Amphibious Architectures:

The Buoyant Foundation Project
in Post-Katrina New Orleans

by
Elizabeth Victoria Fenuta

A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Master of Architecture

Waterloo, Ontario, Canada, 2010

Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

This is a research-based thesis building upon the study conducted over the past two years with Dr. Elizabeth English on the Buoyant Foundation Project (BFP). The BFP is currently developing an amphibious foundation system to retrofit vernacular wooden 'shotgun' houses in the Lower Ninth Ward in New Orleans. This neighbourhood was chosen because of its unique cultural heritage and the severe, but recoverable, damage incurred in the aftermath of Hurricane Katrina. The BFP system will allow homes to float when flooding occurs, rising and descending vertically to avoid flood damage. It provides an alternative solution to permanent static elevation, the mitigation strategy currently recommended by the United States federal government.

The thesis will demonstrate how the Buoyant Foundation Project is a culturally supportive, technically feasible, economical, sustainable and resilient form of flood mitigation for post-Katrina New Orleans.

Acknowledgements

Dr. Elizabeth English
Eric Haldenby and Jeff Lederer
Jana Levitt

I wish to extend my heartfelt gratitude to my supervisor Dr. Elizabeth English, for her encouragement and commitment throughout the course of this thesis.

I would like to thank my committee members, Eric Haldenby and Jeff Lederer for their support and invaluable insight.

I would like to acknowledge Philip Beesley, Andrew Levitt and Ryszard Sliwka for their guidance during the initial exploration.

To Prithula Prosun, Andre Arseneault and Maria Alexandrescu for their research contributions.

To the Musagetes library staff, thank you for your patience and help with my numerous requests.

To my dearest friends who kept me grounded and sane through the ups and downs of these past years. You all have been a great inspiration: Angelene Fenuta, Cristina Papa, Ida Caruso, Lejla Odobasic, and James Swain.

To my parents and family for their constant love and support.

To the people of New Orleans, and to all those who helped through Katrina and its aftermath.

Table of Contents

	Authors Declaration	ii
	Abstract	iii
	Acknowledgements	iv
	Dedication	v
	Table of Contents	vi
	List of Illustrations	viii
	List of Acronyms	xxxiv
01	Introduction	**1**
i	Endnotes	4
02	Challenges	**6**
i	Introduction	8
ii	Ecology	9
iii	Unnatural Disaster	23
iv	Infrastructure	44
v	Summary	61
vi	Endnotes	62
03	Context	**65**
i	Introduction	67
ii	Diaspora	68
iii	Site: Lower Ninth Ward	83
iv	The Shotgun House	99
v	Summary	114
vi	Endnotes	115
04	A Solution: The Buoyant Foundation Project	**119**
i	Introduction	121
ii	Project	122
iii	Policy	137
iv	Legislation	144
v	Summary	153
vi	Endnotes	154
05	Technical Feasibility	**157**
i	Introduction	159
ii	Pointe Coupee Parish	160
iii	Maasbommel	167

Table of Contents

05 Technical Feasibility (continued)

iv LSU Hurricane Center Prototype 192
v Noah's Ark Project 199
vi FLOAT House 206
vii LIFT House 223
viii Analysis 238
xi Summary 247
x Endnotes 248

06 Efficiency **252**

i Introduction 254
ii Economy 255
iii Sustainability 260
iv Resilience 265
v Summary 270
vi Endnotes 271

07 The Future of the Buoyant Foundation Project **274**

i Introduction 276
ii Future of the BFP 277
iii Timelines 284
iv Summary 287
v Endnotes 288

08 Conclusions **289**

Bibliography **292**

Appendices **307**

i Primitive Amphibious Architecture 308
ii Canadian Floating and Amphibious Architecture 317
iii Floating Recycled Structures 325
iv The Winston Land-Locked House 332
v Articles on the BFP 340
vi Interview by Charlotte Garson with Dr. Elizabeth English 384
vii BFP Powerpoint Presentation 397
viii Paper for the Urban Flood Management Conference in Paris 412
ix Richard Campanella at the Building Resilience Workshop 421
x The People's Plan 423
xi The Buoyant Foundation Project Movie 455

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
2	1	Post-Katrina, New Orleans, 2005 photo by Rick Wilkings/Reuters c2010.
13	2	Artificial Levee System, Sections McCulloh, Heinrich and Good. 2006, 31
13	3	Artificial Levee System McCulloh, Heinrich and Good. 2006, 31
14	4	Natural Levee System McCulloh, Heinrich and Good. 2006, 12
15	5	Before and After Artificial Levees graphic by Dan Swenson, [http://www.nola.com/hurricane/popup/goingunder_jpg.html], accessed August 5, 2010.
17	6	Three-Dimensional Subsidence Diagram graphic by Dan Swenson, [http://www.nola.com/hurricane/popup/goingunder_jpg.html], accessed August 5, 2010.
17	7	Schematic Cross-Section Diagrams Depicting Subsidence At Submerged and Superficial Scales McCulloh, Heinrich and Good. 2006, 10
19	8	Defining the ‘Bowl’ graphic by Dan Swenson, [http://www.nola.com/hurricane/popup/goingunder_jpg.html], accessed August 5, 2010.
19	9	Possible Storm Surge and Inundation ibid.
20	10	2-Foot Sea-Level Rise, Context ibid.
20	11	1-Foot Sea-Level Rise graphic by Dan Swenson, [http://blog.nola.com/graphics/2008/12/ChangingCoastline121408.pdf], accessed July 8, 2010.
20	12	2-Foot Sea-Level Rise ibid.
21	13	3.3-Foot Sea-Level Rise ibid.

