Dangerous Aspects of Reclamation Along Manila Bay and Laguna de Bay

NAST Policy Discussion on the Hazards, Risks and Profits of Reclamation

Hotel Jen Manila, Roxas Blvd., Pasay City
15 February 2016

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Four reasons why reclamation of nearshore Manila Bay and Laguna de Bay is a VERY BAD IDEA:

1. Rapid subsidence of coastal lands is enhancing the risk of flooding and high tides.
2. Storm surges are an ever-worsening threat, due in part to subsidence, but also because climate change is increasing the frequency of the strongest typhoons.
3. Reclaimed coastal areas are very susceptible to liquefaction and enhanced ground-shaking during earthquakes.
4. These risks are enhanced by DPWH's and JICA's ignoring or minimizing the phenomena in their projects.

Our most susceptible area is the site of the Laguna Lake Expressway-Dike and proposed airport.

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Business Insigh

Most read, best source!

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Gov't drops airport plan at Manila Bay

BULACAN
METRO MANILA
RIZAL
Manila Bay
TAGUIG
CHOICE 1
SANGLEY POINT
WEST LAGUNA LAKE OFF SHORE SITE
CHOICE 2
Laguna de Bay
CAVITE
LAGUNA

SANGLEY POINT

WEST LAGUNA LAKE

BY MYLA IGLESIAS

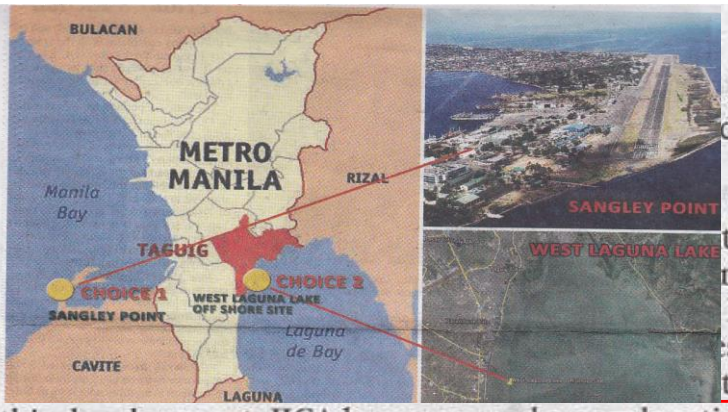
THE government has scrapped the proposal to build a new international airport at Central Manila Bay since it will disrupt shipping flow at the bay.

Joseph Emilio Abaya, transport secretary said the $13 billion airport plan was opposed by the Philippine Ports Authority.

Out of five locations proposed by the Japan International Cooperation Agency (JICA), two viable locations –Central Manila Bay and Sangley Point in Cavite – were identified and presented to the National Economic and Development Authority last year.

With this development, JICA has proposed a new location, the West Laguna Lake site, together with Sangley Point.

"JICA said let's scrap this (Central Manila Bay). Now let's use the Sangley and the Laguna Lake – those are the two locations," Abaya said.



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to the … t year.

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JICA will conduct a feasibility study to give an in-depth view which of the two locations is the ideal site for the new airport. The study is targeted to be completed next month or by April.

Abaya said the first phase of the feasibility study will delve more on the technical details and would thus determine the best location for the new airport. JICA then moves to phase two of the study which will cover further details like the cost and design.

Abaya said JICA is waiting for the government's go signal to proceed on the full feasibility study.

"So we'll wait for their (JICA) final report then we'll give them the letter (to proceed to full feasibility study)," he told reporters.

Lutong Macao! It is taken for granted that both locations are feasible; the only question is which is best.

In fact, both are very dangerous and unsuitable.

This is a prime example of how JICA, DPWH, JBIC and other foreign lnders make suckers out of the Filipino taxpayers, and endanger them at the same time.

I have a list of expensive and lethal examples.

How the scam works

1. A private or public proponent (or both together) propose an expensive project.
2. DPWH arranges for JICA to conduct a feasibility study FOR FREE.
3. JICA confirms that the project is feasible and suggests a budget.
4. DPWH approaches NEDA, requesting approval.
5. NEDA approaches JBIC, which offers a loan with attractively low interest rates.

Conditions of the loan:

Japanese consultants

Japanese-Filipino contractor consortia

Buy materials, instruments and equipment from Japan

Project success: Japan profits; Pinoy taxpayer foots the bill.
Project fails: Japan still profits; Pinoys pay with taxes and lives.

One of the worst aspects of this practice is it ignores the good science generated by Filipinos, and Filipino scientists themselves, in preference to foreign consultants.

A prime example is how the Laguna Lake Expressway-Dike and Laguna Lake proposals were generated.

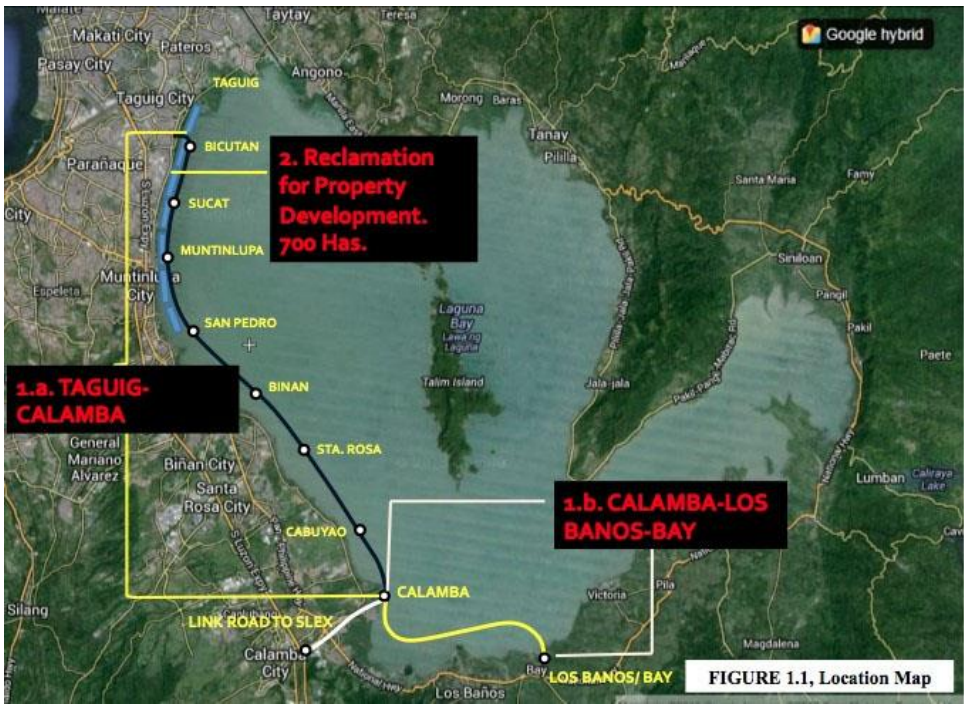
Objections to the Laguna Lake Dike Expressway

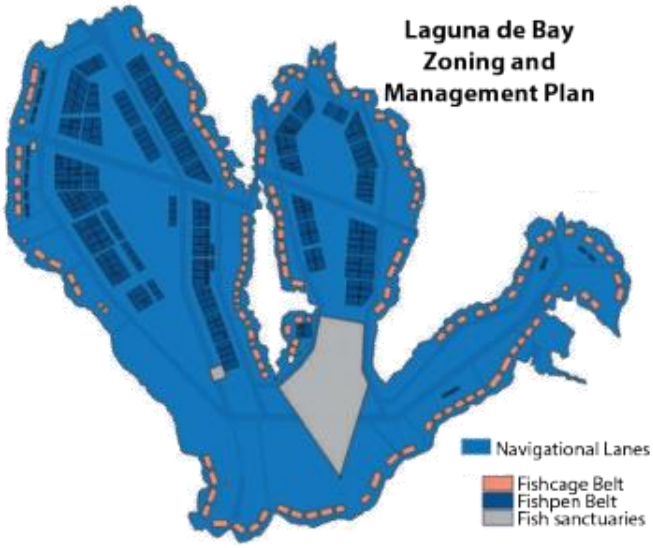
A. If the project is constructed and protects Metro Manila from lake-water floods, people living elsewhere along the lake will suffer, simply because the flood water will have to go *somewhere*.

