pokuru N400_31 Result Pressure
Node Rotowaro N400_41A Result Pressure
Node Rotowaro Suction Result Pressure
Node Te Awamutu N N421_01 Result Pressure
Node Te Kuiti N N406_01 Result Pressure
Node Te Kuiti S N412_01 Result Pressure

Peak Week 2031 Central North System
Mokau CS Failure, Proposed Sch1

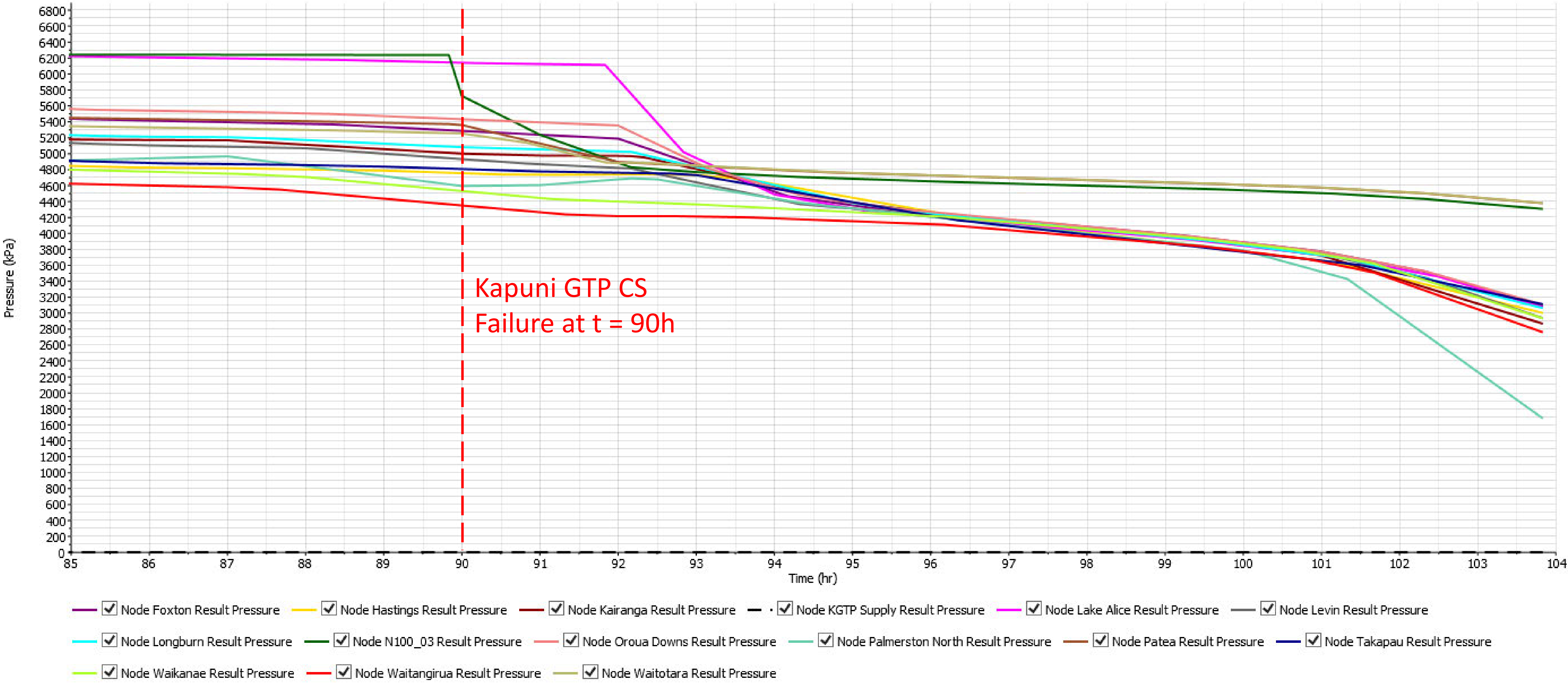


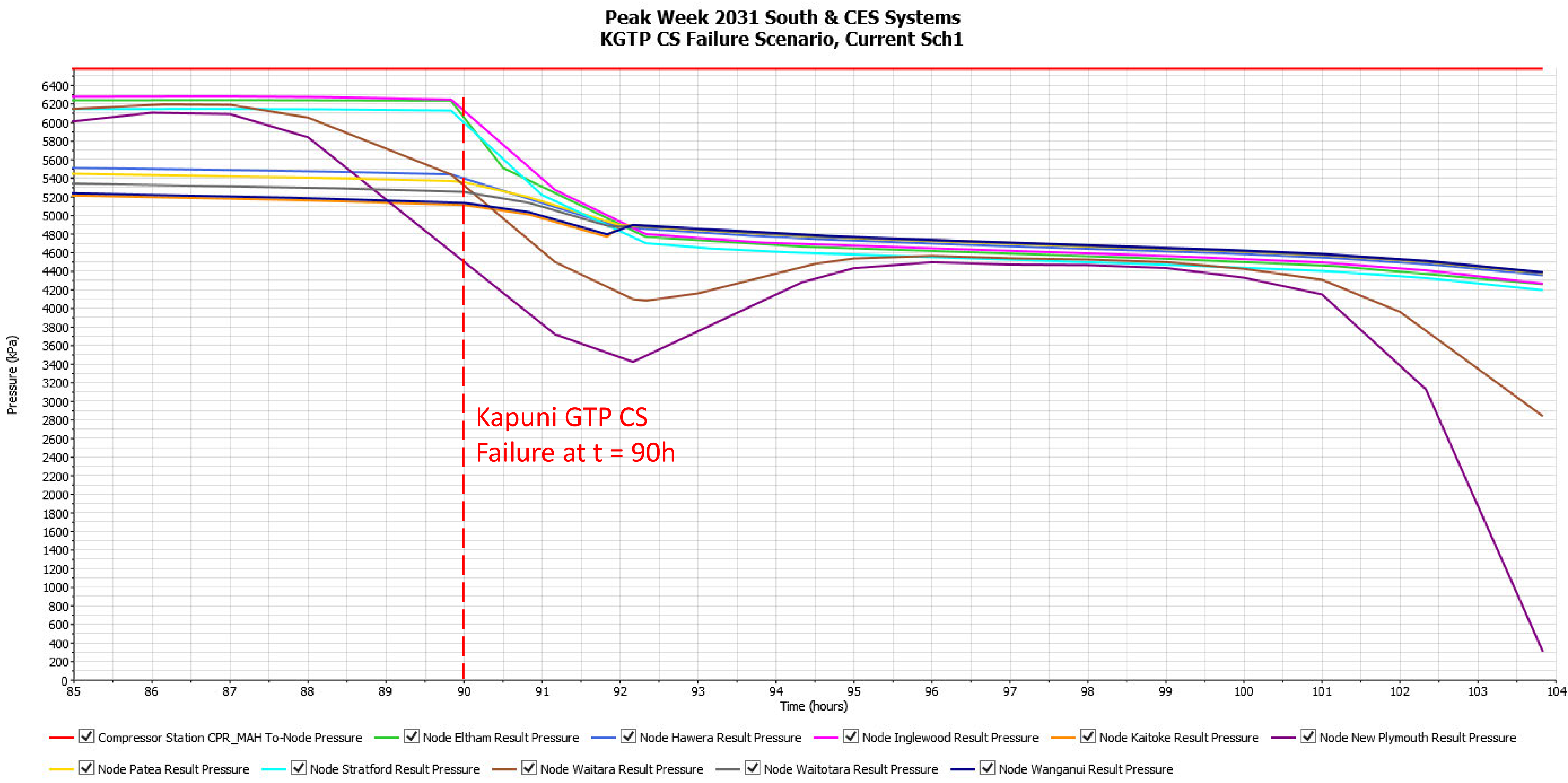

Peak Week 2031 North
Mokau CS Failure Scenario, Proposed Sch 1
Mokau CS
Failure at t = 90h
Pressure (kPa)
6600
6400
6200
6000
5800
5600
5400
5200
5000
4800
4600
4400
4200
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
Time (hours)
Node Alfriston Result Pressure
Node Bruce Maclaren Result Pressure
Node Drury Result Pressure
Node Flatbush Result Pressure
Node Glenbrook Result Pressure
Node Harrisville Result Pressure
Node Henderson Result Pressure
Node Hunua Result Pressure
Node Kingseat Result Pressure
Node Papakura Result Pressure
Node Pukekohe Result Pressure
Node Ramarama Result Pressure
Node Tuakau Result Pressure
Node Waikumete Result Pressure
Node Waiuku Result Pressure
Node Westfield Result Pressure
Regulator TRS_PEP To-Node Pressure

Peak Week 2031 100 & 200 lines from KGTP
KGTP CS Failure Scenario, Current Sch 1

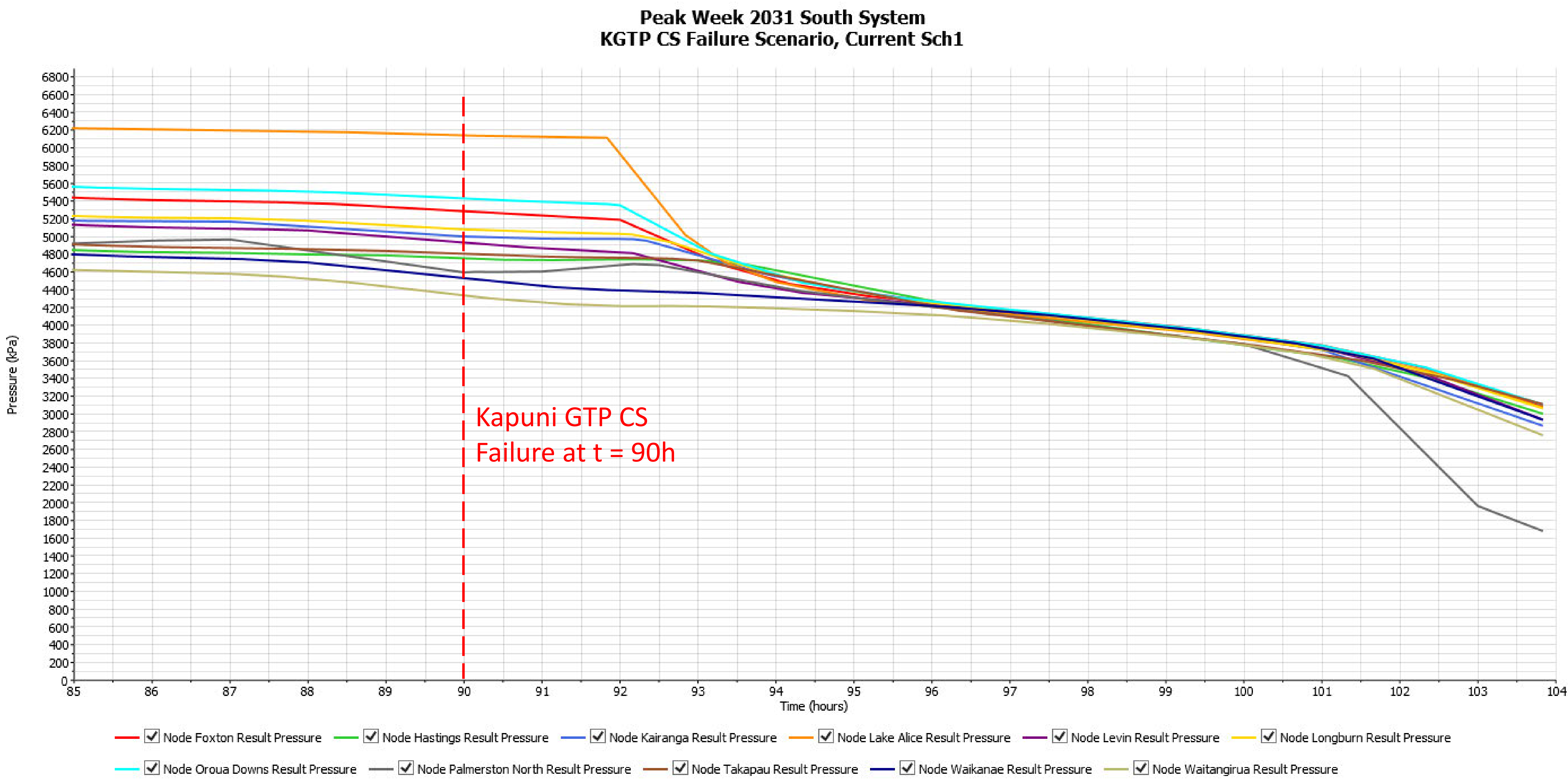


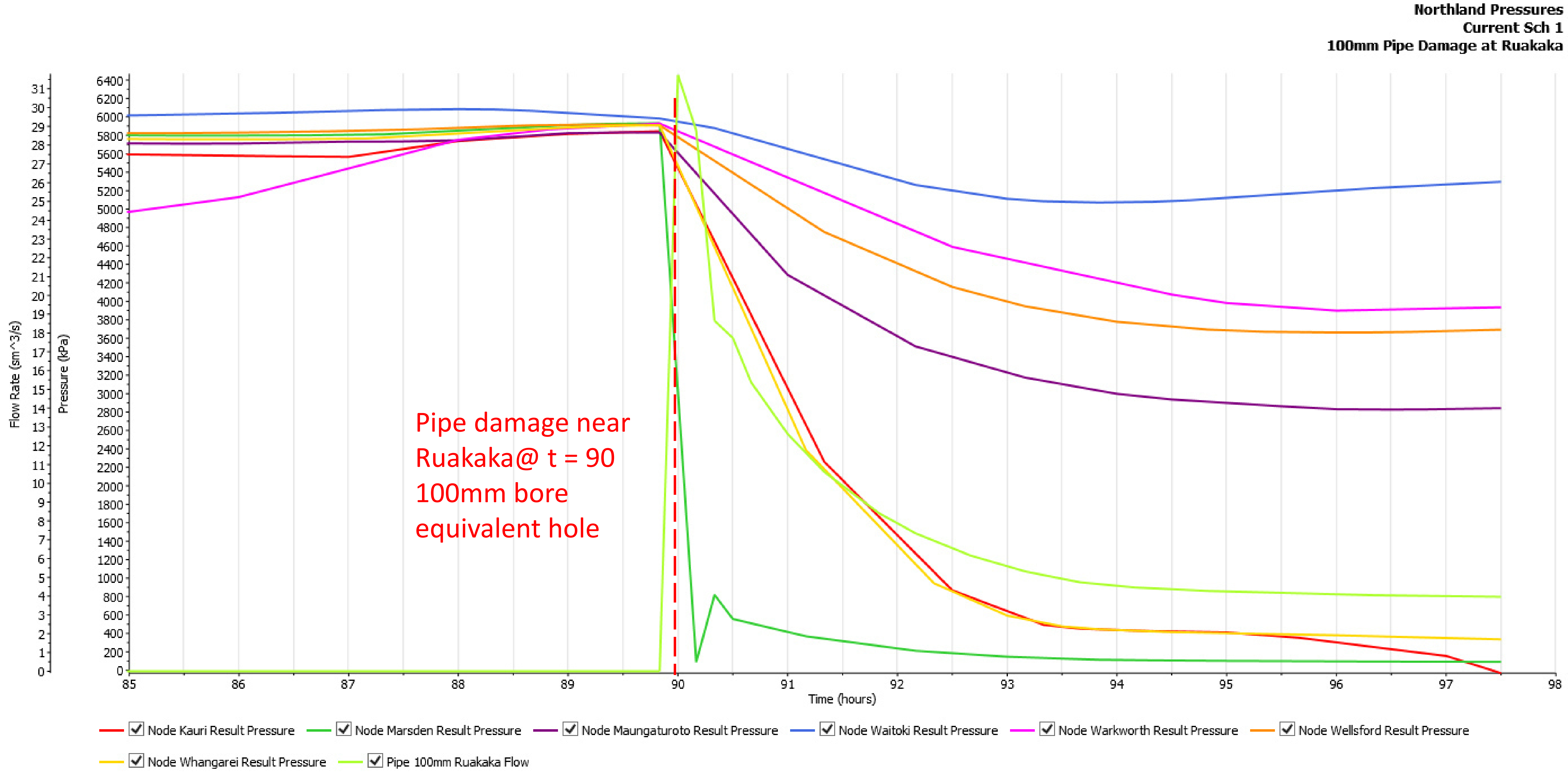
Peak Week 2031 South System
KGTP CS Failure Scenario, Current Sch 1