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
21	14	Sea-Level Rise at Grand Isle Relative to the 2002-2007 mean Sea-Level graphic by Dan Swenson, [http://www.nola.com/hurricane/popup/goingunder_jpg.html], accessed August 5, 2010.
23	15	Areas of Land Loss and Gain in Coastal Louisiana for 1932-2000 and the projected from 2000-2050 [http://coastal.er.usgs.gov/hurricanes/], accessed December 23, 2009.
26	16	Hurricane Katrina Approaching the Gulf Coast on August 28, 2005, Aerial View [http://www.nasa.gov/vision/earth/lookingatearth/h2005_katrina.html], accessed September 1, 2009.
27	17	Saffir-Simpson Hurricane Scale [http://www.usatoday.com/weather/graphics/hurricane/hurricane2005/flash.htm], accessed October 4, 2009.
27	18	Comparison of the Deadliest, Strongest and Costliest Hurricanes in the United States ibid., accessed November 20, 2009.
28	19	Hurricane Katrina Timeline graphics by Dan Swenson, [http://www.nola.com/katrina/graphics/credits.swf], accessed September 1, 2009.
36	20	Destroyed Neighbouhood, Post-Katrina New Orleans, 2005 [http://hurricanearchive.org/content/fullsize/1282481704_d498090b87_fullsize.jpg], accessed March 28, 2010.
36	21	Flooded Street, Post-Katrina New Orleans, 2005 [http://www.raywert.blogspot.com/2005/08/more-katrina-pictures.html], accessed July 23, 2009.
37	22	Rescue Boat, Post-Katrina New Orleans, 2005 [http://www.doubletruckmagazine.com/issues/dt_005/], accessed September 24, 2009.
37	23	US Coast Guard Rescue Boat,Post-Katrina New Orleans, 2005 photo by John McQuaid, [http://www.flickr.com/photos/mcquaid/134941682/in/photostream/], accessed September 1, 2009.
38	24	Exterior Photo Montage of Post-Katrina, New Orleans [http://www.arthurrogergallery.com/dynamic/artwork_detail.asp?ArtworkID=1402] accessed January 26, 2010. [http://www.metiviergallery.com/artist_artwork.php?artist=polidori&artwork=5979_west_end_boulevard] accessed April 23, 2010. [http://www.metiviergallery.com/artist_artwork.php?artist=polidori&artwork=munster_boulevard] accessed April 23, 2010.

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
38	24	Exterior Photo Montage of Post-Katrina, New Orleans (continued) [http://www.arthurrogergallery.com/dynamic/artwork_detail.asp?ArtworkID=1408] accessed April 23, 2010. [http://www.takepart.com/news/tag/new-orleans-katrina] accesed August 1, 2010. [http://www.flickr.com/photos/gailevans/379052353/#/] accessed January 26, 2010. [http://www.asergeev.com/pictures/archives/2006/490/jpeg/01.jpg], accessed April 28, 2010. [http://krisarnold.com/2010/08/17/5-years-after-hurricane-katrina-a-retrospect/] accessed August 1, 2010. [http://krisarnold.com/wp-content/uploads/2010/07/New_Orleans_in_January_Part_4_by_cangceiro.jpg] accessed August 1, 2010.
40	25	Interior Photo Montage of Post-Katrina, New Orleans Polidori, Robert. 2006, 16-32
42	26	The Superdome, Post-Katrina photo by John McQuaid, [http://www.flickr.com/photos/mcquaid/134953448/], accessed July 1, 2010.
42	27	People Waiting Outside the Superdome photo by REUTERS/Jason Reed, [http://www.flickr.com/photos/95818633@N00/232406129/], accessed July 1, 2010.
42	28	Inside the Superdome, Post-Katrina [http://www.digitaljournal.com/img/8/9/9/i/4/8/8/o/SuperdomeRefugees.jpg], accessed July 1, 2010.
42	29	Vacant FEMA Trailers, Post-Katrina [http://thehubsterblog.blogspot.com], accessed July 1, 2010.
43	30	Hurricane Katrina Entergy Restoration Assessment Summary image provided by Dorothy Reed on December 3, 2009 via email, original source Entergy, 2006
44	31	Homes Inspected by National Guard [http://www.flickr.com/photos/drp/228254340/], accessed November 20, 2009.
45	32	Diagram of Markings Made by National Guard graphic by Dan Swenson, [http://danswenson.com/paper/katrinagraphics/04Kat-house-marks.jpg], accessed November 20, 2009.
45	33	Markings Made by National Guard on Homes Campanella, Richard. 2008, 405
47	34	Typical USACE Flood Protection Structures Andersen, Christine F. 2007, 21

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
48	35	T-Wall and I-Wall, Three-Dimensional Section [http://www.mvn.usace.army.mil/hps2/images/t-wall_prescour.jpg], accessed September 1, 2009.
48	36	Increasing the Top Elevation of an Earthen Levee Andersen, Christine F. 2007, 21
50	37	Areas of Levee Failure, Plan view McQuaid and Schleifstein. 2006, 1
50	38	Areas of Levee Failure, Three-Dimensional View McQuaid and Schleifstein. 2006, 2
51	39	NOLA 17th Street Breach, August 31, 2005 [http://ngs.woc.noaa.gov/storms/katrina/24425575.jpg], accessed December 10, 2009.
52	40	Levee Overtopping at the Industrial Canal [http://kathyprice.typepad.com/dispatch_from_new_orleans/lower_ninth_ward/], accessed November 4, 2009.
54	41	Extent of Flooding from Katrina Levee Failures by District [http://www.gnocdc.org], accessed January 18, 2010.
55	42	Post-Katrina Aerial Photograph, New Orleans, Louisiana, 2005 [http://www.gettingprepared.info/blog/hurricane-katrina-five-years-later/], accessed November 1, 2009.
56	43	Post-Katrina Aerial Photograph, New Orleans, Louisiana, 2005 [http://www.katrinadestruction.com/images/v/hurricane/hurricane+katrina+flooding.html], accessed December 8, 2009.
57	44	Diagram Showing the Extent of Flooding After Hurricane Katrina Correa, Felipe. 2007, 105
58	45	New Orleans House Flooded in the Aftermath of Katrina photo by Elizabeth English
58	46	Katrina Flood Depths and Impacts in the Greater New Orleans Region Campanella, Richard. 2008, 399
59	47	Depth of Flooding by Block [http://gnocdc.org/], accessed August 6, 2009.
61	48	Days Wet by Block ibid., accessed August 6, 2009.

