

THE GAINS IN RIVER REHABILITATION ESTERO DE PACO STORY

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Case Example of Improvement of Super Levee (Sumida River) (Hakozaki Area)



Before

After

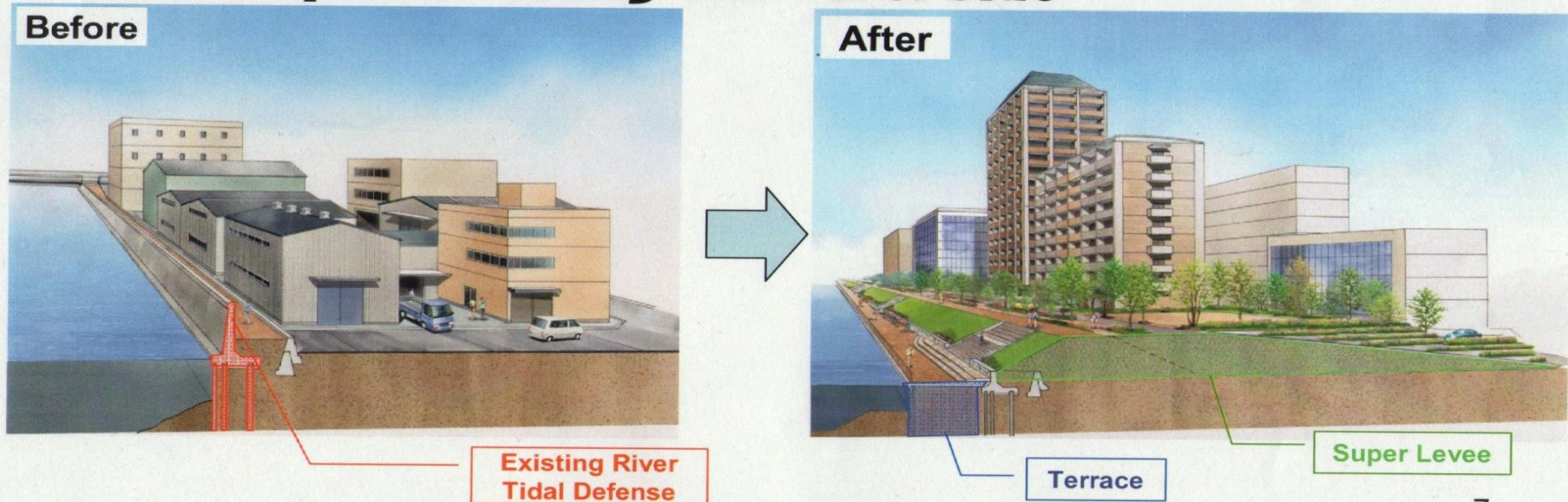


Improvement of Super Levees

○ Two Aims

**Earthquake Resistance and
Improvement of Water Accessibility**

○ Implemented in cooperation with local development along the riverside



Major Sumida River's wall has been replaced about 28 % with Super Levee.

Case Example of Improvement of Super Levee (Sumida River) (Ohkawabata Area)



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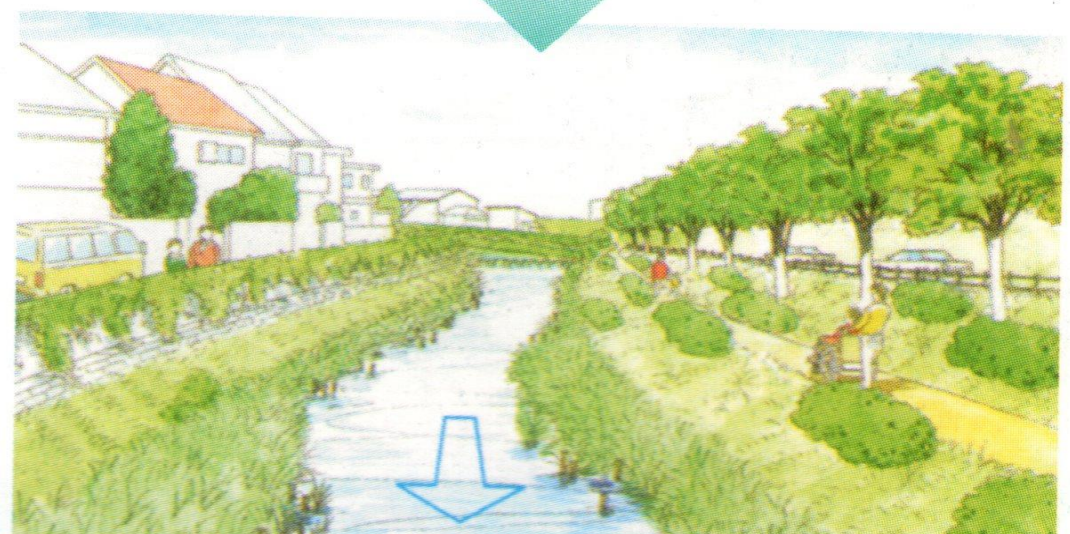


