



IT-Lifeline Green River Valley Flood Awareness Summary November 2009

Purpose

The intent of this document is to summarize the key points and issues surrounding potential flooding that may result indirectly from the weakening of the abutment to the Howard A. Hanson Dam. This paper includes the historical and current status of the integrity of the Howard A. Hanson Dam and the repairs planned both short and long term. The risk of flood is analyzed and calculated and the potential impact on day-to-day operations of organizations in or near the flood zone is clearly identified. Solutions are provided as to risk mitigation strategies including the value and misconceptions of insurance and the benefit and key steps of disaster recovery and business continuity preparations. The use of this document is intended to be for the internal benefit of IT-Lifeline, ITL Business Partners, ITL customers and prospects located along the Green River Valley.

As of the publish date of this paper, the Army Corps of Engineers has stated publically that the risk of flooding along the Green River has now been reduced. The likelihood of a flood has lessened from 1 in 3 to 1 in 25. This is due to the temporary repairs being completed. Effectively, these newly completed repairs now allow the Army Corps of Engineers to increase the amount of water held behind the dam from 30% to 50%. However, the dam's capacity remains severely reduced. Significant rain fall or snow melt close to or exceeding the levels as recent as January 2009 coupled with the dam's reduced capacity will no doubt cause flood concerns this winter. Organizations cannot become complacent or assume that the risk of flood does not remain significant.

The Situation

The Howard A. Hanson Dam is an earth and concrete structure at the headwaters of the Green River which is 65 miles long and empties into Elliot Bay in Seattle.

The Dam creates a reservoir that provides water for the city of Tacoma and surrounding communities. Another key purpose of the dam is to control flood water for the valley downstream. Since the dam was made operational in 1962 there have been no floods along the Green River. The US Army Corps of Engineers operates the dam. The reservoir is part of the Green River Watershed, a protected area with limited access.

The man-made portion of the dam represents about ½ of the structure. A significant part of the dam is an earthen abutment created by a massive ancient landslide. The abutment is effectively the right side of the dam. As is standard procedure for earthen dams, wells have been drilled to monitor the presence of water infiltrating both the man-made and abutted areas.

In 1965, water was found in the earthen portion of the dam, and several more wells were drilled to drain or pump the water out. The winter of 2008-2009 was one of the rainiest on record in Western Washington. Twelve to 15 inches of rain fell in 48 hours. Runoff from this downpour filled the dam reservoir quickly to record levels. When the water was drawn down in late January 2009, a depression was identified on the earthen side of the structure.

A well near the depression showed evidence of a contaminant. The water in the wells should be clean and clear. Any contaminant (dirt color) is concerning as it is a sign that key sediments may be washing away inside the structure. Further contamination was confirmed by drilling and monitoring several more wells in the abutment.

The Risk

The earth abutment portion of the dam is weakening due to sediment washing away from inside the dam and creating cavities.

The Army Corps of Engineers have identified that the weakest points are along the abutment and where the earthen abutment and man-made structure interface.

Another high volume of rain or snow melt like the 2009/2010 year could put excessive pressure on the weakening dam, creating the potential of catastrophic failure.

The Short-Term Solution

The short term strategy is to add new wells to drain and/or pump the water out of the inside of earthen portion of the dam.

Where the earthen abutment and man-made structure connect, holes are being drilled 40 feet deep and eight feet apart and perforated pipes inserted. These pipes are then being filled with a grout, which is essentially a plastic-cement that can set in water. Once the grout fills the pipe, it is pressurized, forcing the grout out and into the cavities in the dam. The grout from each pipe mixes with the grout from others to create a barrier and provide internal strength. In essence, the dam is being rebuilt from within. This work was started in July 2009, and was due for completion by November 2009.

Testing the Short Term Solution

Due to the complexity of the strengthening technique and the technologies involved, and because of the porosity of the materials in which the grout is being injected, the ultimate degree of effectiveness of this emergency measure remains unknown.

