



INTEGRATED WATER RESOURCES MANAGEMENT: THE PANAMA CANAL EXPERIENCE

Carlos A. Vargas
Vice President
Water and Environment



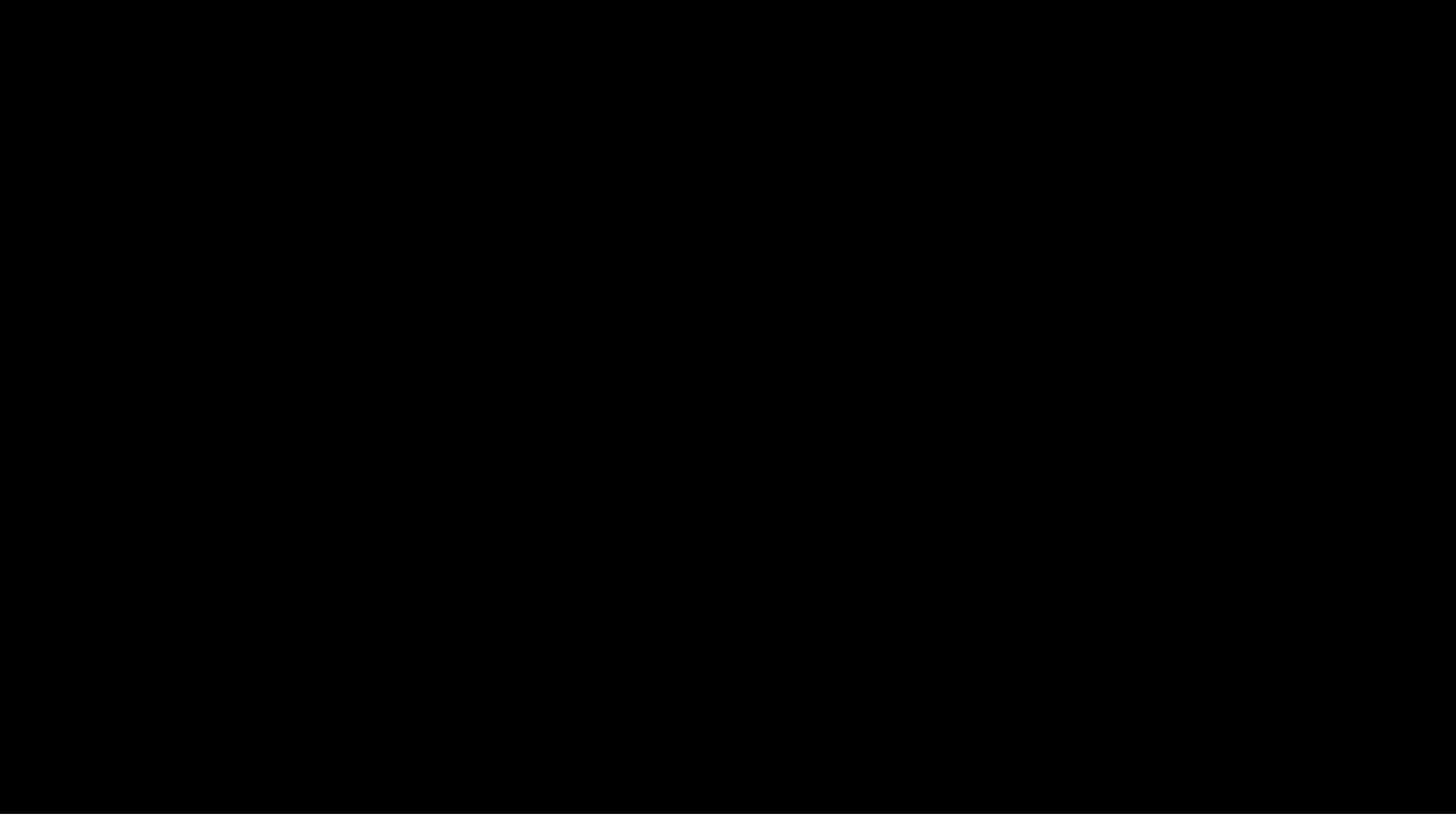
IWHR's Global Vision Forum



April 8th, 2019

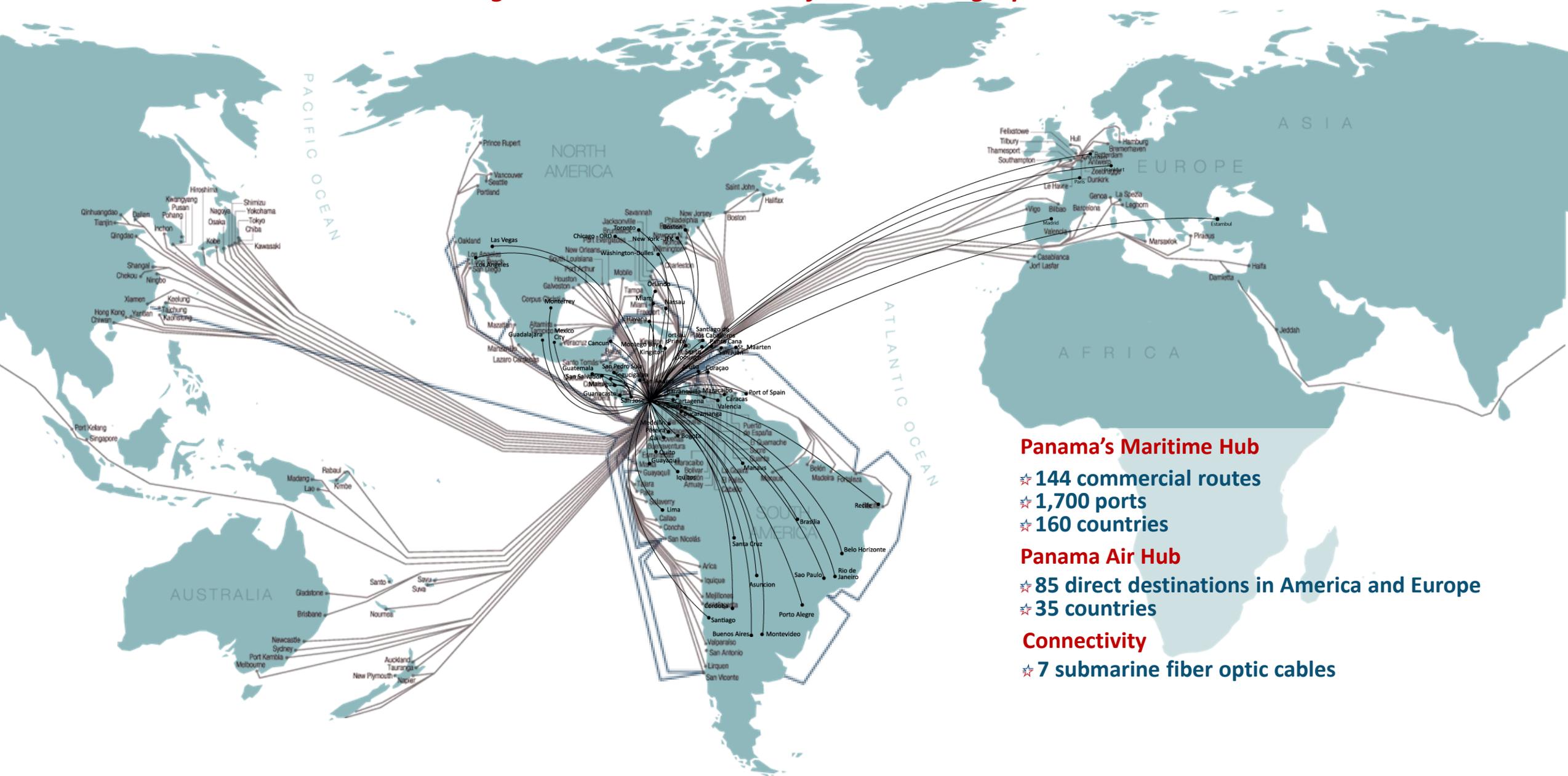


Panama Canal: Introduction

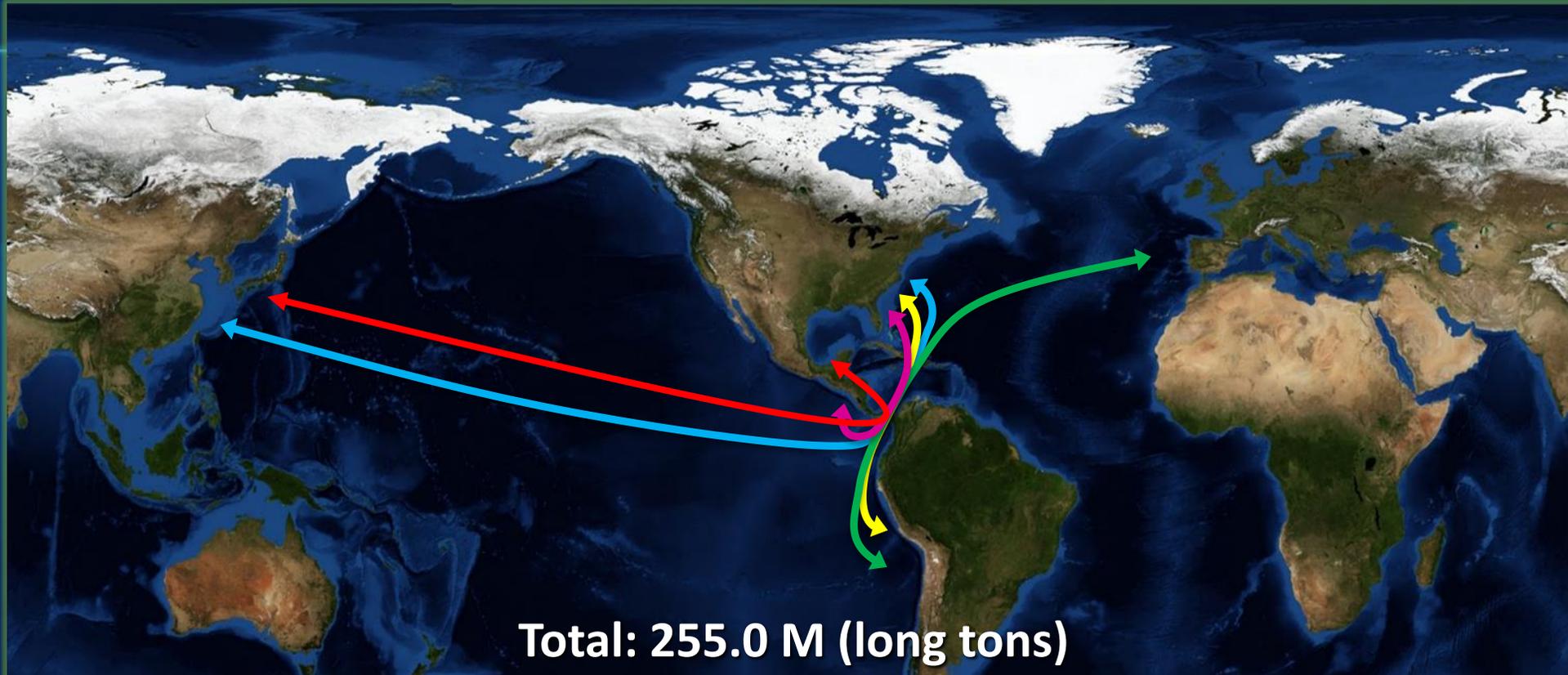


Panama: Logistics and Transportation Hub of the Americas

Reaching the Maximum Potential from our Geographic Location