隅田川旧防潮堤





② 緩やかに蛇行する低水路とし、水際は、生き物が生息していけるように工夫。



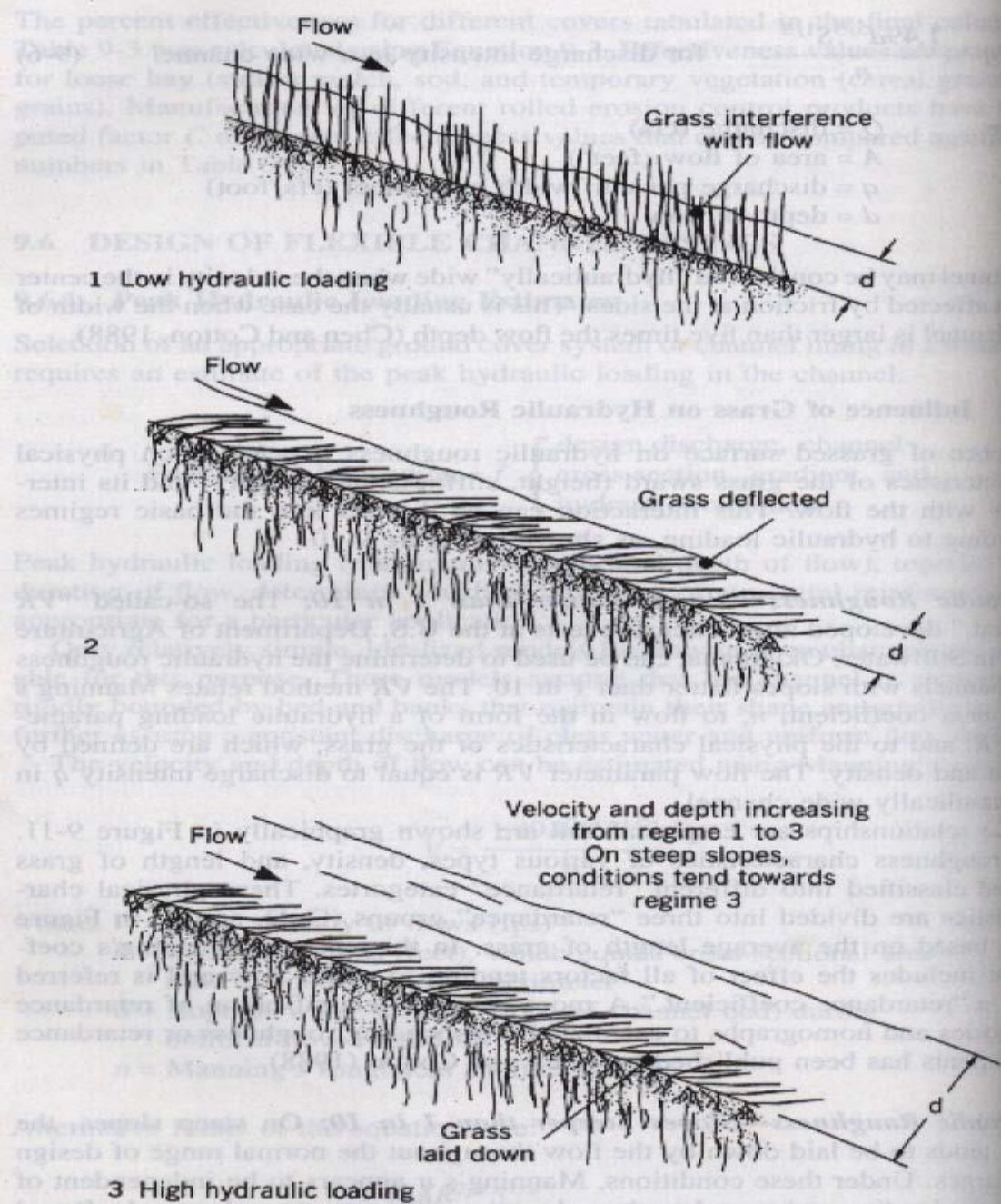


Figure 9-10. Effect of hydraulic loading on grassed surface. (From Hewlett et al. 1987. Design of reinforced grass waterways. CIRIA Report 116. Used with permission of Construction Industry and Information Association.)