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
71	49	Katrina's Exodus graphic by Dan Swenson, [http://danswenson.com/paper/katrina.html], accessed August 30, 2009.
73	50	Population Redistribution in Louisiana, September 20, 2005. [http://lagic.lsu.edu/hurricanes.htm], accessed October 4, 2009.
74	51	Population Decline Comparison Andersen, Christine. 2007, 9
74	52	Total Population Estimates by Parish 2000-2009 [http://www.gnocdc.org/census_pop_estimates.html], accessed July 1, 2010.
75	53	Population Density Map, May 2008 [http://www.nolamasterplan.org], accessed August 6, 2009.
77	54	Number of Unoccupied Residential Addresses by Planning District and Percent by Census Tract, March 2009 [http://gnocdc.org/recoverbyneighbourhood], accessed August 6, 2009.
78	55	Percentage of New Orleans Addresses Actively Receiving Mail in June 2005 and June 2010 [http://media.nola.com/news_impact/photo/census070210jpg-dbf6783cf6a5e26c.jpg], accessed June 1, 2010.
79	56	Planning District 8: Working Draft of Future Land Use Map [https://www.communicationsmgr.com/projects/1371/docs/District%208_012610_11x17.pdf], accessed February 1, 2010.
82	57	Northern Portion of the Lower Ninth Ward - Post-Katrina New Orleans [http://www.raytown.mo.us/vertical/Sites/percent7B418C71C3-E397-4C87-B464-C498EC8900F9percent7D/uploads/percent7BAB7684B1-5F9C-49B8-9934-3E830C40177Apercent7D.JPG], accessed January 29, 2010.
83	58	Structural Damage in the Lower Ninth Ward [http://www.rebuildingtheninth.org/resources/], accessed January 29, 2010.
83	59	Damage due to Flooding in the Lower Ninth Ward [http://www.rebuildingtheninth.org/resources/], accessed January 29, 2010.
84	60	Residential Recovery in the Lower Ninth Ward [http://www.rebuildingtheninth.org/resources/], accessed January 29, 2010.
84	61	Desire to Move Back to the Lower Ninth Ward [http://www.rebuildingtheninth.org/resources/], accessed January 29, 2010.

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
87	62	Aerial View of Southeast Louisiana adapted by Elizabeth Fenuta from Google Earth, [http://earth.google.com], accessed October 6, 2009.
89	63	Diagram of the 17th Wards in New Orleans adapted by Elizabeth Fenuta from [http://www.gnoinfo.com/east], accessed October 6, 2009.
91	64	Partial Aerial View of New Orleans adapted by Elizabeth Fenuta from Google Earth, [http://earth.google.com], accessed October 6, 2009.
93	65	Boundaries in New Orleans image by Elizabeth Fenuta adapted from [http://www.gnocdc.org], accessed July 1, 2010.
96	66	Lower Ninth Ward, Pre and Post Katrina Housing Darden, Thomas. 2007, 4
97	67	Mardi Gras, New Orleans [http://www.bourbonstreet-tokyo.com/contents/mardi_gras], accessed November 11, 2009.
97	68	Jazz Festival, New Orleans [http://www.kalamu.com/bol/wp-content/content/images/rebirthpercent2001.jpg], accessed November 11, 2009.
99	69	Second Line Parade in the Lower Ninth Ward, Post-Katrina New Orleans [http://www.flickr.com/photos/40280626@N08/3904422941/in/photostream/], accessed November 21, 2009. [http://www.flickr.com/photos/40280626@N08/3905206276/sizes/l/], accessed November 21, 2009. [http://www.flickr.com/photos/40280626@N08/3904423831/sizes/l/in/photostream/], accessed November 21, 2009.
103	70	The Louisiana Shotgun House, Montage assembled by Elizabeth Fenuta, images from various listed below, accessed July 30 2009: [http://www.asergeev.com/pictures/archives/compress/2005/452/18.htm] photo by Infrogmation, [http://en.wikipedia.org/wiki/File:BayouStJohnHeartMarkTires.jpg], [http://bywaterneighbors.com/images/photo_shotgun03.jpg] [http://bywaterneighbors.com/images/photo_shotgun01.jpg] [http://www.flickr.com/photos/fej/2770098628/] [http://en.wikipedia.org/wiki/File:TH234.jpg] [http://z.about.com/d/architecture/1/0/E/u/shotgunflickr.jpg] [http://upload.wikimedia.org/wikipedia/en/a/ab/GTWN236.jpg] [http://www.blahedo.org/pix/nola/shotgun-house.jpg] [http://www.jetsettersmagazine.com/archive/jetezine/sports02/bike/bigeasy/photos/shotgun.jpg]