Main Routes – FY 2018



Asia – US East Coast



78.4M

South America West Coast – US East Coast



37.2M

Central America West Coast – US East Coast



17.0M

South America West Coast - Europe



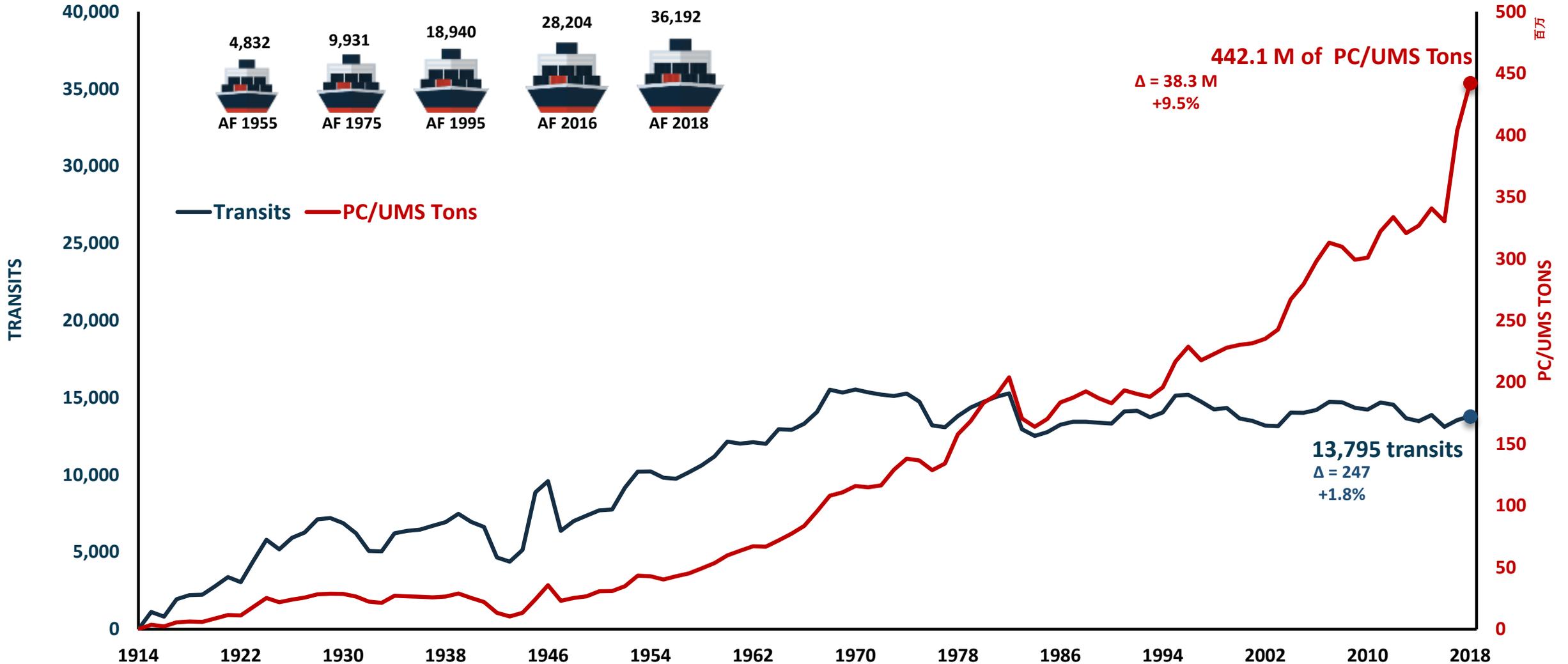
16.9M

Asia – East Coast Central America

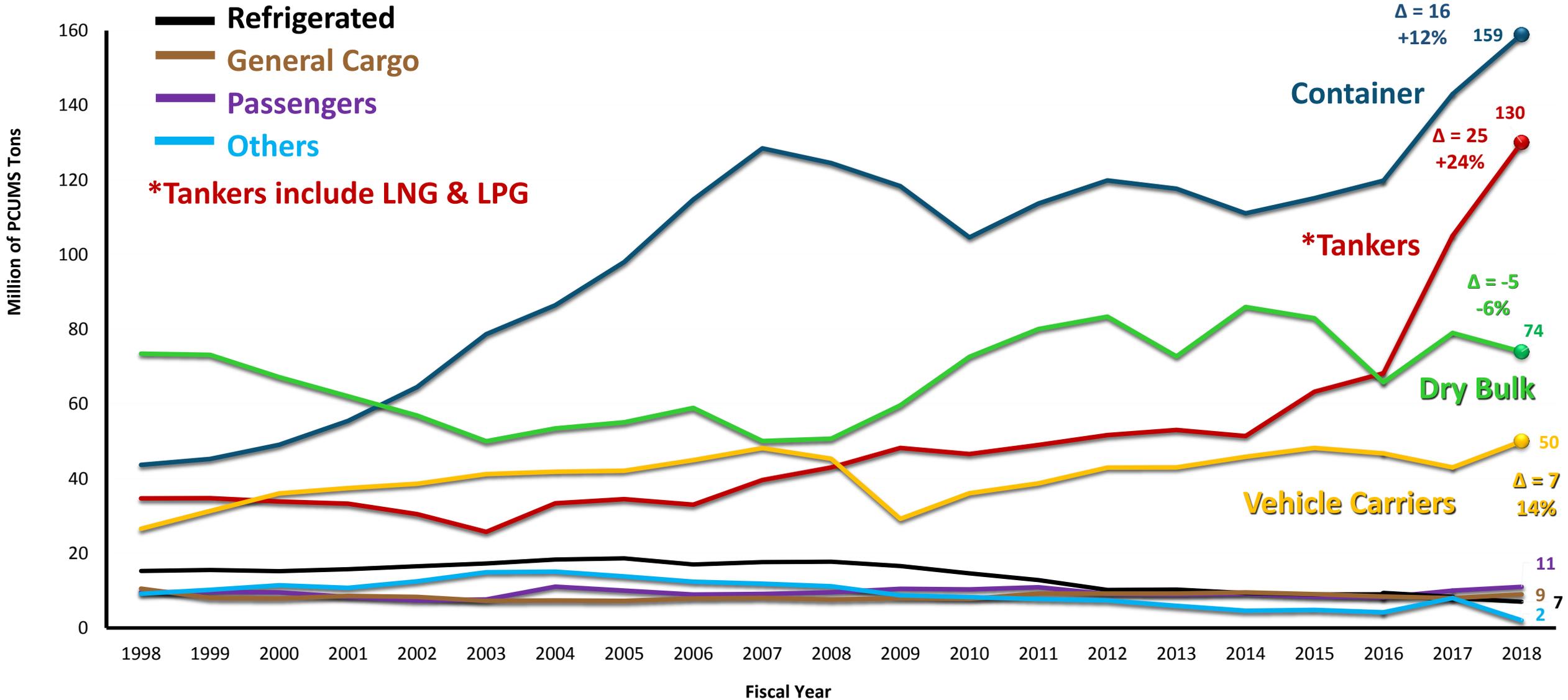


8.1M

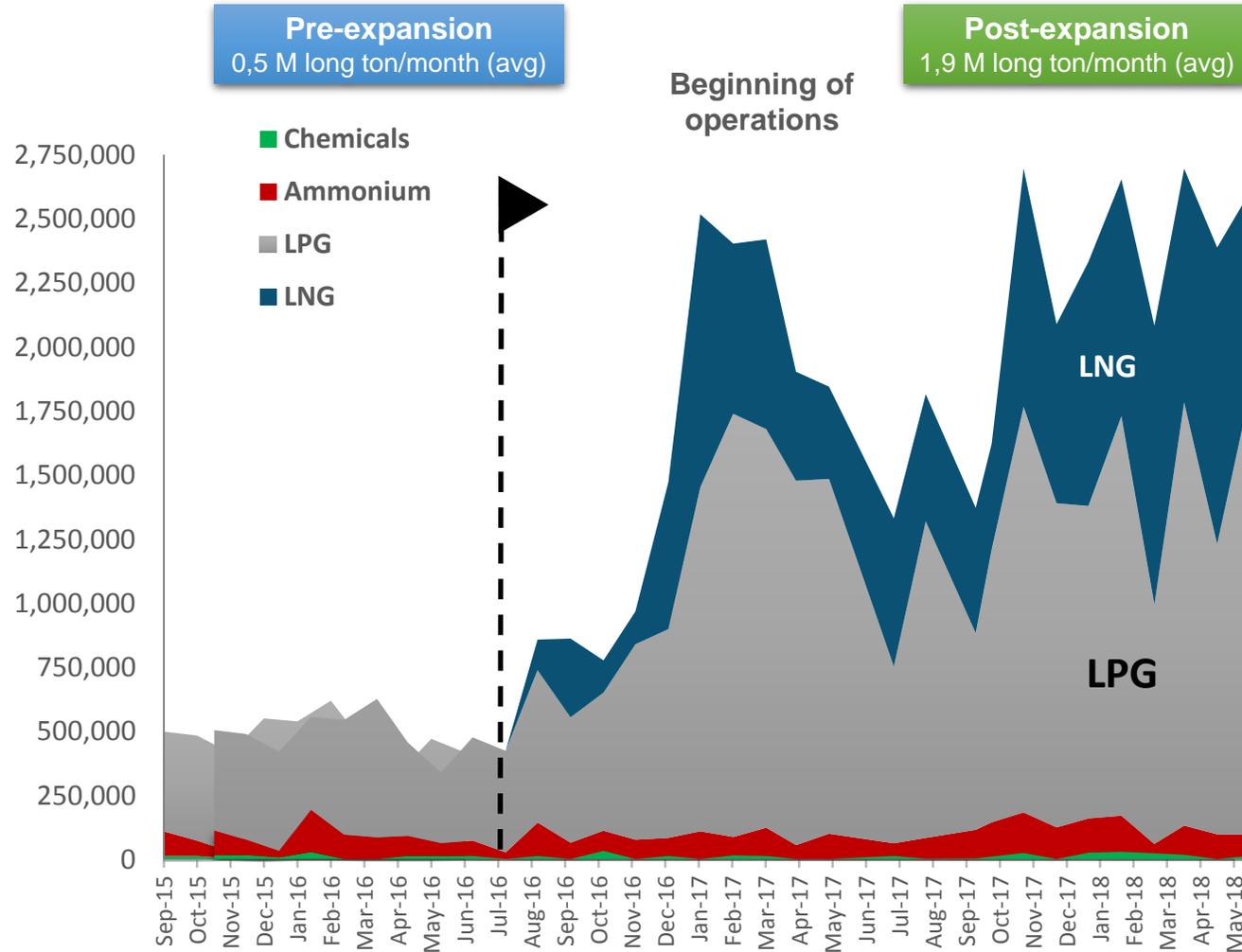
Transits and PC/UMS Tons



PCUMS Tonnage by Market Segment