Repair work was completed in November 2009, at which time the Army Corps of Engineers performed strength testing of their temporary measures. Before the repair, the Corps had established a 30% reservoir holding capacity load limit on the weakened dam, but after testing, this limit was raised to 50% (as noted at the beginning of this paper). However, during past rainy seasons the reservoir was allowed to reach 80% or more of its holding capacity when significant precipitation occurred.

At those peak times, sustained releases occurred at a rate equal to the greatest carrying capacity of the downstream levees—a maximum of 12,500 cubic feet per second (cfs). Whatever rainfall conditions occur this year, the Corps will not allow the reservoir to reach more than 50% of total capacity, regardless of the levee capacity, to safeguard the structure and protect it from catastrophic failure.

The amount of rainfall and the severity (duration and intensity) of the various winter storms, plus any limit on the dam's capacity, will dictate the potential for flooding downstream.

Long Term Solution

According to the Army Corps of Engineers the only reliable permanent fix for the Howard A. Hanson Dam is to sheath the entire structure in concrete. The expectation is that funds can be raised for this purpose, and the work completed in the next few years. At a minimum, the widespread belief of state and local emergency management organizations is that it will be five years minimum before concrete sheathing can be installed. While the temporary fix is in place, a higher risk for flood remains until a permanent structure is ready.

Flood Risk

The 2008-2009 winter storm season in Western Washington was one of the highest on record in terms of the amount of precipitation that fell in the Cascade foothills. Although it is unlikely that such record levels will result in the near future, that fact may be irrelevant. This is because the temporary repairs to the dam by the Army Corps of Engineers in 2009 will for the first time limit the dam's capacity to hold flood water. Even normal amounts of rain water deposited during this year's winter storm season could potentially result in the Corps releasing higher than normal flows from the dam to ease the strain on the temporary repair.

At the height of rainfall in January 2009, 30,000+ cfs flowed into the drawn down reservoir behind the dam. The Corps released as much water as possible—12,500 cfs—which is the maximum flow the downstream levees can handle. Although it was close, no flooding occurred because the reservoir had the capacity to store additional runoff until the storm passed. This winter storm season, the levee's capacity will be challenged due to the dam's reduced capacity.

The reality is the Army Corps of Engineers may be forced to release water at a level that exceeds the downstream levees capacities; causing possible flooding. What is unique is that this is not a threat that is limited to one event per rainy season. Flooding could occur multiple times as the combination of winter storms and reduced dam reservoir capacity place the Corps in a difficult case by case decision situation.

Levee Weakness

Where the Green River meanders through the valley where Auburn, Kent, Renton and Tukwila are located, miles of levees have been built for the purpose of flood control. Many of these levees were originally built in the early part of the 20th century by farmers wanting to keep fields from being flooded.

There were no guidelines on the construction of the levees in the early 1900's and today there is no way to know which areas of the levees are strong and which are weak. Other areas have been shored-up, but the effectiveness of the levies during an extended period of high water flow remains unknown. The levees run the risk of degradation in the following ways:

- Undermining and scouring from faster flows on the outside bends of the river could lead to water leaking under the levee.
- Erosion due to the topping of the levee would remove levee material leading to more flooding.
- Breaching the levee where the levee is already weak, or weakened due to saturation, leading to collapses similar to what happened in New Orleans at Lake Pontchartrain during Katrina, or in 2007 with the Chehalis River in the Centralia / Chehalis area.

Debris Flow

If the level of water released from the dam exceeds 12,500 cfs, the maximum amount released in years past, a debris flow may result. This is caused by higher than normal water flows scouring the sides of the river bank. This is a particularly serious issue further up river in the foothills, where a significant number of trees, brush accumulations, and stream-side structures could be washed down river.

