



## Howard Hanson Dam FREQUENTLY ASKED QUESTIONS March 2011

U.S. ARMY CORPS OF ENGINEERS

BUILDING STRONG®

### **Q1: What work has been done to fix Howard Hanson Dam?**

A1: The Corps constructed a grout curtain and improvements to the drainage tunnel and in 2009, and these measures underwent rigorous testing in 2010. Tests showed that the repairs completed to date have improved the control of seepage through the area of concern. However, the grout curtain is not considered a permanent solution. At the same time, the Corps initiated the dam safety study to determine how best to permanently repair the dam. Since 2009, the Corps has completed an extensive site investigation and collected a substantial amount of data that will be used to develop a long-term repair plan. Since approval of the study may still be years away, the Corps determined that additional interim measures were needed to restore the dam to a safe condition and provide full flood storage capacity for the time the study is being finalized and approved. One interim repair is additional improvements to the drainage tunnel by installing additional vertical and horizontal drains. Construction began in January 2011 and is expected to be substantially complete by November, which is beginning of the 2011/2012 flood season. Three repairs required to further protect the dam in extreme flood, including rock anchors to stabilize the spillway gate structure, additional rock protection on the upstream dam face and a new log boom system in the reservoir are scheduled to begin construction in 2011.

### **Q2: What does the Corps know now compared to January 2009?**

A2: In January 2009, the Corps became concerned after the discovery of two sinkholes, muddy seepage and high flow rates through the right abutment after the reservoir held a pool of record in 2009. To date, engineers have excavated the depressions, installed additional monitoring equipment, conducted sub-surface exploration, and conducted tests while water was held at the traditional summer conservation pool elevation. Scientists and engineers agree that the two depressions formed for reasons that do not significantly affect the safety of the dam's operation. Repairs, including a grout curtain and drainage tunnel improvements, have resulted in better control of seepage through the area of concern. Data from sub-surface exploration and new instrumentation has provided engineers and scientists a much better idea of what is going on inside the dam's abutment and has provided the basis for determining what repairs will reduce risk of failure in the interim and long term by the most economical means. Increased instrumentation data and other new information allow the Corps to make better decisions about flood storage, enabling them to see and react quickly to any signs of concern.

### **Q3: Should I still be concerned about flooding?**

A3: Yes. The repairs which are currently being constructed and once completed should return the dam to its full 140 year flood protection. The Corps will finalize its assessment of seepage failure risk as repairs are complete and tested. However, the return of full operational capacity of Howard Hanson Dam, in partnership with a functioning levee system downstream, does not eliminate all risks of flooding. The dam and levees only reduce the risk of flooding.

### **Q4: How long will it take to fix the dam?**

A4: The drainage tunnel improvements will be substantially complete by November 2011, which is the beginning of flood season in the Pacific Northwest. Additional work may be required depending on the study findings. However, at this time we anticipate that the interim measures will resolve the most serious concerns at Howard Hanson Dam.

### **Q5: Is the grout curtain an effective risk reduction measure?**

A5: Yes. The combination of the grout curtain and the additional drainage features in the right abutment are effective short term interim risk reduction measures. Monitoring done during the 2010 conservation pool showed that seepage is more effectively controlled now through the area of highest concern in the right abutment. However, grout curtains degrade over time, and

cannot be relied upon as a permanent repair. Therefore, additional drainage improvements are required and currently are under construction.

**Q6: Do you have the money to fix the problem?**

A6: Prior to passage of the recent legislation, the dam safety modification study was fully funded as were preliminary design efforts. The additional funding is considered sufficient for construction of the four additional risk reduction measures, including construction of filtered vertical wells to drain water from the abutment into the drainage tunnel. The Corps expects that completion of these projects will allow it to resume operating the dam at its design capacity, to retain flood waters of a 140-year return-rate storm. Funding requirements for any additional repairs, if any, would be determined after the dam safety study is completed.

**Q7: You have told us that the grout curtain is temporary, and the recommended plan was the concrete cut off wall – is that still the plan?**

A7: No. We believe that constructing a concrete cutoff, although an effective solution is not as efficient or cost-effective as the alternatives the Corps currently is developing and certainly not as timely.