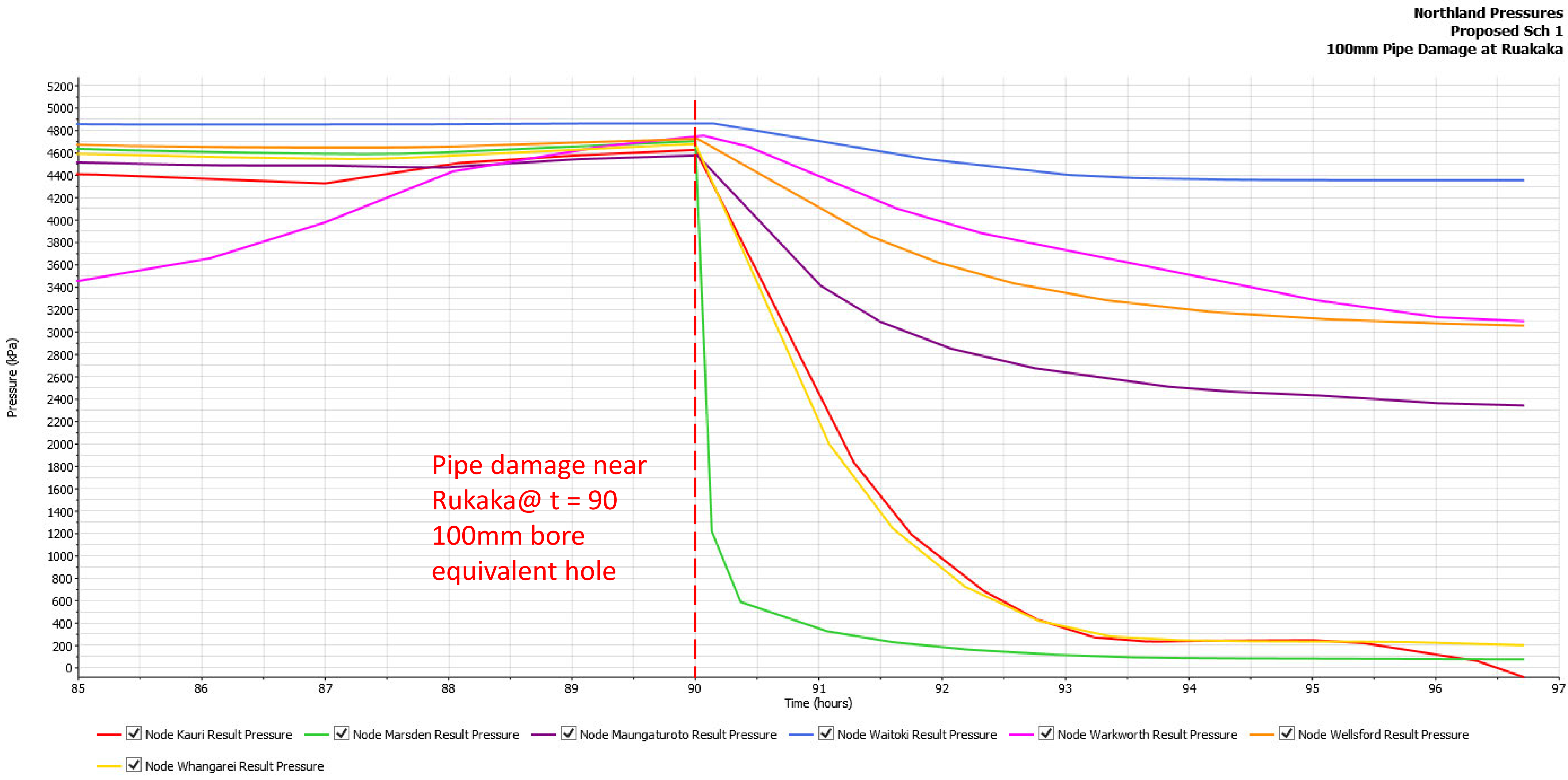


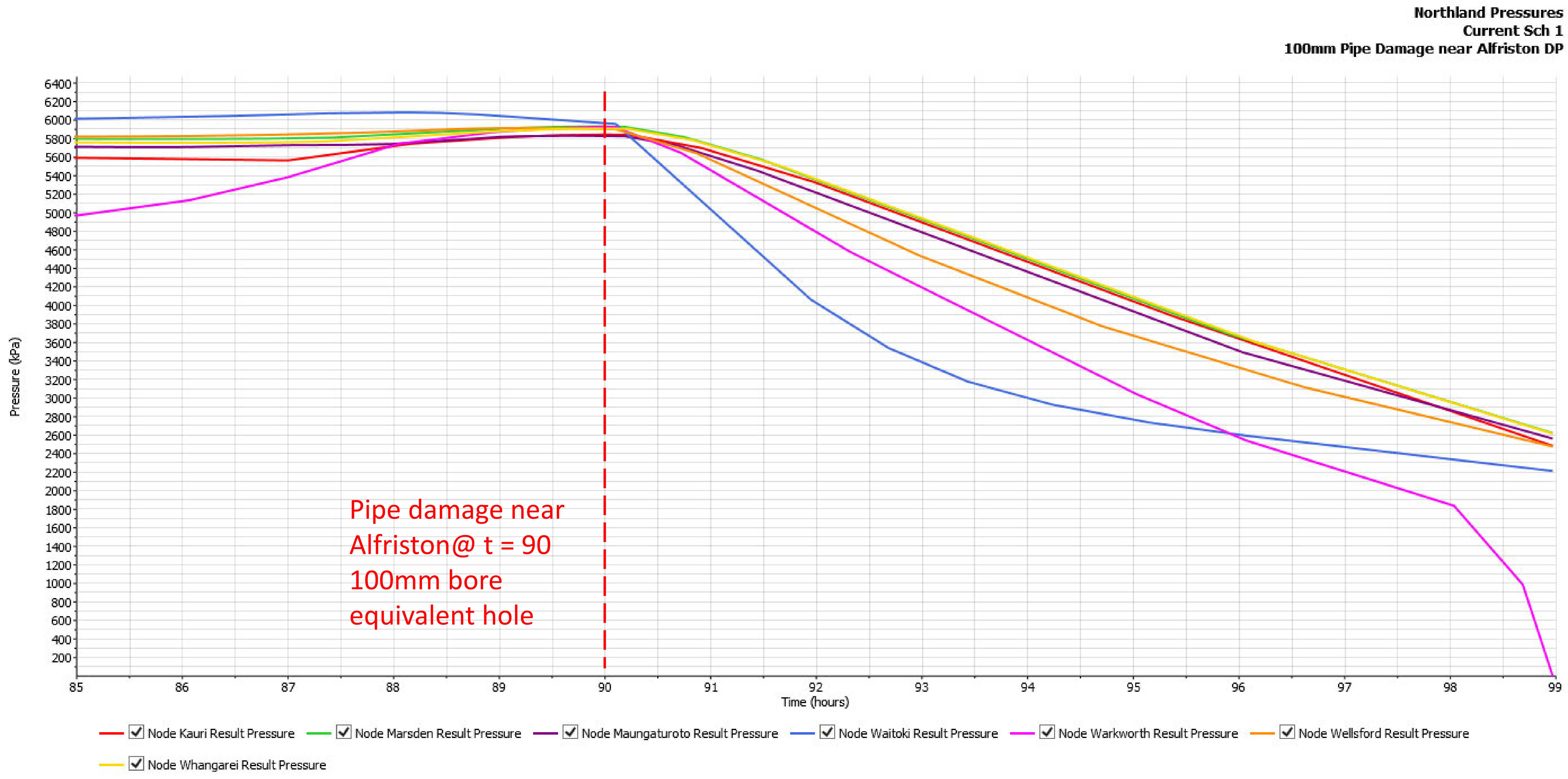


Peak Week 2031 South & CES Systems
KGTP CS Failure Scenario, Current Sch1
Pressure (kPa)
Time (hours)
Kapuni GTP CS
Failure at t = 90h
6400
6200
6000
5800
5600
5400
5200
5000
4800
4600
4400
4200
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
Compressor Station CPR_MAH To-Node Pressure
Node Eltham Result Pressure
Node Hawera Result Pressure
Node Inglewood Result Pressure
Node Kaitoke Result Pressure
Node New Plymouth Result Pressure
Node Patea Result Pressure
Node Stratford Result Pressure
Node Waitara Result Pressure
Node Waitotara Result Pressure
Node Wanganui Result Pressure

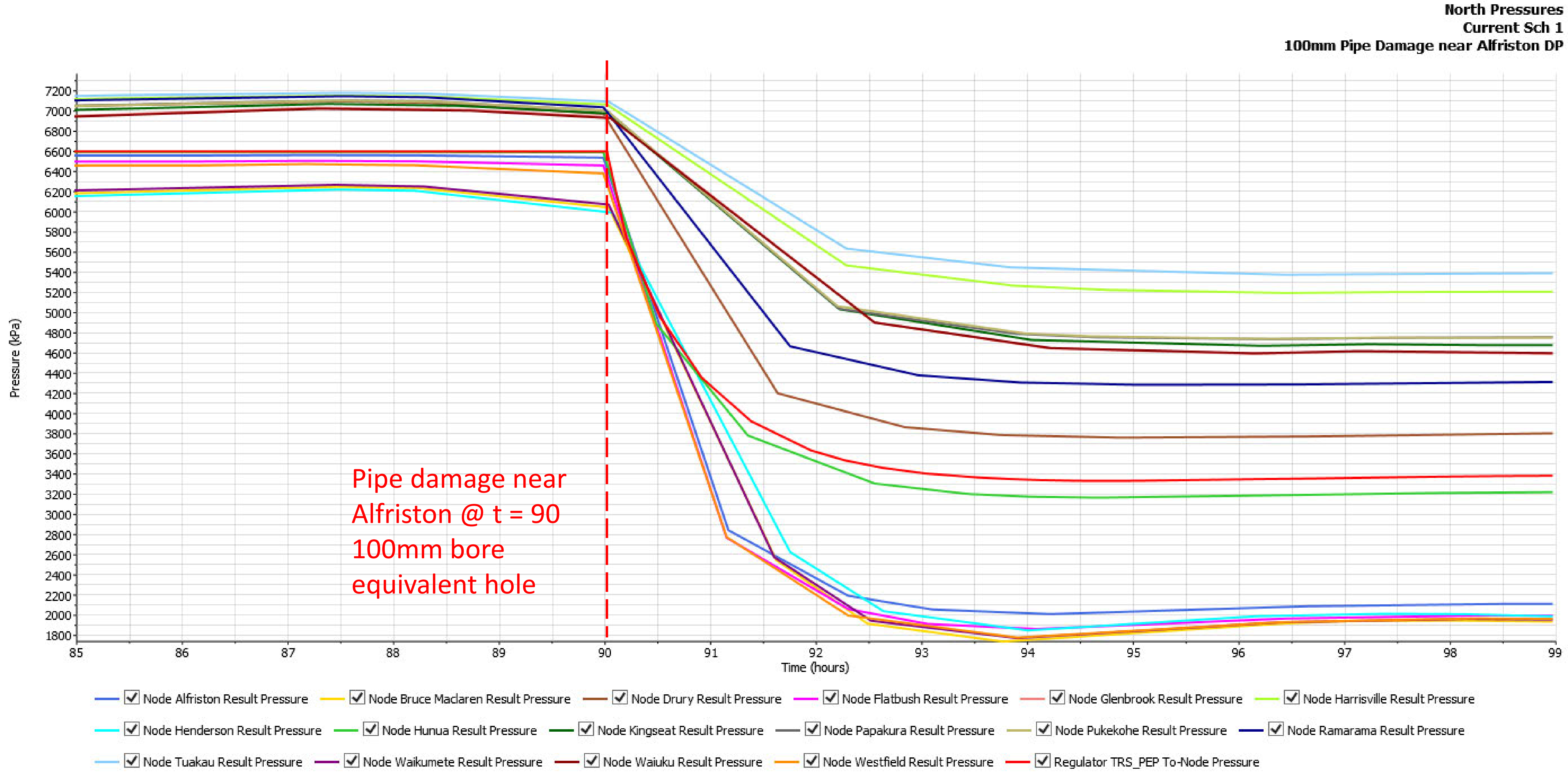

Peak Week 2031 South System
KGTP CS Failure Scenario, Current Sch1
Pressure (kPa)
Time (hours)
Kapuni GTP CS
Failure at t = 90h
Node Foxton Result Pressure
Node Hastings Result Pressure
Node Kairanga Result Pressure
Node Lake Alice Result Pressure
Node Levin Result Pressure
Node Longburn Result Pressure
Node Oroua Downs Result Pressure
Node Palmerston North Result Pressure
Node Takapau Result Pressure
Node Waikanae Result Pressure
Node Waitangirua Result Pressure