Debris Flow Impacts

Areas along the river where bridges, utility pipes, etc., or where the river bends tightly, can be potential locations for a flood breakout. Much will depend on the height of the water and the amount of debris in the flow. The risk results from debris piling up at key locations. The effects of debris accumulation include:

- Flooding behind the concentration of debris. Ironically this can occur at many places along the river and is not necessarily due to extremely high water. If enough debris accumulates to form a blockage, it will act as a dam, flooding areas behind.
- If the debris builds up against a bridge, a transportation problem can arise. Although there is no indication from authorities in King County that bridges will fail, it is likely that bridges could be closed as a precaution. The impact on transportation is related to the importance of the bridge in day to day use, or its role as an emergency route.
- Impact on utilities is perhaps the largest unknown, but potentially the most disruptive. Water, gas, power and communications providers have run pipes and lines across the Green River in several locations in order to service customers. In many cases these lines and pipes cross the river at dedicated crossings, but frequently they rely on the bottom or sides of a bridge for support. The impact of a debris flow on bridges where these utilities cross is obvious. The likelihood of failure is high due to damage from the debris and the related water damage.

Flood Impact

Flood Scenario damage in order of likelihood:

- Leaking and/or overflowing levees. Estimated advance notice: 24 to 36 hours.
- Degradation of levees (slow breakdown). Estimated advance notice: 4 to 6 hours.
- Debris flow causing i or ii above. Estimated advance notice: 2 to 6 hours.
- Catastrophic failure of levees. No advance notice.

For example, the Tukwila EMD reports that a total failure of the levee near South Center Mall would result in no time to escape from the area because water would be emptying into the flood zone too rapidly. Mall employees, customers and surrounding business personnel and patrons would need to get to higher ground and shelter in place.

It is estimated that three feet of water would be in the mall area, with eight feet further south on South Center Mall Boulevard. Further, if flooding occurs during the holiday shopping period, the number of people affected would be significantly higher as indicated by the estimated 120,000 cars in the area.

Event Notification

The emergency management departments (EMD) of the cities in the flood zone, King County EMD and the State of Washington EMD, have reported they will be monitoring the status of the levees 24/7 throughout the winter storm season. Any sign of system degradation will result in the following notices:

- Level 1 Notice: 72 hours notice in advance of a potential flooding and its anticipated location. Notice will state that a flooding will likely occur during the next three days.
- Level 2 Notice: 24 hours notice that flood danger is highly likely. An effort will be to identify the potentially affected areas and recommended travel and escape routes.
- Level 3 Notice: Flooding is imminent. Notice will be given to move to higher ground.
- Final Level Notice: An automated telephone notice from the King County EMD out-dial system is placed to residences and businesses. The message will depend on the situation, but in a worse case scenario, it may simply recommend to “shelter in place”.

Impact on Power

Representatives from Puget Sound Energy (PSE) have been very forthcoming concerning the potential impact of flooding on their infrastructure.

PSE Preparation

- Moving major PSE depot of equipment that is located in flood zone.
- Moving and purchasing equipment to put out of the flood zone.
- Identifying bridges where PSE’s gas and power lines run to determine risk.
- Identifying substations that may need to be moved depending on the flow of the Green River based on flows.
- Building protective barriers around two key substations that must be operational even during a flood event.
- PSE has sub-stations throughout the flood zone. Depending on the severity (the height of the river flow) the following impact scenarios apply PSE:

Over 12,500 cfs to 17,599 cfs:

- Relocation of PSE offices/equipment in flooded areas
- 2 transmission stations may be impacted
- Will need to relocate some sub-stations

15,600 cfs to 19,999 cfs:

- 10 substations impacted
- 20,000 electric energy users will lose service
- 3,000 gas users will lose gas service

20,000 cfs up (at a minimum)

- 18 substations impacted
- 33,000 electric energy users will lose service
- 5,000 gas users will lose service

Scope of Outage

The response from PSE is not like a wind storm where power goes out and they locate and fix it as soon as they can get a crew to the failed area. The PSE response to flooding will be proactive and the impacts to customers longer-lasting.