**Q8: Why aren't you extending the grout curtain? What has changed?**

A8: Based on the exploration completed in the right abutment and sophisticated computer seepage modeling under numerous flood and conservation pool scenarios, The Corps now believes that seepage in the area of most concern is best addressed in the long term by more efficient alternatives. Although the grout curtain is working as anticipated, increasing the length and/or width would have minimal impact in the areas we are most concerned about.

**Q9: Should we take down our sandbags and stop other preparations for floods?**

A9: At this time, the Corps encourages everyone to continue to be prepared for potential flooding during this flood season. Although there is increased confidence in the dam's flood storage capacity given the analyses we have done to date, as of today, the risk is still higher than it has been in nearly 50 years.

**Q10: How long will I need to be concerned about a higher risk of flooding?**

A10: We have increased confidence in the project's capabilities; we do not have full confidence. The consequences remain the same. While the dam is not in immediate danger of failing, downstream residents and businesses should note that this increased risk for higher flood levels will exist at least through the end of this flood season. The Corps has been working closely with King County and the downstream cities of Auburn, Kent, Renton and Tukwila to prepare for flood season, should higher-than-standard flows be necessary from the dam. The Corps of Engineers will continuously reassess the pool capacities as conditions change and may change the capacity of pool storage after careful deliberation.

**Q11: I am just finding out about this situation; what is the history of the problem with Howard Hanson Dam?**

A11: Following a record high level of water behind Howard Hanson Dam in January 2009, the Corps of Engineers became concerned after discovery of two depressions on the right abutment, increased water levels in groundwater monitoring wells, and the appearance of sediment-laden water entering the abutment drainage tunnel. To date, engineers have excavated the depressions, installed additional monitoring equipment and conducted tests while water was held at the traditional summer conservation pool elevation. Scientists and engineers agree that the two depressions formed for reasons that do not significantly affect the safety of the dam's operation. However, the seepage in the abutment continues to be a problem. Ongoing evaluation of the seepage issue, as well as the construction of a seepage barrier (grout curtain) has raised the operational capacity of the dam, but the risk of flooding still remains higher than in several decades

**Q12: What does the problem mean to communities along the Green River?**

A12: Potential impact of the lower flood storage capacity is increased flood risk to the Green River Valley below the dam. Should a major flood event occur with the dam's current operational capacity, it is possible that levees in the lower valley could be overtopped. The Corps of Engineers is working with King County and city officials to quantify the increased risk to downstream areas using the best available information.

**Q13: What areas are at risk in what conditions?**

A13: The Corps of Engineers has provided to King County and the local communities a variety of possible mapped flood scenarios, and local emergency management officials are using that information in developing response plans. The scenarios that the Corps has provided represent only a few of the virtually limitless possibilities for what may occur in a storm event or events, and all residents in the valley are urged to plan and prepare for flooding as a prudent precaution.

**Q14: Will I be flooded every time it rains?**

A14: No. Before the damages were discovered, the Corps operated the dam to reduce the risk of exceeding channel capacity on the Green River at Auburn. The Corps will continue to operate this way. The dam is kept empty during the flood season except during flood events that would otherwise cause the Green River to exceed downstream channel capacity. In these cases, water is stored behind the dam. Even with the current operational capacity of the dam, there is still room to store flood water behind the dam, especially for small to moderate rain events. It is during the less frequent, large rain events that there would be a higher risk for dam releases that may exceed the channel capacity downstream.

Public safety remains our number one priority. We encourage local residents and businesses to contact local emergency managers and work with them to determine the best path for being prepared for any contingency.

**Q15: Why am I just hearing now that I'm at risk for flooding?**

A15: Since 1961, Howard Hanson Dam has been providing flood risk reduction on the Green River to the point that many residents didn't even know the dam existed. Before the construction of the dam, the floodwaters of the Green River would spread out almost unimpeded across the valley. With major flooding reduced, the Green River Valley has attracted residential and industrial growth, raising its economic worth substantially. During the January 2009 flood event, prevented damages were approximated at \$4 billion. However, the area remains an active flood plain and will always be at some risk of flooding even with the dam and levees in place and fully functioning.