New Markets Are Opening As Well



LPG-Panamax



Average load: 25,000 metric tons

VLGC



Average load: 43,000 metric tons



LNG – New market segment



Average load: 70,000 metric tons



CANAL DE PANAMÁ

Largest Containership

14,863 TEU



CMA CGM T Roosevelt (largest containership vessel to date August 22, 2017)



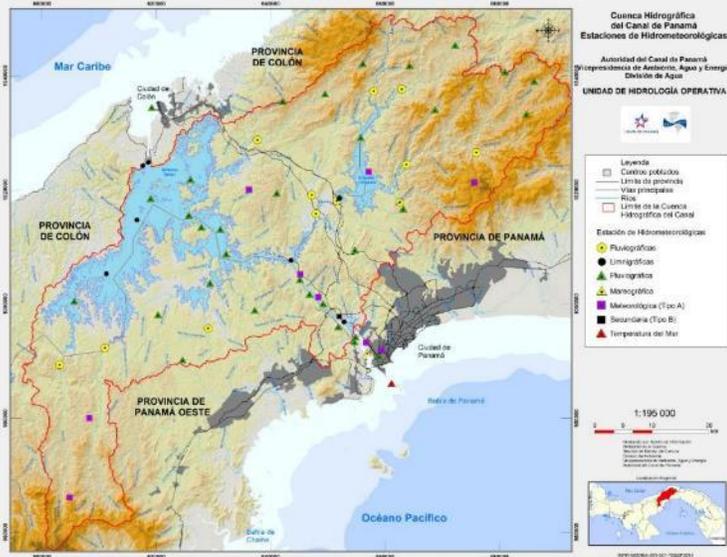
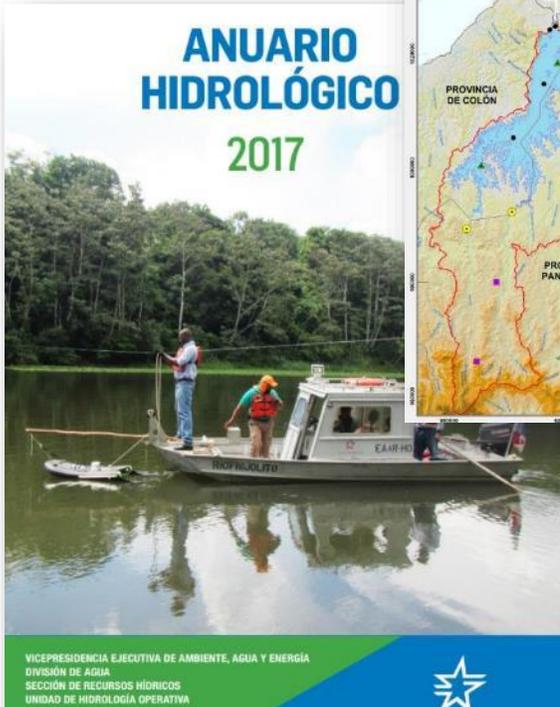
CANAL DE PANAMÁ



