

Integrated watershed management – Protection – Tourism & Water

SALZBURG 2006

Dusan Huska - Lubos Jurik

OVERVIEW

- INTEGRATED WATERMANAGEMENT
 - LANDSCAPE
 - FOREST
 - AGRICULTURE
 - PASTURES AND MEDOWS
 - ARRABLE FARMING
 - LIVING AREAS
 - WATER
 - SPORT & RECREATION

SPORT & RECREATION

- COMMON WATER USE
- WATER FOR NATURE
- WATER FOR SOCIETY
 - DRINKING WATER SUPPLY
 - WASTE WATER TREATMENT
 - TECHNICAL USE
 - WATER FOR SPORT



NORTHERN CHOPOK



LOW TATRAS

- LARGEST MOUNTAIN IN THE CENTRAL SLOVAKIA
NATIONAL PARK LOW TATRAS
- LARGES SPORT AREALS FOR DOWNHILL SKYING
- HIGHER PEAK Ďumbier, 2043m a.s.l.

ELEVATION

- Banska Bystrica 360 m n.m.,
- Ďumbier 2043 m n.m
- 5 types of climate
 - HILLS above 1500 m n.m.
 - Very cold average temperature January -7° to -8° C
 - Lower afforested areas average temperature January -5° to -7° C

Precipitation

- Depends on the elevation above a sea level
- At the top of mountain Chopok 1400 mm
- In the lower parts 1400 mm
- In walleyes less than 900 mm.

SNOW COVER

- WALLEYS 60 DAYS A YEAR
- HILLS 130 DAYS
- IN SHADOW NORTHERN WALLEYS (Dumbier) SNOW COVER AUP TO 200 DAYS.
- SNOW LAYER IN THE WALLEYS AVERAGE DEPTH 20 cm IN JANUARY AND FEBRUARY
- ON THE HILLS UP TO 145 cm.
- MAXIMUM WAS RECORDED AT LOCATION KOSODFREVA 295 cm

SPORT CENTERS

- *Jasná.* : Jasná - Biela púť, Jasná – Luková, Jasná – Záhradky, Jasná – Otupné. SKI RUNS - 15 OF WHICH IS 8,4km ARTIFICIALLY SNOWED WIDTH 40m.
- *Chopok Juh* – Srdiečko. 2 SNOW RUN LENGTH 1700m, 500m ARTIFICIALLY SNOWED.
- *Chopok Juh* – Kosodrevina. 4 L- 6340m, AS 4500 m
- *Čertovica.* – Sedlo and Čertovica Čertova Svadba. SR - 6 L - 5,5km, AS - 2,2km
- *Liptovský Ján* – Javorovica. 6/ 3,01km, ALL AS
- *Liptovský Ján* – Za Štartom. 1/400m WITHOUT TECHNICAL SNOW
- *Tále.* 5 / 2,57km, ALL AS.

SPORT CENTERS

- *Pohorelská Maša – Pod Gindurov. 4 /5km/ NO AS.*
- *Opalisko – Závažná Poruba. 5 / 3,2km / 2,7 AS.*
- *Polomka – Bučník. 2 / 3,2km, / AS.*
- *Krpačovo. 3 / 1,03km, / AS.*
- *Liptovská Teplička. 3 / 3km. / AS 1,25km.*
- *Mýto Pod Ďumbierom. 1 / 2,8km./ AS.*
- *Vyšná Boca – Bačova Roveň. 1 / 900m / AS*

Beginning of technical snow

- End of 40. artificial snow produced by Ing. Phillip Tropeano / experiment for increasing of sprinkler performance he added compressed air and at low temperature under 0 degree centigrade was result snow

- 1958 in the USA was registered „patent Hanson“, which is a base for the present snow gun – snowing device.
- In Germany - 1963 they started production of artificial snow In Garmisch - Partenkirchen they installed snowing device AMF with 5 snow gun on the 6th December 1963 at 19.00 was produced the first technical snow in the Europe.(IB 1/2005)

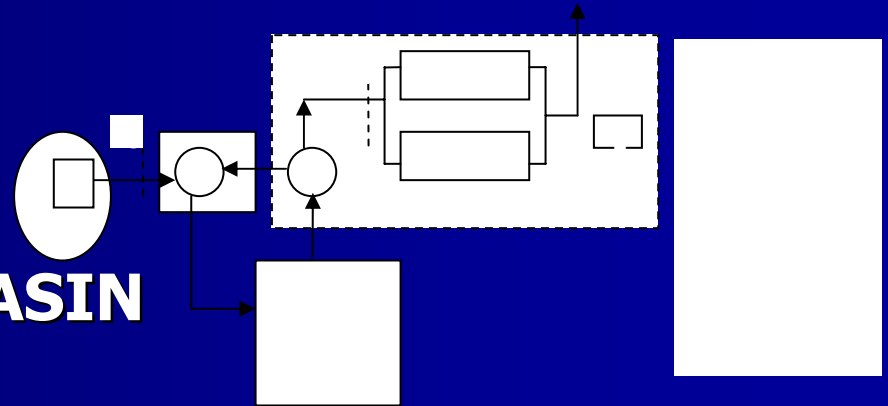


SLOVAKIA

- Technical snowing began in years
1992 1993

PARTS OF TECHNOLOGY

- 1 WATER SOURCE
- 2 SUCTION CORB
- 3 FILTER
- 4 ACCUMULATION BASIN
- 5 BUFFER PUMP
- 6 COOLING TOWER
- 7 PUMPING STATION
- 8 DELIVERING PUMP
- 9 COMPRESSORS
- 10 MANAGEMENT



