Soil Piping under Seawall

It is the due diligence of the Supervisors to dig into issues that are presented to us. We should be questioning the answers we are given; especially when there are changes made between old and new reports. We need a full explanation of what forced the engineers to make the changes. We have heard how we should have oversight of the landscaping. It has been stated time and again since MB's beginning that what attracted most of us to MiraBay was the appearance as we drove into the community. Considering how satisfied and even proud we have been of MiraBay's common areas' appearance over the last 16 years, why would we suddenly want anyone (with questionable credentials) to tell us whether what we see every day is satisfactory or not.. Even if we accept that our landscaping needs independent oversight, why wouldn't we also want to carefully look into the details provided us for a project that will cost this community millions. Why is the due diligence and questioning not encouraged on an even tougher scale on the wall than landscaping?

Regardless of the slings and arrows directed at me, I still have a responsibility to ask the questions and make statements based on those facts presented to me while sitting on the Board as a supervisor. The facts I present are from reports from *all* the engineers involved, present and past.

It is instructive to be familiar with the details in documents from the engineers as well as from the present Board members in reports they have shared over time. There have been significant changes from the past to now.

For example, one major issue I brought up was the movement of our upland soils going under the wall. In recent CDD meetings, the engineers say that is not happening. However, in speaking at length with the former District Engineer, he told me he witnessed it first-hand. This raises the question again of whether soil migration contributes to the observed upland damage and its role in seawall failure over time.

First, let's look at the Project Engineers' presentation from March, 2016 which compares the relative advantages/disadvantages of the Rip/Rap Repair and the New Wall Repair.

Points below are taken directly from that report:

STRUCTURAL INTEGRITY—Both options are technically viable. However, the New Bulkhead would be structurally superior due to its thicker cross-section, higher stiffness, and deeper penetration of the FRP wall.

DURABILITY & LIFE SPAN—Both systems are durable. The New Bulkhead system would likely last longer since it is approximately 12 to 13 years younger.

SOIL MIGRATION—The New Bulkhead alternative is a sealed system (lean concrete on landside) that would prevent soil migration. We anticipate localized soil migration to occur with the Rip Rap alternative which could be minimized with a monitoring and maintenance plan.

SEAWALL SYSTEM MAINTENANCE—Rip Rap Alternative will require periodic monitoring and maintenance; while the New Bulkhead Alternative will require minimal to no maintenance.

MAINTENANCE DREDGING—Rip Rap Alternative could experience undermining at its toe from dredging activities. This impact could be minimized with an intensified monitoring and maintenance program during dredging activities. The New Bulkhead Alternative would not experience this issue due to its deeper penetration.

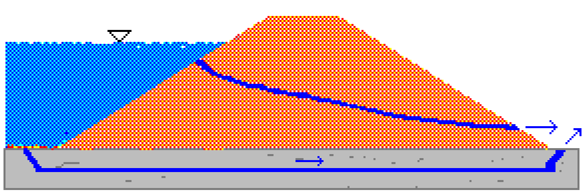
CONSTRUCTABIITY—Either alternative is readily constructible. Rip Rap Alternative is somewhat more manual labor intensive but less complex to construct.

The question I raise now is what has changed between the time of this report and now? Last year, soil migration was an issue and this year we are told that it won't happen. Was something about the old seawall discovered that we didn't know a year ago? Last year it was indicated that there would be substantial, or at least some, costs involved in monitoring and maintaining the Rip Rap Alternative. What has changed from last year to this and what are the estimates of those costs that have not yet been incorporated into the planning for the Rip Rap Alternative? Last year the engineers anticipated a longer life span for the New Wall as compared to the Rip Rap Alternative; but this year, they are rated as having the same life span; but described in rather vague terms. Last year undermining by dredging was highlighted, but with more monitoring and maintenance, it could be kept to a minimum, but this year that concern went away.

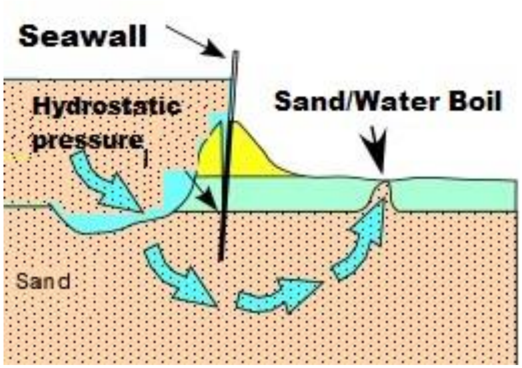
Coming back to the mysterious soil migration—a problem last year but gone this year—let's consider one possible cause. We know the soil has migrated somewhere since there have been so many holes needing filling. One phenomenon is known as piping and/or boiling. So how did the former Engineer see this in our canal? Well the canals were dry while they built out these walls. During the build out, Tampa went through some very wet years and the water buildup behind the walls was so great and the hydrostatic pressure built up so much that piping and boiling occurred. I asked what steps were taken to fix the design to correct this, I was told *none that he knew of*. Why do I go back to this? Recently a resident let me know that their upland holes were filled in with a lot of sand. Those holes are now back and deeper than before. The engineers say it is going into the bend, yet the last few measurements show almost no movement of the cap suggesting no further bowing of the wall. The question becomes where is it going?