Panama Canal: Water Resources Management

Water Monitoring

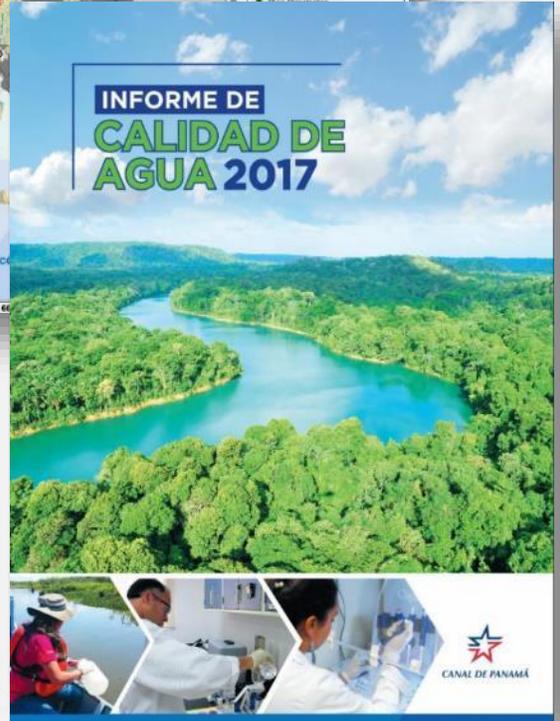
Quantity



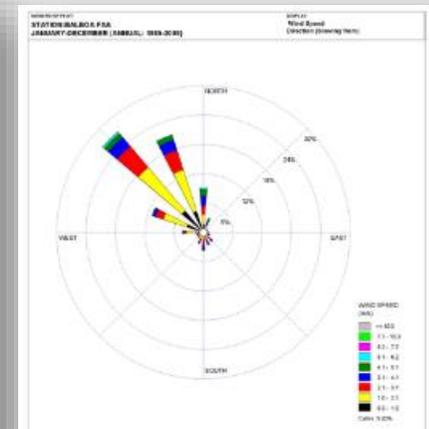
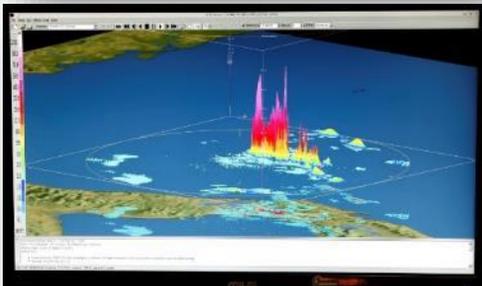
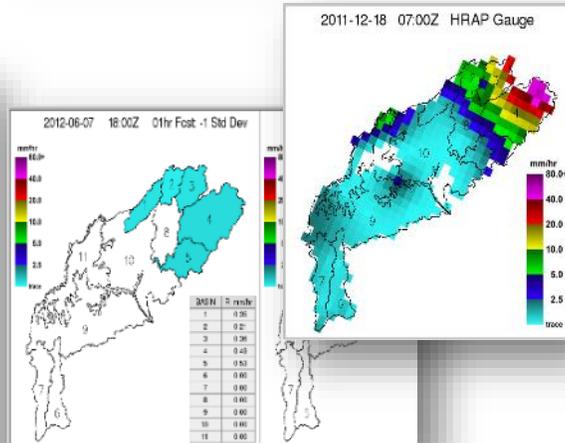
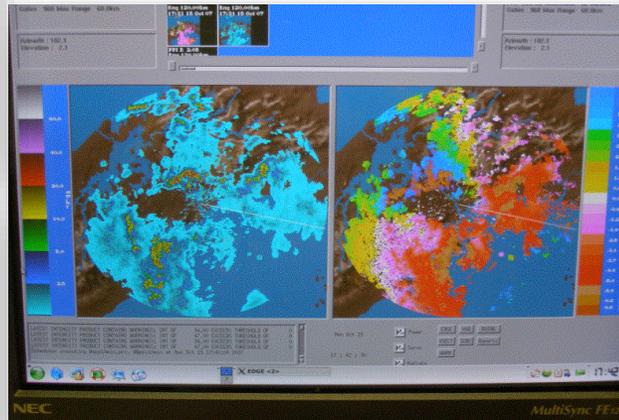
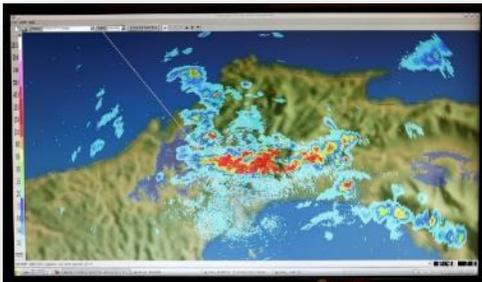
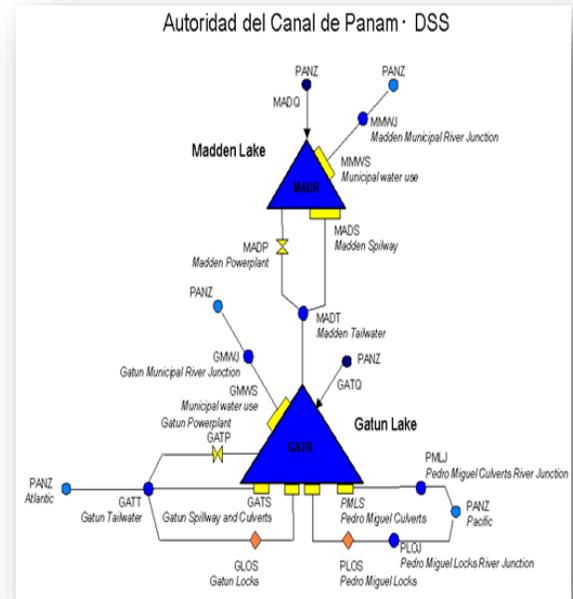
60 stations



