Gualala River Lagoon Breach

Saturday, April 6, 2013

Photography and annotation: Peter Baye

1. **Pre-breach**: Rapidly rising lagoon levels morning to mid-afternoon at lowest beach crest elevation in lee of headland, north end of Gualala Point Beach. Lagoon high water line moves seaward in shallow trough on beach at bedrock outcrop in beach berm.

11:12 a.m.

11:25 a.m.

12:50 p.m

2:13 p.m.

2. **Beach overtopping** (spill elevation threshold crossed)

2:18 p.m. Lagoon water line reaches berm crest; threshold for spillover. Lagoon seeps into beach, saturating sand across beach profile at the narrow spill zone.

3:19 p.m. Beach sapping of lagoon outflow by seepage slows as the sand saturates at the spill zone. Lagoon water surface starts to overtop the crest, with slow sheetflow currents that terminate as seepage (infiltration) into the sand.

3:21-3:23 p.m. Lagoon discharges at surface as rapid sheetflow (shallow but current velocity), but the overtopping of the berm remains very slow due to sapping of lagoon outflow by infiltration into the upper beachface, seaward of the flat-topped berm crest. Sand in beachface is saturated around the foam line.

3:26-3:29 p.m. Overtopping starts to discharge as channelized flow as it passes over the steep upper beachface. Delta lobes of sand deposit along the creeping front, but at the berm crest, the channel begins to erode into defined beds and banks.

3:33- 3:34: Surface discharge of lagoon is confined to a narrow (< 0.5 m), unstable, shifting linear shallow channel with rapid currents that flow down the steep beachface. The front migrates rapidly towards the swash zone, one to several meters per minute.

3:34-3:39: The front of the surface discharge reaches the most recent swash line (wave uprush) position, and flows accelerate all along the entire channel across the beachface, where standing waves begin to form.


3:40 p.m. The surface discharge of the lagoon connects directly into the active swash zone of the beach.

3. Lagoon outlet channel incision and widening.

3:43 p.m. The channel rapidly downcuts through the berm crest as it captures more lagoon outflow, and the erosional “nick” in the berm crest erodes headward (upstream, landward).

3:43 p.m- 3:47 p.m. Standing waves in the rapidly downcutting channel in the upper beachface form hydraulic jumps as they rapidly steepen. The channel is about a meter wide, and the bank scarp is up to about 20 cm high. Flows are very rapid (floating debris moves over 1 meter/second in glides between standing waves).

3:50-3:51 p.m. The channel head-cut narrows, deepens, and steepens as it migrates upstream across the berm crest. The jumps multiply and enlarge (about half a meter high) as the channel also narrows and deepens rapidly in the beachface. Breaching is now rapidly progressing and accelerating.

3:59: The breach in the beachface is a whitewater chasm over a meter deep and two meters wide, but the berm crest adjacent to the bedrock outcrop (overtopping zone) is still shallow, wide, and discharging with laminar to turbulent flow.

4:08 p.m. The breach is over a meter deep at the beach crest, and the head-cut (rapid change in channel slope) is migrating past the bedrock outcrop's seaward edge.

4:12 p.m. The head-cut (rapid change in channel slope) is migrating past the bedrock outcrop's seaward edge, but the gentle landward slope (overwash fan) of the barrier beach is still acting as a flat-topped sill or spillway, prior to full breach threshold.

4:17 p.m. The outlet channel in the beachface is a cascading series of high jumps – giant ripples, breaking, roaring standing waves - each over a meter high, cresting above the level of the beach. The channel is over 4 meters wide, and the vertical banks are over a meter high.

4. Initial full breach stage

4:20 p.m. View of the narrow (less than about 2 m wide) outlet neck of the breach after the channel cuts across the entire beach profile. Deep lagoon water directly flows across the breach, without passing over a shallow sill. Lagoon begins full breach stage.

4:18-4:20 p.m. A breaking standing wave with a green (algal-hued) “curl” forms at the nick point when the head-cut crosses the barrier top profile, and flows cross the gradient between shallow and deep lagoon. Lagoon enters full breach stage.

4:19-4:26 p.m. Once the barrier crest spillway or sill is cut through, the discharge increases and the roaring jumps increase to more than about 1.5 m high. The channel widens seaward.

5. Full breach stage

4:30-4:31 p.m. The outlet channel widens and flattens as massive lagoon outflows lower the channel gradient across the breach from the lagoon to the surf zone. Jumps flatten out, and standing waves interact with wave bores from ocean swell. The narrowest neck of the breach rapidly widens to several meters.

4:36 p.m. Steep and relatively smooth water surface slides from the lagoon across the widened, deepened breach at the barrier crest. Floating debris crosses the breach and reaches the ocean in 5-6 seconds.

4:33 p.m. A huge jump forms at the toe of the channel where it scours deep below the adjacent beachface level. Note the swash pouring over the channel edge.

4:37 p.m. The lagoon outflow captures and slows breakers. The channel bank cuts (scarps) are over about 2 m above the water surface, and the channel is over about 10 m wide, and is continuing to widen slowly.

4:42 p.m. The breach continues to deepen and widen rapidly while the steep water slope surface between lagoon and channel smoothes over the deep channel breach, turbulent only around the banks of the breach.

6. Late breach and tidal inlet stage

5:30 p.m. The lagoon water level falls over 2 m, exposing extensive sand and gravel flats in the lower lagoon. Beach groundwater rapidly discharges as flowing seeps and springs above the lagoon surface.

5:37 p.m. As the lagoon grows shallower after an hour of high discharge during low tide, outflows across the lagoon grow turbulent again, but more chaotic and complex than the cascade of jumps and standing waves in early breach stages. The full size outlet channel has widened to about 30 m.

5:38-5-42 p.m. The beach scarp along the beach crest channel bank ranges about 3-4 m high. Slumping and widening has slowed as the tide rises and swell starts to enter the eroded channel, which begins to act as a tidal inlet.

5:56 p.m. Breaking swell starts to enter the new deep tidal inlet throat.

5:58 p.m. A juvenile harbor seal investigates the seaward end of the inlet before entering the lagoon on the rising tide.

11:06 a.m. Near-full lagoon submerges the mid-channel bar island to the edge of vegetation.

6:43 p.m. Mid-channel bar island gravel flats are emergent less than 2 hours after full breach.