LONG TERM PERFORMANCE GUIDELINES

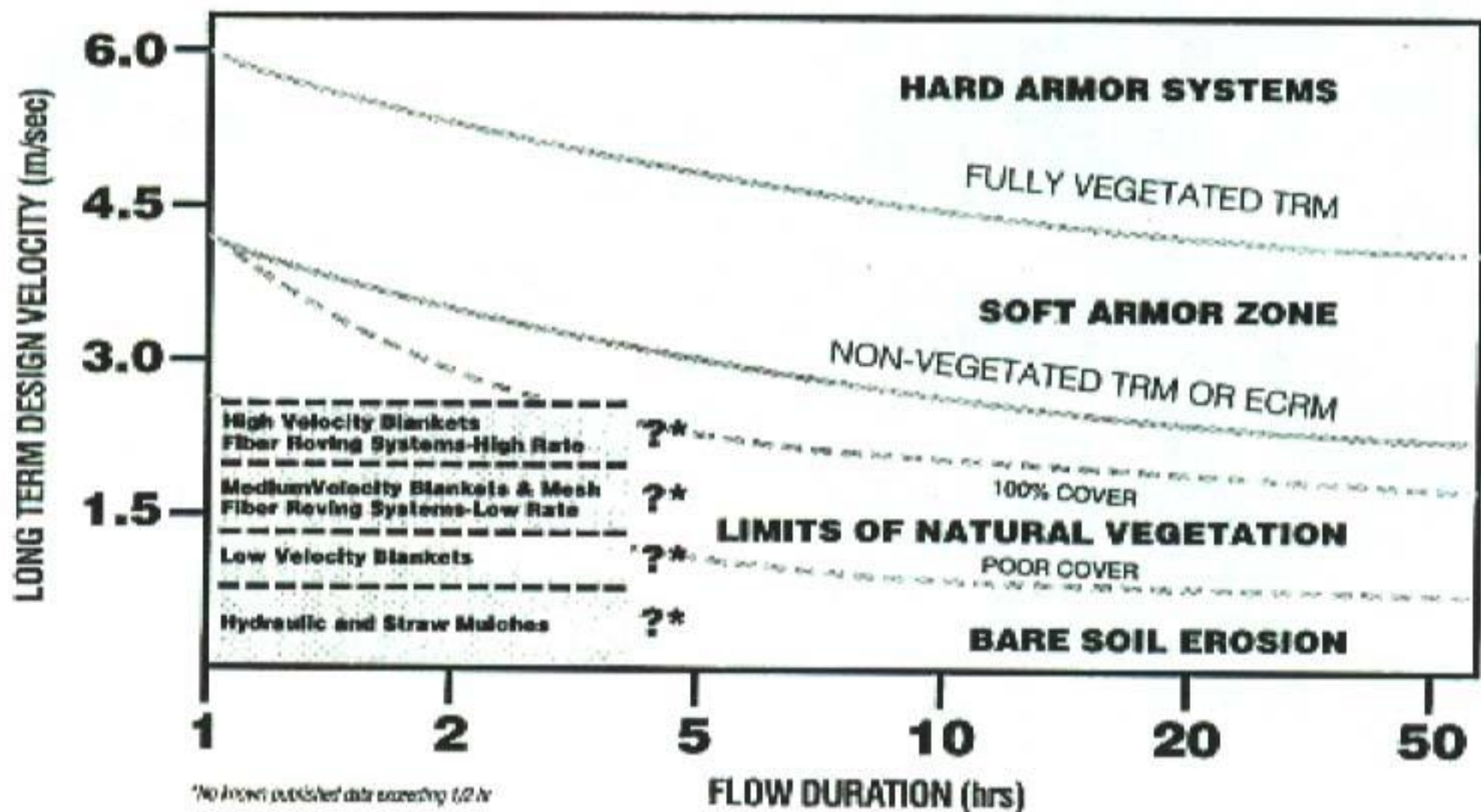
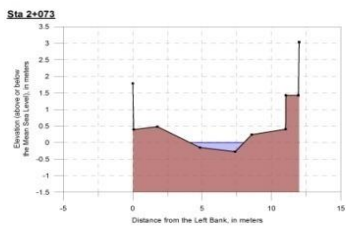
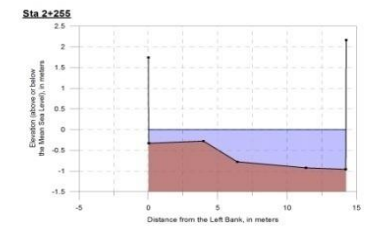
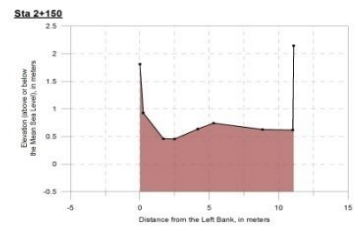
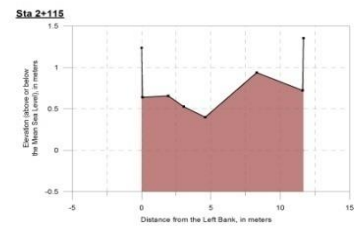
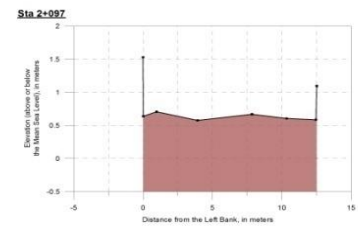
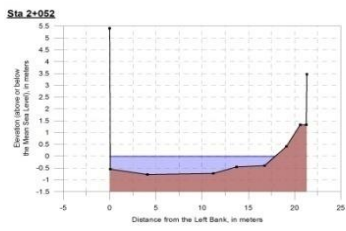
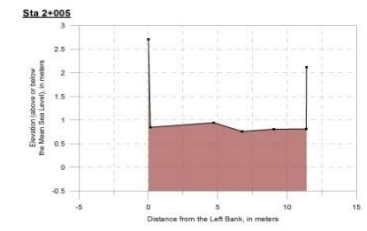
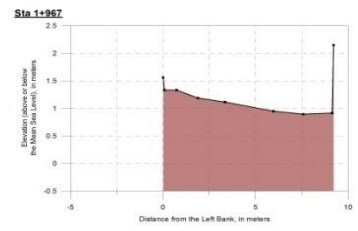
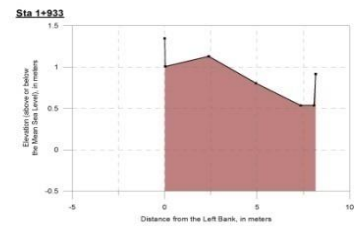
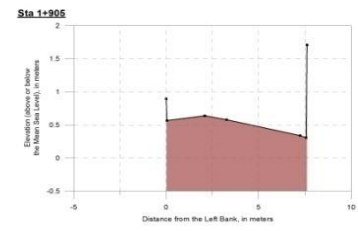
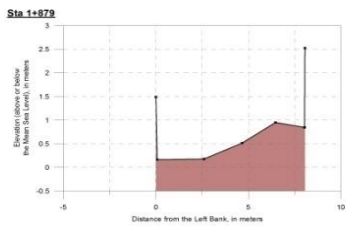
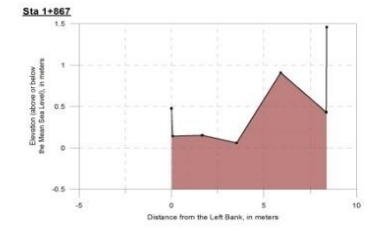
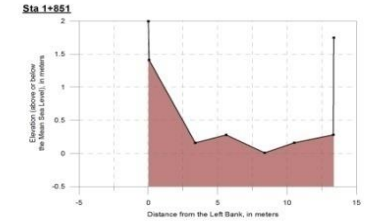
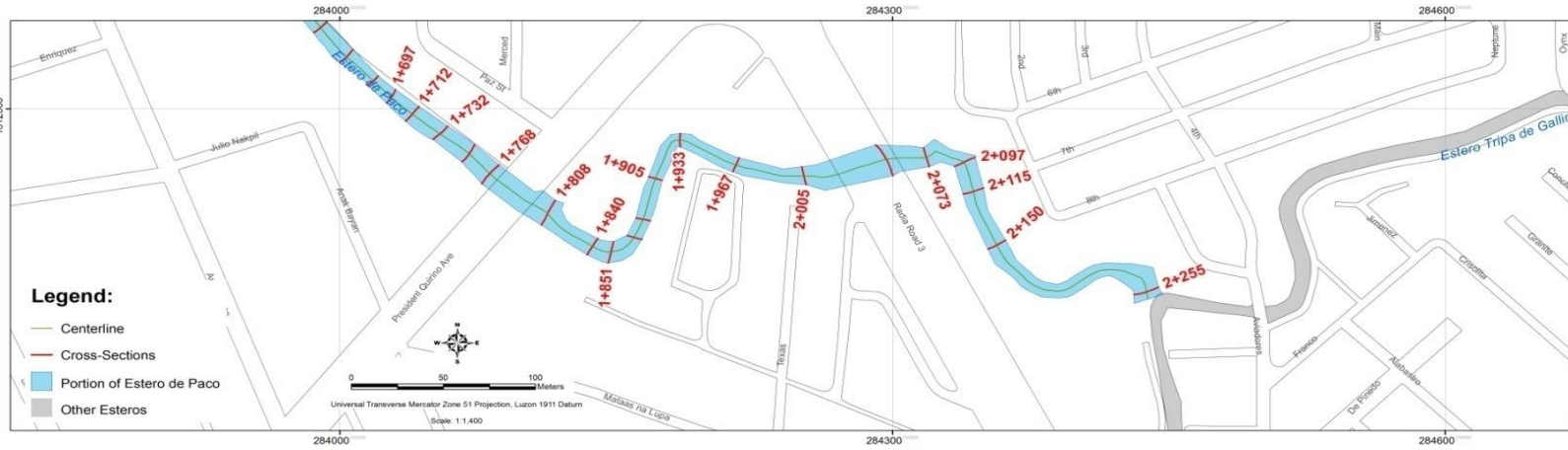


Figure 9-13. Suggested limiting velocities for erosion resistance of natural vegetation, "soft" and "hard" armor systems. (Used with permission of Synthetic Industries, Inc.)