De-energizing

If PSE knows of a flood threat to a particular area, the utility will, without notice to the customers in that given area, de-energize the system and stop gas flowing through lines. If there is active flooding occurring, power and gas to the affected area will be turned off.

Outage duration is directly related to the magnitude of flooding. PSE cannot address the outage when their equipment is either inaccessible because roads are out, or because the facility itself is inundated. PSE will not put work crews in harms way to address outages.

Repair work can only be performed once the flood water threat is gone. So flood waters must recede, levee breaches must be fixed, and roads must be cleared because most of PSE's equipment is underground.

Re-energizing

The process of starting electricity and gas flowing again is methodical and follows the order below:

- Main lines are checked
- Electric substations and gas governor sites are examined, equipment that was submerged must be dried out and cleaned, and any parts damaged by the water must be replaced
- Electricity and gas distribution infrastructure must be examined, dried out, cleaned or repaired
- Transformers and switches must be examined, dried out, cleaned or repaired
- Substations will be re-energized and gas will flow to governors once all these steps are taken. This does not mean the power and gas will be immediately available. Individual businesses must confirm that their buildings can be re-energized:

- Each building will be examined from the perspective of the power and gas feeds from the PSE equipment at the street into the buildings
- Any internal, power- or gas-related devices will be examined, dried, cleaned and repaired if necessary

This level of inspection is not a service provided by PSE—PSE’s responsibility stops at the street. Companies should address ahead of time how their on-site power equipment can be best protected from flood waters and pre-arranged service from a qualified power technician to clean and repair damaged power and gas equipment. To be ill-prepared is to invite long delays in resumption of service.

Reality: A flood event is acutely disruptive when power, gas and communications (voice, internet, and data) are impacted. The loss of electricity, gas or communications (for whatever period) severely affects an organization’s ability to operate. Extended outages are a real possibility with flooding. It is not about hours of down time as with a typical winter storm. Disruption from flooding can last days or weeks

And you don’t need to get wet to be affected. The impact of a loss of power or communications reaches out far beyond the flood zone. Many businesses that are on valley sides or slightly higher ground could receive their electricity by substations in the flood zone, or their communications via bridges in the impact area. Preparation is strongly advised for critical functions such as data backup and recovery requirements.

Impact of Waste Water

The King County waste water treatment plant is located in the Green River valley—effectively “ground zero” in the flood zone.

- 100 million gallons of waste water and sewage is treated at this facility every day.
- The facility can handle 300 million gallons as its maximum capacity.
- Most residential and business sewage and waste water in south King County is processed by this plant.
- The plant is preparing readiness for Green River flows of 25,000 cfs.
- The Plant is installing generators in the event of power loss to be able to continue to process critical functions.

Although the level of preparedness is high, facility managers state there are still unknowns:

- The system is not designed specifically for flood water processing.
- Exposure is not so much at the plant, but with the sewage and waste water pipes/lines feeding the facility.

If, for example, the facility is maxed-out processing 25,000 cfs of waste water from the flood, the lines from the other cities in the valley and highlands (well outside the flood zone) containing their own waste water and sewage will simply back due to lack of processing capacity. In this scenario, sewage could well back up into the residences and businesses connected to these lines. It was suggested by facility management that people may need to limit their use of restroom and bathroom facilities.

Sewage and waste water line back-up could continue for several days, until flood waters recede. Some companies are ordering temporary restroom facilities now; there is concern that in time of need, they will be unavailable due to demand.

There is also concern that companies be aware and prepare for pathogens both inside and outside the flood zone due to raw sewage leakage or lines backing up and spilling over.

Impact of Hazardous Materials

The King County Public Health Department not only warned about the obvious threat of raw sewage, but because the valley is home to many industrial companies, the threat of hazardous spill/leakage as well. Companies that have such material on site have been warned to remove it—liability for any damage or contamination and the related clean-up will be borne by the company owning the hazardous material, regardless that it is caused by flooding.