B. Reclamation would reduce the size of the lake, so storms would make higher floods than before.

C. People would be forced to leave their homes and livelihood to make room for the expressway-dike and reclamation.

D. Failure of the expressway-dam would be catastrophic.





2010 Fisheries Data

Fisheries Production:
140, 426 metric tons
(17% National Production)

Aquaculture:
57,805 metric tons
(10% National Production)

Municipal Fisheries:
82, 621 metric tons
(44% National Production)

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Tectonophysics 415 (2006) 17–38

TECTONOPHYSICS

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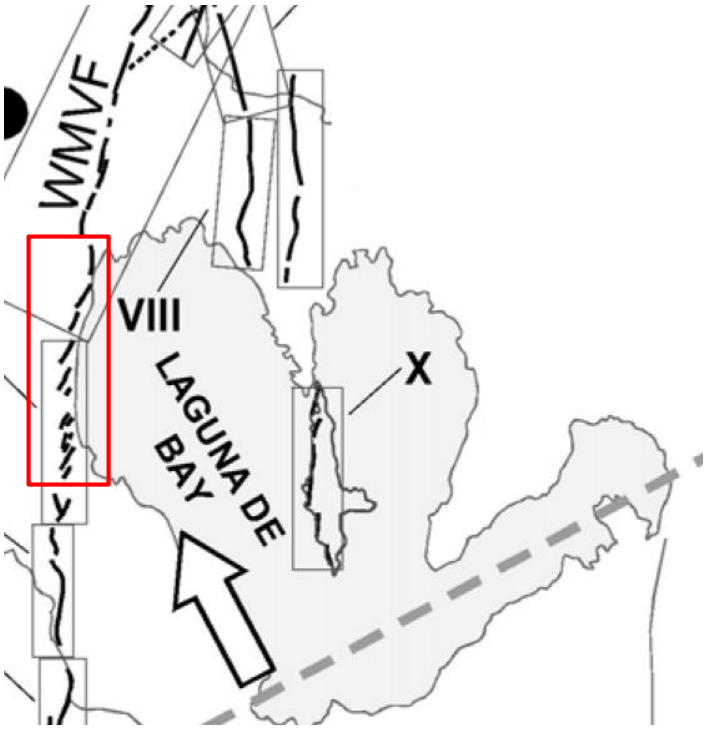
Neotectonics of the Marikina Valley fault system (MVFS) and tectonic framework of structures in northern and central Luzon, Philippines

Rolly E. Rimando [a,*], Peter L.K. Knuepfer [b,1]

[a] *Philippine Institute of Volcanology and Seismology, PHIVOLCS Bldg., C.P. Garcia Ave., U.P. Campus, Diliman, Quezon City, Philippines*
[b] *Department of Geological Sciences and Environmental Studies, State University of New York, P.O. Box 6000, Binghamton, NY 13902-6000, Science 1, 161, United States*

Received 10 February 2004; accepted 23 November 2005
Available online 30 January 2006



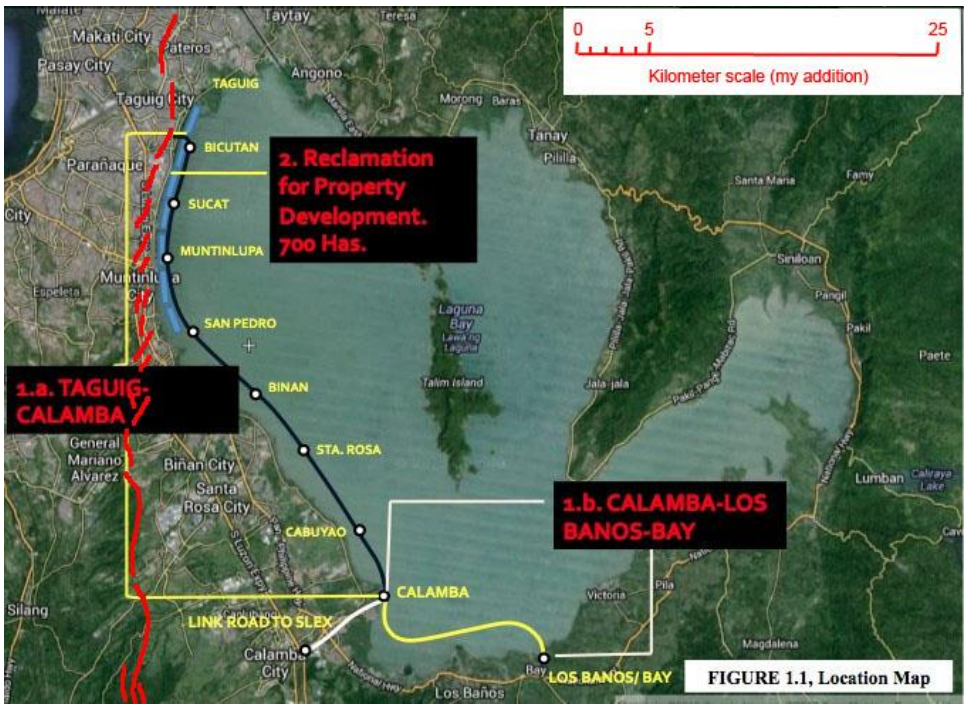
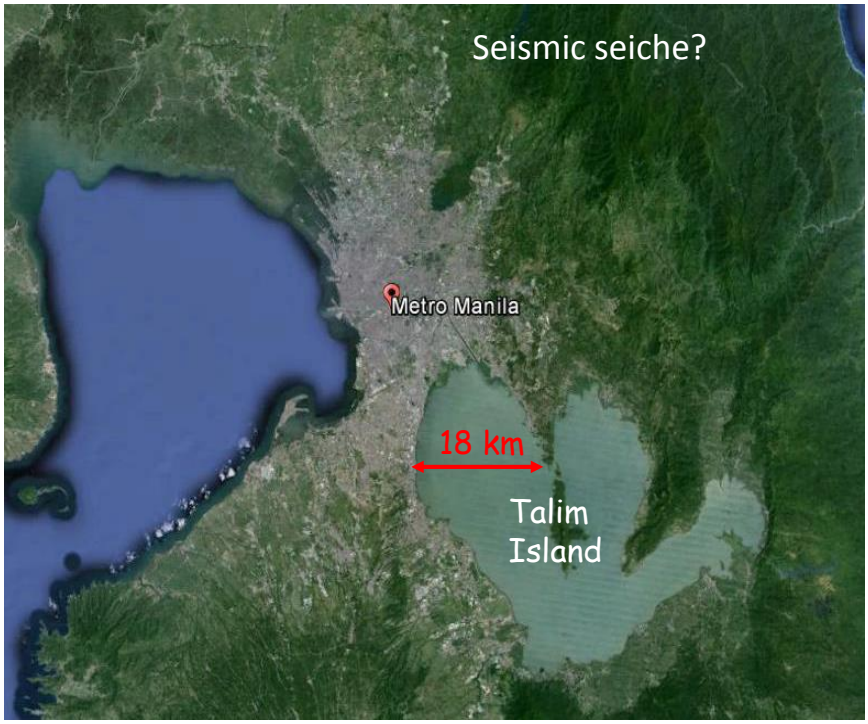
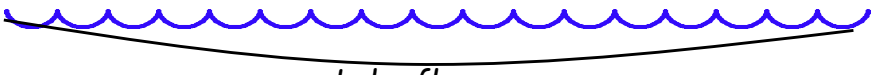


FIGURE 1.1, Location Map



Seismic seiches



$$T = \frac{2L}{\sqrt{gh}}$$

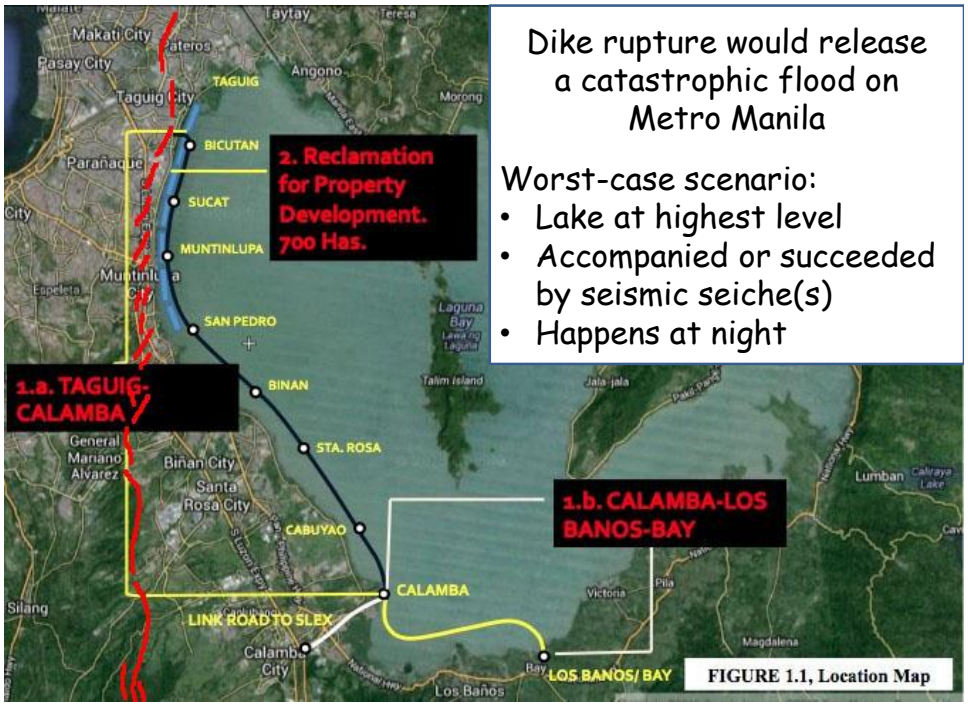
T = seiche period (seconds)
L = West shore to Binangonan = 18 km = 18,000 meters
g = gravitational acceleration = 9.8 msec^2
h = average depth = 2.5 meters

T = 36,000m/~5 = ~2 hours

See also: DOST-PHIVOLCS warns Muntinlupa of quake or eruption-induced hazard called "seiche".
http://nstw.dost.gov.ph/?p=610

Villa Teresita, Talisay City, Cebu
15 Oct 2013 Bohol Earthquake 40 km away, felt as Intensity VI in Talisay.