JASNÁ



NEED OF TECHNICAL SNOW

- FIRST SNOWING **134 400 m³**
- NEED OF WATER **59 136 m³.**
- TIME OF SNOWING - FULL CAPACITY OF THE PUMPING STATION) **150 m³.hod-1**
394,3 hours – APPROXIMATELY 16,4 days.
- SNOWING "STEP BY STEP" / FIRST OPTIMAL SNOWING IS 4 TO 5 days.
- SNOWING TIME USUALLY IN THE NIGHT FROM 20.00 TO 22.00 AND THAN 3.00 do 6.00. am.

VOLUME 1th SNOWING

- SNOW

- $Q_S = DZ * \check{S}Z * HS \quad [m^3]$

- WATER

- $Q_W = (Q_S / Q_{VS}) * k \quad [m^3]$

- TIME

- DEPENDS ON THE CAPACITY OF PS (150 m³.hod⁻¹) AND VOLUME OF WATER

PARAMETERS

- **QS** VOLUME OF SNOW [m³]
- **QV** **VOLUME OF WATER** [m³]
- **DZ** LENGTH OF THE SNOW RUN [m]
- **ŠZ** WIDTH OF THE SNOW RUN [m]
= 40m
- **HS** DEPTH OF THE SNOW [m] =
0,4m
- **QVS** VOLUME OF WATER IN SNOW =
2,5
- **k** LOSS COEFFICIEN = 1,1

INFORMATION "JASNA"

	Length [m]	area [m ²]	Snow volume[m ³]	Water volume [m ³]	Snowing time [hod]
I. Etapa	2 900	116 000	46 400	20 416	136,1
II. Etapa	2 100	84 000	33 600	14 784	98,6
III. Etapa	3 400	136 000	54 400	23 936	159,6
Spolu	8 400	336 000	134 400	59 136	394,3

Total snowing

- During the winter season content of the accumulation basin is pumped up 5 times
- cca 125 000 m³
- from it Revival snowing 65 864 m³vody.

Strediská	length [m]	surface [m ²]	Snow content [m ³]	Water volume [m ³]	time 1. zasneženia [hod]
Jasná	8 400	336 000	134 400	59 136	394,3
Chopok Juh - Srdiečko	500	20 000	8 000	3 520	23,5
Chopok Juh - Kosodrevina	4 500	180 000	72 000	31 680	211,2
Čertovica	2 200	88 000	35 200	15 488	103,3
Lipt. Ján - Javorovica	3 010	120 400	48 160	21 190	141,3
Lipt. Ján – Za Štartom	0	0	0	0	0
Tále	2 570	102 800	41 120	18 093	120,6
Pohorelská Maša	0	0	0	0	0
Opalisko – Závažná Poruba	2 700	108 000	43 200	19 008	126,7
Polomka - Bučník	3 200	128 000	51 200	22 528	150,2
Krpačovo	1 030	41 200	16 480	7 251	48,3
Liptovská Teplička	1 250	50 000	20 000	8 800	58,7
Mýto Pod Ďumbierom	2 800	112 000	44 800	19 712	131,4
Vyšná Boca	900	36 000	14 400	6 336	42,2
Together	33 060	1 322 400	528 960	232 742	1 551,6