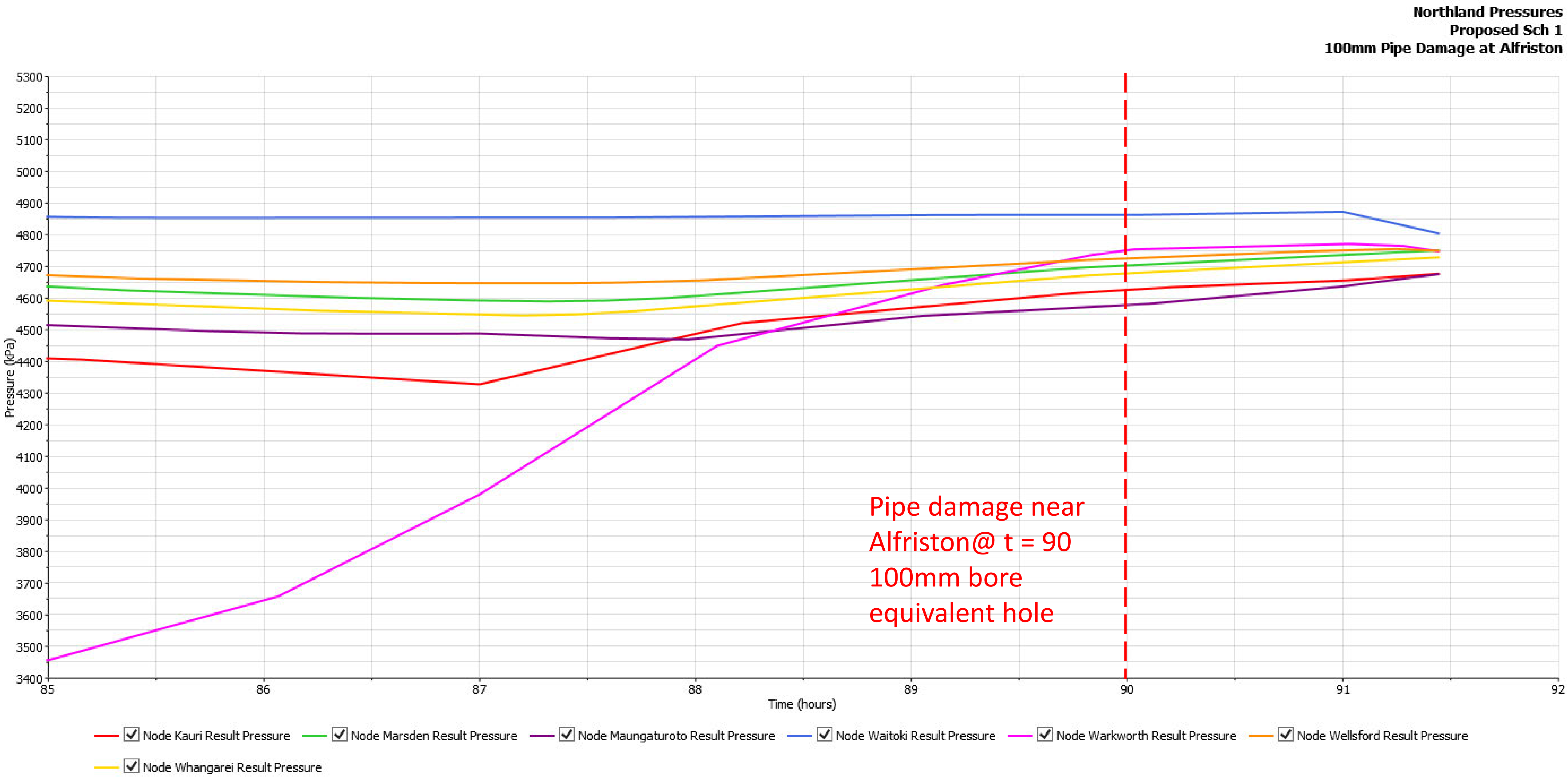

Northland Pressures
Current Sch 1
100mm Pipe Damage at Ruakaka
Pipe damage near
Ruakaka@ t = 90
100mm bore
equivalent hole
Flow Rate (sm^3/s)
Pressure (kPa)
Time (hours)
Node Kauri Result Pressure
Node Marsden Result Pressure
Node Maungaturoto Result Pressure
Node Waitoki Result Pressure
Node Warkworth Result Pressure
Node Wellsford Result Pressure
Node Whangarei Result Pressure
Pipe 100mm Ruakaka Flow

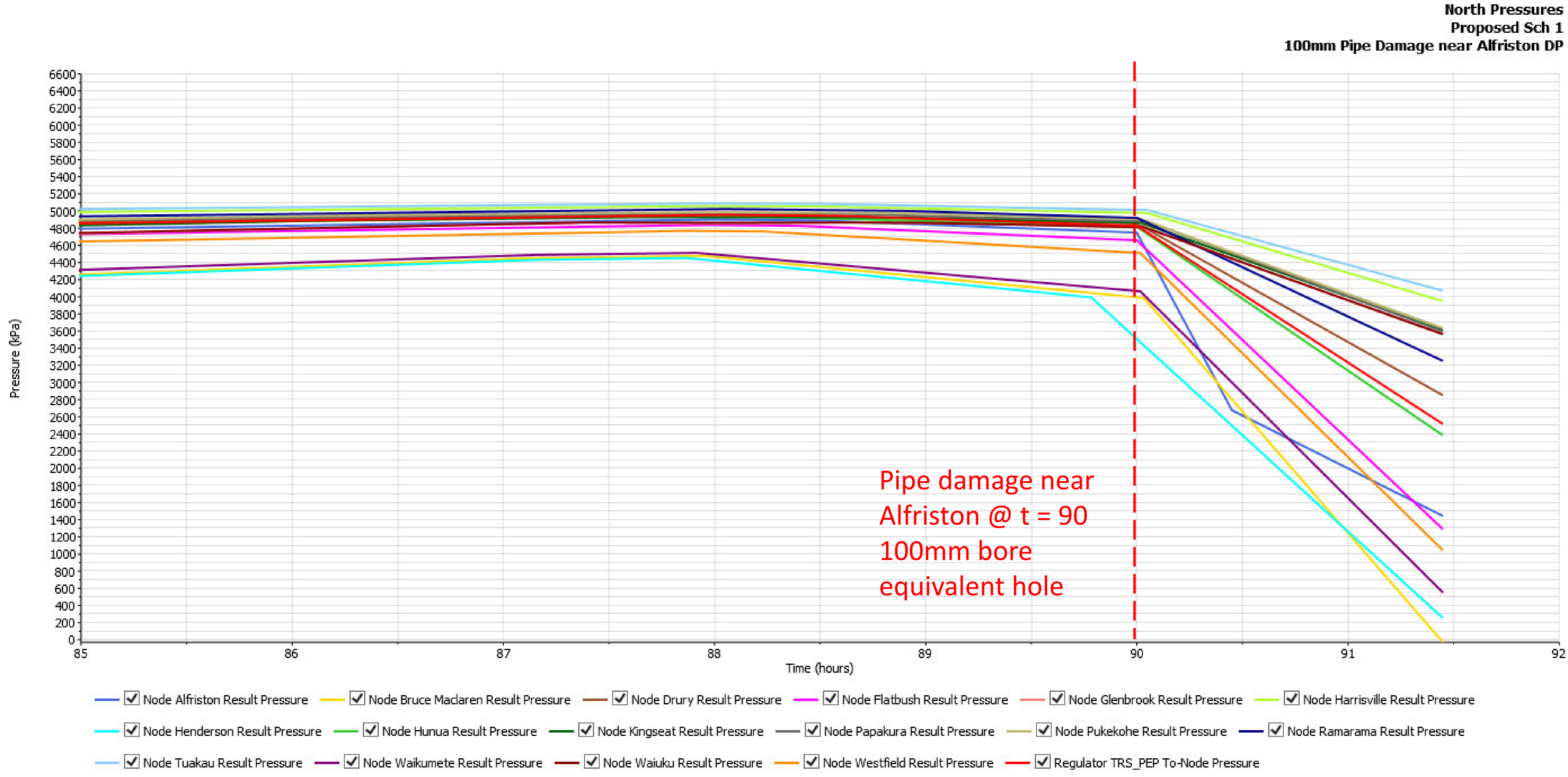

Northland Pressures
Proposed Sch 1
100mm Pipe Damage at Ruakaka
Pressure (kPa)
5200
5000
4800
4600
4400
4200
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
85
86
87
88
89
90
91
92
93
94
95
96
97
Time (hours)
Pipe damage near
Rukaka@ t = 90
100mm bore
equivalent hole
Node Kauri Result Pressure
Node Marsden Result Pressure
Node Maungaturoto Result Pressure
Node Waitoki Result Pressure
Node Warkworth Result Pressure
Node Wellsford Result Pressure
Node Whangarei Result Pressure

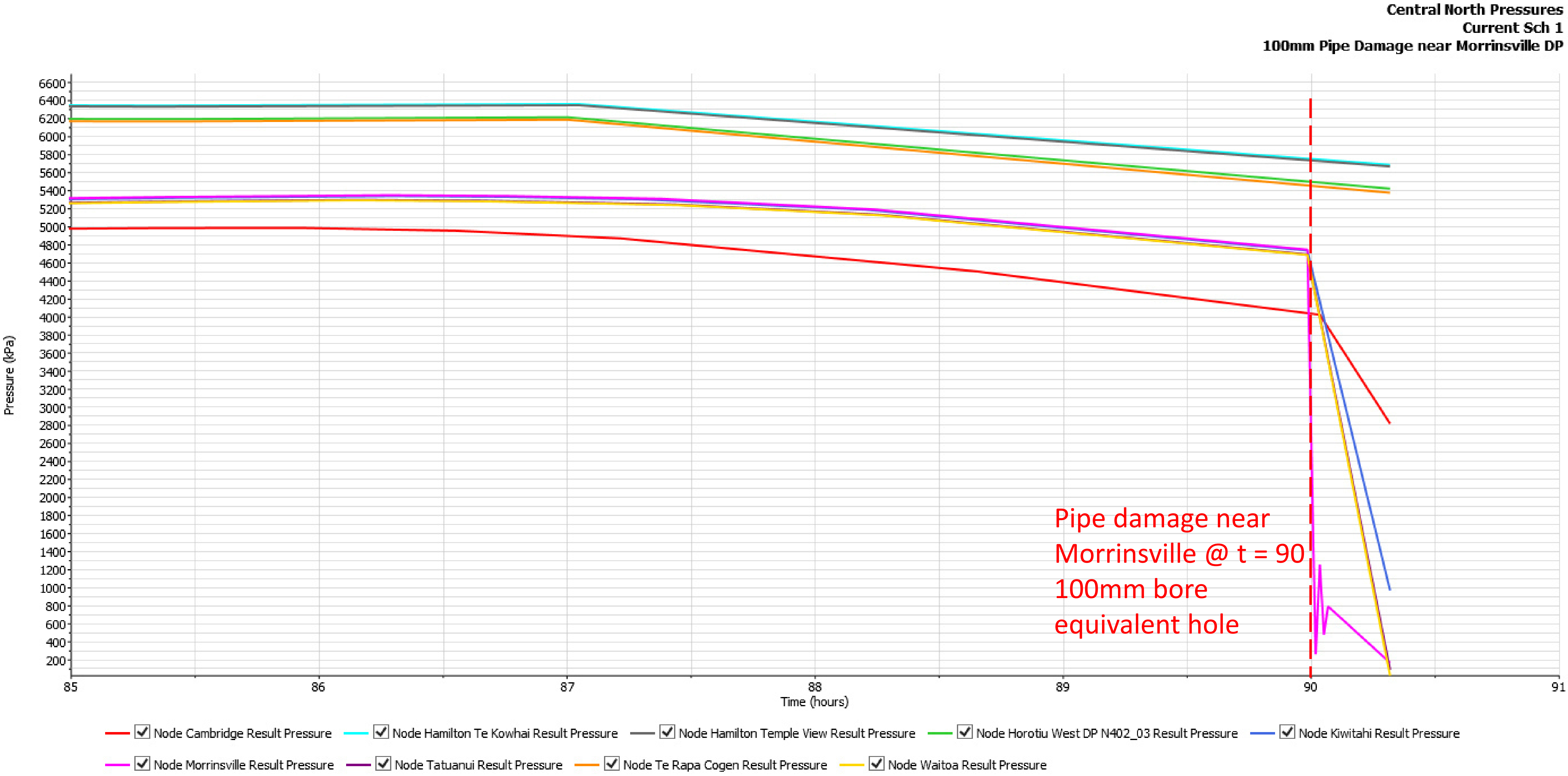


Northland Pressures
Current Sch 1
100mm Pipe Damage near Alfriston DP
Pressure (kPa)
6400
6200
6000
5800
5600
5400
5200
5000
4800
4600
4400
4200
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
Time (hours)
Pipe damage near
Alfriston@ t = 90
100mm bore
equivalent hole
Node Kauri Result Pressure
Node Marsden Result Pressure
Node Maungaturoto Result Pressure
Node Waitoki Result Pressure
Node Warkworth Result Pressure
Node Wellsford Result Pressure
Node Whangarei Result Pressure