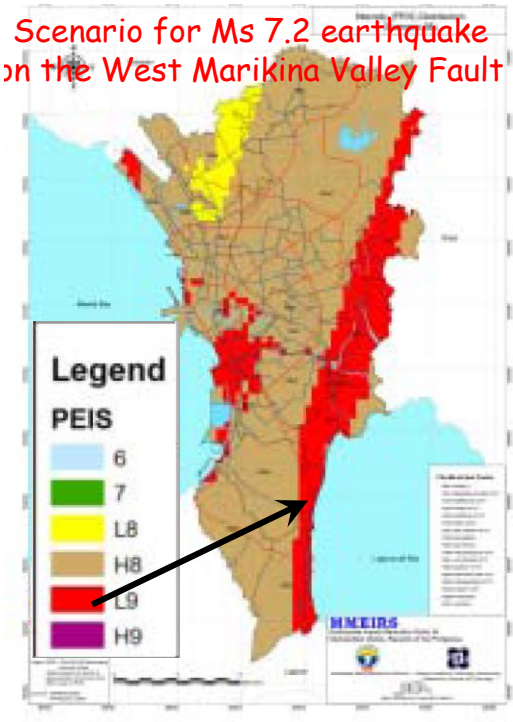
Wave period is 5 seconds, set by the pool width and depth.



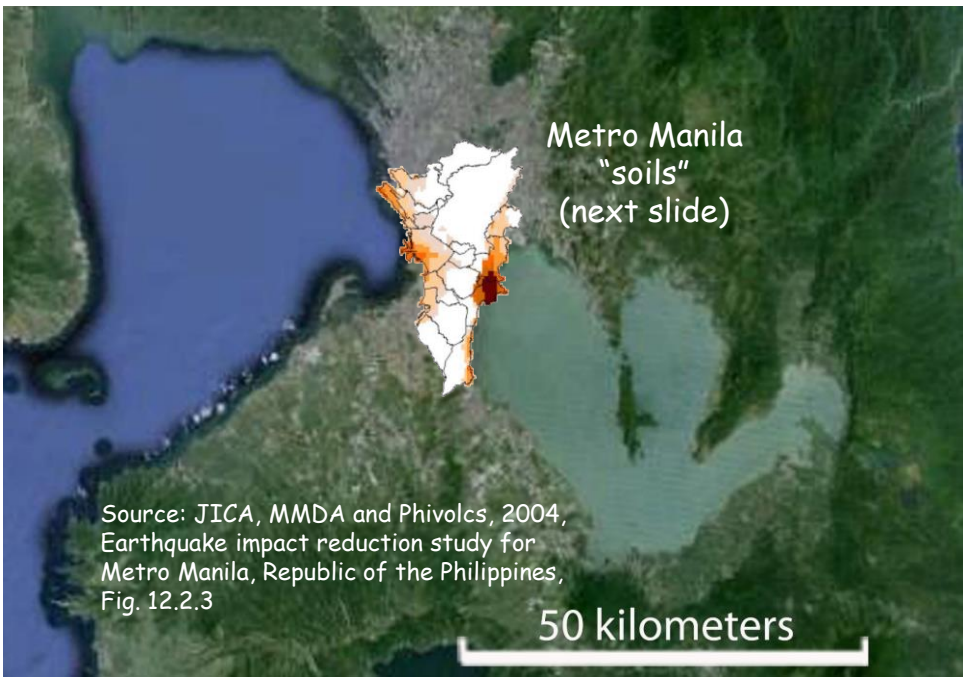
Dike rupture would release a catastrophic flood on Metro Manila

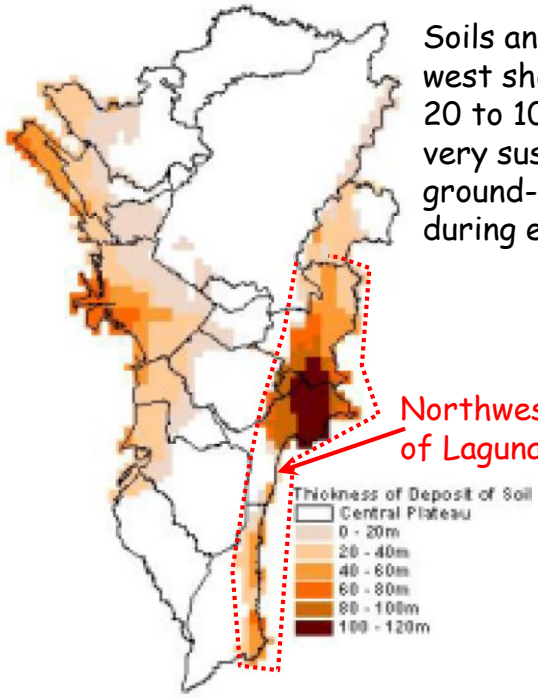
Worst-case scenario:

- Lake at highest level
- Accompanied or succeeded by seismic seiche(s)
- Happens at night

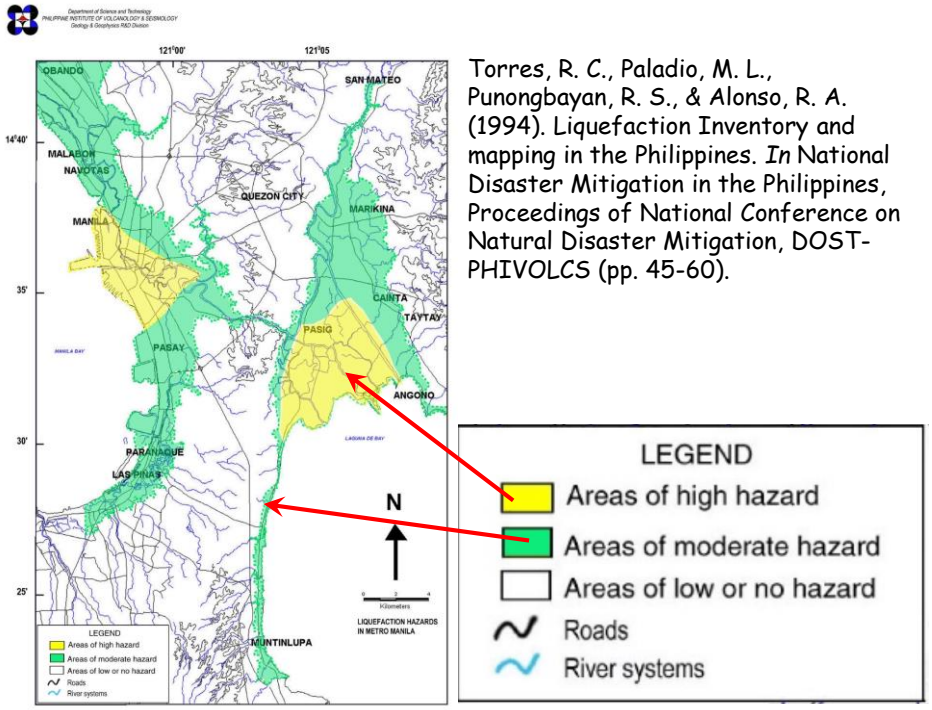


Intensity 9 on the Phivolcs Earthquake Intensity Scale: "Devastating - People are forcibly thrown to ground… Most buildings are totally damaged. Bridges and elevated concrete structures are toppled or destroyed…. Water sewer pipes are bent, twisted or broken. Landslides and liquefaction …are widespread. The ground is distorted into undulations… Boulders are commonly thrown out. River water splashes violently or slops over dikes and banks."



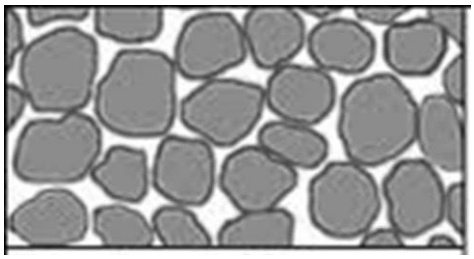


Soils and sediments along the west shore of Laguna de Bay are 20 to 100+ meters thick and thus very susceptible to enhanced ground-shaking and liquefaction during earthquakes.

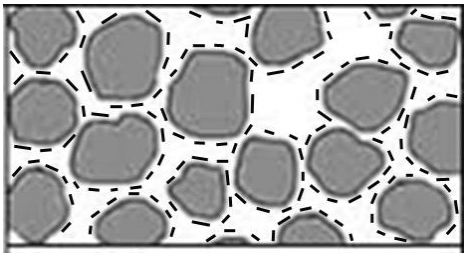


Torres, R. C., Paladio, M. L., Punongbayan, R. S., & Alonso, R. A. (1994). Liquefaction Inventory and mapping in the Philippines. *In* National Disaster Mitigation in the Philippines, Proceedings of National Conference on Natural Disaster Mitigation, DOST-PHIVOLCS (pp. 45-60).