Map No. EdePaco RHS 02-04
**ESTERO DE PACO CROSS SECTIONS
 (STA 1+851 to STA 2+255)**



Remarks:
 Left bank is on the left of one's self when facing downstream (towards the estero's junction with the Pasig River).

About the Datasets:
 Collected on April 7-25, 2010 by:
 The PRTSAS Phase I River and Hydrographic Surveys Component
 Project Component Leader: Engr. Joene R. Santillan, TCAGP
 Research Assistant: Engr. Glenn C. Paraiso, TCAGP
 Processed and Plotted by: Engr. Joene R. Santillan

Implemented by:
 The Training Center for Applied Geodesy and Photogrammetry (TCAGP)
 College of Engineering, University of the Philippines, Diliman, Quezon City

Funded by:
 The Pasig River Rehabilitation Commission (PRRC)

**PASIG RIVER TRIBUTARIES SURVEY
 AND ASSESSMENT STUDY (PRTSAS) PHASE I**

Mannings Formula Computations of Paco Estero High Tide

	Top Width	Maximum	Bottom	e	Area	Wetted	Hydraulic	Slope	roughness	Velocity (v)
	(T)	Depth (D)	width (b)		(A)	Perimeter (P)	radius, R	(0.5/1000)	coefficient, n	m/sec
	(m)	(m)	(m)		(m ²)		(R = A/P)	(m/m)		
Sta 0 + 0	32	3.5	25	3.5	99.75	34.8995	2.8582	0.0005	0.030	1.5012
Sta 0 + 100	23	3.5	16	3.5	68.25	25.8995	2.6352	0.0005	0.030	1.4220
Sta 0 + 200	22.5	3.5	15.5	3.5	66.5	25.3995	2.6182	0.0005	0.030	1.4159
Sta 0 + 300	21	3.5	14	3.5	61.25	23.8995	2.5628	0.0005	0.030	1.3959
Sta 0 + 400	23	3.5	16	3.5	68.25	25.8995	2.6352	0.0005	0.030	1.4220
Sta 0 + 500	24	3.5	17	3.5	71.75	26.8995	2.6673	0.0005	0.030	1.4336
Sta 0 + 600	16	3.5	9	3.5	43.75	18.8995	2.3149	0.0005	0.030	1.3043
Sta 0 + 700	12	3.5	5	3.5	29.75	14.8995	1.9967	0.0005	0.030	1.1819
Sta 0 + 800	11.5	3.5	4.5	3.5	28	14.3995	1.9445	0.0005	0.030	1.1612
Sta 0 + 900	13	3.5	6	3.5	33.25	15.8995	2.0913	0.0005	0.030	1.2189
Sta 1 + 0	25	3.5	18	3.5	75.25	27.8995	2.6972	0.0005	0.030	1.4442
Sta 1 + 100	15	3.5	8	3.5	40.25	17.8995	2.2487	0.0005	0.030	1.2793
Sta 1 + 200	10	3.5	3	3.5	22.75	12.8995	1.7636	0.0005	0.030	1.0880
Sta 1 + 300	16	3.5	9	3.5	43.75	18.8995	2.3149	0.0005	0.030	1.3043
Sta 1 + 400	13	3.5	6	3.5	33.25	15.8995	2.0913	0.0005	0.030	1.2189
Sta 1 + 500	10	3.5	3	3.5	22.75	12.8995	1.7636	0.0005	0.030	1.0880
Sta 1 + 600	9.5	3.5	2.5	3.5	21	12.3995	1.6936	0.0005	0.030	1.0590
Sta 1 + 700	11	3.5	4	3.5	26.25	13.8995	1.8886	0.0005	0.030	1.1388
Sta 1 + 800	13.5	3.5	6.5	3.5	35	16.3995	2.1342	0.0005	0.030	1.2355
Sta 1 + 900	7.5	3.5	0.5	3.5	14	10.3995	1.3462	0.0005	0.030	0.9087
Sta 2 + 0	10.5	3.5	3.5	3.5	24.5	13.3995	1.8284	0.0005	0.030	1.1145
Sta 2 + 100	12	3.5	5	3.5	29.75	14.8995	1.9967	0.0005	0.030	1.1819
Sta 2 + 200	8.5	3.5	1.5	3.5	17.5	11.3995	1.5352	0.0005	0.030	0.9919

Low Tide

	Top Width (T)	Maximum Depth (D)	Bottom width (b)	e	Area (A)	Wetted Perimeter (P)	Hydraulic radius, R	Slope (1/1000)	roughness coefficient, n	Velocity (v)
	(m)	(m)	(m)		(m ²)		(R = A/P)	(m/m)		m/sec
Sta 0 + 0	32	3.5	25	3.5	99.75	34.8995	2.8582	0.001	0.030	2.1230
Sta 0 + 100	23	3.5	16	3.5	68.25	25.8995	2.6352	0.001	0.030	2.0110
Sta 0 + 200	22.5	3.5	15.5	3.5	66.5	25.3995	2.6182	0.001	0.030	2.0024
Sta 0 + 300	21	3.5	14	3.5	61.25	23.8995	2.5628	0.001	0.030	1.9740
Sta 0 + 400	23	3.5	16	3.5	68.25	25.8995	2.6352	0.001	0.030	2.0110
Sta 0 + 500	24	3.5	17	3.5	71.75	26.8995	2.6673	0.001	0.030	2.0274
Sta 0 + 600	16	3.5	9	3.5	43.75	18.8995	2.3149	0.001	0.030	1.8446
Sta 0 + 700	12	3.5	5	3.5	29.75	14.8995	1.9967	0.001	0.030	1.6714
Sta 0 + 800	11.5	3.5	4.5	3.5	28	14.3995	1.9445	0.001	0.030	1.6422
Sta 0 + 900	13	3.5	6	3.5	33.25	15.8995	2.0913	0.001	0.030	1.7238
Sta 1 + 0	25	3.5	18	3.5	75.25	27.8995	2.6972	0.001	0.030	2.0425
Sta 1 + 100	15	3.5	8	3.5	40.25	17.8995	2.2487	0.001	0.030	1.8092
Sta 1 + 200	10	3.5	3	3.5	22.75	12.8995	1.7636	0.001	0.030	1.5387
Sta 1 + 300	16	3.5	9	3.5	43.75	18.8995	2.3149	0.001	0.030	1.8446
Sta 1 + 400	13	3.5	6	3.5	33.25	15.8995	2.0913	0.001	0.030	1.7238
Sta 1 + 500	10	3.5	3	3.5	22.75	12.8995	1.7636	0.001	0.030	1.5387
Sta 1 + 600	9.5	3.5	2.5	3.5	21	12.3995	1.6936	0.001	0.030	1.4977
Sta 1 + 700	11	3.5	4	3.5	26.25	13.8995	1.8886	0.001	0.030	1.6105
Sta 1 + 800	13.5	3.5	6.5	3.5	35	16.3995	2.1342	0.001	0.030	1.7473
Sta 1 + 900	7.5	3.5	0.5	3.5	14	10.3995	1.3462	0.001	0.030	1.2852
Sta 2 + 0	10.5	3.5	3.5	3.5	24.5	13.3995	1.8284	0.001	0.030	1.5761
Sta 2 + 100	12	3.5	5	3.5	29.75	14.8995	1.9967	0.001	0.030	1.6714
Sta 2 + 200	8.5	3.5	1.5	3.5	17.5	11.3995	1.5352	0.001	0.030	1.4028



