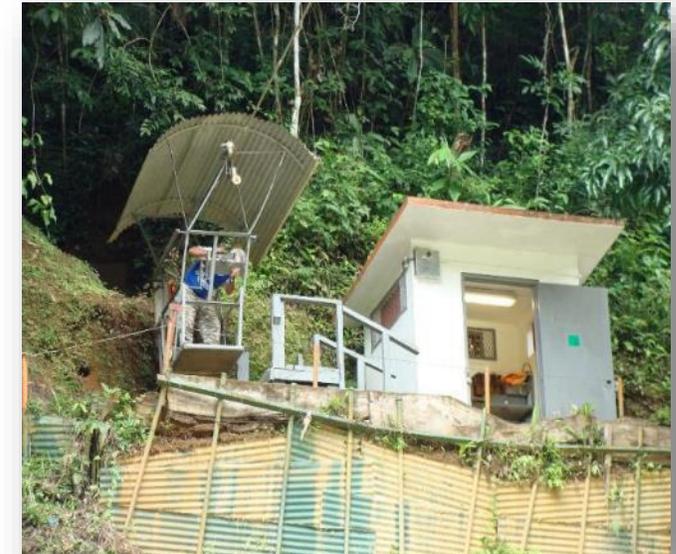
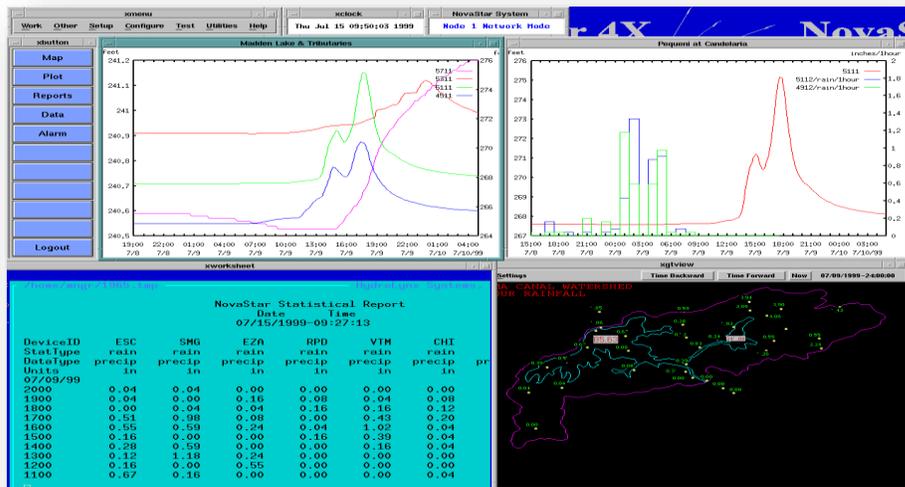
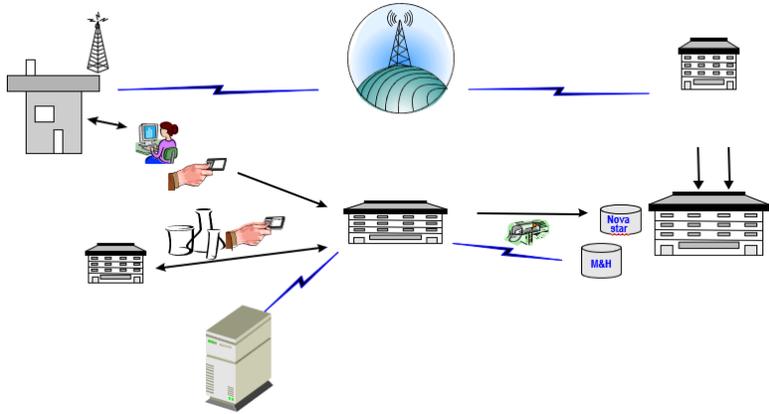
Quality



Technology



Telemetry System and Master Stations



Hydrometeorological Database

Impreso: 7-Jun-2012 08:20:45
BOH-1001

AUTORIDAD DEL CANAL DE PANAMÁ
DEPARTAMENTO DE AMBIENTE, AGUA Y ENERGÍA
DIVISION DE AGUA
SECCIÓN DE RECURSOS HÍDRICOS

1 de 2
Creado por: DEspinoso

CAUDALES MÁXIMOS INSTANTÁNEOS (m³/s)
ESTACIÓN RÍO CHAGRÉS EN CHICO

Letras: 009° 21' 42"
Longitud: 079° 42' 22"
Elevación: 400 m

AGO	SEP	OCT	NOV	DIC	ANUAL
272	245	126	196	666	1246
523	240	193	335	1449	1449
522	504	1096	169	2001	2001
588	281	201	541	622	622
583	65.8	193	1204	125	1204
545	212	172	277	479	545
551	301	332	2084	1233	2084
552	481	245	238	198	729
553	184	622	1518	342	1518
532	169	255	1788	1129	1788
580	144	133	655	452	1002
516	740	491	1367	77	1367
075	231	166	711	3531	3531
419	371	389	1958	1188	1958
075	740	1096	2084	3531	3531

Impreso: 7 Jun 2012 12:20:21
BOH-M2005

AUTORIDAD DEL CANAL DE PANAMÁ
DEPARTAMENTO DE AMBIENTE, AGUA Y ENERGÍA
DIVISION DE AGUA
SECCIÓN DE RECURSOS HÍDRICOS

1 de 1
Creado por: DEspinoso

INFORME DE PRECIPITACIÓN POR AÑO (mm)
Estación: Agua Clara
Período: 1994 - 2010

Letras: 000°21' 52" N
Longitud: 079°42' 22" O
Elevación: 400 m

Año	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC	Total
1996	665.3	175.3	312.4	200.7	908.8	574.0	213.4	414.0	281.9	233.7	975.4	180.3	4843.1
1997	33.0	10.2	15.2	20.3	360.7	388.1	136.7	215.9	297.2	215.9	632.5	33.0	2389.7
1998	43.2	7.6	65.9	307.3	467.2	373.4	373.4	543.0	408.9	381.0	416.1	500.4	3871.0
1999	20.3	129.5	178.3	373.4	332.7	612.1	515.6	492.8	236.2	353.1	703.6	812.9	4757.4
2000	106.7	17.8	15.2	114.3	312.4	600.4	261.0	420.3	355.0	845.8	256.5	726.4	4008.1
2001	134.6	6.1	76.7	33.0	248.9	170.2	287.0	438.9	304.6	322.6	538.3	617.2	3187.4
2002	132.1	15.2	142.2	212.0	64.0	220.1	290.7	623.2	231.1	450.7	580.3	58.4	2687.0
2003	63.5	20.3	45.7	183.4	487.7	335.3	419.1	315.0	456.4	482.0	721.4	421.9	3964.0
2004	33.0	17.8	71.1	294.0	681.7	410.1	207.2	657.0	548.0	487.7	655.3	180.3	4244.3
2005	248.9	61.0	63.5	548.0	342.9	200.7	228.1	254.0	416.9	309.9	596.0	124.5	3291.9
2006	65.8	38.1	114.3	100.2	365.8	342.9	449.6	383.7	383.7	342.0	812.8	160.1	3578.9
2007	10.2	35.3	76.2	420.0	721.0	294.0	343.0	358.0	250.0	441.0	384.0	681.0	3953.8
2008	25.0	40.0	31.0	65.0	212.0	345.0	368.0	412.0	184.0	282.0	936.0	151.0	3025.0
2009	90.0	102.0	80.0	133.0	434.0	369.0	381.0	518.0	164.0	456.0	799.0	65.0	3815.0
2010	38.0	123.0	78.0	88.0	276.0	175.0	330.0	481.0	253.0	632.0	1012.0	1655.0	5122.0
Promedio	114.2	52.9	89.7	194.5	378.9	366.7	327.0	425.3	316.6	415.3	673.3	426.9	2768.8
Máximo	665.3	175.3	312.4	425.0	721.0	612.1	515.6	657.9	548.0	845.8	1012.0	1655.0	
Mínimo	15.2	6.1	15.2	20.3	64.0	170.2	136.7	215.9	184.0	215.9	256.8	33.0	

BDH - Sistema

AMBIENTE, AGUA Y ENERGÍA
Manten el Canal día a día

Eluviometría

Eluviometría

Desarrollado para ACP

Control Aforo Modo Consulta

Identificación
Región: CUENCA DEL CANAL DE PANAMÁ Estación: ...
Cuenca: ... Fecha: 07/06/2012 Hora: ...
Sistema Inglés [X]
[X] PIES

Tipo de Aforo
[X] Con Aguacalí
[X] Con audifono
[X] Estimado con

Tipo de Cauce
Carilidad de brazos: ...
Sección: [X] Revestida [X] Uniforme
Flujo: [X] Olla Izquierda [X] Olla Derecha

Hidromensurador: ...
Datos Relevantes
Origen de las abscisas: [X] Olla Izquierda [X] Olla Derecha

Precipitación Pluvial Formulario M-1 Usuario: despinoso ..