Liquefaction during earthquakes



In water-saturated material such as natural bay fill or reclamation materials, the solid grains normally are touching. The lower grains bear the weight of grains and buildings on top of them.



But during the minute that an earthquake lasts, the shaking breaks the contact between grains. Together, the solids and water behave as a "slurry", or liquid without strength. Buildings sink or topple into it.

Liquefaction during the Fukushima earthquake

Japan Earth Moving – Liquefaction http://www.youtube.com/watch?v=j0sLyJpfTE8

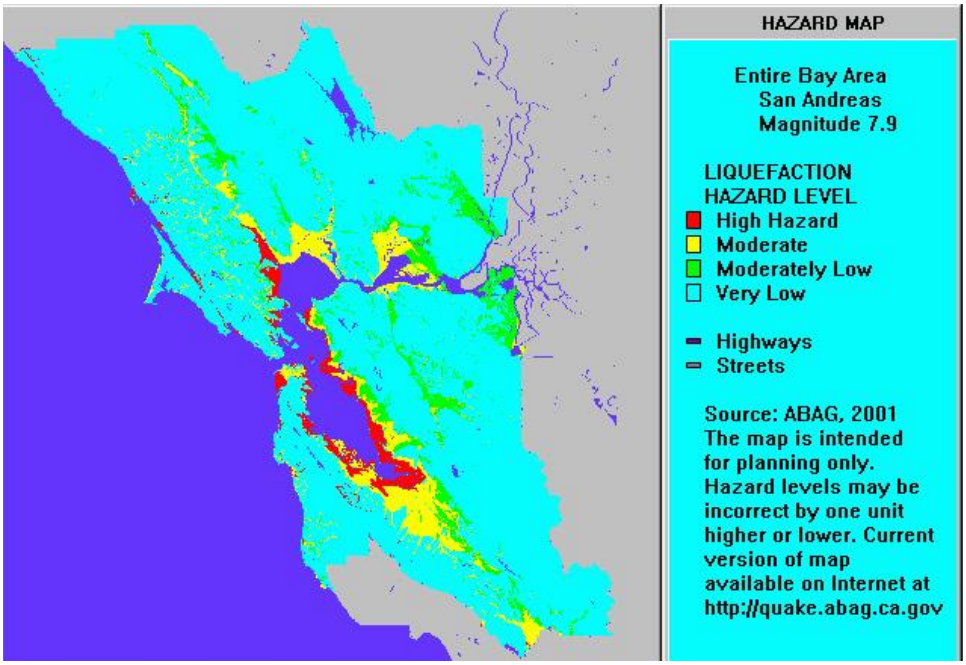
"Sand boils"

Liquified sand comes up to the surface during the earthquake

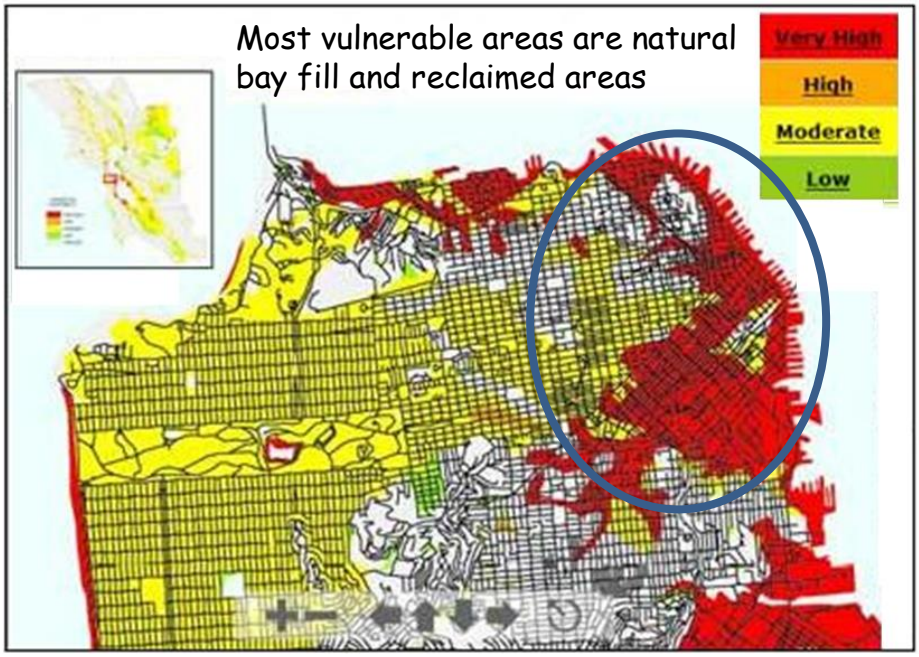
Coastal areas underlain by natural sediment and artificial reclamation fill are particularly susceptible to liquefaction during earthquakes.

This is true for California's Bay area as well as Manila Bay.

Earthquake hazard map, Bay Area, California



Northeastern San Francisco California



Liquefaction in the Marine District in San Francisco, Calif., caused damage during the October 1989 Loma Prieta earthquake.

Dagupan, Pangasinan 1990

Let's stop playing games!

CHOICE 1: We take the earthquake threat seriously, prepare for it with disaster preparation such as earthquake drills in all schools, and ***not*** worsen the potential disaster by building the Laguna Lake Expressway-Dike and Manila Bay reclamations.

CHOICE 2: Let's all pretend that the earthquake will never happen, and build reclamation projects in the lake and Manila Bay.

WE CANNOT RATIONALLY DO BOTH

Regarding the Sangley Airport: We need to recognize that Japan is capable of making massive engineering mistakes.

REGARDING JICA-DPWH-JBIC projects
Serious point to consider #1
Being foreign does not make consultants infallible.

Kansai Airport in Osaka Bay opened in 1994. Cost: US$ 15 billion; 40% over budget because it unexpectedly sank 11.5 meters (37 ft 8") since construction began in 1987. Sank 17 cm in 2002. Repair costs include $2.21 billion for a concrete wall to stop seawater seepage into basement rooms.

Caviteños must acquaint themselves with Kansai International Airport in Osaka Bay, Japan. Start here:
http://en.wikipedia.org/wiki/Kansai_International_Airport

Taken from the section on Construction:

"As of 2008, the total cost of Kansai Airport was $20 billion including land reclamation, two runways, terminals and facilities. Most additional costs were initially due to the island sinking, expected due to the soft soils of Osaka Bay. After construction the rate of sinking was considered so severe that the airport was widely criticized as a geotechnical engineering disaster. The sink rate fell from 50 cm (20 in) during 1994 to 7 cm (2.8 in) in 2008.*"

*Kansai International Land Company Ltd. website:
http://www.kiac.co.jp/en/tech/sink/sink3/index.html

An airport built by piling dredged sand and Pampanga lahar deposits would be especially susceptible to liquefaction.

Two other serious problems that confront reclamation are:

A. land subsidence, which increasingly enhances flooding and the impact of…

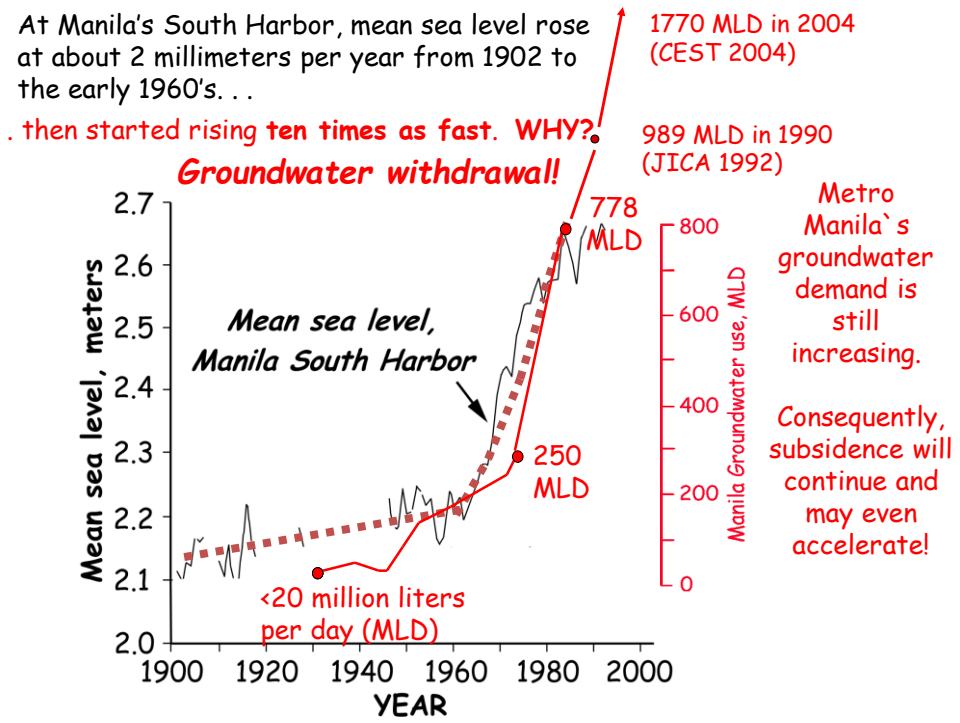
B. Storm surges and waves.