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
103	70	The Louisiana Shotgun House, Montage (continued) [http://www.asergeev.com/pictures/archives/compress/2005/451/03.htm] [http://www.asergeev.com/pictures/archives/zb.htm]
104	71	Single Shotgun House, 3913 St. Claude Avenue, Upper Ninth Ward photo by Michael Eastman, [http://www.nola.com/living/index.ssf/2009/08/katrina_adds_poignancy_to_a_pi.html], accessed October 31, 2009.
104	72	Brightly Painted Shotgun Houses [http://www.thoracic.org/sections/meetings-and-courses/international-conference/2010/what-o-see-and-do/images/shotgun-house-architecture.jpg], accessed November 11, 2009.
105	73	Shotgun Interior [http://kathyprice.typepad.com/dispatch_from_new_orleans/lower_ninth_ward/], accessed November 4, 2009.
107	74	Shotgun House, Room Assembly Holl, Steven. 1998, 34
107	75	Shotgun House-Typical Plan Edwards, Jay. 2008, 4
107	76	New Orleans Block Plan with Shotgun and Double Shotguns in 1908 Edwards, Jay D. “New Orleans Shotgun: An Historical Cultural Geography, Cultures of Re building Conference.” Department of Geography and Anthropology. Louisiana State University, Powerpoint Presentation. 2008.
107	77	New Orleans Block Plan with Shotgun and Double Shotguns - (Date Unknown, Post 1908) Holl, Steven. 1998, 34
108	78	Single Shotgun House, 3D View and Plan image by Elizabeth Fenuta
108	79	Double Shotgun House, 3D View and Plan image by Elizabeh Fenuta
109	80	Camelback Shotgun House, 3D View and Plan image by Elizabeth Fenuta
109	81	Double Camelback Shotgun House, 3D View and Plan image by Elizabeth Fenuta
110	82	Shotgun Typologies by Parish in Southern Louisiana image by Elizabeth Fenuta adapted from Vlach, John Michael. 1975, 237-296

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
113	83	Shotgun Design Process image by Elizabeth Fenuta adapted from Vlach, John Michael. 1975, 35-36
114	84	An Elevated Double Shotgun House Campanella, Richard. [http://www.designobserver.com/places/entry.html?entry=12978] accessed July 1, 2010.
126	85	Shotgun House on Buoyant Foundation - Normal Position image by Elizabeth Fenuta
126	86	Shotgun House on Buoyant Foundation - Extended Position image by Elizabeth Fenuta
128	87	Static Elevation versus Amphibious Foundations During a Flood image by Elizabeth Fenuta
128	88	Streetscape Comparison Diagram During a Flood image by Elizabeth Fenuta
129	89	A Floating Dock System [http://www.dockaccents.com/floating_docks_specs.htm], accessed October 11, 2009.
129	90	BFP Section image by Elizabeth Fenuta
130	91	The Buoyant Foundation System, Exploded Axonometric image by Elizabeth Fenuta
131	92	1315 Lamanche Street, Shotgun House photo by Ezra Boyd
133	93	Aerial View of 1315 Lamanche Street adapted by Elizabeth Fenuta from Google Earth, [http://earth.google.com], accessed September 11, 2009.
135	94	Three Zones in the Lower Ninth Ward image by Elizabeth Fenuta, base image from Google Earth, [http://earth.google.com], accessed September 11, 2009.
135	95	Conceptual Rendering of 1315 Lamanche Street, Existing Conditions, Three Quarter View model by Andre Arseneault, rendering by Elizabeth Fenuta
135	96	Conceptual Rendering of 1315 Lamanche Street, Existing Condition, Back View with Addition model by Andre Arseneault, rendering by Elizabeth Fenuta

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
136	97	Conceptual Rendering of 1315 Lamanche Street, retrofit with the Buoyant Foundation System model by Andre Arseneault, rendering by Elizabeth Fenuta
136	98	Conceptual Rendering of 1315 Lamanche Street, retrofit with the Buoyant Foundation System, Fully Extended model by Andre Arseneault, rendering by Elizabeth Fenuta
137	99	1315 Lamanche, Street Plan model by Andre Arseneault, rendering by Elizabeth Fenuta
137	100	1315 Lamanche, Street Elevation model by Andre Arseneault, rendering by Elizabeth Fenuta
141	101	Letter from FEMA, Friday, September 28, 2007 letter from Ross K Richardson to Elizabeth English on Friday September 28, 2007.
142	102	Letter from Tri-Parish Times, Monday December 14, 2009 letter from Brett D Schweinberg to Elizabeth English on Monday December 14, 2007.
143	103	Letter from FEMA, Friday December 11, 2009 letter from Earl Armstrong to Elizabeth English on Friday December 11, 2009.
144	104	Assembly Process image by Elizabeth Fenuta
145	105	Components for Static Elevation to BFE, Diagram (Previously Phase 1) image by Elizabeth Fenuta
145	106	Addition of Buoyancy Components and Vertical Guidance, Diagram (Previously Phase 2) image by Elizabeth Fenuta
147	107	An Elevated Home in New Orleans photo provided by Elizabeth English
147	108	Flood Level Exceeded BFP [http://www.fema549_apndx_e_ra8.pdf], accessed October 6, 2009.
147	109	ABFE Guidance and Levee Sub-Basin Locations for Orleans Parish Federal Emergency Management Agency, “Advisory Flood Elevations and Disaster Assistance,” ABFE_FAQ.pdf, http://www.fema.gov/news/newsrelease.fema?id=23283, 2 (accessed October 23, 2009).
148	110	Flooding Beyond the Special Flood Hazard Area [http://www.fema549_apndx_e_ra8.pdf], accessed October 6, 2009.