**Q16: Why is seepage a concern at the dam?**

A16: The right abutment has seeped since its construction. Howard Hanson Dam's seepage has always been highly monitored and mitigated, allowing for safe operations for nearly 50 years, which in turn allowed the development of the Green River Valley. The record high flood storage pool in January 2009 resulted in several internal and external changes to the right abutment never before observed that may be symptoms of internal erosion within the right abutment. The sediment-laden water in the drainage tunnel, high water levels within the right abutment and the depressions that were discovered after the January pool of record alerted the Corps to a new situation. Until engineers are able to fully resolve seepage concerns, the Corps may limit the flood pool capacity.

**Q17: How do I know I'm safe?**

A17: Howard Hanson Dam presents no immediate danger to people and property below the dam. However, the lowered flood reservoir capacity behind Howard Hanson Dam does increase the risk of river flows above levee protection levels in the Green River Valley. The Corps urges citizens to contact their local emergency managers and work with them to determine the best path for being prepared for any contingency. Public safety is our number one

priority. The safety of our employees, visitors, and everyone in or around Howard Hanson Dam is of paramount importance to us.

**Q18: What are the chances the dam could break?**

A18: Howard Hanson Dam presents no immediate danger to people and property below the dam. The dam structure itself is not experiencing any symptoms that would indicate potential failure. The abutment is the concern. However, the Corps urges citizens to contact their local emergency managers and work with them to determine the best path for being prepared for any contingency. Public safety is our number one priority. The safety of our employees, visitors, and everyone in or around Howard Hanson Dam is of paramount importance to us.

**Q19: If there is a huge flood, how much time will I have to evacuate?**

A19: The Corps is in frequent communication with county and city officials and emergency managers. The Corps urges Green River Valley residents to be in contact with those agencies to ensure preparedness for any contingency. Any emergency messages regarding evacuation will come from those entities. For preparedness information for your community, you may want to begin with King County's portal to local emergency management organizations:

<http://www.kingcounty.gov/safety/FloodPlan/GreenRiverValley.aspx>

Or their Preparedness website:

<http://www.kingcounty.gov/safety/prepare/residents-business.aspx>

**Q20: If there is a problem, why hold water behind the dam?**

A20: During flood season the Corps doesn't hold any water behind the dam except to store water during a flood to reduce the occurrence of large volume flows that could overtop the levees. The Corps always takes the water level behind the dam down to basically no pool (elevation 1,075 feet) and run of the river operation by the beginning of flood season each year.

The dam's designed flood storage pool is elevation 1,206 feet above sea level. In January 2009 the pool reached a record pool of 1,189 feet in a matter of days, because inflows to the dam were as high as 30,500 cubic feet per second and outflows were cut to zero to limit flooding in the Green River Valley, which was experiencing high tributary inflows to the river downstream of the dam. Because of ongoing concerns with the right abutment, the Corps will be carefully monitoring the dam at any time when the pool elevation surpasses 1,170 feet above sea level and may release outflows that could exceed the capacity of the levees and channel downstream in an effort to ensure safety of the dam.

**Q21: What monitoring equipment is in place to help the Corps understand what is going on inside the dam's abutment?**

A21: Since the flood of 2009, the Corps has installed more than 30 new piezometers, which measure water levels within the right abutment. The above instrumentation, combined with on-site visual monitoring, provides a real time determination of water levels, and any undesirable material movement in the right abutment. The Corps has also installed weir boxes within the drainage tunnel to collect and measure the volume of water coming from the various vertical and horizontal drains in the drainage tunnel. Transducers that measure water level with the weir boxes were installed so that the flow through the weir boxes can be automatically calculated and displayed real time. The Corps also installed automated turbidity meters in some weirs to alert scientists to any sudden movement of material through the drains. To date we have seen no unusual turbidity readings.