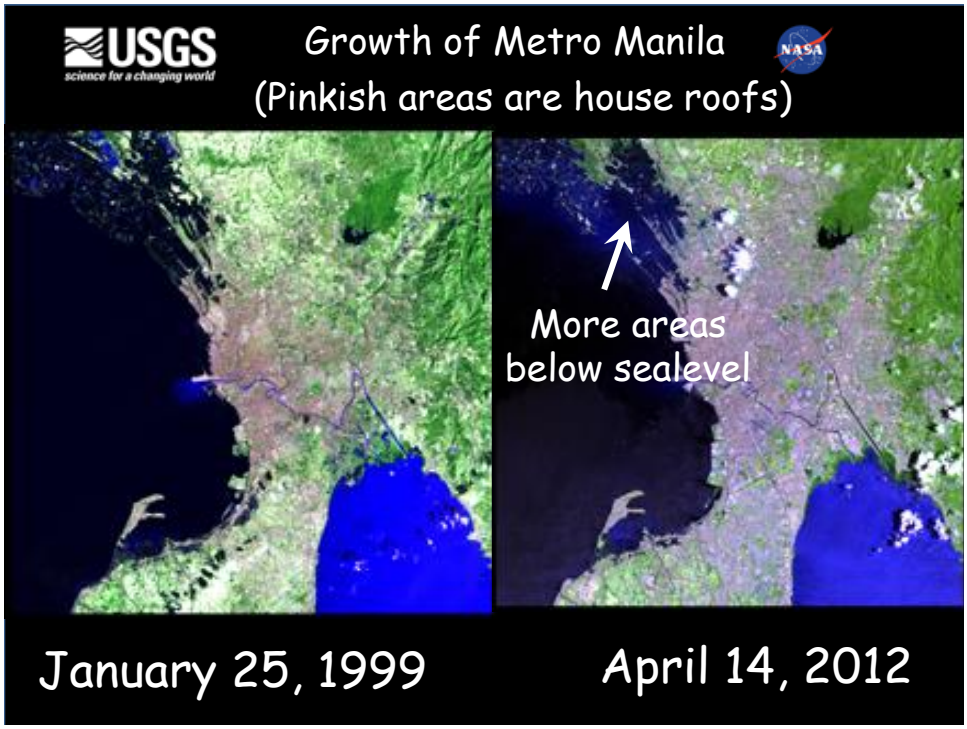
Land subsidence

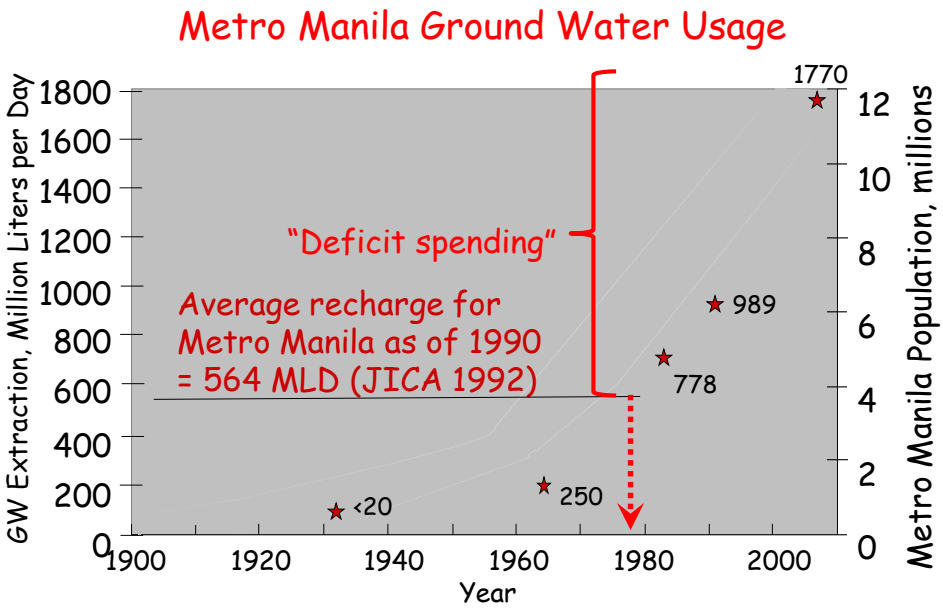
Global warming is giving the Philippines the fastest sea level rise in the world, about 1 centimeters per year.

This is serious: 1 cm in 10 years = $\frac{1}{2}$ meter in 50 years.

But this problem is SMALL compared to what we are doing to our environment by using too much groundwater.







As population increases, groundwater use increases !!!

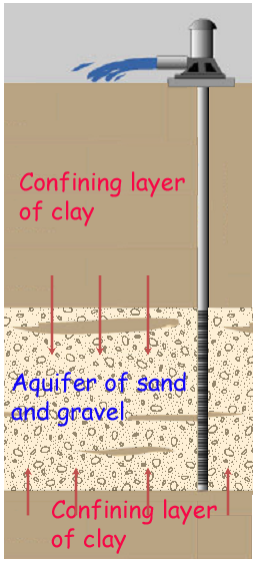
How groundwater withdrawal causes land to subside

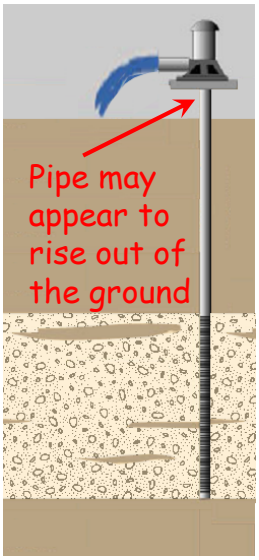
Pumps extract water from "aquifers" – layers of sand and gravel soaked with water.

Pumping water too rapidly out of the aquifer reduces the pressure pore spaces between grains of sand and gravel.

Water in the clay layers is sucked into the aquifer.

This causes the clay layers to shrink . . .

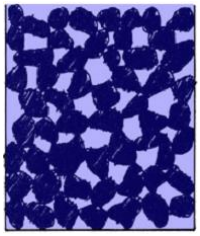




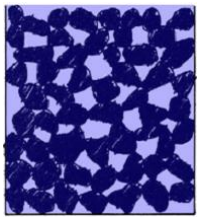
. . . and the ground surface to sink.

Subsidence from water withdrawal

Loosely packed sand



When water is removed, grains crowd together a little more closely.



Volume is somewhat reduced, so land sinks a little.

But sand cannot compact very much.

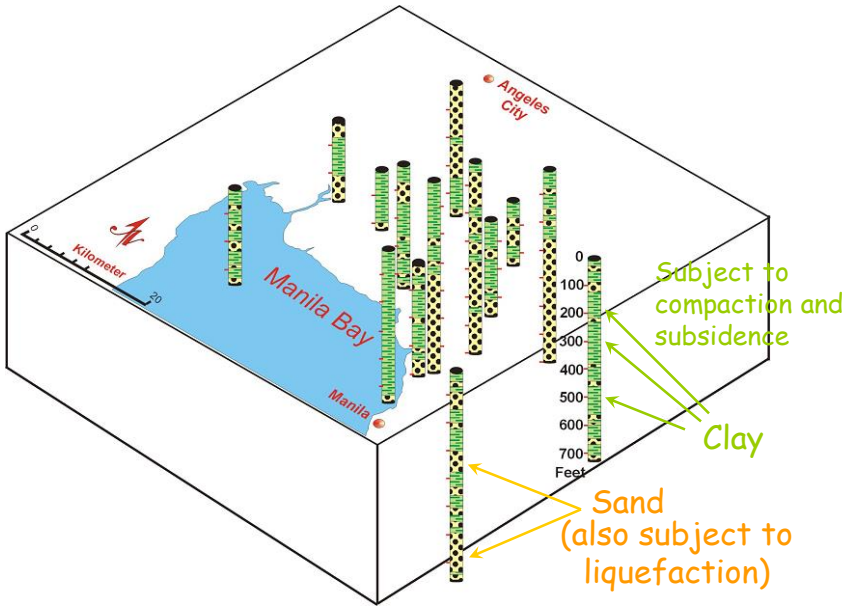
Clay deposits contains **much more** water . . .