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
149	111	Hurricane Katrina Surge Inundation and Advisory Base Flood Elevation Map for Orleans Parish, Louisiana [http://www.fema.gov/hazard/flood/recoverydata/katrina/katrina_la_orleans.shtm] accessed November 20, 2009.
151	112	FEMA Flood Zone Plan, Lower Ninth Ward [http://www.fema.com/], accessed September 11, 2009.
152	113	Flood Insurance Rate Map Zones Defined by the NFIP [http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/zone_a.shtm], accessed September 11, 2009.
153	114	Recommended Construction in Zones A and V [http://www.fema549_apndx_e_ra8.pdf], accessed October 6, 2009.
153	115	Recommended Construction in Zones B, C and X [http://www.fema549_apndx_e_ra8.pdf], accessed October 6, 2009
154	116	Damage to Owner-Occupied Housing Units in the Lower Ninth Ward, Post-Katrina [http://www.huduser.org/publications/destech/GulfCoast_HsngDmgEst.html], accessed November 20, 2009.
163	117	Partial Aerial View of Pointe Coupee Parish adapted by Elizabeth Fenuta from Google Earth, [http://earth.google.com], accessed September 28, 2009.
165	118	Pointe Coupee Parish Key Map [http://en.wikipedia.org/wiki/File:Map_of_Louisiana_highlighting_Pointe_Coupee_Parish.svg], accessed September 28, 2009.
165	119	Old River, Key Map [http://www.fishinglouisiana.com/area2/#Oldpercent20River], accessed September 28, 2009.
165	120	Permanent Static Elevated Fishing Camp in Raccourci Old River photo by Dustin Ewing
165	121	Fishing Camp of Amphibious Foundations in Raccourci Old River photo by Dustin Ewing
166	122	Dry in September photo by Dustin Ewing
166	123	Floating in February photo by Elizabeth English

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
166	124	Detail of Amphibious Foundations photo by Dustin Ewing
166	125	Fishing Camp of Amphibious Foundations in Raccourci Old River photo by Dustin Ewing
167	126	Montage of Fishing Camps on Amphibious Foundations Dry in September montage by Elizabeth Fenuta, original photos taken by Dustin Ewing
168	127	Montage of Fishing Camps on Amphibious Foundations Floating in February montage by Elizabeth Fenuta, original photos taken by Stuart Brussard and Elizabeth English
170	128	Aerial View of Maasbommel, Netherlands adapted by Elizabeth Fenuta from Google Earth, [http://earth.google.com], accessed October 25, 2009.
172	129	Aerial View of Maasbommel, Netherlands adapted by Elizabeth Fenuta from Google Earth, [http://earth.google.com], accessed October 25, 2009.
174	130	Two-Thirds of the Netherlands Protected image by Elizabeth Fenuta, adapted from [http://www.waterland.net], accessed April 7, 2010.
174	131	Maasbommel, Site photo by Dura Vermeer [http://www.clinq.eu/wie-dura-klimaatadaptief], accessed November 1, 2009.
175	132	Maasbommel photo by Hans van Beek
175	133	Maasbommel photo by Hans van Beek
176	134	Municipality of West Maas en Waal [http://en.wikipedia.org/wiki/File:Map_NL_-_West_Maas_en_Waal_-_Maasbommel.png], accessed September 10, 2009.
176	135	Town of Maasbommel and Municipal Boundary [http://upload.wikimedia.org/wikipedia/commons/thumb/1/12/Map_-_NL_-_West_Maas_en_Waal_-_Wijk_07_Maasbommel_-_Buurt_00_Kern_Maasbommel.svg/375px-Map_-_NL_-_West_Maas_en_Waal_-_Wijk_07_Maasbommel_-_Buurt_00_Kern_Maasbommel.svg.png], accessed August 3, 2009.

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
176	136	Site Sections, Maasbommel [http://www.worldarchitecturenews.com/index.php?fuseaction=wanappln.showprojectbigimages&img=5&pro_id=995], accessed September 14, 2009.
177	137	Fixed and Floating Position, Maasbommel Kengen, Ger A.L. 2007. 5
178	138	Construction Process of Amphibious Homes at Maasbommel - Foundation Structure Kengen, Ger A.L. 2007.22-27
180	139	Construction Process of Amphibious Homes at Maasbommel - Structure of House Kengen, Ger A.L. 2007.22-27
181	140	Vertical Guidance Post Connection photo by Hans van Beek
181	141	Vertical Guidance Post Detail [http://www.europress.pl/newsletter/09_2007/obrazki/technologypercent20review4.jpg], accessed September 14, 2009.
181	142	Floating City, Conceptual Rendering [http://www.duravermeerbusinessdevelopment.nl/output/project/911/tn_911_drijvende_stad_500_breed.jpg], accessed September 14, 2009.
182	143	Maasbommel [http://static.worldarchitecturenews.com/news_images/995_4_1000percent20Maasbommelpercent20Floatingpercent20Homespercent205.jpg], accessed July 30, 2009.
182	144	Maasbommel [http://static.worldarchitecturenews.com/news_images/995_4_1000percent20Maasbommelpercent20Floatingpercent20Homespercent205.jpg], accessed August 4, 2010.
183	145	Dura Vermeer and Kengen Architect Kengen, Ger A.L. 2007, 20
184	146	Section, Type A Kengen, Ger A.L. 2007, 42
184	147	Section, Type B Kengen, Ger A.L. 2007, 43
185	148	Elevation Kengen, Ger A.L. 2007, 47

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
185	149	Ground Floor Plan Kengen, Ger A.L. 2007, 45
186	150	Upper Level Plan Kengen, Ger A.L. 2007, 46
187	151	Lower Level Plan Kengen, Ger A.L. 2007, 44
188	152	Foundation Detail Kengen, Ger A.L. 2007, 49
189	153	Connection Detail Kengen, Ger A.L. 2007, 50
190	154	Wall Section, Floor Kengen, Ger A.L. 2007, 52
191	155	Wall Section, Window Kengen, Ger A.L. 2007,
192	156	Roof Section Kengen, Ger A.L. 2007, 53
193	157	Floor Section Kengen, Ger A.L. 2007, 51
195	158	Partial Aerial View of Louisiana State University Campus adpated by Elizabeth Fenuta from Google Earth, [http://earth.google.com], accessed September 14, 2009.
197	159	The Original Team of LSU Mechanical Engineering Students photo by Elizabeth English
198	160	Diagram of Vertical Guidance Post and Sleeve image by Dustin Ewing
198	161	Diagram of a Typical Shotgun House image by Ben Morvant
198	162	Diagram of Foam Buoyancy Block, Angles and T-Beams image by Dustin Ewing
198	163	Diagram of LSU Prototype's Components Assembled image by Elizabeth Fenuta