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The Rehabilitated Estero de Paco has been dredged and garbage input has been stopped. Water can flow freely and it has been designed to contain a ten year return period rainfall intensity

GAINS IN REAL PROPERTY VALUES

Humans need water to survive and are naturally drawn to bodies of water. Civilizations and cities started along river banks until they were severely overused and polluted. It has been shown in all cities that have rehabilitated their rivers that locations with access to clean rivers or lakes became prime land as men have the natural tendency to seek the comfort of cool breeze and sight and sounds of flowing water . These locations became the centers of economic activity and propelled the development of the cities.



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Case Example of Improvement of Super Levee (Sumida River) (Hakozaki Area)



Before

After

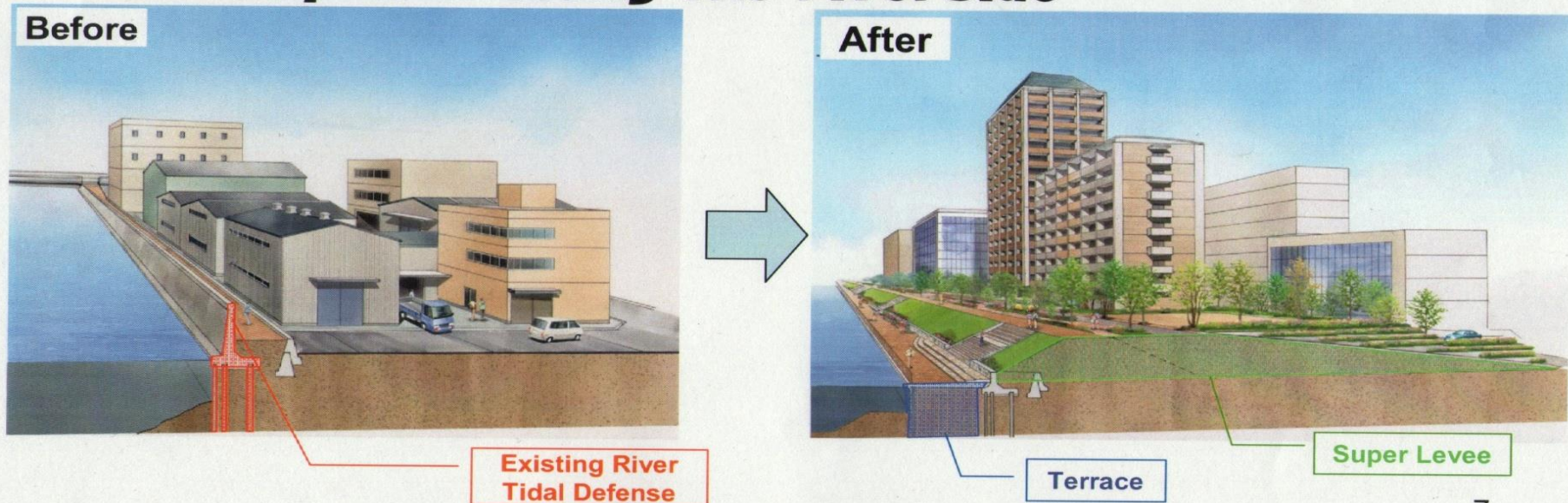


Improvement of Super Levees

○ Two Aims

**Earthquake Resistance and
Improvement of Water Accessibility**

○ Implemented in cooperation with local development along the riverside



Major Sumida River's wall has been replaced about 28 % with Super Levee.

Case Example of Improvement of Super Levee (Sumida River) (Ohkawabata Area)



Before

After





The Sumida River of Tokyo was transformed in 30 years from a black stinking river to a prime business and commercial center, and the river banks serving as parks where workers can relax and relieve their tensions.



RDO NO. 34	PACO/PANDACAN/STA. ANA	DO No.	37-03
CITY/MUNICIPALITY: MANILA/METRO MANILA		Effectivity date	1-Mar-04
RDO NO. 34	PACO/PANDACAN/STA. ANA	DO No.	37-03
CITY/MUNICIPALITY: MANILA/METRO MANILA		Effectivity date	1-Mar-04
BAKANGAY: 0//	ZONE: /4		
		CLASSI-	4TH REVISION
STREET/SUBDIVISION	VICINITY	FICATION	ZV/SQ.M.
BATUTE	EST. DE PACO-CRISTOBAL	RR	4,040.00
CRISTOBAL	ROTONDA ZULUETA	CR	11,070.00
CIPVAS	ULILANG KAWAYAN-PAZ	RR	4,040.00
LACTAO	EST. DE PACO-CRISTOBAL	RR	4,040.00
PAZ	SAN GREGORIO-QUIRINO AV	RR	5,100.00
PAZ	SAN GREGORIO-QUIRINO AV	CR	13,125.00
PACO QUIRINO AVENUE	ROTONDA PAZ	CR	32,400.00
SAN GREGORIO	EST. DE PACO-PAZ	RR	6,060.00
ULILANG KAWAYAN	EST. DE PACO-END	CR	8,820.00
UN AVENUE	EST DE PACO-ROTONDA	CR	48,750.00
UN AVENUE	EST DE PACO ROTONDA	I	33,750.00
UN AVENUE	EST DE PACO-ROTONDA	RC	48,750.00
ZULUETA	CRISTOBAL-PAZ	RR	4,040.00