Datos Estación
Región: 1 CUENCA DEL CANAL DE PANAMÁ Estación: 01000002 Agua Clara
Cuenca: Lago Gatún Período: 01/2010
Observador: ... Digitador: ...
Analista: ...
[Imprimir reporte] [ESTADO INGRESADO]

Detalle de Precipitación Pluvial

Día	Precipitación Diaria	Día	Precipitación Diaria
2	-	18	-
3	1.0	19	1.0
4	-	20	-
5	-	21	-
6	-	22	-
7	-	23	1.0
8	2.0	24	-
9	1.0	25	-
10	2.0	26	-
11	-	27	17.0
12	5.0	28	-
13	4.0	29	-
14	3.0	30	-
15	-	31	-
16	1.0	32	-
17	-		

[Analizar] [Grabar] [Nuevo] [Eliminar] [Cerrar]

Abscisa (m.)
24/1/2011 Altura: 83.3 Caudal: 53.8
17/1/2011 Altura: 83.96 Caudal: 121.26
17/1/2011 Altura: 84.36 Caudal: 182.44

Fecha	Hora	Altura	Caudal	Brazo	Tipo
17/11/2011	16:15	84.36	182.44	1	M
17/11/2011	18:15	83.98	121.26	1	M
24/11/2011	13:50	83.30	53.80	1	M

Alturas asociadas a la curva gaticada
Fecha: ... Hora: ... Altura: ... Caudal: ... Área: ... Vel: ... Med: ...
[Imprimir] [Cerrar]

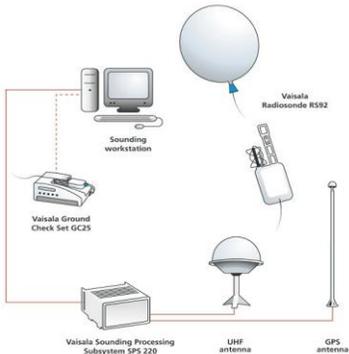
Satellite Weather Data Receiving Station