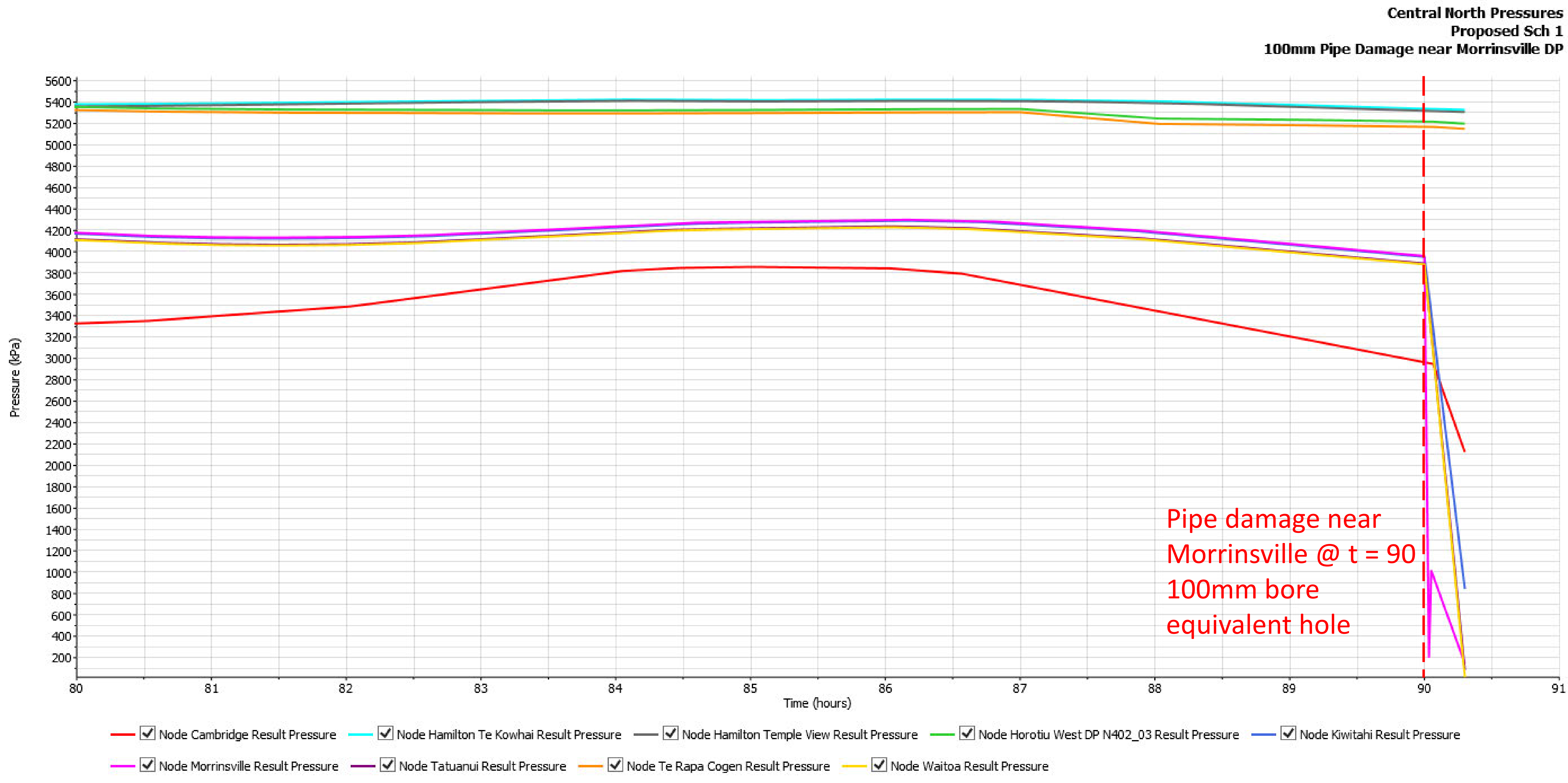

North Pressures
Current Sch 1
100mm Pipe Damage near Alfriston DP
Pressure (kPa)
Time (hours)
Pipe damage near
Alfriston @ t = 90
100mm bore
equivalent hole
Node Alfriston Result Pressure
Node Bruce Maclaren Result Pressure
Node Drury Result Pressure
Node Flatbush Result Pressure
Node Glenbrook Result Pressure
Node Harrisville Result Pressure
Node Henderson Result Pressure
Node Hunua Result Pressure
Node Kingseat Result Pressure
Node Papakura Result Pressure
Node Pukekohe Result Pressure
Node Ramarama Result Pressure
Node Tuakau Result Pressure
Node Waikumete Result Pressure
Node Waiuku Result Pressure
Node Westfield Result Pressure
Regulator TRS_PEP To-Node Pressure

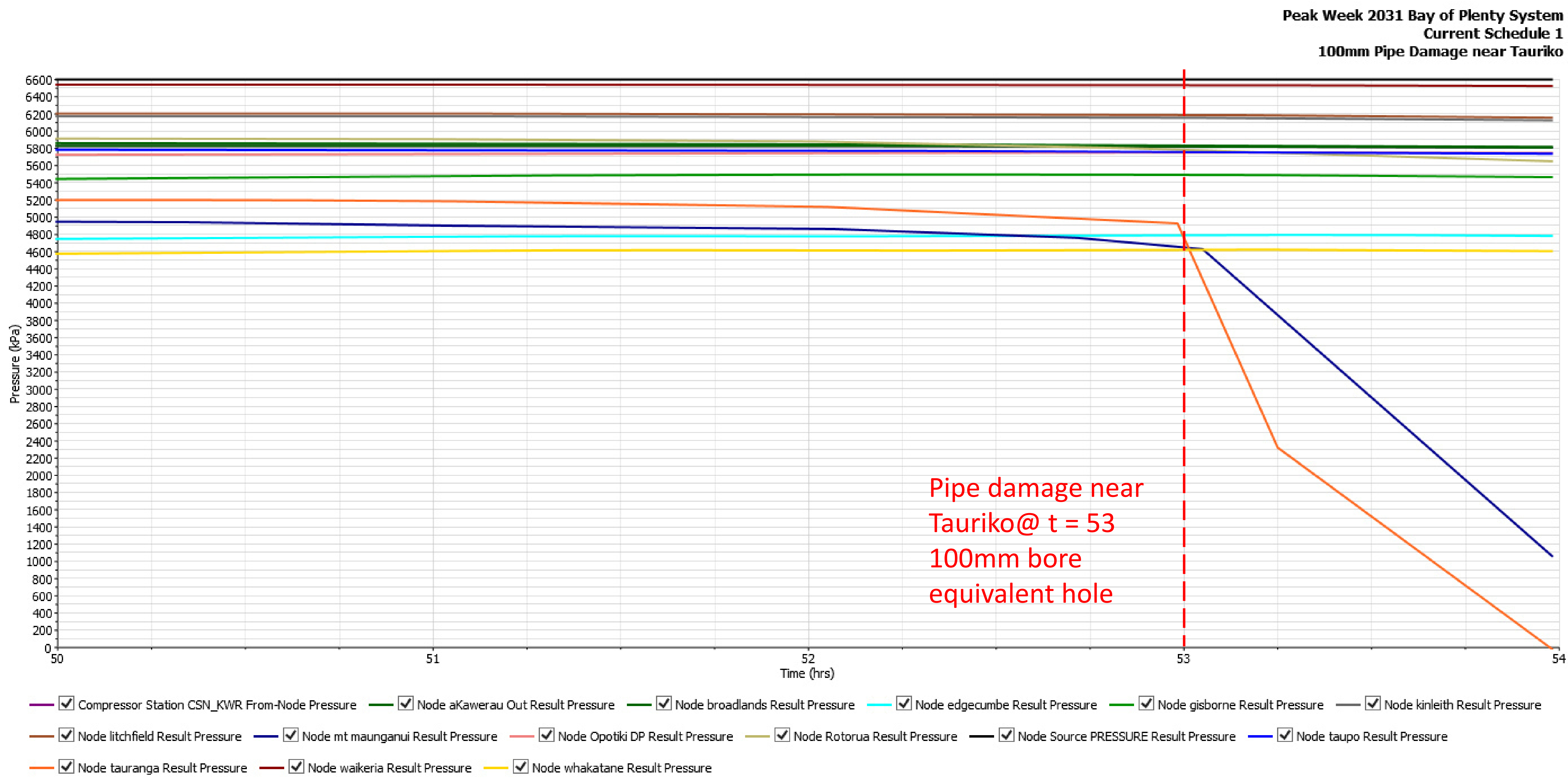

Northland Pressures
Proposed Sch 1
100mm Pipe Damage at Alfriston
5300
5200
5100
5000
4900
4800
4700
4600
4500
4400
4300
4200
4100
4000
3900
3800
3700
3600
3500
3400
Pressure (kPa)
85
86
87
88
89
90
91
92
Time (hours)
Pipe damage near Alfriston@ t = 90 100mm bore equivalent hole
Node Kauri Result Pressure
Node Marsden Result Pressure
Node Maungaturoto Result Pressure
Node Waitoki Result Pressure
Node Warkworth Result Pressure
Node Wellsford Result Pressure
Node Whangarei Result Pressure

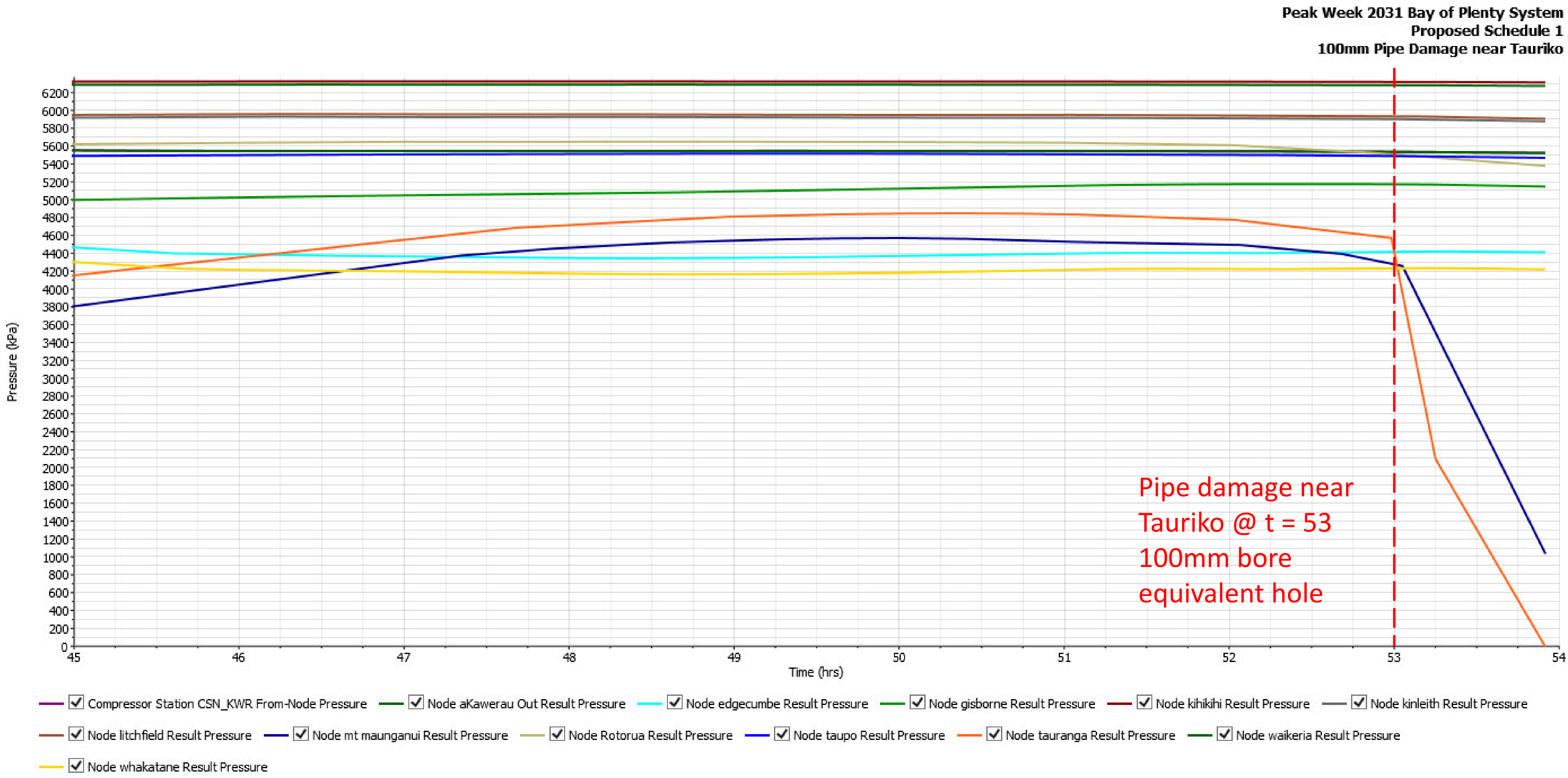

North Pressures
Proposed Sch 1
100mm Pipe Damage near Alfriston DP
Pressure (kPa)
Time (hours)
Pipe damage near
Alfriston @ t = 90
100mm bore
equivalent hole
Node Alfriston Result Pressure
Node Bruce Maclaren Result Pressure
Node Drury Result Pressure
Node Flatbush Result Pressure
Node Glenbrook Result Pressure
Node Harrisville Result Pressure
Node Henderson Result Pressure
Node Hunua Result Pressure
Node Kingseat Result Pressure
Node Papakura Result Pressure
Node Pukekohe Result Pressure
Node Ramarama Result Pressure
Node Tuakau Result Pressure
Node Waikumete Result Pressure
Node Waiuku Result Pressure
Node Westfield Result Pressure
Regulator TRS_PEP To-Node Pressure