Impact on Transportation

Preparation

King County Emergency Management has developed flood escape routes in various areas. But route identification isn't foolproof because flood vulnerability is difficult to gauge as it is unknown which levees are weak and susceptible to collapse.

Signing up for alerts as to flood status and transportation routes is available via rpin.org. Such notification is advantageous because in case of flooding, transportation routes could change minute by minute due to developing failures. In fact, King County suggests businesses, customers, and residents maintain a healthy skepticism and review published maps of transportation alternatives before they are needed.

During the Flood Event

Listen to real time news sources and continuously monitor updates.

There are maps available indicating where the flooding could occur in the valley. King County Emergency Management suggests business owners, customers and residents maintain a healthy skepticism because flooding can occur even in areas where maps indicate otherwise.

The following means of transportation and routes are likely to be affected by flooding:

- The Sounder
- Highway 18
- Highway 167
- Of the 33 bus routes operated by Metro, 17 are very exposed

Preparation

Insurance to the rescue?

There has been a much discussion in the press and by government officials about the role of insurance in such a disaster. A great deal has been said about US Government backed insurance – the long-established National Flood Insurance Program (NFIP). This coverage plays an important role where insurance cannot be obtained from insurers directly due to risk or insurability, and where the value of the insured property is under \$500K for commercial property, and \$250K for residential. But insurance alone is only part of the answer when owners deal with flood losses. Some would say insurance is of limited value, a solution prone to escape clauses and exceptions. From a risk perspective:

Profile of Insured

Although there are numerically more private residences at risk of flooding in the valley, businesses could well represent a much higher financial loss potential. From an insurance perspective, even just a few businesses can represent a higher cumulative value—in the building and in the contents—than residences.

Coverage Limits

The coverage limits offered by the NFIP for commercial enterprises is \$500,000 for the structure and \$500,000 for its contents. In most cases \$1M in coverage is insufficient, many times not even close to cover the loss or damage to a company's building and its contents (including damage to grounds and equipment outside the building but on the business's property).

Equally important to know is that although the building is covered up to \$500k for replacement value—the building will be repaired or rebuilt to pre-damage condition (but at today's costs)—the contents are not replaced on the same basis. Insurance coverage for contents is on the actual cash value basis, which means their depreciated value is paid out from the insurance proceeds. Consequently, the content value shortfall can be a significant if the infrastructure and equipment is older or depreciates quickly.

Additional Flood Insurance

Typically, business people who feel they have need of flood coverage beyond the government's policies limits, go to surplus lines insurance brokers. These brokers cover the risk with underwriters either more familiar with specific types of risk, or who are willing to take on the risk due to their own or other's specialized risk analysis. However with the Howard A. Hanson Dam and the potential flooding that could be related to actions by the Army Corps of Engineers, such actions can create major policy issues that affect where and if coverage applies.

Government Action

Most insurance policies do not cover actions by government as a named peril. It is usually clearly identified as excluded under policies, even "all risk" policies. With the NFIP, government action is covered. However, in seeking coverage beyond NFIP's \$500K for buildings and contents, the exclusion for government action applies. It is widely agreed that if the release of water behind the Howard A. Hanson Dam by the Army Corps of Engineers causes downstream flooding, such damage would clearly be the result of a government action and therefore would not be covered by surplus lines insurers.

Further, much of the Lloyd's market, a major surplus lines underwriter for this type of risk, is saying they do not want to offer coverage for flood losses since insurance is based on the "risk of unforeseen events". So clearly, the Green River flood risk is plainly confirmed in the Army Corps of Engineer's flood strategy. Consequently, the underwriters can interpret Green River as foreseen and effectively uninsurable. In fact, many insurers are presently rescinding or cancelling surplus line's flood policies of many companies located in the Green River flood risk zone.