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
199	164	First Prototype at LSU, Construction Process photos by Gerry Masterman, Elizabeth English et al.
200	165	First Prototype at LSU, Construction Process photos by Elizabeth English and Jill Bamburry
202	166	Aerial View of Louisville Street, Lakeview, New Orleans adapted by Elizabeth Fenuta from Google Earth, [http://earth.google.com], accessed September 14, 2009.
203	167	6222 Louisville Street, Lakeview, New Orleans photo by Elizabeth English
203	168	Entry Stair photo by Elizabeth English
204	169	Vertical Guidance Post photo by Elizabeth English
204	170	View of Vertical Guidance Post at Corner photo by Elizabeth English
204	171	Vertical Guidance Post - Detail photo by Elizabeth English
205	172	Noah’s Ark Project, Front View photo by Elizabeth English
206	173	Noah’s Ark Project, Side View photo by Elizabeth English
209	174	Aerial View of Tennessee Street, Lower Ninth Ward, New Orleans adapted by Elizabeth Fenuta from Google Earth, [http://earth.google.com], accessed September 14, 2009.
211	175	Design Evolution Morphosis. 2009, 13
212	176	Morphosis’ Initial Conceptual Rendering of FLOAT House Morphosis. 2009, 14
214	177	Initial Residence Assemblage Morphosis. 2009, 15

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
215	178	Initial Plan Morphosis. 2009, 19
216	179	Initial Section Morphosis. 2009, 23
216	180	Initial Detail Section Morphosis. 2009, 24
217	181	Initial Water Equipment Diagram Morphosis. 2009, 17
218	182	Initial Water Usage Flowchart Morphosis. 2009, 17
218	183	Initial Emergency Mode Flowchart Morphosis. 2009, 17
218	184	Initial Water Usage Table Morphosis. 2009, 17
219	185	Initial Ventilation Diagram Morphosis. 2009, 17
220	186	Initial Materiality Morphosis. 2009, 18
221	187	FLOAT House, Model photo by Chandler McWilliams, [http://www.flickr.com/photos/__chandler__/2091146679/], accessed September 10, 2009. ibid., [http://www.flickr.com/photos/__chandler__/2095694181/in/set-72157603408537401/], accessed September 10, 2009
222	188	FLOAT House, North East Perspective, August 2009 photos by Elizabeth English
222	189	FLOAT House, East View, August 2009 photos by Elizabeth English
222	190	FLOAT House, Scaffolding on South West Perspective, August 2009 photos by Elizabeth English
222	191	FLOAT House, North View, August 2009 photo by Elizabeth English

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
222	192	FLOAT House, Base of Vertical Guidance Post, August 2009 photo by Elizabeth English
222	193	FLOAT House, Foundation, August 2009 photo by Elizabeth English
223	194	FLOAT House Completed October 6th 2009, Front View [http://morphopedia.com/view/float-house-photograph], accessed November 19, 2009.
223	195	FLOAT House, Recent Exploded Axonometric [http://morphopedia.com/view/float-house-photograph], accessed November 19, 2009.
223	196	FLOAT House, Completed October 6th 2009, Interior View [http://www.dwell.com/articles/morphosis-float-house-for-nola.html], accessed November 18, 2009.
223	197	FLOAT House, Back View [http://morphopedia.com/view/float-house-photograph], accessed November 19, 2009.
224	198	FLOAT House Completed October 6th 2009, Corner View [http://morphopedia.com/view/float-house-photograph], accessed November 19, 2009.
224	199	FLOAT House, Final Plan and 3D Axonometric [http://morphopedia.com/view/float-house-photograph], accessed October 19, 2000.
226	200	Partial Aerial Map of Dhaka Bangladesh adapted by Elizabeth Fenuta from Google Earth, [http://earth.google.com], accessed November 23, 2009.
230	201	LIFT House, Rendered Plan by Prithula Prosun
231	202	LIFT House, Rendered Section In Dry Conditions by Prithula Prosun
231	203	LIFT House, Rendered Section During a Flood by Prithula Prosun
232	204	LIFT House, Design Elements by Prithula Prosun
232	205	LIFT House, Rendered Perspective During a Flood by Prithula Prosun

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
233	206	LIFT House, Rendered Perspective of Courtyard by Prithula Prosun
233	207	LIFT House, Rendered Sectional Perspective of Amphibious Structure by Prithula Prosun
234	208	LIFT House, Double Unit Rendering, Front Perspective model and rendering by Prithula Prosun
235	209	LIFT House, Double Unit Rendering, Side Perspective model and rendering by Prithula Prosun
236	210	Digging Bore Hole for Soil Test photo by Shahid Hossain
236	211	Prithula Overseeing Excavation photo by Shahid Hossain
236	212	Excavation photo by Shahid Hossain
236	213	Preparing Foundation photo by Shahid Hossain
236	214	Preparing Foundation 2 photo by Shahid Hossain
236	215	Capped Water Bottle Buoyancy System photo by Shahid Hossain
237	216	Prithula Overseeing Wall Construction photo by Shahid Hossain
237	217	Wall Construction photo by Shahid Hossain
237	218	Construction Team Assembling Masonry Wall photo by Shahid Hossain
237	219	Bamboo Structure in Place photo by Shahid Hossain
237	220	Bamboo Structure in Place beside Concrete Spine photo by Shahid Hossain