Projected Increase in Real Estate Values Along Estero de Paco As Experienced in Other Countries which Rehabilitated River Banks

	2012	2015	2020	2025	2030
Land Value per sq. meter	4,000	10,000	20,000	30,000	50,000
Building Value per sq. Meter	15,000	30,000	45,000	60,000	75,000
Building Ave. Height	1 floor	2 floors	3 floors	4 floors	5 floors

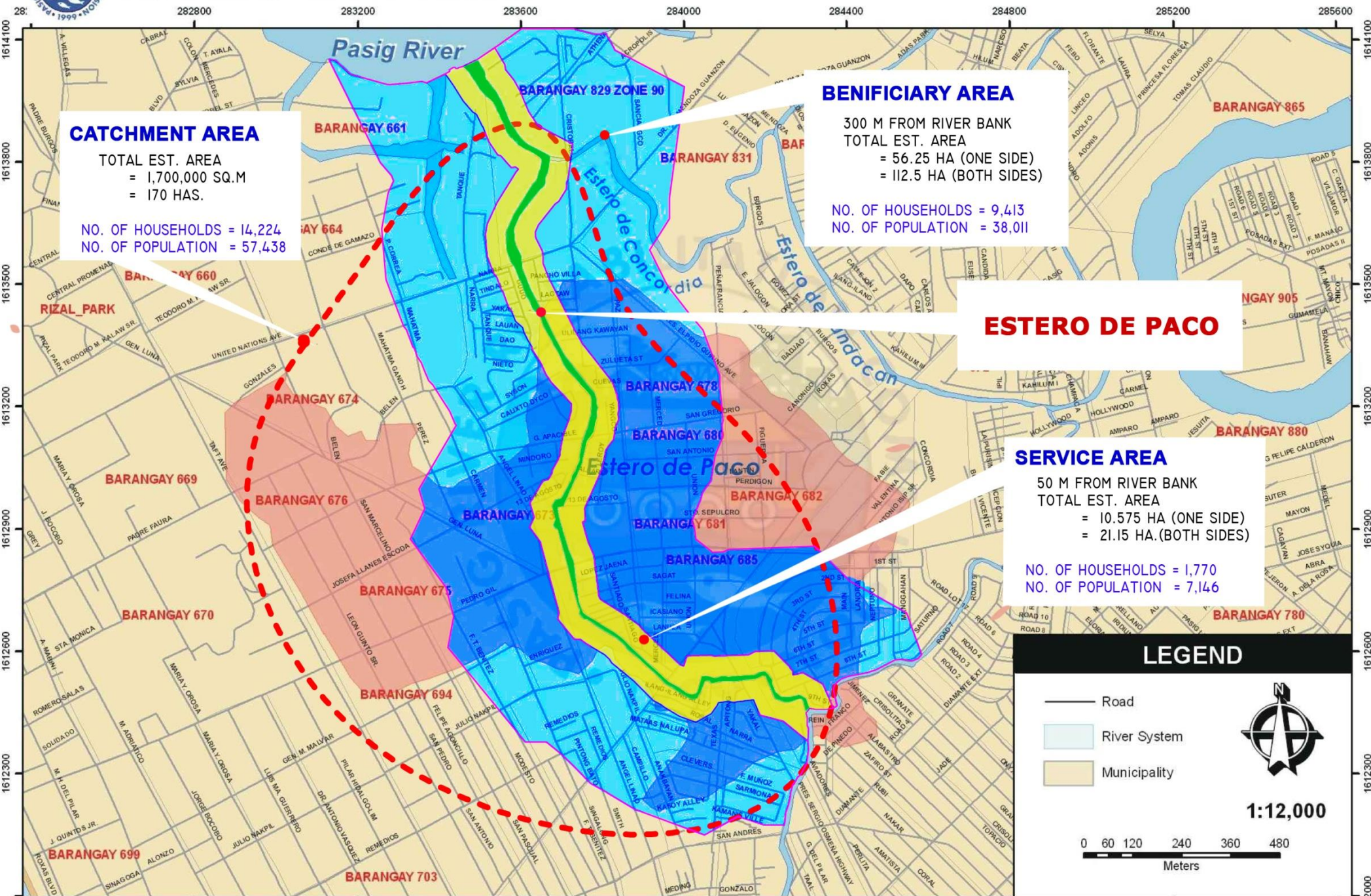
Area Benefitted by the Improvements:

Area Directly Served by the Estero:	10.575 Hectares	(100,575, sq. meters)
Beneficiary Area (Indirect Benefits):	56.25 Hectares	(560,250 sq. meters)
Total Area:	66.825 Hectares	(668,250 sq. meters)



ESTERO DE PACO

VICINITY MAP



CATCHMENT AREA

TOTAL EST. AREA
= 1,700,000 SQ.M
= 170 HAS.

NO. OF HOUSEHOLDS = 14,224
NO. OF POPULATION = 57,438

BENEFICIARY AREA

300 M FROM RIVER BANK
TOTAL EST. AREA
= 56.25 HA (ONE SIDE)
= 112.5 HA (BOTH SIDES)

NO. OF HOUSEHOLDS = 9,413
NO. OF POPULATION = 38,011

ESTERO DE PACO

SERVICE AREA

50 M FROM RIVER BANK
TOTAL EST. AREA
= 10.575 HA (ONE SIDE)
= 21.15 HA. (BOTH SIDES)

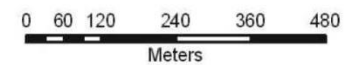
NO. OF HOUSEHOLDS = 1,770
NO. OF POPULATION = 7,146

LEGEND

- Road
- River System
- Municipality



1:12,000



Simple Benefit Calculation

Benefit to the Land Owners

Total Area: 668,250 sq. Meters
Less Road
and Common Areas : 133,650
Residential and Com Area: 534,600

Land Value Increase:

Ave. Land Value in Affected Area: 7,000/sq.m
Value After 20 years: 50,000/sq. meter
Gain in Value: 42,000/sq. meter
Average Land Size: 50 sq. meters
Ave. Benefit per Land Owner: P2,100,000