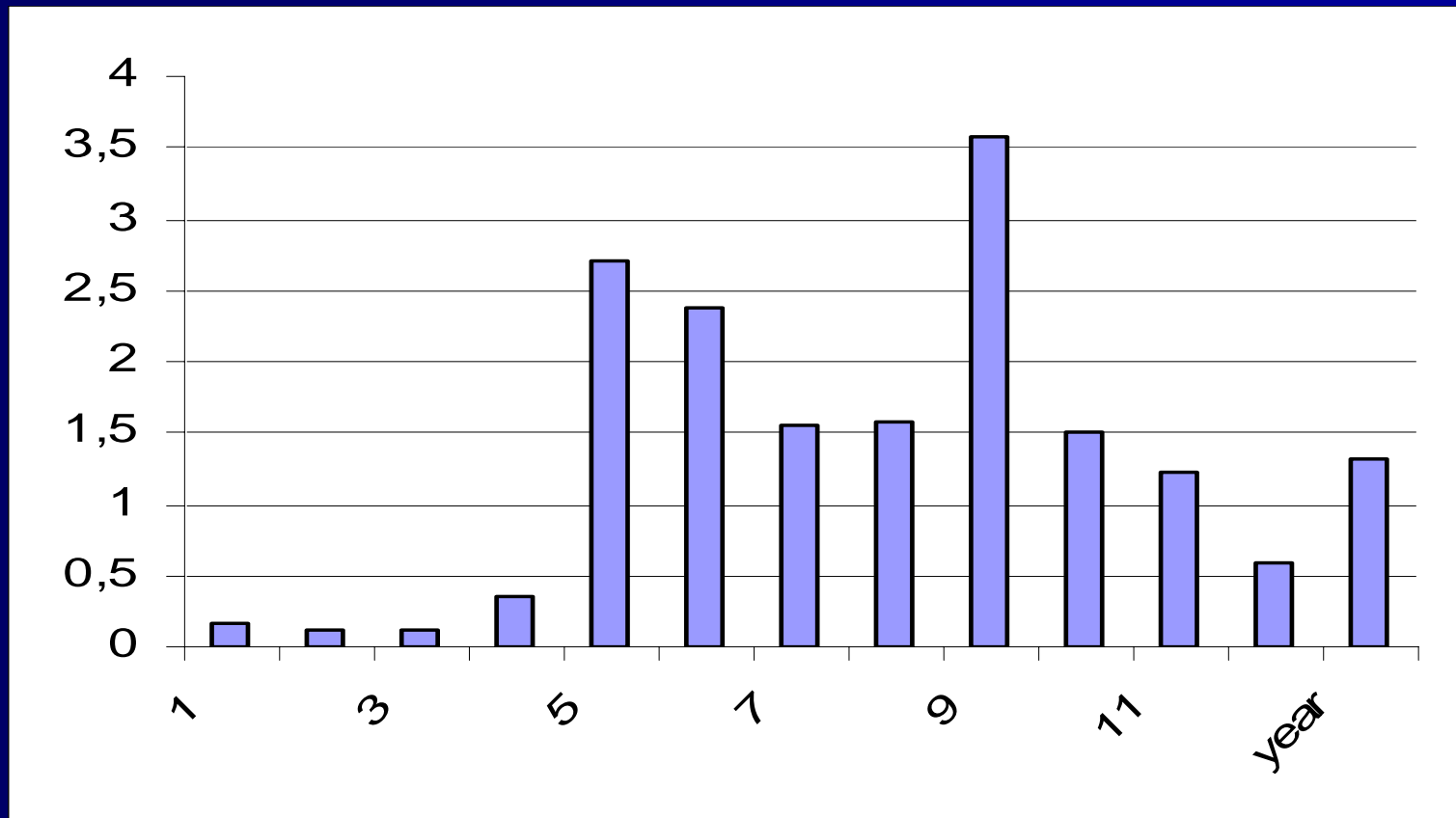
Strediská	Potreba vody [m ³]		Celková potreba vody [m ³]
	1. zasneženie	*udržiavacie zariadenie	
Jasná	59 136	65 864	125 000
Chopok Juh - Srdiečko	3 520	3 929	7449
Chopok Juh - Kosodrevina	31 680	35 280	66 960
Čertovica	15 488	17 248	32 736
Lipt. Ján - Javorovica	21 190	23 598	44 788
Lipt. Ján – Za Štartom	0	0	0
Tále	18 093	20 149	38 242
Pohorelská Maša	0	0	0
Opalisko – Závažná Poruba	19 008	21 168	40 176
Polomka - Bučník	22 528	25 088	47 616
Krpačovo	7 251	8 075	15 326
Liptovská Teplička	8 800	9 800	18 600
Mýto Pod Ďumbierom	19 712	21 952	41 664
Vyšná Boca	6 336	7 056	13 392
Spolu	232 742	259 190	491 932

Total need

- **Together**
- **First snowing 232 742 [m3]**
- **Revival snowing 259 190 [m3]**
- **Total water need 491 932 [m3]**

- Source of water:
- Water stream, natural basin, artificial basin pipelines
- Delivering of water alongside the sky run by pumping station.
- Source of compressed air is Center compressor in the station added to any snow gun
- Fan as a part of snow gun

Outflow in the stream Deménova m³/sec



OUTFLOW

- MINIMUM:
- JANUARY – APRIL
- MAY – 2.5 m³ IS INFLUENCED BY MELTING OF TECHNICAL SNOW – INCREASE OF OUTFLOW PEAK

BILLANCE

- TECHNICAL SNOW
- INCERASE OF PEOPLE IN THE TERRITORY
- INCREASE OF CONSUMPTION OF WATER FOR RECREATION
- PRODUCTION OF WASTE WATER
- INCREASE REQUIREMENT FOR WASTE WATER TREATMENT

WATER BASIN



COOLING DEVICE



INFLOW INTO BASIN



CONCLUSION

- TECHNICAL SNOWING IMPROVES QUALITY OF CONDITION FOR DOWN HILL SKIING
- IMPROVES ECONOMICAL PROSPERITY OF SKIING CENTERS
- SPORT CENTERS ARE MORE INDEPENDENT ON THE NATURAL PRECIPITATION
- INCREASE WATER EROSION
- CREATE DECREASE OF WATER QUALITY DUE TO LARGE IMPACT OF PEOPLE

BIG PROBLEM

- LIMITED RESOURCES OF WATER IN THE HIGH ELEVATION
- ALMOST NO ONE SKY CENTER HAS NO WASTE WATER TREATMENT STATION