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
237	221	Bamboo Structure in Place beside Concrete Spine, Perspectival View photo by Shahid Hossain
238	222	LIFT House Completed January 2010, Front View photo by Prithula Prosun
239	223	LIFT House Completed January 2010, Three-Quarter View photo by Prithula Prosun
241	224	Amphibious Foundation, Pointe Coupee Parish, Raccourci Old River, Louisiana photo by Dustin Ewing
241	225	Amphibious Housing, Maasbommel, Netherlands [http://upload.wikimedia.org/wikipedia/en/b/bd/LocatieWest_Maas_en_Waal.png], accessed August 4, 2009.
241	226	LSU Prototype, Baton Rouge, Louisiana photo by Elizabeth English
241	227	Noah's Ark Project, New Orleans, Louisiana photo by Elizabeth English
241	228	FLOAT House, Lower Ninth Ward, New Orleans [http://morphopedia.com/view/float-house-photograph], accessed December 12, 2009.
241	229	LIFT House, Dhaka, Bangladesh photo by Prithula Prosun
243	230	Technical Feasibility Comparison Chart by Elizabeth Fenuta
258	231	Permanently Raised House image by Elizabeth Fenuta
258	232	House with Buoyant Foundation image by Elizabeth Fenuta
260	233	Six Ways FEMA Recommends to Protect a Home From Flooding [http://www.fema.gov/rebuild/mat/fema312.shtm], accessed July 1, 2010.
261	234	Detailed Cost Estimate for a Permanently Elevated Home USACE and the National Flood Proof Committee, "Raising and Moving a Slab-on-Grade House with Slab Attached," 1990, [http://www.nwo.usace.army.mil/nfpc/fpslab/ace2_10.htm#TopOfPage], accessed May 1, 2010.

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
265	235	Bridge made of Thermoplastic Timber [http://www.igsfederal.com/index.html], accessed November 2, 2009.
265	236	Thermoplastic Timber Beam ibid.
265	237	Thermoplastic Dock ibid.
266	238	Thermoplastic Timber Piling Installation ibid.
266	239	Plastic Water Bottles Used for Flotation [http://www.inhabitat.com/wp-content/uploads/david-de-rothschild.jpg] , accessed October 22, 2009.
266	240	Plastic Water Bottle Raft [http://zedomax.com/blog/2007/03/23/diy-hack-how-to-build-a-raft-with-gatorade-plastic-bot tles/], accessed October 22, 2009.
269	241	Paths of Significant Hurricanes which affected New Orleans Betsy - [http://en.wikipedia.org/wiki/File:Betsy_1965_track.png], accessed May 1, 2010. Camille - [http://en.wikipedia.org/wiki/File:Camille_1969_track.png], accessed May 1, 2010. Katrina - [http://en.wikipedia.org/wiki/File:Katrina_2005_track.png], accessed May 1, 2010. Rita - [http://en.wikipedia.org/wiki/File:Rita_2005_track.png], accessed May 1, 2010.
280	242	Focus of the BFP, Lower Ninth Ward, New Orleans image by Elizabeth Fenuta, base image from Google Earth, [http://earth.google.com], accessed May 1, 2010.
281	243	The Future of the BFP, 100-Block Concept image by Elizabeth Fenuta, base image from Google Earth, [http://earth.google.com], accessed May 1, 2010.
281	244	Housing Recovery By Block, 2010 [http://www.gnocdc.org/RecoveryByNeighborhood/index.html], accessed May 1, 2010.
281	245	Households Actively Receiving Mail in New Orleans, 2010 [http://www.gnocdc.org/], "Block by Block Re-population," accessed May 1, 2010.
282	246	Aerial View of Partial Lower Ninth Ward, 2010 image by Elizabeth Fenuta, base image from Google Earth, [http://earth.google.com], accessed September 11, 2009.

List of Illustrations

PG	FIG	DESCRIPTION + SOURCE
284	247	Thermoplastic Timber Pilings Installation [http://www.igsfederal.com/index.html], accessed April 23, 2009.
284	248	Elevated Rail in Chicago Using Thermoplastic Ties ibid.
284	249	Water Bottle "Junkraft" [http://junkraft.com/blog/wp-content/uploads/2009/04/junk1.jpg], accessed October 22, 2009.
285	250	Capped-Water Bottle Raft [http://www.cynical-c.com/archives/bloggraphics/sodaraft.jpg], accessed October 22, 2009.
285	251	Flotation Platform by N55 [http://www.n55.dk/MANUALS/FLOAT_PLAT/FP4.jpg], accessed November 26, 2009.
285	252	Plastic Water Bottles Used for Testing Prior to Construction of the LIFT House photo by Shahid Hossain
287	253	BFP Timeline by Elizabeth Fenuta
288	254	Amphibious Architecture Timeline by Elizabeth Fenuta

List of Illustrations in Appendix

PG	FIG	DESCRIPTION + SOURCE
311	255	Location Vietnam image by Prithula Prosun
311	256	Halong Bay, Vietnam [http://farm1.static.flickr.com/159/418630851_c476250c15_o.jpg], accessed September 30, 2009.
311	257	Floating House, Halong Bay, Vietnam ibid.
311	258	Floating House, Halong Bay, Vietnam 2 ibid.
311	259	Location Philippines image by Prithula Prosun
312	260	Floating House, Agusan Marsh [http://farm3.static.flickr.com/2048/2247653391_26c11414cb.jpg], accessed September 30, 2009.
312	261	Floating House, Agusan Marsh 2 [http://www.simcarrd.org/image/news_picture/photo16.jpg], accessed September 30, 2009.
312	262	Floating House, Agusan Marsh 3 [http://www.ecoboot.nl/artikelen/WeblogTiesFloatingCommunities.html.php], accessed September 30, 2009.
312	263	Floating House, Agusan Marsh 4 [http://travel.webshots.com/photo/2084544180092787231sFOWES],, accessed September 30, 2009.
313	264	Location Cambodia image by Prithula Prosun
313	265	Floating Church, Cambodia [http://images.lightstalkers.org/images/278709/Diane_Langlum___-_Cambodia__5_.jpg], accessed September 30, 2009.
313	266	Chong Kneas Village, Cambodia [http://farm3.static.flickr.com/2632/4179119751_26cb01ccd4.jpg],accessed September 30, 2009.