As this paper neared completion, there were some high risk underwriters who came out publicly to affirm a willingness to underwrite the risk. Such coverage will be expensive. Before purchasing such coverage, companies should be extremely clear in asking about the terms and exclusions as described above.

In summary, insurance will offer limited assistance. But if a company has a building value of over \$500K and contents valued in excess of \$500K, you must determine:

- Do you want additional insurance?
- Can you get additional insurance?
- How soon will that insurance be in effect (most policies have waiting periods, including the NFIP that requires 30 days before the coverage is effective)?
- What are the policy coverage exclusions?

The issues noted above are causing many company managers to seriously question the value associated with the effort and cost of the search for additional insurance. They understand that insurance—though helpful—is not going to reduce the serious impact of flooding on business.

Insurance benefits and proceeds are paid only after the event. Managers are now asking the central question—how can we reduce downtime? What can we do right now to prepare our company to continue operating in the face of flooding, operations that assure our clients and earn trust and loyalty? First-class company managers are looking at Disaster Recovery and Business Continuity.

Disaster Recovery and Business Continuity

The risk of Green River flooding is well established—the resulting impact to power, communications, and transportation has been predicted. Further, issues with waste water and hazardous materials are likely if conditions worsen. Area flooding will undoubtedly seriously impact company staff and management, facilities, technology and the firm’s ability to deliver products and services. As a consequence, astute managers will develop a comprehensive risk management or mitigation strategy to deal with these eventualities. The first step is to address business continuity management plan.

Crisis Management

First, develop the crisis management portion of the plan. The crisis management, or response portion of the plan lines out how the company works through problems as they arise. A viable response strategy identifies key people and the specific tasks and responsibilities each perform following an event. Companies ensure that they have the right people, in the right place, at the right time, all in advance of the crisis. During the event is not the time to put this together.

Business Continuity

Second, develop the business continuity portion of the plan. Business continuity is defined as the resumption of the critical business functions and the recovery of the other business functions over time. The key phrase here is ‘critical business functions’. Managers should conduct a formal business impact analysis in order to determine (and gain agreement) on what operations are indeed critical. This process done correctly, will define which functions are essential, which are supportive, and what can wait.

Recovery time objectives must be determined for each function—the day of event—no later than 3 days—no later than 5 days—10 Days or longer, etc. Build the plan around the sequence that is defined from the business impact analysis—it is NOT every function or process that is performed in the organization; all you should care about is that is critical. If a flood event—and there may be several—lasts 10 to 14 days (as is being widely viewed as possible by emergency management groups), managers must ask themselves; “What do I need operationally to continue doing business, even at reduced service levels, for a two week period?”

Disaster Recovery

Third, develop the disaster recovery element of the plan. Disaster recovery is defined as the recovery of the Information System assets (systems, applications, and data) that support the critical business functions. Again this is NOT all your technology—only the technology infrastructure that supports the critical business functions. Address data backup, procuring or access to specific hardware needs, and the establishment or procurement of alternate workspace for displaced workers. This should be done in advance of the event.

Summary

Finally, once the plan has been developed, consider exercising the plan—a tabletop exercise should suffice to determine plan viability. All the above, crisis management, business continuity and disaster recovery should be documented. The documented plan and its elements should be kept safely off-site, but should be easily accessible in time of need via a web based solution.

Sources

Army Corps of Engineers	Surpluslines.org
Puget Sound Energy	Cities of Tukwila, Kent, Auburn
King County Emergency Management	King County Waste Water
King County Public Health	info@RPIN.org
Washington State EMD	www.emd.wa.gov

Author:

Jim Sandford has been in risk management for 20 years. His risk analysis and insurance underwriting experience are built upon years of insurance policy development, claims adjusting and underwriting in the United States, Europe and Southeast Asia. Jim is the Chief Operations Officer at IT-Lifeline.