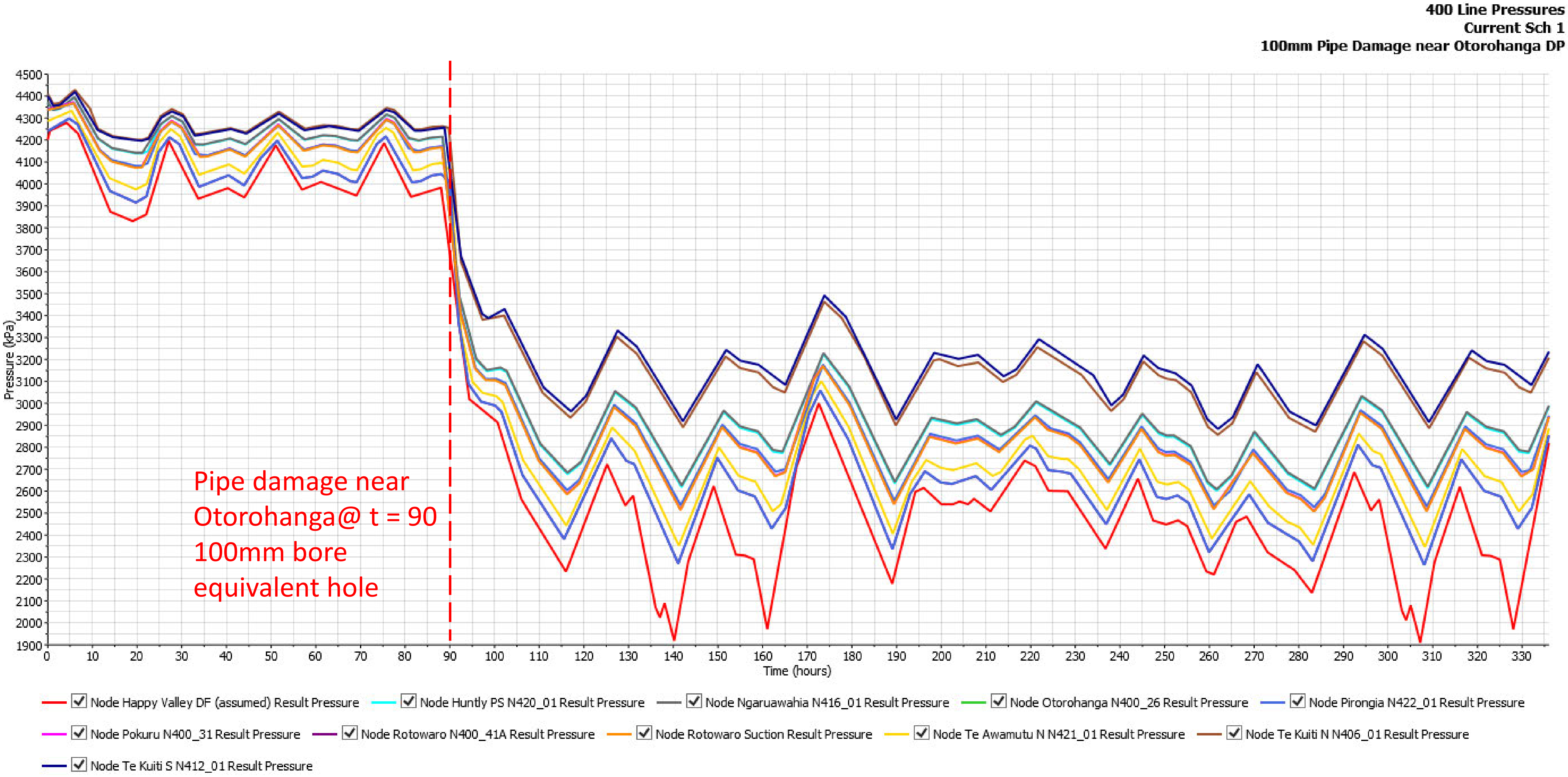
Central North Pressures
Current Sch 1
100mm Pipe Damage near Morrinsville DP
Pressure (kPa)
6600
6400
6200
6000
5800
5600
5400
5200
5000
4800
4600
4400
4200
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
85
86
87
88
89
90
91
Time (hours)
Pipe damage near
Morrinsville @ t = 90
100mm bore
equivalent hole
Node Cambridge Result Pressure
Node Hamilton Te Kowhai Result Pressure
Node Hamilton Temple View Result Pressure
Node Horotiu West DP N402_03 Result Pressure
Node Kiwitahi Result Pressure
Node Morrinsville Result Pressure
Node Tatuanui Result Pressure
Node Te Rapa Cogen Result Pressure
Node Waitoa Result Pressure


Central North Pressures
Proposed Sch 1
100mm Pipe Damage near Morrinsville DP
Pressure (kPa)
5600
5400
5200
5000
4800
4600
4400
4200
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
80
81
82
83
84
85
86
87
88
89
90
91
Time (hours)
Pipe damage near
Morrinsville @ t = 90
100mm bore
equivalent hole
Node Cambridge Result Pressure
Node Hamilton Te Kowhai Result Pressure
Node Hamilton Temple View Result Pressure
Node Horotiu West DP N402_03 Result Pressure
Node Kiwitahi Result Pressure
Node Morrinsville Result Pressure
Node Tatuanui Result Pressure
Node Te Rapa Cogen Result Pressure
Node Waitoa Result Pressure

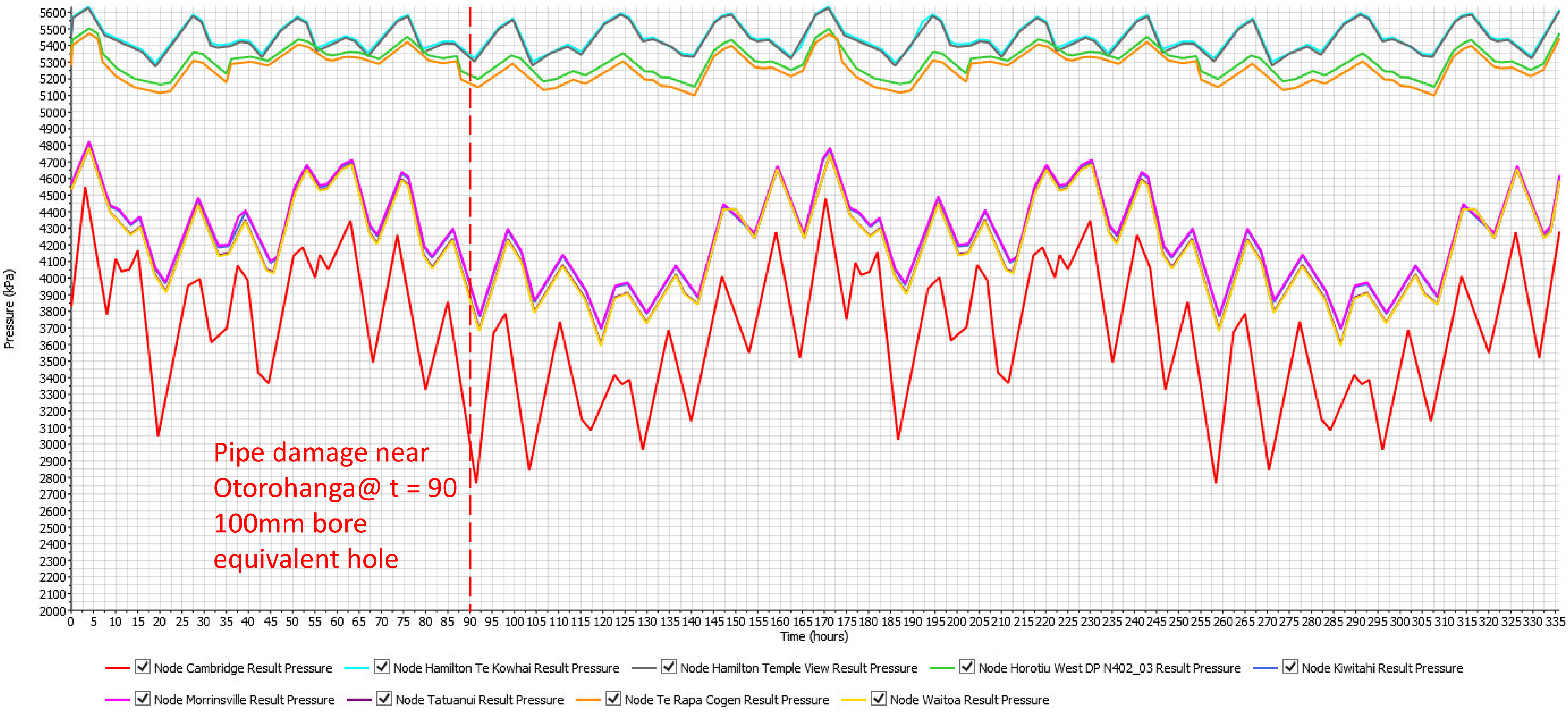

Peak Week 2031 Bay of Plenty System
Current Schedule 1
100mm Pipe Damage near Tauriko
Pressure (kPa)
6600
6400
6200
6000
5800
5600
5400
5200
5000
4800
4600
4400
4200
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
50
51
52
53
54
Time (hrs)
Pipe damage near
Tauriko@ t = 53
100mm bore
equivalent hole
Compressor Station CSN_KWR From-Node Pressure
Node aKawerau Out Result Pressure
Node broadlands Result Pressure
Node edgecumbe Result Pressure
Node gisborne Result Pressure
Node kinleith Result Pressure
Node litchfield Result Pressure
Node mt maunganui Result Pressure
Node Opotiki DP Result Pressure
Node Rotorua Result Pressure
Node Source PRESSURE Result Pressure
Node taupo Result Pressure
Node tauranga Result Pressure
Node waikeria Result Pressure
Node whakatane Result Pressure

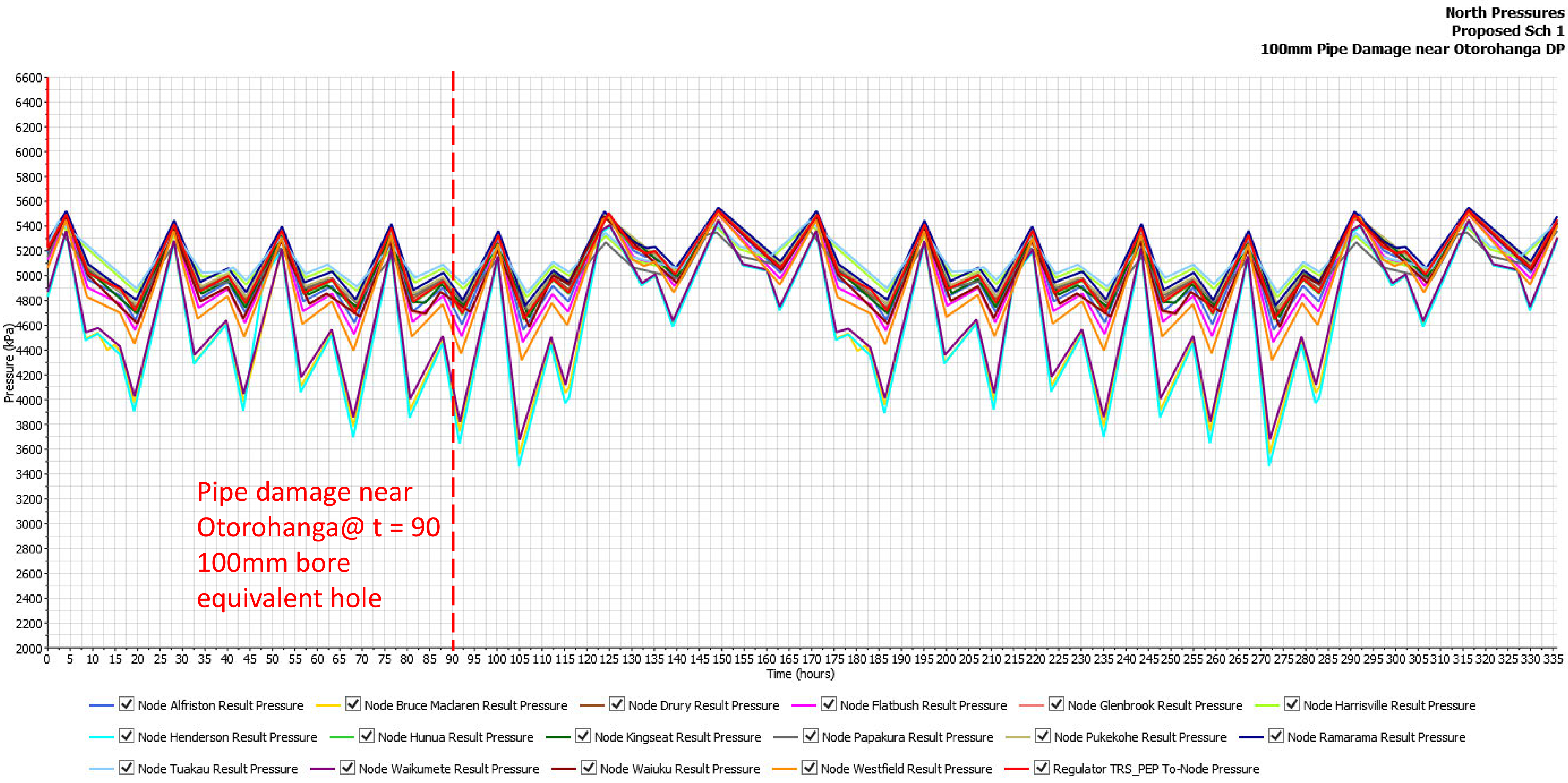


Peak Week 2031 Bay of Plenty System
Proposed Schedule 1
100mm Pipe Damage near Tauriko
Pressure (kPa)
Time (hrs)
Pipe damage near Tauriko @ t = 53 100mm bore equivalent hole
Compressor Station CSN_KWR From-Node Pressure
Node aKawerau Out Result Pressure
Node edgecumbe Result Pressure
Node gisborne Result Pressure
Node kihikihi Result Pressure
Node kinleith Result Pressure
Node litchfield Result Pressure
Node mt maunganui Result Pressure
Node Rotorua Result Pressure
Node taupo Result Pressure
Node tauranga Result Pressure
Node waikeria Result Pressure
Node whakatane Result Pressure