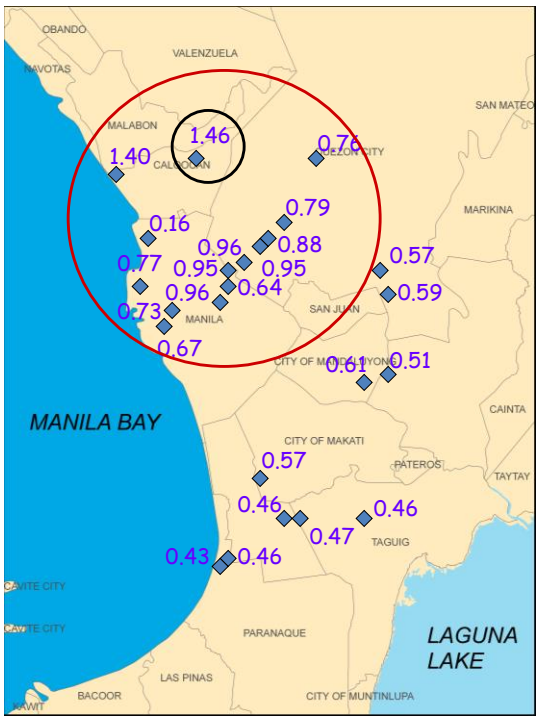
and can shrink **much more**.

. Clay shrinkage, and associated subsidence, are PERMANENT

Our delta sediments are very clayey!

Delta sediments encountered in wells around northern Manila Bay



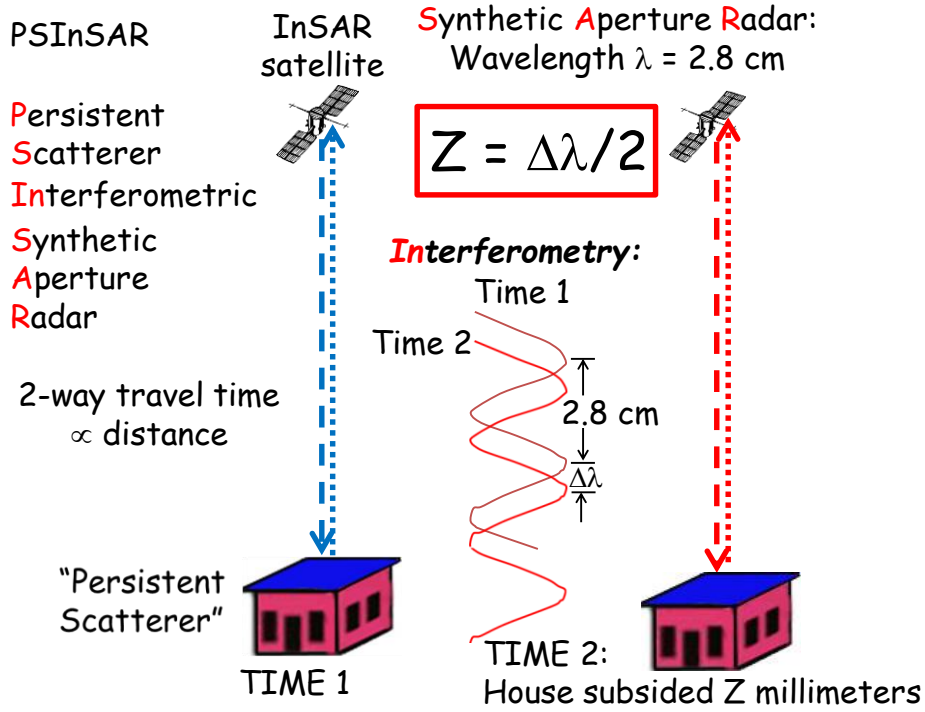


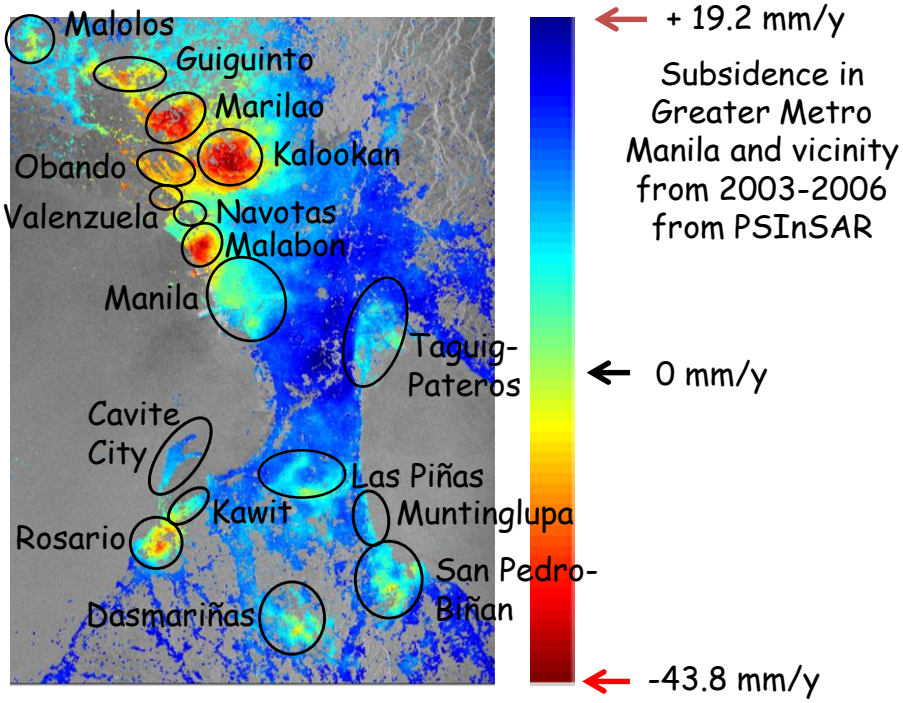
Benchmarks used for re-leveling (1978 vs 2000) survey (Jacob 2004)

Maximum magnitude of subsidence – 1.46 meters or 6.4 centimeters/year (about 2½ inches/year) .

DPWH either minimizes or ignores the subsidence problem, and even its own data.

More recently, Mahar Lagmay's group at UPD-NIGS has measured subsidence using satellite-borne Persistent Scatterer Interferometric Synthetic Aperture Radar.


PSInSAR
Persistent
Scatterer
Interferometric
Synthetic
Aperture
Radar
2-way travel time
∝ distance
InSAR
satellite
Synthetic Aperture Radar:
Wavelength λ = 2.8 cm
Z = Δλ/2
Interferometry:
Time 1
Time 2
2.8 cm
Δλ
"Persistent
Scatterer"
TIME 1
TIME 2:
House subsided Z millimeters


Malolos
Guiguinto
Marilao
Obando
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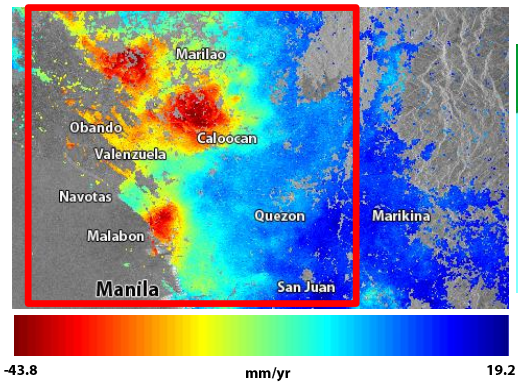
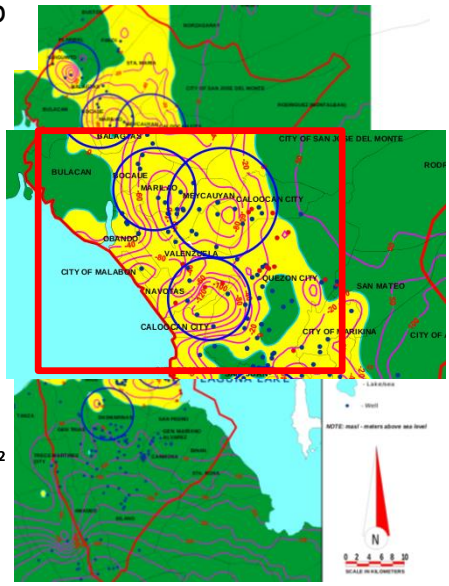
Valenzuela
Navotas
Malabon
Manila
Taguig-
Pateros
Cavite
City
Las Piñas
Kawit
Muntinglupa
Rosario
San Pedro-
Biñan
Dasmariñas
+ 19.2 mm/y
Subsidence in
Greater Metro
Manila and vicinity
from 2003-2006
from PSInSAR
0 mm/y
-43.8 mm/y

Major cones of depression due to over-extraction of groundwater.





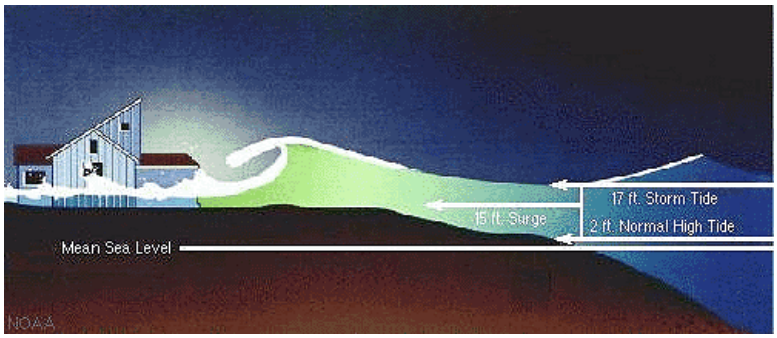
Because Manila Bay coastal plains slope very gently, even a small rise in sea level or land subsidence is very important.