TOTAL BENEFITS FOR Land Owners :
P22,453,200,000.00 after 20 years

Benefit to the Government

Land Tax:

Ave. Increase in Value in 20 Years
 $42,000/20 = 2,100$
 $2,100 \times 534,600 = 1,122,660,000.00$
 $1,122,660,000.00 * 2.5\% = P28,000,000/\text{year}$
 $28,000,000 \times 20 = \mathbf{561,330,000.000}$

Real Estate Tax:

Ave. Increase in value of Real Estate Structures
in 20 years = $75,000 - 15,000 / 20 = 3,000$
 $3,000 \times 534,600 = 1,603,800,000.00$
 $1,603,800,000.00 * 2.5\% = 40,095,000.000$
 $40,095,000.000 \times 20 = \mathbf{P801,900,000.000}$
TOTAL BENEFIT FOR GOVERNMENT FOR 20
YEARS: 1,363,230,000.000

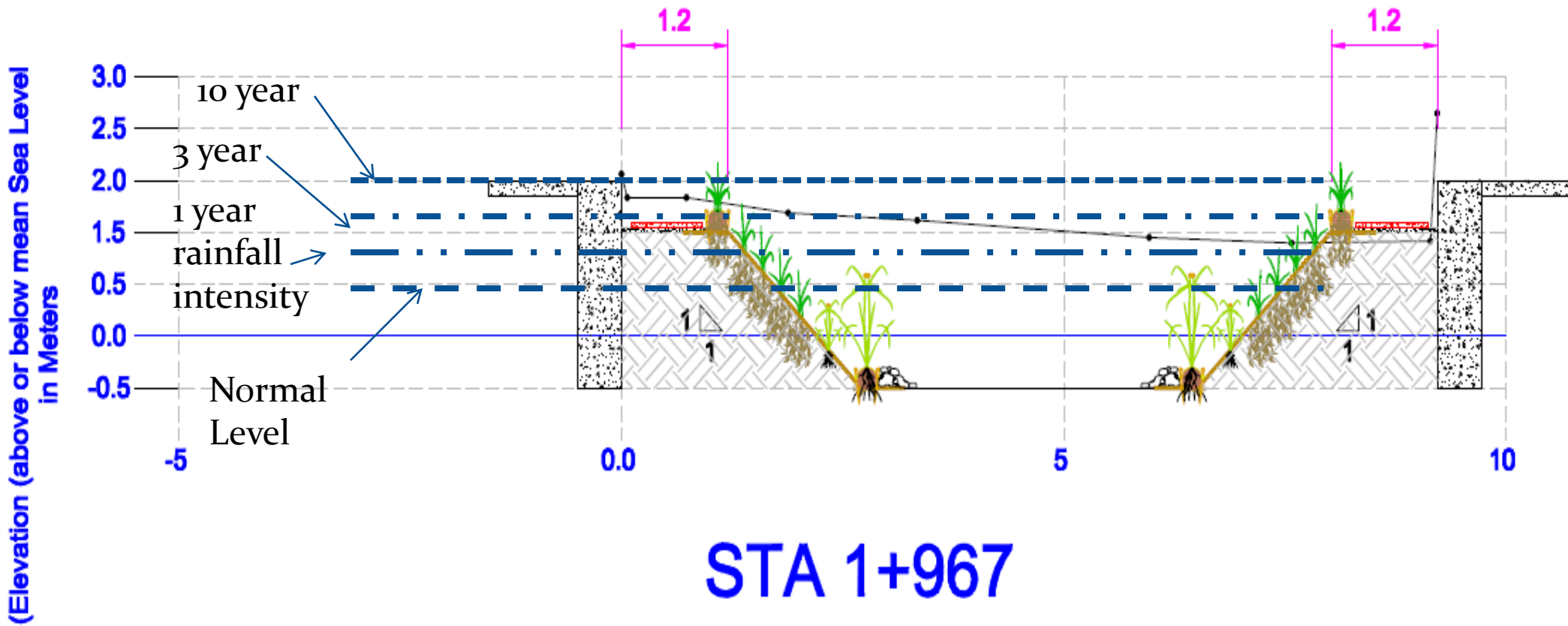
Benefits Due to Minimized Flooding

In the past, the most intense rainfall which recurs every year is 100mm-150mm which last for 1 hr already floods 1,770 households along Estero de Paco.

A more intense rainfall with a 3 year return period of 200mm lasting for 6 hrs inundated around 4,500 households around Estero de Paco

