

Spirit Lake & Lower Gar Forecasts and Mitigation Alternatives 8 March 2010

Tables 1 and 2 show forecasted Maximum lake levels for Spirit Lake and Lower Gar for various conditions with and without mitigation alternatives compared to the 1993 peak levels and current conditions as of March 2, 2010.

No Action Forecasts

No action forecasts were made using the existing snow pack information with an estimated 6 inches of Snow Water Equivalent (SWE) as of March 2, 2010. Forecasts were made using various runoff (RO) percentages of 60%, 80% and 100%. The 60% RO condition assumes that 3.6 inches of the existing SWE would runoff with 40% lost to infiltration and depression storage. Likewise, the 100% RO condition assumes that all 6 inches of the existing SWE would become runoff and inflow to Spirit Lake and the Okoboji lakes. Inflow to the lakes from the snowmelt runoff was patterned after the March through April 1993 inflows by factoring the 1993 inflow hydrographs by the ratio of 2010 runoff to 1993 runoff during March and April. Additional forecasts were made to add normal precipitation and 1993 precipitation to this years existing snow pack.

Spirit Lake Spillway Wall Cut 100'

The first alternative evaluated to reduce expected maximum levels in Spirit Lake included cutting the wall along the spillway approach channel to elevation 1401.07 (same elevation as existing spillway crest) for a length of 100 feet. This would allow more flow into the spillway channel until the lake reaches elevation 1402. Once Spirit Lake levels exceed elevation 1402, the culverts would control the flow. Results of this analysis indicated that the maximum lake level would only be reduced by about 0.1 foot. This alternative would also reduce the maximum level in the Okoboji system by about 0.1 foot by pushing more water through the system earlier.

Lower Spirit Lake Spillway Weir 1.5'

This alternative includes notching the spillway crest at Spirit Lake to lower it by 1.5 feet. Again this option would only increase outflows until the lake levels exceed elevation 1402. This alternative would lower the maximum level of Spirit Lake by 0.5 foot and would reduce the peak levels in the Okoboji chain by 0.2 foot by pushing more water through the system earlier.

Add Pumps to Lower Gar

Three different scenarios were evaluated to include adding pumping capacity at the Lower Gar outlet. Pumping capacities of 50, 100 and 200 cfs were evaluated and added to the existing culvert capacity at the Lower Gar outlet. Results of this analysis indicated the maximum lake levels in the Okoboji chain would be reduced 0.2 to 0.7 foot.

Notch Weir Downstream from Lower Gar 1.5'

This alternative included notching the weir downstream from the lower Gar outlet 1.5 feet for lengths from 25 to 160 feet. Results of this analysis indicate that the expected maximum lake levels could be reduced from 0.4 to 0.7 foot. Combining a 50 feet wide notch with lowering the Spirit Lake Spillway crest by 1.5 feet would result in reducing the peak elevation of the Okobojis by 0.6 foot.

Add New Culvert Capacity

This alternative included adding 1 or 2 new 4' x 14' Reinforced Box Culverts (RCB) at the Lower Gar outlet. Inlet invert elevation of the new culverts would be 6 inches above the Weir crest at elevation 1396.4 feet NGVD29. Results indicate that adding one new RCB would lower the maximum water level by 0.6 foot while adding two RCB's could lower the maximum level by 0.8 foot. In addition, if two new RCB's were added along with a 50' notch in the downstream weir, the maximum water levels would be lowered by 1.1 feet.

Breach Lower Gar Road

The final alternative evaluated was to breach the Lower Gar Road with a 50 feet wide section. This alternative was also combined with a 1.5 feet deep notch in the downstream weir 50 feet wide. This alternative would lower the maximum water levels by 1.1 feet with the 50' feet wide breach and 1.4 feet when combined with a 1.5 feet deep notch in the downstream weir 50 feet wide. Combining the Lower Gar road breach with notching the downstream weir and lowering the Spirit Lake Spillway crest by 1.5 feet would result in reducing peak water levels in the Okoboji Chain by 1.5 feet.

Table 1. Spirit Lake Forecasts

Condition	Peak Elevation (Ft – NGVD29)	Peak Outflow(cfs)
1993 Observed	1405.7	700 approx
Current (March 2, 2010)	1401.7	98
No Action Forecasts		
Existing SWE 60% RO	1402.2	244
Existing SWE 80% RO	1402.5	353
Existing SWE 100% RO	1402.8	417
Existing SWE 100% RO + Normal Precip	1403.9	559
Existing SWE 100% RO + 1993 Precip	1403.9	559
Alternatives – All Include Existing SWE 100% RO + Normal Precip		
Spirit Lake Spillway Wall Cut 100'	1403.8	542
Lower Spirit Lake Spillway Weir 1.5'	1403.4	497

Table 2. Lower Gar Forecasts

Condition	Peak Elevation (Ft – NGVD29)	Peak Outflow(cfs)
1993 Observed	1400.0	1147
Current (March 2, 2010)	1396.0	198
No Action Forecasts		
Existing SWE 60% RO	1397.3	375
Existing SWE 80% RO	1397.9	571
Existing SWE 100% RO	1398.3	675
Existing SWE 100% RO + Normal Precip	1399.2	924
Existing SWE 100% RO + 1993 Precip	1399.7	1061
Alternatives – All Include Existing SWE 100% RO + Normal Precip		
Add Pump 50 cfs	1399.0	925
Add Pump 100 cfs	1398.8	924
Add Pump 200 cfs	1398.5	926
Notch Weir 25' – 1.5' Deep	1398.8	911
Notch Weir 50' – 1.5' Deep	1398.7	904
Notch Weir 75' – 1.5' Deep	1398.7	900
Notch Weir 160' – 1.5' Deep	1398.5	895
Add 1 - 4' x 14' RCB (IE=1396.3)	1398.6	940
Add 2 – 4' x 14' RCB (IE=1396.3)	1398.4	962
Add 2 – 4' x 14' RCB + Notch Weir 50' (IE=1393.8)	1398.1	955
Spirit Lake Spillway Wall Cut 100'	1399.1	912
2 – 4'x14' RCB + Notch 50' + Spirit Wall Cut (IE=1393.8)	1398.1	942
Breach Lower Gar Road 50' Wide	1398.1	977
Breach Lower Gar Road 50' + Notch Weir 50'	1397.8	973
Lower Spirit Lake Spillway Weir 1.5'	1399.0	879
Breach Road+ Notch Weir + Lower Spirit Weir	1397.7	924

Notch Weir 50' + Lower Spirit Spillway Weir	1398.6	869
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