So a one-meter rise in sea level or subsidence makes the sea advance ten or twenty kilometers inland.

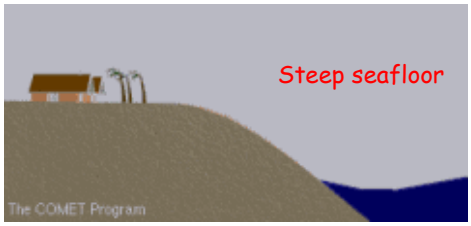
Lowering of coasts (land subsidence) makes them increasingly vulnerable to the attack of storm surges and waves.

Storm surge and waves

Storm surge



Storm surges are most dangerous if the seafloor slopes gently, as in Manila Bay.



2. Storm surge

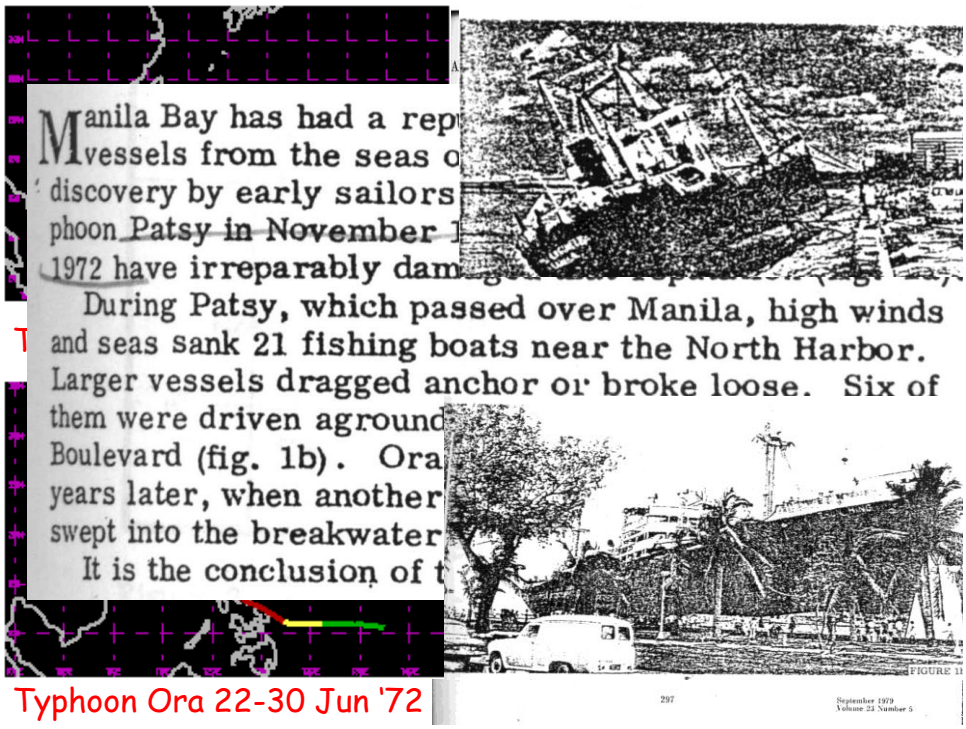
23 September 2011: Super Typhoon Pedring
Roxas Boulevard, Manila

What we see in the two videos is NOT storm surge, but storm waves riding atop the surge

The 23 September 2011 Super Typhoon Pedring storm surge took 36 hours to occur.

The following animation explains the point.

hurricane_stormsurge.swf



Manila Bay has had a rep
vessels from the seas o
discovery by early sailors
phoon Patsy in November
1972 have irreparably dam

During Patsy, which passed over Manila, high winds and seas sank 21 fishing boats near the North Harbor. Larger vessels dragged anchor or broke loose. Six of them were driven aground
Boulevard (fig. 1b). Ora
years later, when another
swept into the breakwater
It is the conclusion of t

FIGURE 1

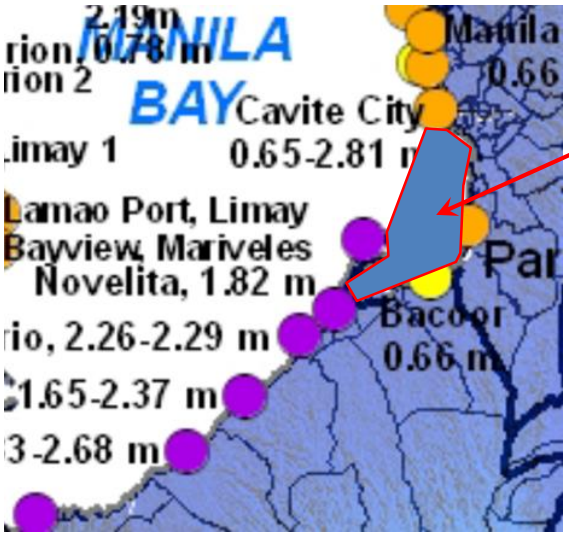
297

September 1979
Volume 23 Number 5

Typhoon Ora 22-30 Jun '72


Tacloban November 7 2013


Lighthouse, Subic
Lighthouse Subic
Pasay City
Parañaque City
Port, Limay
Bacoor
0.66 m
Ternate, 1.75-2.13 m
Cavite

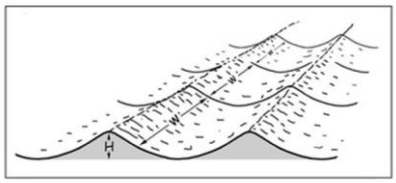


Ocean front of this reclamation would experience storm surges as high as 4 meters (13+ feet) – increasing as climate change increases the strength of typhoons.

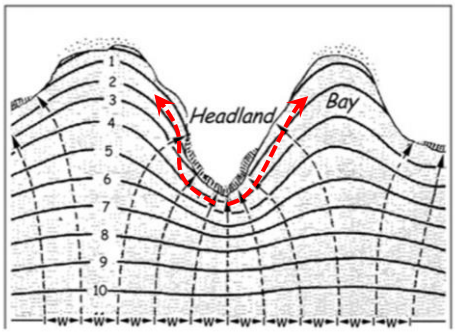
Large storm waves would ride <u>on top</u> of these surges.

