



TRONDHEIM KOMMUNE

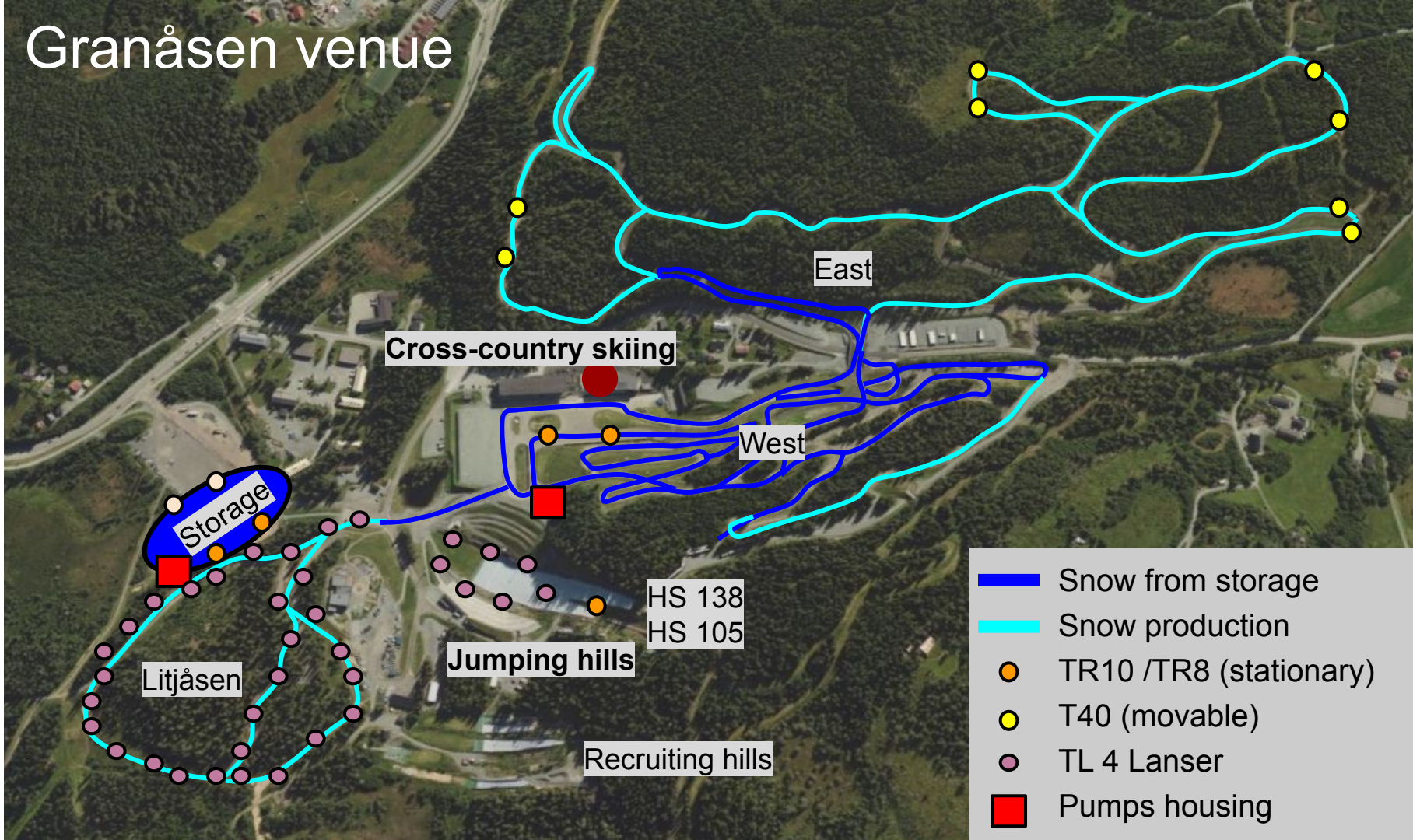
Trondheim Bydrift - Idrett, park og skog

# Granåsen sports park

Snow for the Future - Workshop 26. okt. 2022 - Snow production and storage in Granåsen venue  
Pål Bjørset, operations manager and Heidi Arnesen, operations planner



# Granåsen venue



# Snow system cross country

- East and west: 8 mobile fan guns - T40
- Stadium: 2 fan guns on tower - TR10
- Litjåsen: 29 stk permanent snow lances - TL4
- Snow storage: 2 fan guns - TR10



# Snow production capacity

Production system	T = - 3 degrees		T = - 7 degrees		Number of units	T = - 3 degrees		T = - 7 degrees	
	Water (l/s)	Snow (m3/t)	Water (l/s)	Snow (m3/t)		Water (l/s)	Snow (m3/t)	Water (l/s)	Snow (m3/t)
Snow lance TL4	0,83	7	3	19	29	24	209	84	548
Fan gun T40	1,2	21	5	39	8	10	166	37	312
Fan gun TR10	2,1	32	6	63	4	8	128	25	252
					Water demand (l/s)	42	m/day	146	m/day
					Utilized capacity	51%	12058	176%	26 690

## Amount of snow

Plase	m3
East	18 000
West	15 000
Stadium	7 000
Litjåsen	6 000
Jumping hills	5 000
<b>Total</b>	<b>51 000</b>

# Operation

- Mobile fan guns - T40
  - Departure and connection
  - Automatic or manual setting
  - Controlled from mobile or PC
  - Frequent supervision to avoid snow build-up on equipment
- Permanent fan guns - TR10
  - Fully rigged
  - Automatic start-up
  - Controlled from mobile or PC
  - Some supervision to avoid snowing of the tower and cannon
- Permanent snow lances - TL4
  - Fully rigged
  - Automatic start-up
  - Controlled from mobile or PC
  - Less supervision to avoid snowing the tower and cannon