NOAA Port

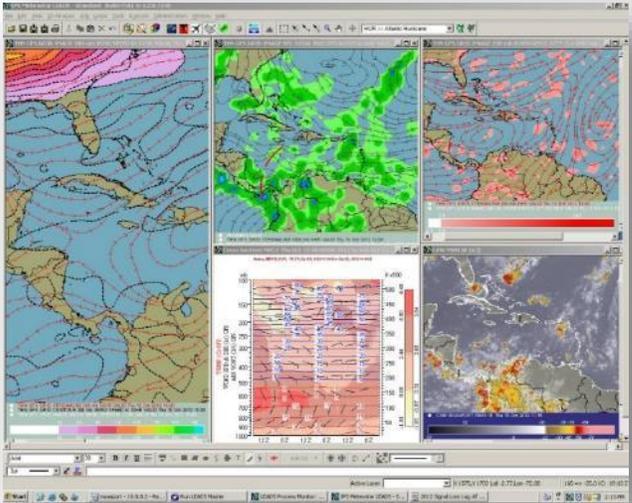


VAISALA

System Structure



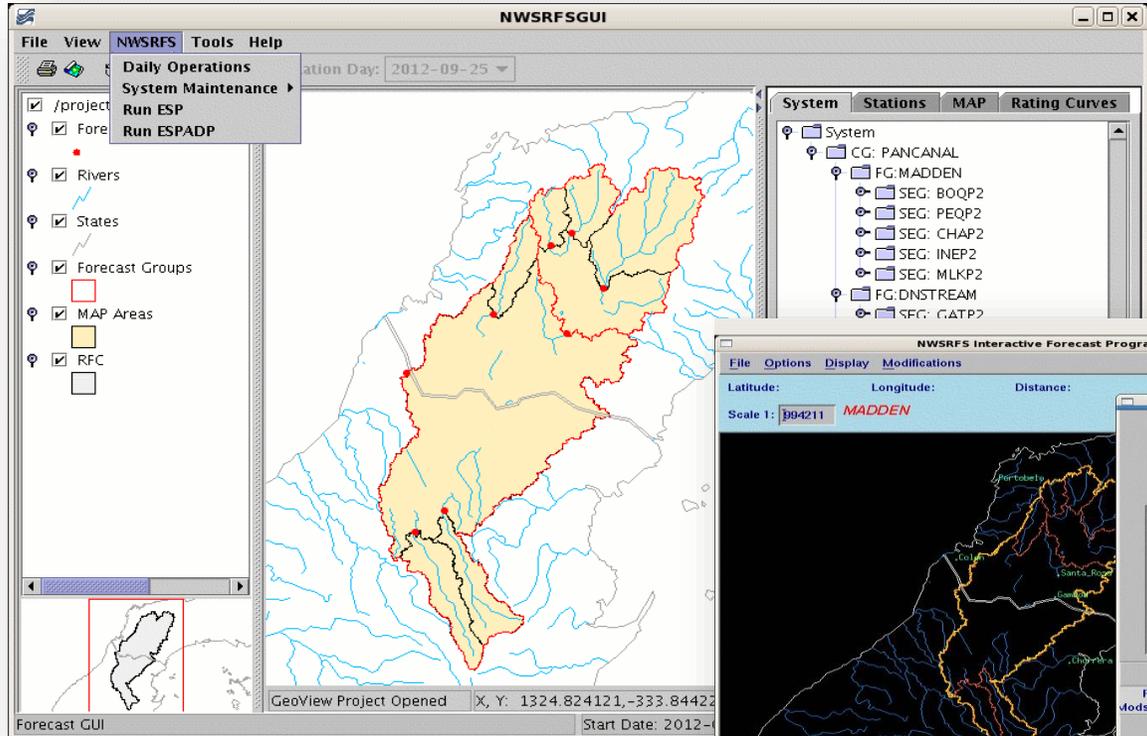
© Vaisala 2003-04-05 MaKa



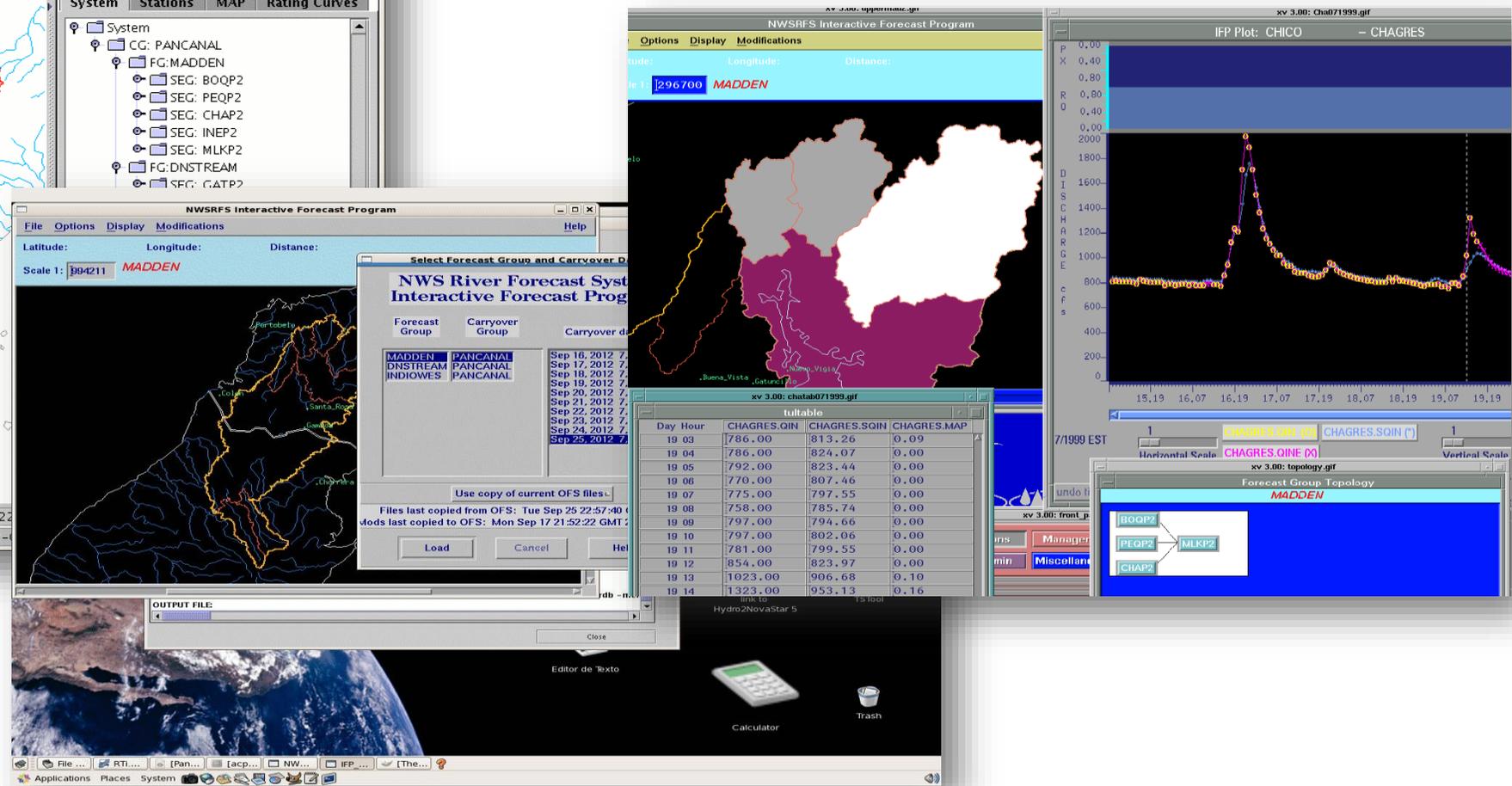
Radiosonde



Hydrologic Forecast Model of Rivers and Lakes



(NWSRFS/CHIPS)



(PANFCST)

Water Use



**Municipal and Industrial
Consumption**

Navigation and Lockage



Water Use: Hydroelectric Generation



GATUN



MADDEN



Flood Control



Gatun

Madden



Purísima

7th – 9th December 2010



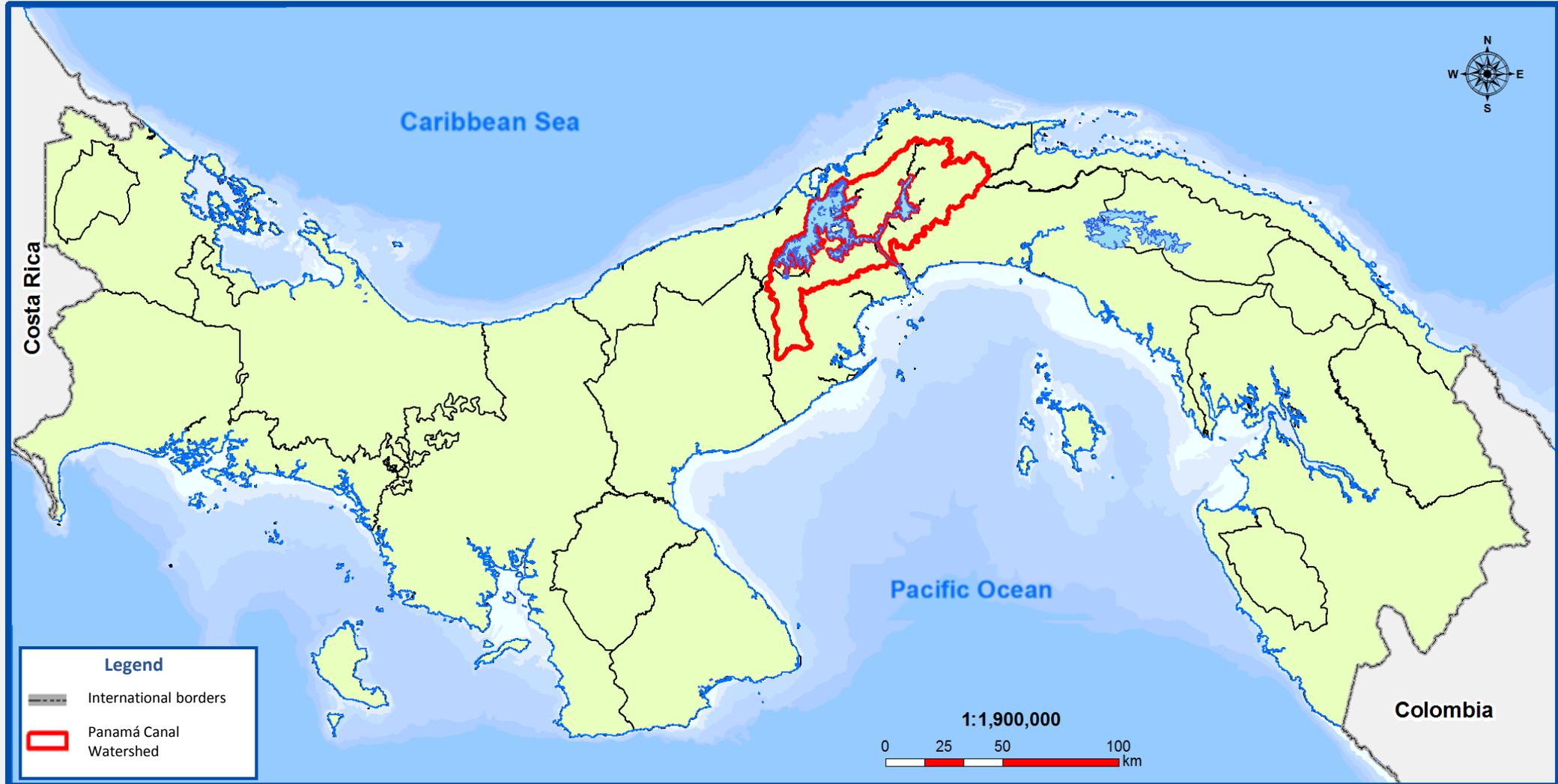
El Niño 2016





Panama Canal: Watershed Management

Panama Canal Watershed



Political Constitution

TITLE XIV

Article 316

The Panama Canal Authority, in accordance with state organisms determined by law, is responsible for the administration, maintenance, use and conservation of the Panama Canal watershed hydrological resources, which include the water in lakes and their tributary streams.



Constitutional
Title
November 25th,
1994

Law 19
June 11th, 1997

Regulations
June 17th, 1999

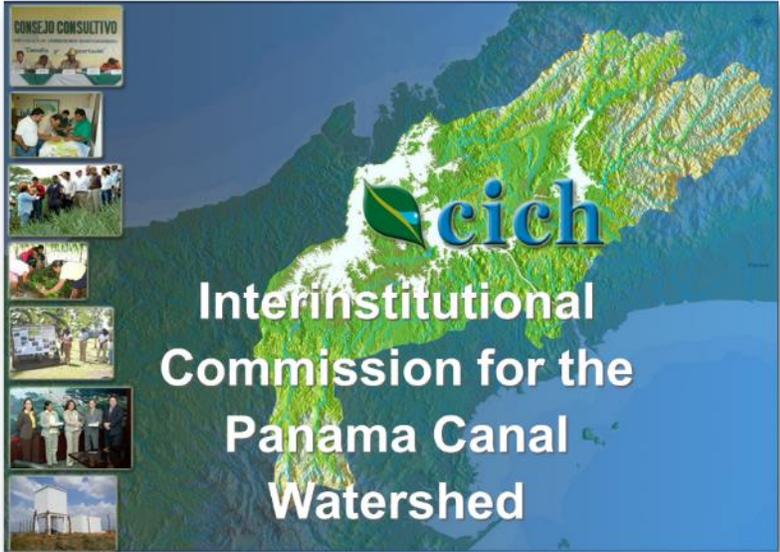
Regulations and
agreements
ACP: 1999 - 2006

Law 20
June 21th 2006

Panama Canal Watershed Interinstitutional Commission (CICH)