Sticking an erection into the Bay: very ill-advised

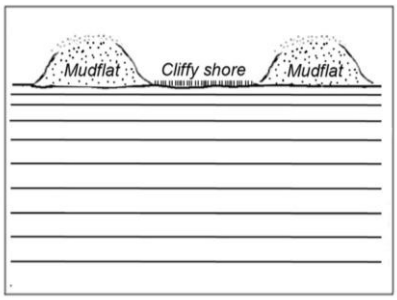
A: *Nature's Power: Water Waves*



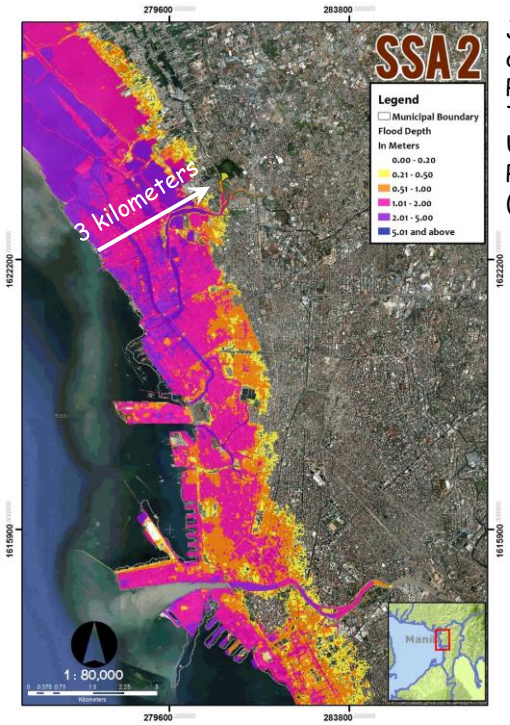
B: *Nature's Tools: Wave Refraction*



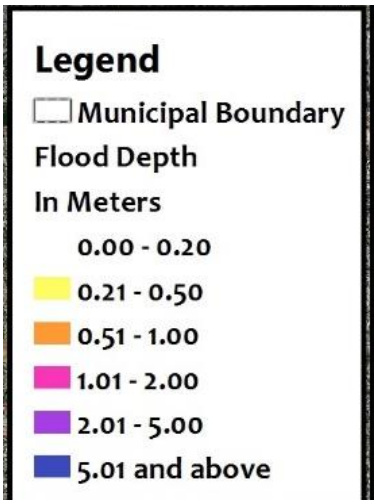
C: *Nature's Goal: Straight Shoreline*



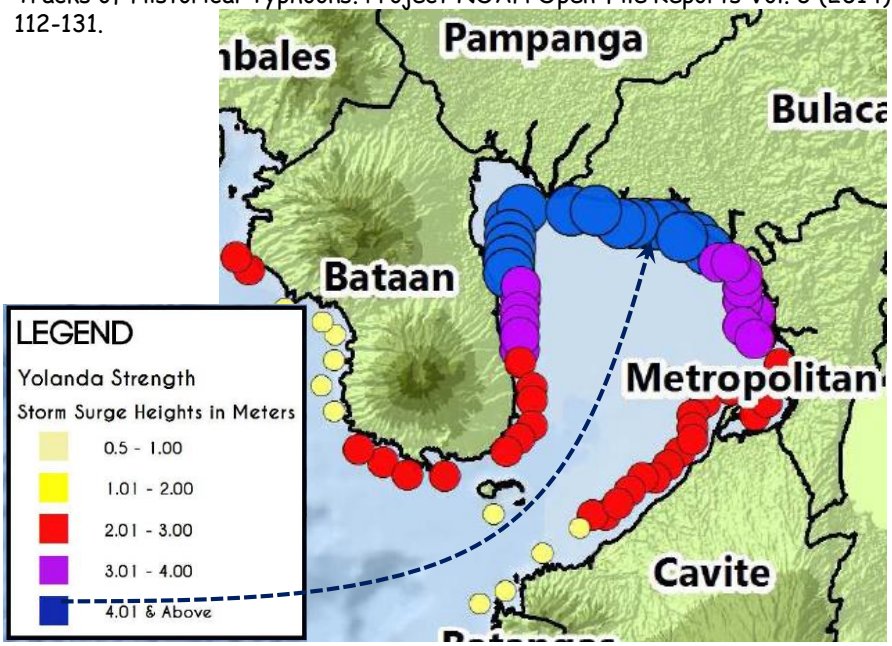
Manila Goldcoast Reclamation Project



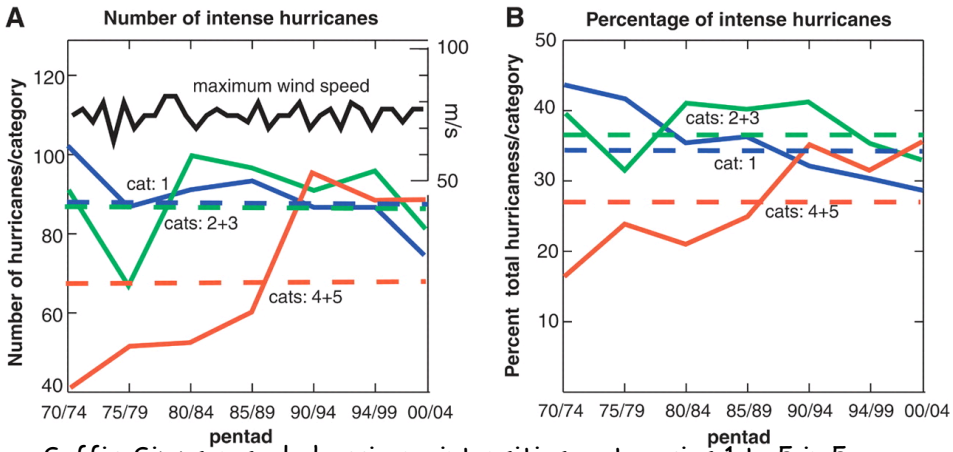
J.P Lapidez et al., 2014, Identification of Storm Surge Vulnerable Areas in the Philippines through Simulations of Typhoon Haiyan-Induced Storm Surge Using Tracks of Historical Typhoons. Project NOAH Open-File Reports Vol. 3 (2014), pp. 112-131.



J.P Lapidez et al., 2014, Identification of Storm Surge Vulnerable Areas in the Philippines through Simulations of Typhoon Haiyan-Induced Storm Surge Using Tracks of Historical Typhoons. Project NOAH Open-File Reports Vol. 3 (2014), p. 112-131.



Only <u>stronger</u> storms are increasing in frequency



Saffir-Simpson scale hurricane intensities, categories 1 to 5 in 5-year periods. **A:** Numbers of storms in each category. Bold curve: maximum hurricane wind speed observed globally, meters per second. Dashed lines: 1970–2004 average numbers in each category. (**B**) Total number of hurricanes in each category class. Dashed lines: average percentages in each category over the 1970–2004 period.
sciencemag.org/content/vol309/issue5742/images/large/309_1844_F4.jpeg

History of ignoring science while building projects that fail

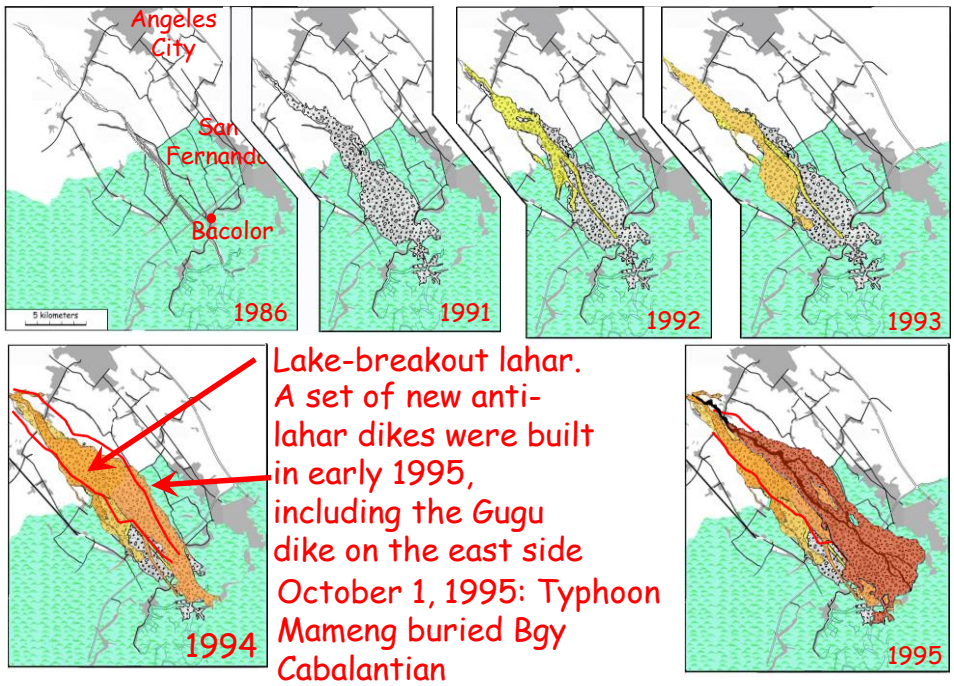
1980s: Flimsy lahar dikes built at Mayon Volcano despite my scientific objections. Dike building continued until Super Typhoon Reming breached them all in 2006, killing 1,266 people who had sought safety by living behind them (Paguican et al. 2009).

1990s: Same lahar-dike builders' mistakes on a much larger scale at Pinatubo despite scientists' objections. October 1995: Tropical Storm Mameng lahars breached Gugu dike, totally destroyed Bgy Cabalantian in Bacolor, Pampanga. Hundreds of people killed.

2000s-present: DPWH builds numerous costly, ineffective flood-control structures in Central Luzon and KAMANAVA. Academician Siringan's and my objections made no difference. Year after year, they fail, and more money is spent on cosmetic repairs.

E. M. R. Paguican et al., 2009, Extreme rainfall-induced lahars and dike breaching, 30 November 2006, Mayon Volcano, Philippines. Bull Volcanology 71:845–857.

Abstract: On 29–30 November 2006, heavy rains from Supertyphoon Durian [Reming] remobilized volcanic debris on the southern and eastern slopes of Mount Mayon, generating major lahars that caused severe loss of life and property in downstream communities. . . For about 18 h, floods and lahars from the intense and prolonged rainfall overtopped river bends, breaching six dikes through which they created new paths, buried downstream communities in thick, widespread deposits, and caused most of the 1,266 fatalities . . .The Durian event was exceptional in terms of rainfall intensity, but the dikes eventually failed because they were designed and built according to flood specifications, not to withstand major lahars.



Cabalantian house

Before Typhoon Mameng

After Mameng lahars

KAMANAVA Flood Control Project

2003: P3-billion contract to Nishimatsu to be completed in June 2007
2007: Extended until September 2008.
2008: Nishimatsu contract expired. Only 88% completed.
February 2009: DPWH awards local contractor BMWAD Joint Ventures P996 million to complete the remaining works.
October 2009, 94% of the project completed.
July 2010: DPWH: "resumes full blast operations, project will be completed by mid-September." P5.18 billion already spent.
2011: project director Macaria Bartolo says project 99.5% complete.
August 2012: Polder dike overtopped by habagat floods, has to be raised another meter.
August 19, 2013: Malabon residents evacuated as floods rise .
July 16, 2014: Typhoon 'Glenda' floods force 1.000+ Malabon evacuation.
September 23, 2014: Tropical storm "Mario", southwest monsoon and high tide force Malabon evacuations.
July 6, 2015: CAMANAVA flooded.
July 29, 2015: MMDA lists 12 most flooded areas in Malabon City.
October 11, 2015: DPWH-NCR office gives additional 931 million to Camanava from the P351-billion Flood Management Master Plan for Metro Manila and Surrounding Areas.
December 15, 2015: Typhoon Nona floods Malabon.
…And so it goes…

Ang halaga ng buhay ng mga mamamayan
ay walang katumbas na salapi!

Marami pong salamat sa inyong lahat…