Do a simple google search on "soil piping under a seawall" and you will see many examples. I am including a couple of pictures here from an article describing both so you can see what "boiling" looks like and what "piping" looks like.

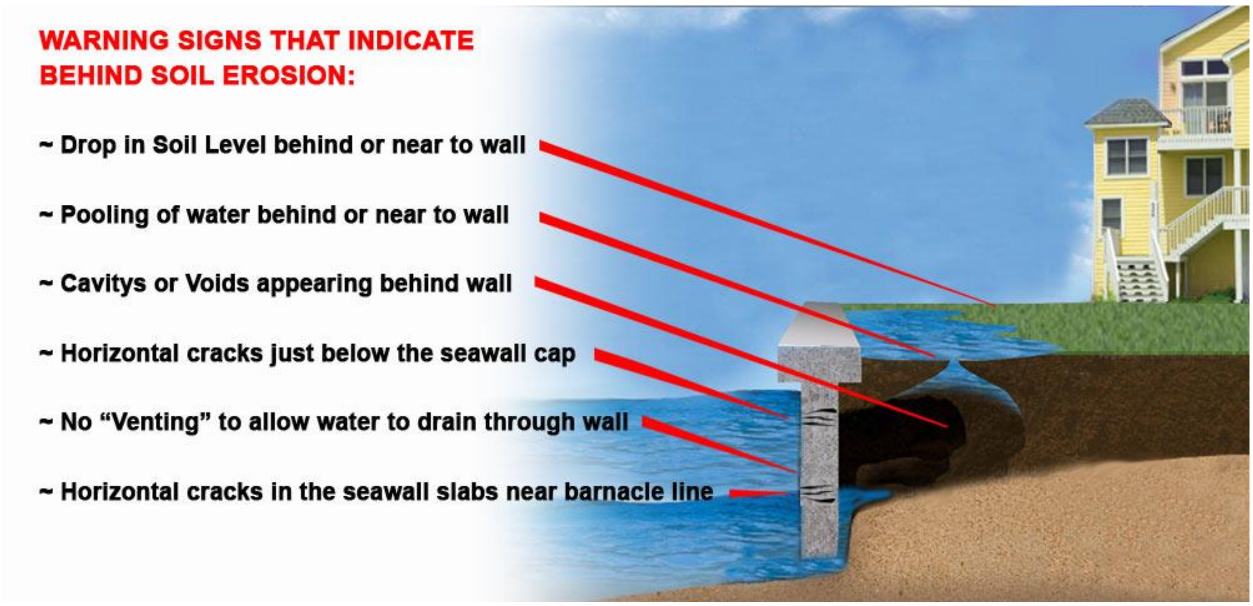
What piping look like. This can apply to any type of dam.