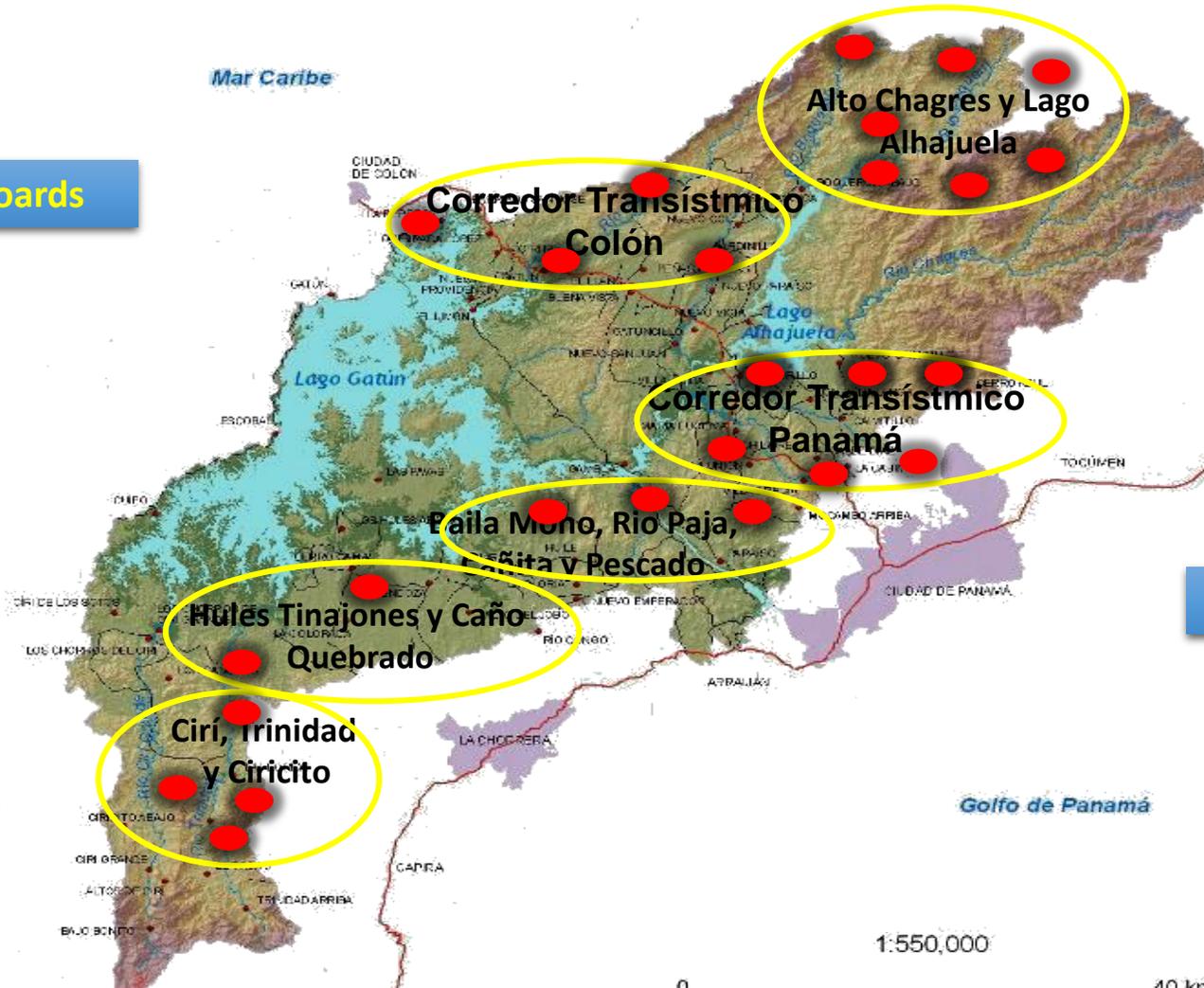


- Encourages mechanisms of coordination
- Establishes resource management and a funding system
- Monitors programs, projects and policies for watershed management
- Evaluates programs, projects and policies to avoid double work
- Administrates an environmental information center



Panama Canal Watershed Participants Scheme

6 Consultive boards



29 Local committees

Environmental Education and Community Program



- Watershed guardians
- Our canal and its basin
- The 3R's Campaign

Reforestation – conservation: Native species reforestation

Environmental recovery of disturbed areas in protected land

Historical background of the origin and purpose of white straw bush (*Saccharum spontaneum* L.) insertion in a Panamá. 2010.

<http://www.cich.org/documentos/paja-blanca.pdf>

Use of native species in land reforestation within the Panam Canal watershed (page 228-233). 2011.

<http://www.cich.org/publicaciones/Memoria-HELP-2011.pdf>



Agroforestry System

- Seeks to reduce the slash and burn - traditional method, by integrating communities as fundamental elements.
- Farm planning, sustainability, natural resources protection and farmers/technician training.
- Use of perennial species (timber types, coffee, fruit trees) combined with crop.



Training and Follow Up



Coffee training workshop (CATIE)



Visits



Field Evaluation



Monitoring evaluation



Plantation monitoring



Field evaluation

Coffee Production and Marketing



Carbon Credits

PANAMA CANAL



Lloyd's Register
LRQA

CERTIFICATE OF APPROVAL

This is to certify that the Management System of:

**Autoridad del Canal de Panama
Division de Ambiente
Edificio N° 706, Corozal
Panama**

has been approved by Lloyd's Register Quality Assurance
to the following Management System Standards:

ISO 14001:2004

The Management System is applicable to:

**Environmental Management Activities in Connection with the
Operation and Maintenance of the Panama Canal.**

This certificate is valid only in association with the certificate schedule bearing the same
number on which the locations applicable to this approval are listed.

Approval Certificate No: MQA 0113221	Original Approval: February 20, 2003
	Current Certificate: September 30, 2015
	Certificate Expiry: September 29, 2018

[Signature]

Issued by: Lloyd's Register Quality Assurance, Inc.
For and on behalf of: Lloyd's Register Quality Assurance Limited



UKAS
Av. Benito Juárez No. 109 Sur, Piso 9, Local 903, Col. Valle Oriente, San Pedro Garza García, N.L. 66269, Mexico
For and on behalf of: 1 Trinity Park, Sickenhill Lane, Birmingham, B37 7Y5, United Kingdom
Trustee of the LRQA Accreditation Fund, whose sole function is to support the accreditation activities of the Accreditation Certificate Number 001

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The Gold Standard®
Premium quality carbon credits

Project 3421



The Climate, Community & Biodiversity Alliance



VERIFICATION STATEMENT

for

AUTORIDAD DEL CANAL DE PANAMÁ

Edificio 705, Corozal Oeste, Calle Nogue, Ciudad de Panamá, República de Panamá

VERIFICATION SCOPE

Rainforest Alliance has verified that the Sustainable Forest Cover Establishment Project is in conformance with the Gold Standard AR Requirements Version 0.9. The project is located in the Panamá Canal watershed. This independent third-party verification covers a reforestation project of 1940 hectares of privately and publicly owned land. The objective of this verification audit is to verify the implementation of the validated GHG project. The information supporting the GHG assertion is historic in nature. The verification assessment covered the monitoring period from 1 April 2009 to 11 July 2016, and verified the following calculated emission reductions and/or removals were achieved during the monitoring period with a reasonable level of assurance.

Total number of verified emission reductions and/or removals: 132,246 tCO₂e
Total number of credits to be deposited in the buffer account: 26,449.2 tCO₂e

Verification Registration Code: RA-VER-GS-021921
Effective Date: 29 September 2016

The validity of this statement is contingent upon the project's continued implementation of the Gold Standard AR Requirements Version 0.9 and as further defined in the Rainforest Alliance Verification Audit Report dated 29 September 2016.

[Signature]
Jon Jickling
Jon Jickling, Certification

Rainforest Alliance
233 Broadway, 29th Floor
New York, NY 10279 USA

Rainforest Alliance provides carbon project validation and verification services based on protocols and standards developed by third-party organizations and for which Rainforest Alliance has been accredited as a validation or verification body. This statement certifies that Rainforest Alliance has verified that the project listed above complies with the particular standard listed above, as set forth in the audit report referenced above. In no circumstance does Rainforest Alliance warrant or guarantee the delivery of carbon emission reduction credits or the financial or market value of any credits verified in connection with this verification statement. This statement is prepared solely for the benefit of the organization listed above and may not be relied upon by any third party without the express written consent of Rainforest Alliance.



*Panama Canal: The **Green** Route*

PANAMA CITY, PANAMA HOTEL RIU PLAZA
IAHR World Congress, 2019
Water – Connecting the World

September 1-6, 2019

<http://iahrworldcongress.org>



CANAL DE PANAMÁ



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