JICA STUDY ON DRAINAGE IMPROVEMENT IN THE CORE AREA OF METRO MANILA
MARCH 2005

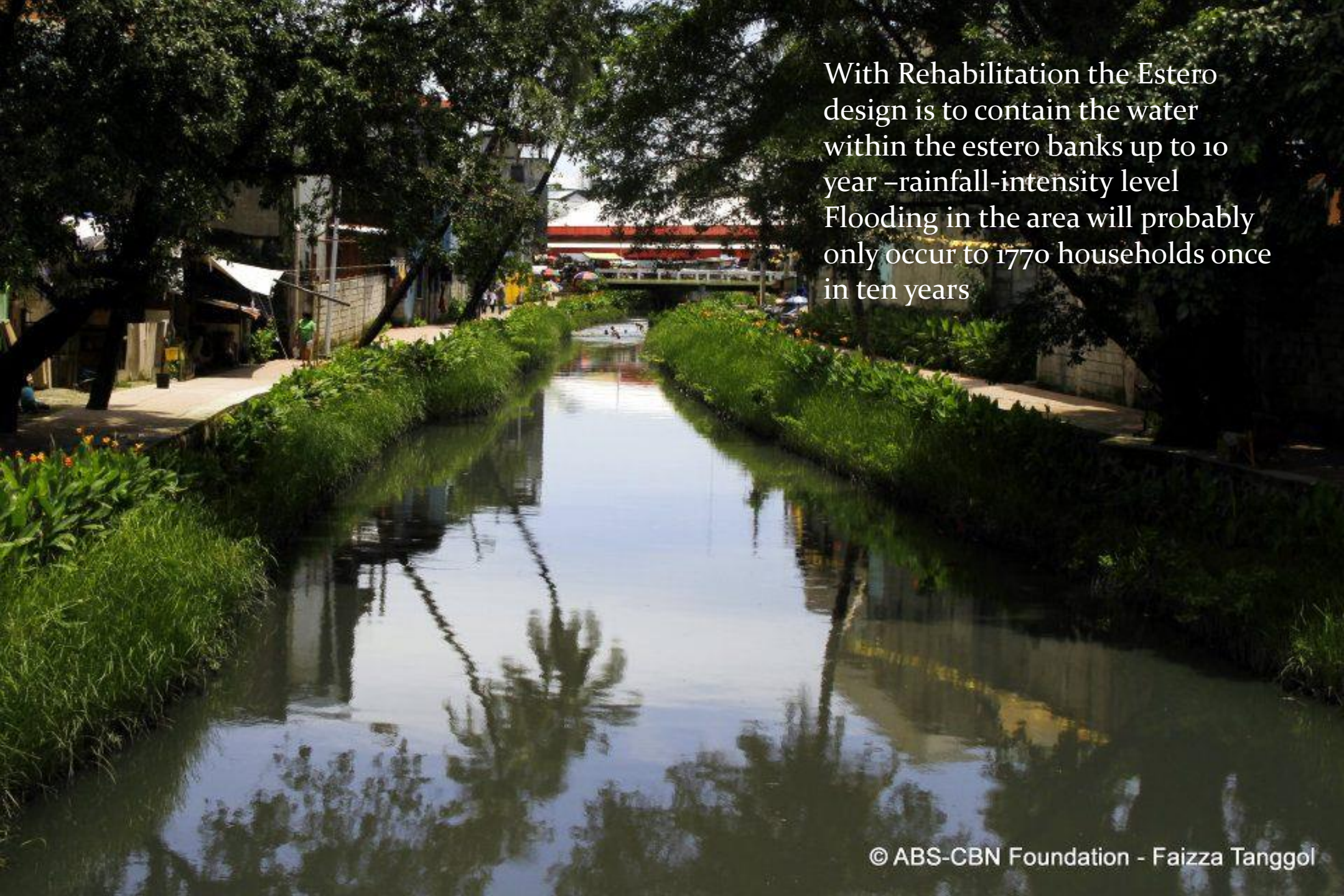
Existing Flood Levels of Estero de Paco





Clogged and Shallow Estero de Paco, about 1,770 households are flooded every year for up to 12 hrs.

An additional 4,500 households are flooded every 3 years for 6 to 12 hrs



With Rehabilitation the Estero design is to contain the water within the estero banks up to 10 year –rainfall-intensity level
Flooding in the area will probably only occur to 1770 households once in ten years



Far

© ABS-CBN Foundation, Inc.

The Estero has become too shallow with garbage and the channels are clogged. Just a small rain floods the area.



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The Rehabilitated Estero de Paco has been dredged and garbage input has been stopped. Water can flow freely and it has been designed to contain a ten year return period rainfall intensity



Each household loses an average of P3,500 for temporary transfer to other locations, repairs and clean-up, and income loss due to failure to report for work, every flood incidence.

What Paco Residents do not have to Spend

Flood Occurrence	Affected Households	Amount of Damage for 20 years
One -Year Rainfall Intensity	1,770	123,900,000.00
Three -Year Rainfall Intensity	4,500	94,500,000.00
Total	6,270	218,400,000.00

JICA STUDY ON DRAINAGE IMPROVEMENT IN THE CORE AREA OF METRO MANILA
MARCH 2005

Recreational Value

Paco Residents do not have to go to a faraway park or seaside to take a leisurely walk and relax



The whole 2 km length of Estero de Paco has become a favorite place of people from the surrounding areas to walk and relax because its completely pedestrian and free from passing vehicles

Recreational Value Of Estero de Paco

- A sample pre-survey questionnaire taken from 7,000 households living within 200 meters from the 2.7 km Estero de Paco revealed that they save about P180 a month from not going to other places to relax



What Paco Residents do not Have to Spend

Number of Households	Average Savings/month	Savings /year	20 Years Savings
6,270	180	13,543,200.00	270,864,000.00

HEALTH

Maybe it is psychological due to more healthy environment. But there is a significant improvement in health of Residents along the Estero

Health Benefits of Estero de Paco Development

- A sample pre-survey questionnaire taken from 7,000 households living within 200 meters from the 2.7 km Estero de Paco, 85% of the respondents revealed that they spent about P2,659 before Estero Clean-up and P1,840 for a savings of P819 a month



What Paco Residents do not Have to Spend

85% of the Number of Households	Average Medical Savings/month per household	Savings /year	20 Years Savings
5,078	819	49,913,463.60	998,269,272.00

Other Benefits

Reduced Crime Incidence: A sample of 7 barangays out of 16 in the Estero de Paco revealed a 40% reduction in crime incidence in the area based on the barangay blotter.

Increased Employment Opportunities: After an urban river Rehabilitation, increase in economic activities follow and employment opportunities increase by at least 300% over a 20 year period.

Estero de Paco Residents' Perceptions on the Benefits of the Estero de Paco Rehabilitation

Perceived Benefits of Residents of Paco	Agree	Disagree
Feel Less Sick	89%	11%
Lower Medical Expenses	85%	15%
Community Pride	97%	3%
Happier Community	97%	3%
Stronger Unity	96%	4%
Feel Safer	89%	11%
Motivation to Clean Up	97%	3%
Greater Peace of Mind	97%	3%
Getting More Exercise	100%	0%
Greater Life Satisfactopn	97%	3%



Total Costs

Excluding the Costs of relocation and costs of other agencies, the total costs incurred by PRRC, KBPIP, DPWH is already P164,000,000. This does not include yet the costs of other agencies. Including the maintenance cost of about P2,000,000 a year and further development costs, the total costs may reach P300,000,000 for the duration of 20 years.

Total Benefits

The River is a very important component of a city's growth. There is no way of accurately measuring the total value of bringing it back to life. There are only some which we can project for 20 years and quantify:

	For the Residents	For the Government
Land Value	p22,453,200,000.00	
Land Tax		P561,330,000.000
Real Property Tax (Buildings)		P801,900,000.000
Savings from Less Flooding	P218,400,000.00	
Recreational Value	P270,864,000.00	
Savings from Decreased Medical Expenses	P998,269,272.00	
TOTAL	P 23,940,733,272.00	P1,363,230,000.00

Cost-Benefit Ratio

Total cost of P300,000,000 in 20 years

Total Benefits of P 25,304,000,000.00

For Every 1 Peso invested a total benefit of 84 pesos in 20 years