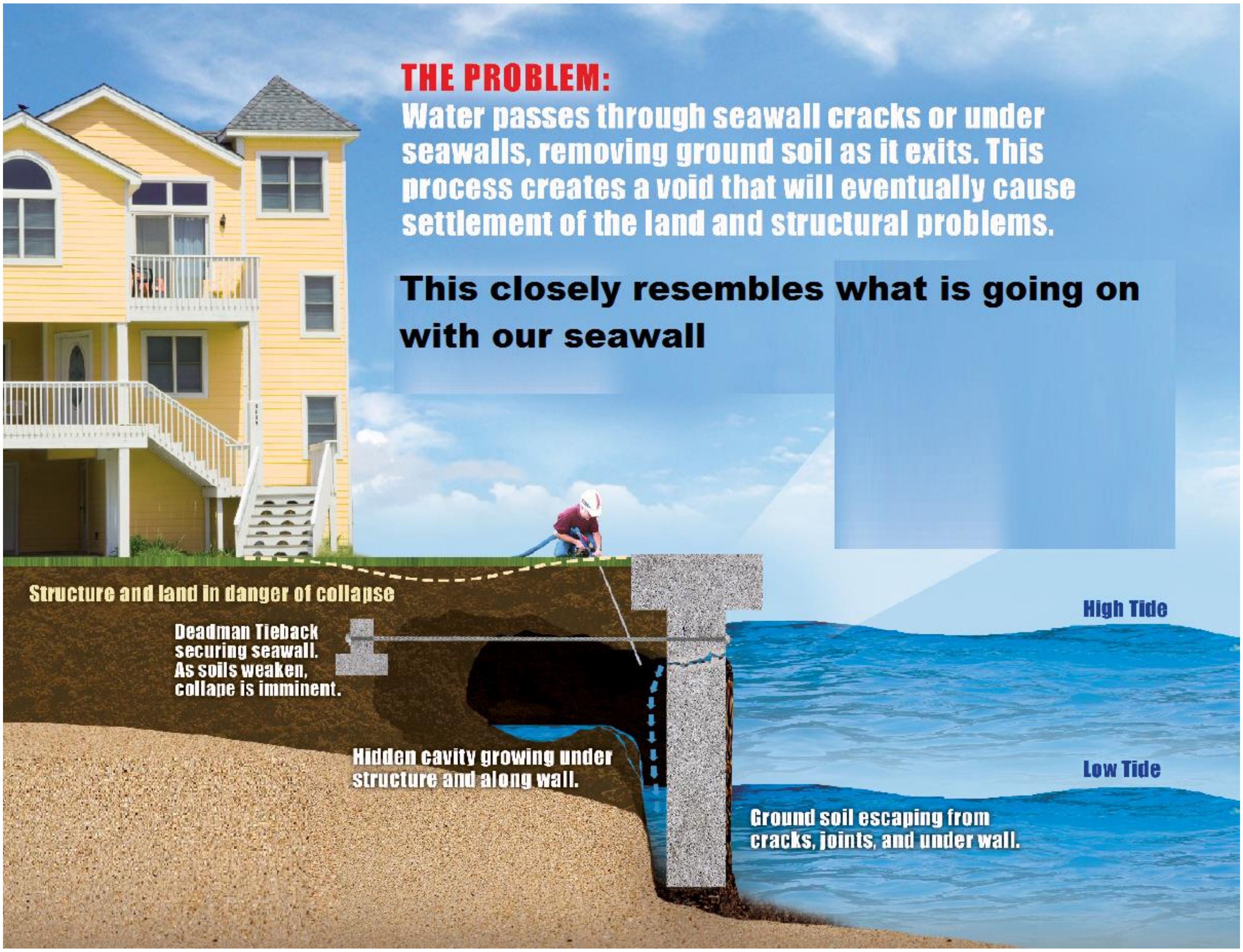


Boiling as observed by the Engineer prior to the canals being flooded



Soil erosion, (What is happening to our walls)





I am merely reporting what I have been told and read, you decide!!!

However as a Supervisor I feel it is my responsibility to let the entire community know these issues are real and must be looked at else it will cost us a heck of a lot more money in the future if we do not do this correctly. Based on this issue, and many others, and considering we know from the litigation that the walls were indeed short sheeted, I am suggesting rip-rap might be the wrong solution as it does not address the piping issue at all. I believe we need to know more about the possibility of these soil leaks. Doing so might save us money in the long run, not some short-term, short-sighted fix to allow a quick exit. Whether Newland is among those remains to be seen.

I have included a couple definitions here for you as well.

Seepage forces and erosion

When the seepage velocity is great enough, erosion can occur because of the frictional drag exerted on the soil particles. Vertically upwards seepage is a source of danger on the downstream side of sheet piling and beneath the toe of a dam or levee. Erosion of the soil, known as "soil piping", can lead to failure of the structure and to sinkhole formation. Seeping water removes soil, starting from the exit point of the seepage, and erosion advances upgradient. The term "sand boil" is used to describe the appearance of the discharging end of an active soil pipe. These are usually hidden from view and the obvious indication of their presence is the formation of holes behind the dam or seawall.

Seepage pressures

Seepage in an upward direction reduces the effective stress within the soil. When the water pressure at a point in the soil is equal to the total vertical stress at that point, the effective stress is zero and the soil has no frictional resistance to deformation. For a surface layer, the vertical effective stress becomes zero within the layer when the upward hydraulic gradient is equal to the critical gradient. At zero effective stress soil has very little strength and layers of relatively impermeable soil may heave up due to the underlying water pressures. The loss in strength due to upward seepage is a common contributor to levee failures. The condition of zero effective stress associated with upward seepage is also called liquefaction, quicksand, or a boiling condition.

Soil liquefaction

If the pressure of the water in the pores is great enough to carry all the load, it will have the effect of holding the particles apart and of producing a condition that is practically equivalent to that of quicksand… the initial movement of some part of the material might result in accumulating pressure, first on one point, and then on another, successively, as the early points of concentration were liquefied.

The phenomenon is most often observed in saturated, loose (low density or uncompacted), sandy soils. This is because a loose sand has a tendency to compress when a load is applied; dense sands by contrast tend to expand in volume or 'dilate'. If the soil is saturated by water, a condition that often exists when the soil is below the ground water table or sea level, then water fills the gaps between soil grains ('pore spaces'). In response to the soil compressing, this water increases in pressure and attempts to flow out from the soil to zones of low pressure (usually upward towards the ground surface). However, if the loading is rapidly applied and large enough, or is repeated many times (e.g. storm wave loading or driving a sheet pile into the substrate) such that it does not flow out in time before the next cycle of load is applied, the water pressures may build to an extent where they exceed the contact stresses between the grains of soil that keep them in contact with each other. These contacts between grains are the means by which the weight from buildings and overlying soil layers are transferred from the ground surface to layers of soil or rock at greater depths. This loss of soil structure causes it to lose all of its strength (the ability to transfer shear stress) and it may be observed to flow like a liquid (hence 'liquefaction').

Internal erosion

Internal erosion of soil particles from within a dam by water that seeps through the dam is one of the most common causes of failure of levees and earth dams. [1]

Internal erosion is especially dangerous because there may be no external evidence, or only subtle evidence, that it is taking place. Usually a sand boil can be found, but the boil might be hidden under water.