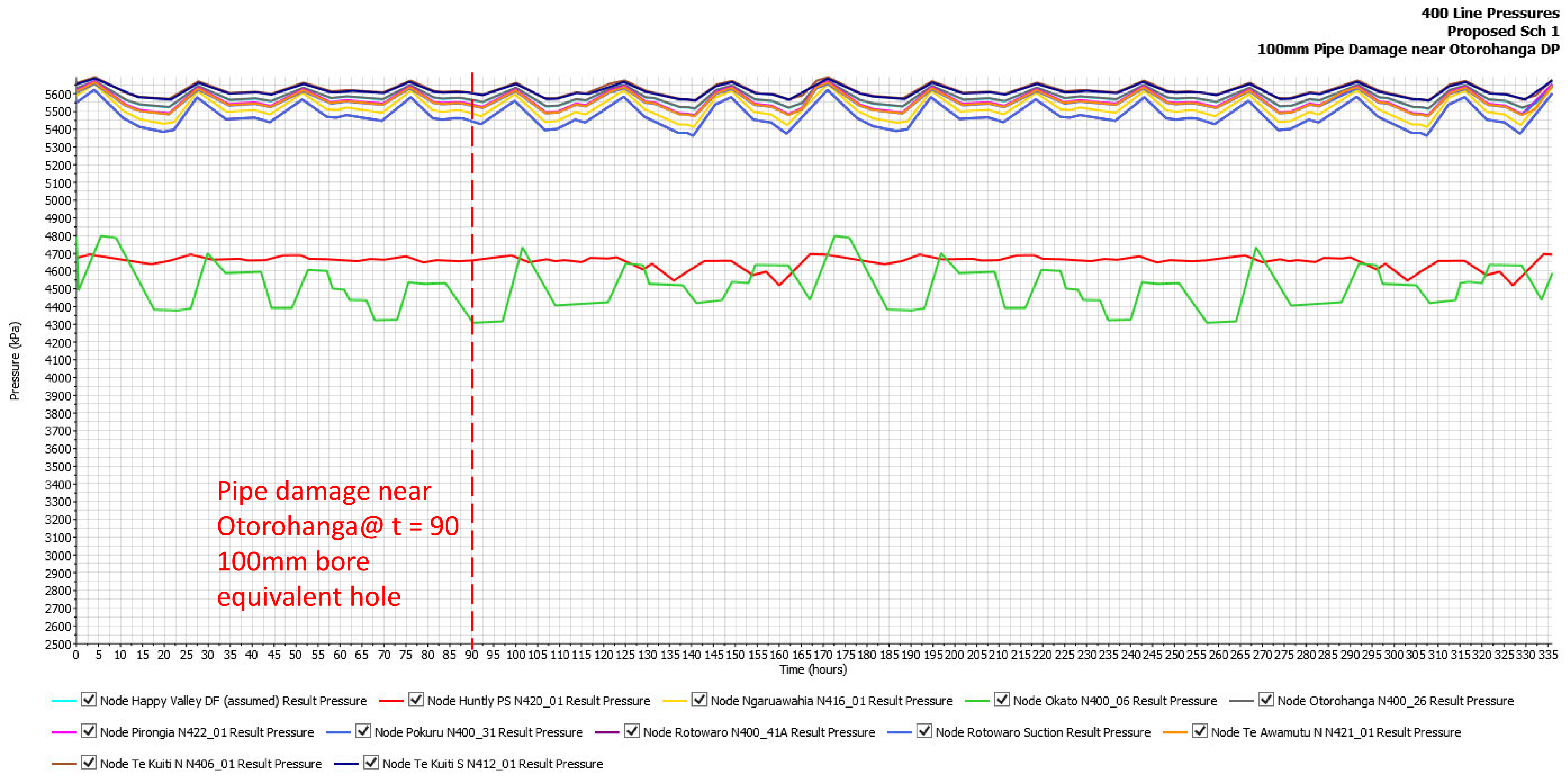

400 Line Pressures
Current Sch 1
100mm Pipe Damage near Otorohanga DP
Pressure (kPa)
Time (hours)
Pipe damage near
Otorohanga@ t = 90
100mm bore
equivalent hole
Node Happy Valley DF (assumed) Result Pressure
Node Huntly PS N420_01 Result Pressure
Node Ngaruawahia N416_01 Result Pressure
Node Otorohanga N400_26 Result Pressure
Node Pirongia N422_01 Result Pressure
Node Pokuru N400_31 Result Pressure
Node Rotowaro N400_41A Result Pressure
Node Rotowaro Suction Result Pressure
Node Te Awamutu N N421_01 Result Pressure
Node Te Kuiti N N406_01 Result Pressure
Node Te Kuiti S N412_01 Result Pressure

Central North Pressures
Proposed Sch 1
100mm Pipe Damage near Otorohanga DP



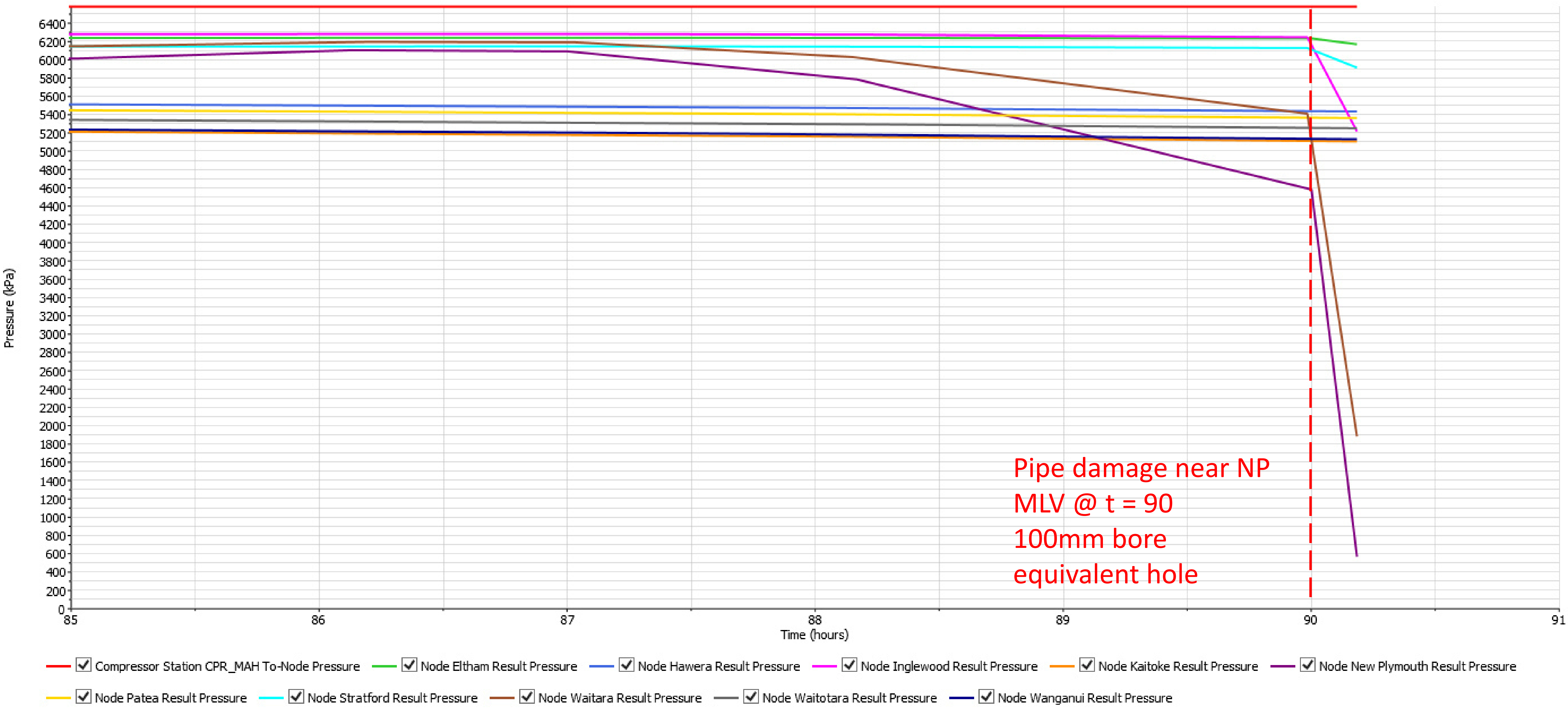


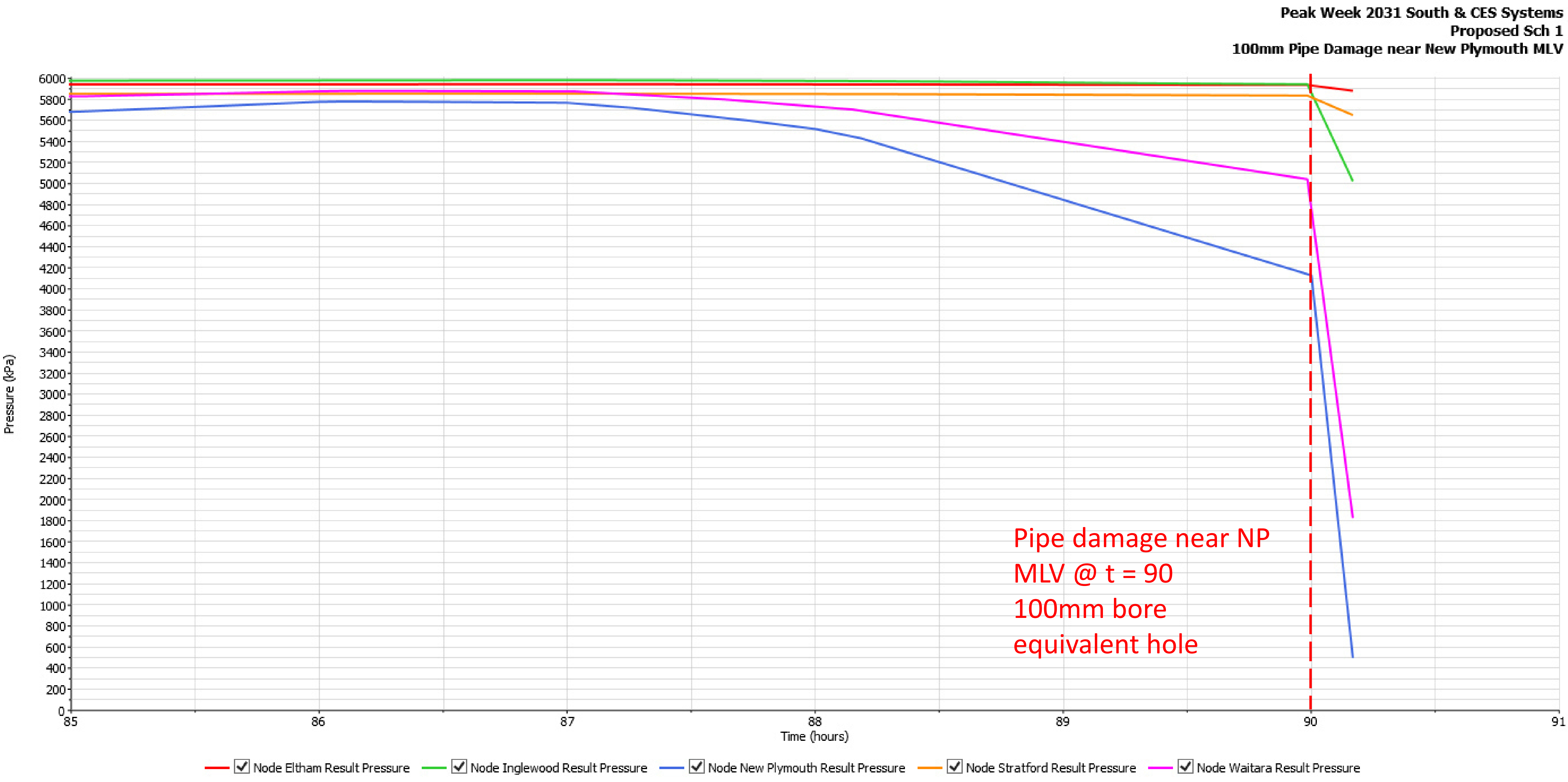
North Pressures
Proposed Sch 1
100mm Pipe Damage near Otorohanga DP
Pressure (kPa)
Time (hours)
Pipe damage near
Otorohanga@ t = 90
100mm bore
equivalent hole
Node Alfriston Result Pressure
Node Bruce Maclaren Result Pressure
Node Drury Result Pressure
Node Flatbush Result Pressure
Node Glenbrook Result Pressure
Node Harrisville Result Pressure
Node Henderson Result Pressure
Node Hunua Result Pressure
Node Kingseat Result Pressure
Node Papakura Result Pressure
Node Pukekohe Result Pressure
Node Ramarama Result Pressure
Node Tuakau Result Pressure
Node Waikumete Result Pressure
Node Waiuku Result Pressure
Node Westfield Result Pressure
Regulator TRS_PEP To-Node Pressure