# Benefits

- Snow lance
  - Simple setup
  - Less supervision
  - Produces the entire route (no moving)
  - Less maintenance on the equipment
  - Productions in small time windows
  - **Less noise**
- Fan guns (mobile)
  - Lower investment cost
  - Mobile (can be used in several places in the facility)

# Disadvantage

- Higher investment cost
- Erection, supervision and dismantling
- Moving during production
- Noise



# Snow system jumping hills

- 1 fan guns on tower - **TR8**
- 7 permanent snow lances - **TL4**



# Priority

- Cross country - Storage snow
- Jumping hill - Snow production
- 





# Snow storage

An aerial photograph showing a large, conical pile of harvested snow. The snow is a yellowish-brown color, indicating it has been stored for some time. The pile is situated in a paved area, likely a parking lot or a designated storage area. In the background, there are several buildings, including houses and a larger structure, surrounded by dense green trees. A road with a white van is visible in the lower right. The overall scene is set in a rural or semi-rural area with a mix of natural and built environments.

- Warm autumn and poor snow production 2014
- Trondheim municipality gave a snow guarantee for autumn 2015
- => Snow storage
- Snow harvesting from the stadium

# Snow storage - The process

Granåsen snølager - avdekking og utkjøring av snø	Jan	Feb	Mars	April	Mai-Sept	Oktober	Nov	Des
Fremdriftsplan								
Snøproduksjon	■	■	■	■				■
Dosing og forming		■	■	■				
Tilkjøring og pålegging av sagflis				■				
Måling av volum				■				
Brukergruppemøte							■	
Avdekking og flishåndtering							■	■
Utkjøring av snø fra lager til stadion og løypenett							■	■
Ferdigstillelse og åpning av 4 km løype								■



# Snow storage - Volum

25.000 m<sup>3</sup> in the storage gives about  
20.000 m<sup>3</sup> snow (4 km ski-tracks)

År	V (m <sup>3</sup> ) april	V (m <sup>3</sup> ) november	Reduksjon
2015	8 000	6 000	25%
2016	16 100	12 200	24%
2017	16 800	12 600	25%
2018	27 000	22 000	19%
2019	19 800	15 000	24%
2020	26 479	21 880	17%
2021	26 547	21 238	20%

Målinger utført NTNU - SIAT



# Snow storage - Recommendation

- Area
- Close to the trail network
- Substrate (drainage and top cover)
- Cleanliness (routes and surrounding area)
- Noise



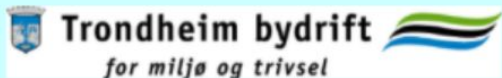
# Operating costs

- Snow production
  - Electricity costs, water charge
  - Crew
  - Machines and fuels
- Snow storage - additional costs
  - Sawdust for roofing (purchasing, transport t/rt, deposit/disposal or reuse)
  - Machines for transport



# HMS Health, environment and safety

## Safe job analysis



### SJA

Sikker jobbanalyse for Trondheim kommune Bydrift.



Stopp opp - tenk deg om sett i gang


Aktivitet:	Snøutkjøring fra lager - maskinarbeid i lageret	
Arbeidssted:	Granåsen skisenter	Dato: 16.11.2020
SJA-ansvarlig:	Pål Jostein Bjørset	

Beskriv arbeidet - hvilke oppgaver er vi bekymret for?	Farer - hva kan gå galt?	Tiltak og sikkerhets-utstyr
Lasting fra snødungen	Utgliding av maskin	Sørge for stabilt platå under maskinen
Lasting fra snødungen	Utrasing	Unngå høye skjæringer.
Lasting	Bilene kan skli i hverandre	God planering. Vurder strøing.
Lasting	Missforståelser	God kommunikasjon. Telefonliste i alle maskiner
Lasting og transport	Personskade	Årvåkenhet mht utedkommende



# Experiences and advice

- Water supply - humus and cold water
- Higher investment can reduce operating costs
- Noise (snowmaking, machines etc)
- Snow storage (draining cover, clean transport routes, location, space-consuming)
- Training and knowledge transfer
- Risk assessment



Location	Tempfukt	Luftfukt
Hopp bunn 5	97.5 %RH	Hopp bunn 5
Hopp bunn 5	-9.7 °C	Hopp bunn 5
Veiebu 6	90.7 %RH	Veiebu 6
Veiebu 6	-9.2 °C	Veiebu 6
Veiebu inne 6	13.5 °C	Veiebu inne 6
Dommertårn 7	-	Dommertårn 7
Dommertårn 7	-8.5 °C	Dommertårn 7
Dommertårn inne 7	14.5 °C	Dommertårn inne 7
Hopp storbakke 8	82.7 %RH	Hopp storbakke 8
Hopp storbakke 8	-7.4 °C	Hopp storbakke 8
Hopp storbakke inni 8	13.5 °C	Hopp storbakke inni 8

# Numerical data

- Water source

- Low temperature, humus
- Capacity 86 l/s

- Hydrants cross country

- East: 32 prod. points - distance  $\approx$  45 m
- Vest: 23 prod. points - distance  $>$  45 m
- Litjåsen: 29 lances - distance  $\approx$  40 m
- Storage and stadium 2 + 2 prod. points

- Length of the courses

- East 4 km
- West 3 km
- Litjåsen 1 km

- Snow storage

- 25.000 m<sup>3</sup> snow in spring gives about 20.000 m<sup>3</sup> for distribution in autumn