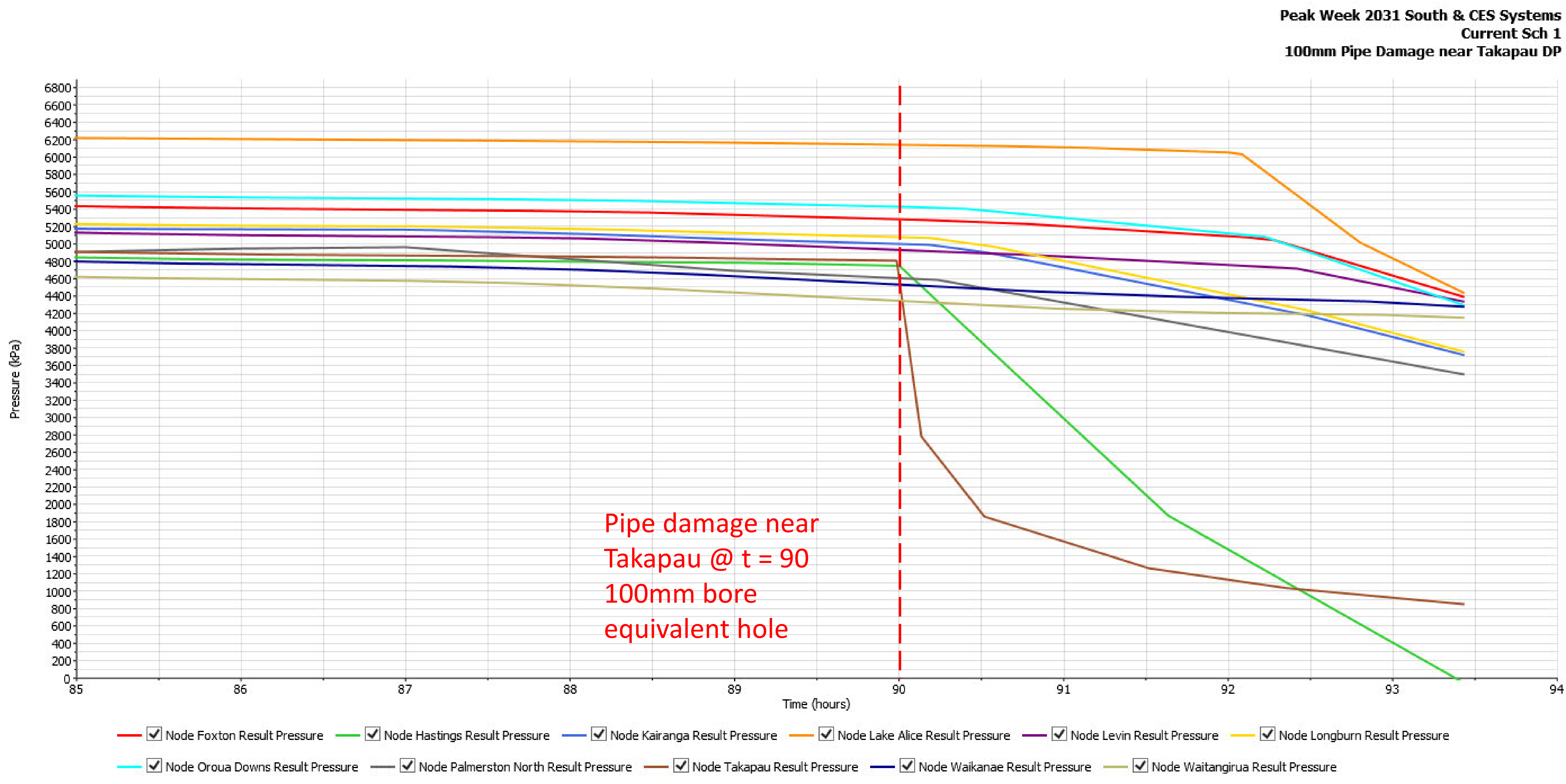


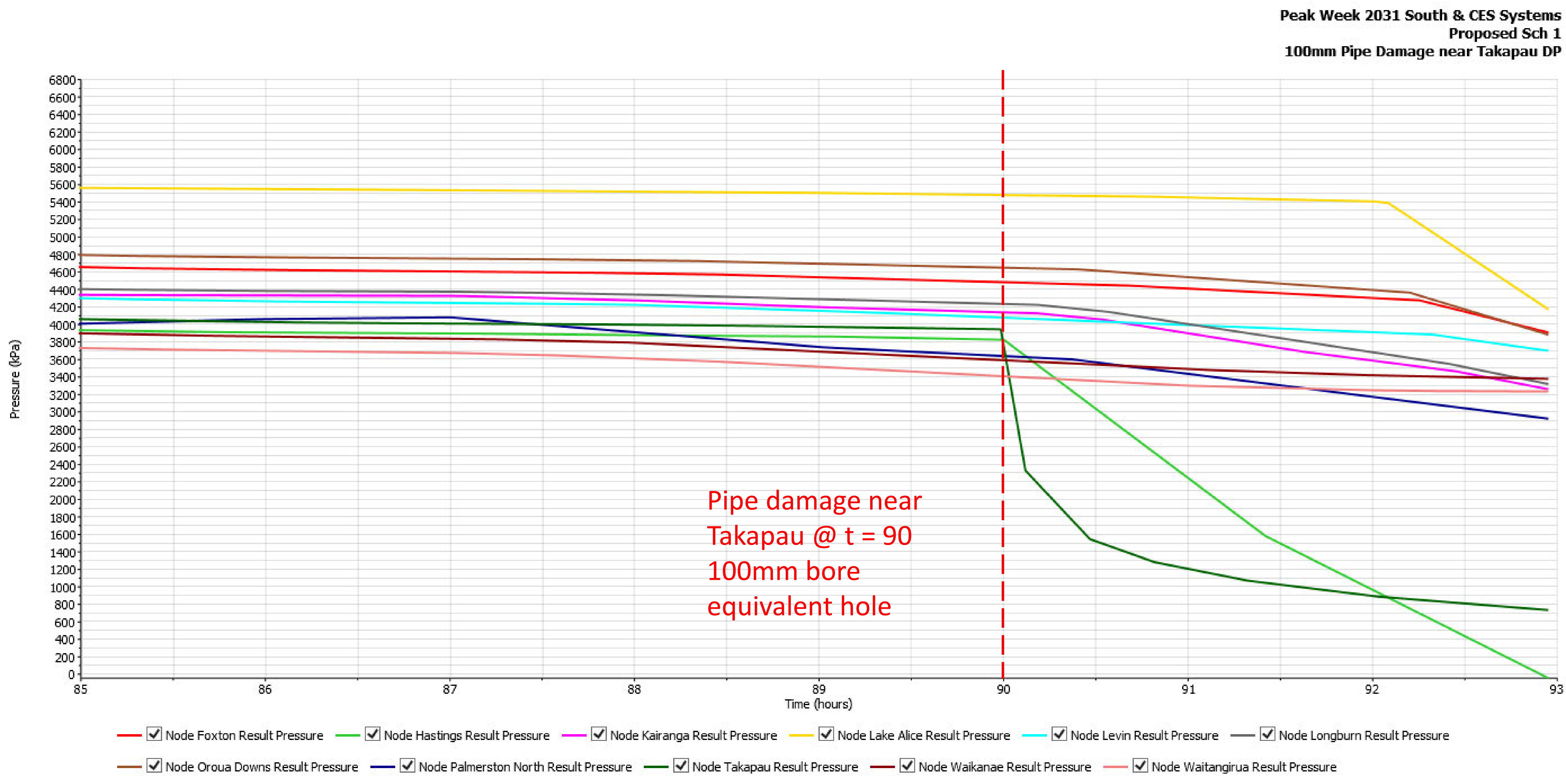
400 Line Pressures
Proposed Sch 1
100mm Pipe Damage near Otorohanga DP
Pressure (kPa)
Time (hours)
Pipe damage near Otorohanga@ t = 90 100mm bore equivalent hole
Node Happy Valley DF (assumed) Result Pressure
Node Huntly PS N420_01 Result Pressure
Node Ngaruawahia N416_01 Result Pressure
Node Okato N400_06 Result Pressure
Node Otorohanga N400_26 Result Pressure
Node Pirongia N422_01 Result Pressure
Node Pokuru N400_31 Result Pressure
Node Rotowaro N400_41A Result Pressure
Node Rotowaro Suction Result Pressure
Node Te Awamutu N N421_01 Result Pressure
Node Te Kuiti N N406_01 Result Pressure
Node Te Kuiti S N412_01 Result Pressure

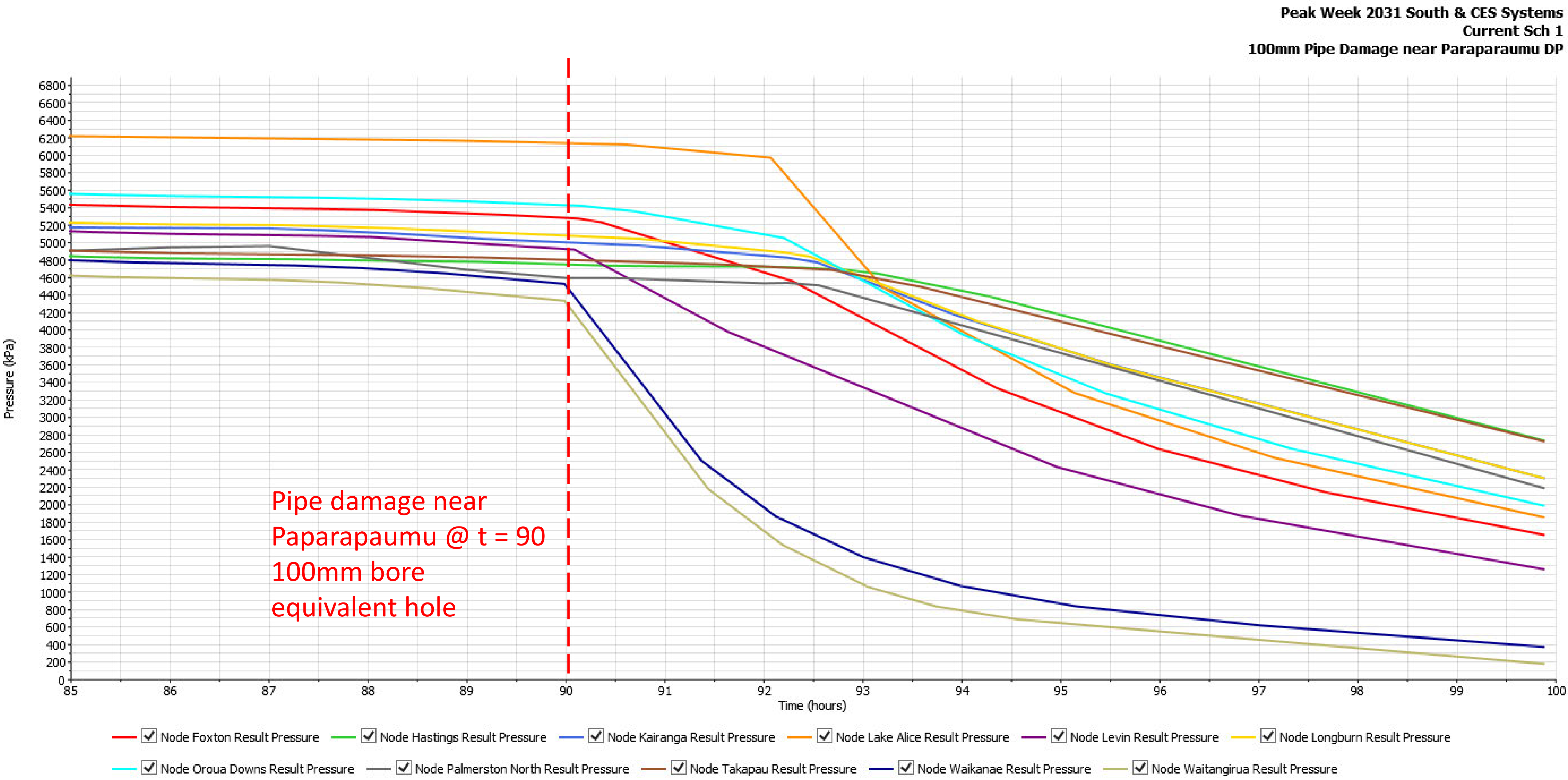
Peak Week 2031 South & CES Systems
Current Sch 1
100mm Pipe Damage near New Plymouth MLV



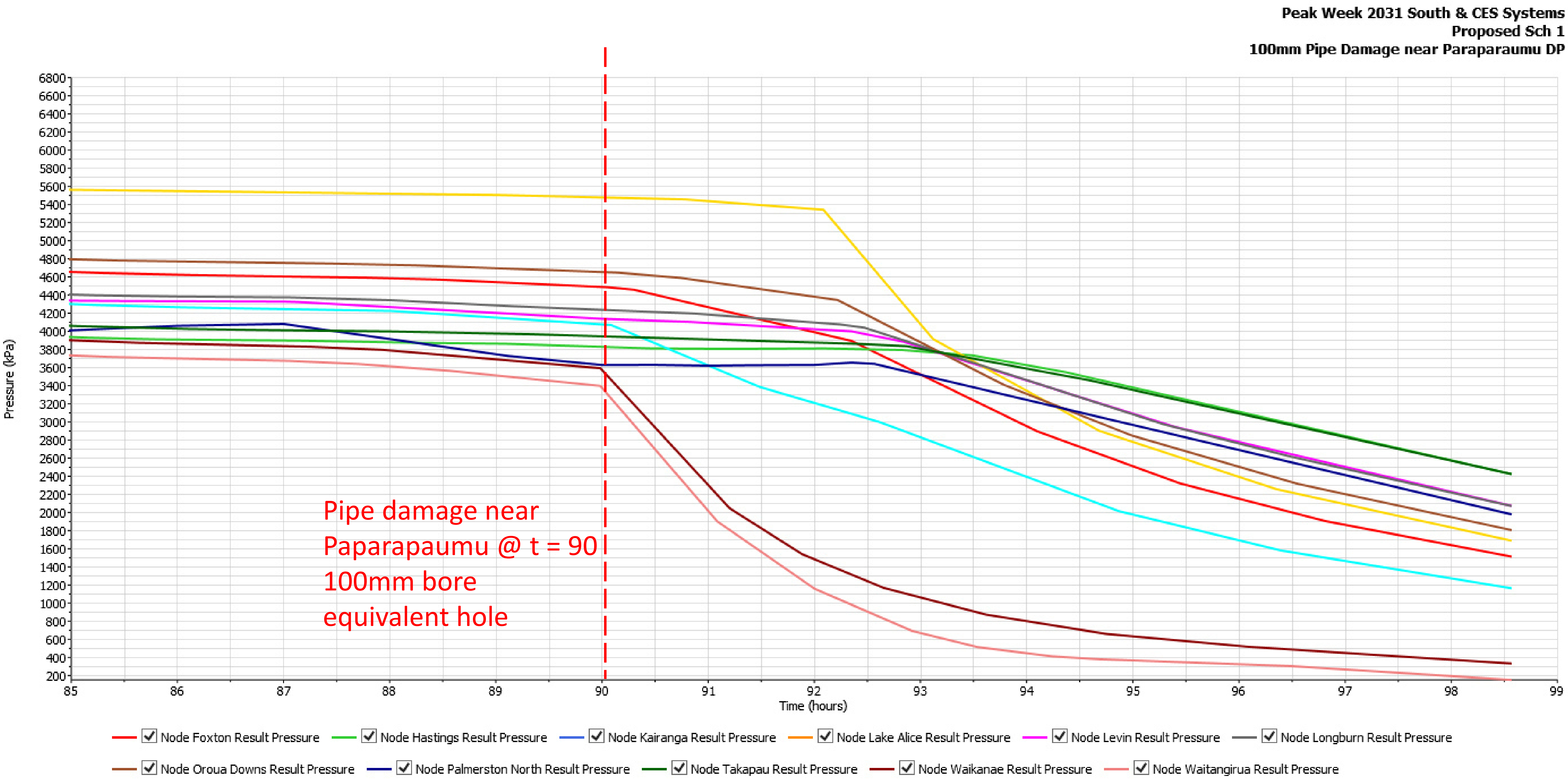

Peak Week 2031 South & CES Systems
Proposed Sch 1
100mm Pipe Damage near New Plymouth MLV
Pressure (kPa)
Time (hours)
Pipe damage near NP
MLV @ t = 90
100mm bore
equivalent hole
Node Eltham Result Pressure
Node Inglewood Result Pressure
Node New Plymouth Result Pressure
Node Stratford Result Pressure
Node Waitara Result Pressure


Peak Week 2031 South & CES Systems
Current Sch 1
100mm Pipe Damage near Takapau DP
Pressure (kPa)
Time (hours)
Pipe damage near
Takapau @ t = 90
100mm bore
equivalent hole
Node Foxton Result Pressure
Node Hastings Result Pressure
Node Kairanga Result Pressure
Node Lake Alice Result Pressure
Node Levin Result Pressure
Node Longburn Result Pressure
Node Oroua Downs Result Pressure
Node Palmerston North Result Pressure
Node Takapau Result Pressure
Node Waikanae Result Pressure
Node Waitangirua Result Pressure


Peak Week 2031 South & CES Systems
Proposed Sch 1
100mm Pipe Damage near Takapau DP
Pressure (kPa)
6800
6600
6400
6200
6000
5800
5600
5400
5200
5000
4800
4600
4400
4200
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
85
86
87
88
89
90
91
92
93
Time (hours)
Pipe damage near
Takapau @ t = 90
100mm bore
equivalent hole
Node Foxton Result Pressure
Node Hastings Result Pressure
Node Kairanga Result Pressure
Node Lake Alice Result Pressure
Node Levin Result Pressure
Node Longburn Result Pressure
Node Oroua Downs Result Pressure
Node Palmerston North Result Pressure
Node Takapau Result Pressure
Node Waikanae Result Pressure
Node Waitangirua Result Pressure



Peak Week 2031 South & CES Systems
Current Sch 1
100mm Pipe Damage near Paraparaumu DP
Pressure (kPa)
Time (hours)
Pipe damage near
Paparapaumu @ t = 90
100mm bore
equivalent hole
Node Foxton Result Pressure
Node Hastings Result Pressure
Node Kairanga Result Pressure
Node Lake Alice Result Pressure
Node Levin Result Pressure
Node Longburn Result Pressure
Node Oroua Downs Result Pressure
Node Palmerston North Result Pressure
Node Takapau Result Pressure
Node Waikanae Result Pressure
Node Waitangirua Result Pressure


Peak Week 2031 South & CES Systems
Proposed Sch 1
100mm Pipe Damage near Paraparaumu DP
Pressure (kPa)
Time (hours)
Pipe damage near
Paparapaumu @ t = 90
100mm bore
equivalent hole
Node Foxton Result Pressure
Node Hastings Result Pressure
Node Kairanga Result Pressure
Node Lake Alice Result Pressure
Node Levin Result Pressure
Node Longburn Result Pressure
Node Oroua Downs Result Pressure
Node Palmerston North Result Pressure
Node Takapau Result Pressure
Node Waikanae Result Pressure
Node Waitangirua Result Pressure

APPENDIX E FIRST GAS STATIONS CAPACITY CALCULATION

FLOW DATA YEAR 2022 Select Year

		Working Stream @ 100 %, Standby Stream Closed Calculated Threshold P min at regulator inlet P1 Inlet Press barg	Total Flow To Station **Max flow 2022** std m³/h	Working Stream @ 100 %, Standby Stream 100% Calculated Threshold P min at regulator inlet P1 Inlet Press barg	Flow per regulator set **Max flow 2022** std m³/h
4190001	Alfriston Delivery Point	23.1	146	11.2	73
3070002	Ammonia Urea (Fuel)	31.4	10397	30.4	5199
3070002	Ammonia Urea (Process)	32.0	12800	30.6	6400
7050001	Ashhurst Delivery Point (1st Cut)	14.8	95	6.9	48
1100028	Belmont Delivery Point	22.1	16793	19.0	8396
5100001	Broadlands Delivery Point	44.9	661	22.4	331
4380001	Bruce McLaren Delivery Point	23.7	2442	14.2	1221
4070227	Cambridge Delivery Point - Station	22.2	3257	18.2	1629
7000503	Dannevirke Delivery Point	39.6	490	20.9	245
7000503	Drury Delivery Point - Common	5.5	2466	4.0	1233
5020192	Edgecumbe DP (1st Cut)	19.7	6124	18.7	3062
2060076	Eltham Delivery Point	47.1	1126	23.6	563
1140087	Feilding Delivery Point	10.9	1834	10.2	917
4003677	Flat Bush Delivery Point	6.4	2588	6.1	1294
1001420	Flockhouse Delivery Point (1st Cut)	7.7	50	6.4	25
1001629	Foxton Delivery Point	30.6	318	15.3	159
5052013	Gisborne Delivery Point	21.7	3104	18.1	1552
5052013	Glenbrook Delivery Point	28.2	12210	13.8	6105
2003207	Harrisville No. 2 Delivery Point	8.8	3788	6.3	1894
7001531	Hastings Delivery Point	24.6	12734	14.5	6367
1000178	Hawera Delivery Point - Powerco	20.4	2678	17.8	1339
4300356	Henderson Delivery Point	20.3	10662	17.8	5331
4020071	Horotiu West Delivery Point	11.0	2087	10.6	1044
4200001	Huntly Delivery Point	13.9	322	8.9	161
4180001	Hunua Delivery Point	4.7	804	3.8	402
2010041	Inglewood Delivery Point	63.9	410	32.4	205
1070244	Kairanga Delivery Point	93.1	335	47.7	168
1050039	Kaitoke No2 Delivery Point	25.6	162	12.5	81
1150001	Kakariki Delivery Point	12.0	413	9.0	206
2070053	Kaponga Delivery Point	6.7	25	3.8	13
3060034	Kapuni (Lactose) Delivery Point	20.5	214	10.3	107
4350215	Kauri Delivery Point (1st Cut)	29.0	3249	18.6	1624
5001820	Kawerau Delivery Point - combined	21.0	2988	11.6	1494
5001820	Kawerau DP Town	22.2	141	12.3	70
5000113	Kihikihi Delivery Point	16.9	880	10.0	440
4050141	Kingseat Delivery Point	3.4	10	2.9	5
5000788	Kinleith SS	31.9	30715	19.2	15357
4090014	Kiwitahi Delivery Point - Degassa	21.7	1185	19.3	592
1160001	Kuku Delivery Point	14.0	50	6.6	25
1060013	Lake Alice Delivery Point	48.4	308	24.3	154
1090052	Levin Delivery Point	25.7	2259	14.2	1129
5090005	L chfield Delivery Point	8.0	2897	7.4	1449
5090005	L chfield Delivery Point - Stream 2	10.2	4587	5.9	2293
1080068	Longburn Delivery Point	25.1	1505	13.9	753
7001469	Mangaroa Delivery Point	24.0	152	11.6	76
7030004	Mangatainoka Delivery Point	10.2	36	10.0	18
4370069	Marsden Point Delivery Point - NZRC	23.7	19178	20.1	9589
1040212	Marton Delivery Point	18.4	1305	15.8	653
4080039	Matangi Delivery Point	14.0	50	6.6	25
1000013	Matapu Delivery Point	14.0	50	6.6	25
4330133	Maungaturoto Delivery Point	12.2	2538	6.4	1269
4230001	Morrinsville SS	23.9	2422	13.9	1211
8040049	Mt Maunganui Delivery Point	19.7	3431	18.8	1715
2030105	New Plymouth Delivery Point	28.8	6598	16.4	3299
4160001	Ngaruawahia Delivery Point	21.6	76	10.4	38
4130001	Oakura Delivery Point	23.0	146	11.2	73
1010016	Okaiawa Delivery Point - Manaia	44.4	156	22.2	78
4000231	Okato Delivery Point	19.5	68	9.3	34
8000175	Okoroire Delivery Point	14.0	50	6.6	25
5060044	Opotiki Delivery Point - Opotiki Town	39.1	701	21.8	351
4000001	Opunake Delivery Point	15.6	100	7.4	50
1130051	Oroua Downs Delivery Point	44.1	280	22.0	140
1002005	Otaki Delivery Point	19.7	222	15.0	111
4002135	Otorohanga Delivery Point	23.6	150	11.4	75
7020212	Pahiatua - shared equipment	24.2	4095	12.9	2047
1070272	Palmerston North Delivery Point	43.4	8475	23.6	4238
2003394	Papakura Delivery Point - Papakura	23.0	18386	19.6	9193
8000805	Papamoa Delivery Point	16.7	1235	16.2	617
1002236	Paraparaumu Delivery Point	12.8	1154	6.3	577
1000422	Patea Delivery Point	38.1	241	18.9	121
1002455	Pauatahanui Delivery Point	20.3	1184	13.7	592
1002423	Pauatahanui No.2 Delivery Point	14.0	50	6.6	25
4220004	Pirongia Delivery Point	4.4	26	3.5	13
4050059	Pukekohe Delivery Point	46.4	661	24.0	330
4000132	Pungarehu No 1 Delivery Point	2.5	1	2.5	1
4010054	Pungarehu No 2 Delivery Point	9.6	15	5.5	7
8000044	Putaruru Delivery Point	8.3	481	4.8	241
8070001	Pyes Pa Delivery Point	3.9	863	3.8	432
4170001	Ramarama Delivery Point	25.6	376	12.5	188
8050083	Rangiuru Delivery Point	8.0	540	4.7	270
5040182	Reporoa Delivery Point	18.2	2565	12.4	1283
5030180	Rotorua Delivery Point	29.3	3525	20.4	1762
2000192	Stratford Delivery Point	36.5	746	19.3	373
7000844	Takapau Delivery Point	34.5	696	18.2	348
4020470	Tatuanui Delivery Point	6.8	2051	5.8	1025
5080389	Taupo Delivery Point	17.1	1333	17.0	667
8030079	Tauranga Delivery Point	23.5	2069	13.2	1034
1190001	Tawa B Delivery Point - Train 2	6.7	2700	6.1	1350
4210102	Te Awamutu North DP - Combined	18.1	4481	18.0	2241
4210102	Te Awamutu North (Town)	7.9	555	5.2	278
4210102	Te Awamutu North DP - Fonterra	6.8	4481	6.6	2241
1170001	Te Horo Delivery Point	2.9	1	2.9	1
2080001	Te Kowhai Delivery Point	31.2	5745	17.5	2872
4060016	Te Kuiti North Delivery Point	19.6	491	12.4	246
4120083	Te Kuiti South Delivery Point	20.0	1035	10.8	518
8000888	Te Puke Delivery Point	20.7	864	17.8	432
8000888	Te Puke Delivery Point - 2nd Cut to DF	10.8	446	10.2	223
4100022	Te Rapa Delivery Point	29.9	27300	23.1	13650
7000433	Te Rehunga Delivery Point	0.6	10	0.2	5
5020093	Te Teko Delivery Point	14.2	50	8.9	25
2002431	Temple View Delivery Point	13.0	10107	11.2	5054
8020020	Tirau Delivery Point - Dairy Co	20.2	2327	12.4	1163
8020020	Tirau Delivery Point - Distribution	12.0	55	10.5	28
5000720	Tokoroa Delivery Point	24.2	1342	18.8	671
2003168	Tuakau Delivery Point	19.0	5239	17.5	2620
1002164	Waikanae No. 2 Delivery Point	24.9	1251	18.0	625
5000176	Waikeria Delivery Point	20.3	184	17.8	92
4300211	Waikumete Delivery Point	19.8	10206	18.8	5103
1002532	Waitangirua Delivery Point	31.2	22598	19.4	7231
1002532	Waitangirua Delivery Point (2)	21.1	22598	19.4	15367
2030046	Waitara Delivery Point	41.6	857	22.0	428
4020500	Waitoa Delivery Point	18.4	2092	17.0	1046
4310001	Waitoki Delivery Point	10.8	3341	10.2	1671
1000692	Waitotara Delivery Point	48.2	307	24.2	153
4050214	Waiuku Delivery Point	23.3	560	11.6	280
1000977	Wanganui Delivery Point	13.5	6503	11.2	3252
4320063	Warkworth No.2 Delivery Point	25.0	2716	17.5	1358
1030058	Waverley Delivery Point	4.0	10	3.6	5
4301075	Wellsford Delivery Point	12.0	1	12.0	1
4003810	Westfield Delivery Point	22.5	47855	19.9	23927
5070137	Whakatane Delivery Point	25.0	4333	18.9	2166
5070137	Whakatane DP - Whakatane Board Mill	80.0	0	80.0	0
4340091	Whangarei Delivery Point	20.8	1073	13.5	537

Color coding for threshold pressures:

Red indicates min threshold pressure > 32 barg

Yellow indicates threshold pressure between 30 and 32 barg

Green indicates threshold pressure less than 30 barg.

APPENDIX F FIRST GAS NOTE ON CC THRESHOLD DEVELOPMENT

Firstgas

Date: 25 Feb 2022
Author: Tim Gray

1. Schedule 1 - Threshold Development.

First Gas's intent here is to define the appropriate point at which a failure in the system is likely to occur. Setting the CC threshold too high is likely to results in unnecessary declaration of a CC event, and potential curtailment prior to it being necessary, while setting too low runs the risk of security of supply being compromised.

First Gas have modelled the pipeline system to determine the failure pressure of its regulators at the current peak load of the system.

1.) *Failure is considered the point at which 2 regulators running in parallel fail to meet the current peak load. This was chosen over a single regulator failure case as this can at times result in an excessively high failure pressure, particularly where high operating pressures are normal, or the regulator is designed to run close to fully open normally for operational reasons.*
2.) *A 30% pressure allowance was applied to allow for safe margin for potential variation in flow demands, regulator performance ect. This also has the distinct advantage of pulling the failure pressure above the single regulator failure pressure in 90% of locations.*

Using the above methodology, failure pressure can be determined for all location on the network. It can be observed that all point fail below 30barg, except for 3 locations on the network where the minor design changes would be required to reduce the failure pressure. It was considered appropriate to apply a minimum pressure of 20barg to any locations where the pressure was less than this. This provided the upper and lower bounds for our recommended Schedule 1 settings.

In terms of the proposed CCMP, FGL would prefer not to use a specific pressure at every location currently, but rather a suitable pressure at the likely failure points, similar to the existing schedule 1 which also accounts for the likely required pressures upstream. Based on our analysis, this is likely to be approximately 26barg for the vast majority of the network.

It should be noted however there are locations on the network where it may be appropriate (either now or in the future) where a specific pressure, or general reduced pressure is ideal. Two locations where this is currently likely include the New Plymouth Delivery Point and Hastings Delivery Point where lower pressures are likely appropriate as they are sufficiently different than the generic threshold.

It is worth noting that should network pressures be reduced now, or in the future then its likely the selection of regulator trims will be optimized to provide for lower failure pressures over time, and potentially increasing of the available contingency, and possible further reductions in CC thresholds as part of the CCMP update process.