List of Illustrations in Appendix

PG	FIG	DESCRIPTION + SOURCE
313	267	Floating House, Chong Kneas, Cambodia [http://www.flickr.com/photos/98052898@N00/4179886172/sizes/l/in/photostream/], accessed September 30, 2009.
314	268	Floating House, Chong Kneas, Cambodia 2 [http://dpmac.com/angkor/trip-reports/07-07/23-tonlesap/kompongpluk-4.jpg], accessed September 30, 2009.
314	269	Floating House, Chong Kneas, Cambodia 3 [http://travel.webshots.com/photo/1128677696047831679kHOaVq], accessed September 30, 2009.
315	270	Iraqi Marsh Villages, Iraq [http://iraqupdate.files.wordpress.com/2007/07/gse_multipart21141.jpg], accessed September 30, 2009.
315	271	Iraqi Marsh House, Iraq [http://www.flickr.com/photos/msharch/56344485/sizes/o/], accessed September 30, 2009.
315	272	Interior of a Reed Hut, Iraq [http://system2.ipressroom.com/portal/ut/artwork/7/5/7/1/6/75716/interior-of-a-mudhif-made-of-woven-reeds.jpg], accessed September 30, 2009.
316	273	Beni Hassan [http://www.toreigeland.com/iraq_marsh-arabs/images/W5908-Iraq-MarshArabs.jpg], accessed September 30, 2009.
316	274	Beni Hassan Interior [http://www.prm.ox.ac.uk/ThesigerWeb/images/Iraq/2004.130.10575.3.jpg], accessed September 30, 2009.
316	275	Beni Hassan 2 [http://system2.ipressroom.com/portal/ut/artwork/7/5/7/1/6/75716/reed-house.jpg], accessed September 30, 2009.
317	276	Floating Islands, Lake Titicaca, Peru [http://jonesnet.ca/Favorite_Photos/Reed_Island_files/IMG_6482.jpg], accessed September 30, 2009.

List of Illustrations in Appendix

PG	FIG	DESCRIPTION + SOURCE
317	277	Floating Islands, Lake Titicaca, Peru 2 [http://www.travelblog.org/Photos/3395171], accessed September 30, 2009.
320	278	Floating Dwelling Sketch Felix and Burchard, 2005, 22
321	279	Floating House, Tilting NFL [http://architecteacadien.blogspot.com/2009/05/tilting-fish-stages-amphibious.html], accessed September 30, 2009.
321	280	Floating House, Tilting NFL 2 Robert Mellin, 2003, 29
321	281	Floating House, Tilting NFL 3 ibid.
321	282	Floating House, Tilting NFL 4 ibid.
322	283	Ontario Place Elevated Walk, Canada Kuroyanagi, Akio. 1993, 43
322	284	Ontario Place, Canada Kuroyanagi, Akio. 1993, 41
322	285	Ontario Place, Canada 2 Kuroyanagi, Akio. 1993, 43
322	286	Ontario Place, Canada 3 Kuroyanagi, Akio. 1993, 40-41
323	287	Lake Huron cottage, Lake Huron, Ontario [http://www.trendir.com/house-design/floating-cottage-prefab-on-lake-huron-canada.html], accessed July 28, 2009.
323	288	Lake Huron cottage, model [http://www.archdaily.com/10842/floating-house-mos/], accessed July 28, 2009.
323	289	Lake Huron cottage, plan [http://www.archdaily.com/10842/floating-house-mos/], accessed July 28, 2009.

List of Illustrations in Appendix

PG	FIG	DESCRIPTION + SOURCE
323	290	Lake Huron Cottage, Upper Level Plan [http://www.archdaily.com/10842/floating-house-mos/], accessed July 28, 2009.
323	291	Lake Huron Cottage, Section [http://www.archdaily.com/10842/floating-house-mos/], accessed July 28, 2009.
324	292	British Columbia, Ladner Community [http://www.floatinghomes.com/floatinghomes.htm#location], accessed July 28, 2009.
324	293	British Columbia, Floating House [http://www.floatinghomes.com/floatinghomes.htm#location], accessed July 28, 2009.
324	294	British Columbia, Floating House 2 [http://www.floatinghomes.com/floatinghomes.htm#location], accessed July 28, 2009.
324	295	British Columbia, Floating House 3 [http://www.floatinghomes.com/floatinghomes.htm#location], accessed July 28, 2009.
325	296	British Columbia, Log Floats [http://tinyhouseblog.com/wp-content/uploads/2009/03/float-cabin.jpg], accessed July 28, 2009.
325	297	British Columbia, Log Floats 2 [http://www.homebysunset.com/photos/uncategorized/2007/09/10/floating_cabin_nov.jpg], accessed July 28, 2009.
325	298	British Columbia, Log Floats 3 [http://www.digsdigs.com/photos/smallcabin_floating_house-554x394.jpg], accessed July 28, 2009.
328	299	Junk Rafts [http://www.swimmingcities.org/the-rafts/], accessed June 30, 2009.
328	300	Junk Rafts 2 [http://www.swimmingcities.org/photos/], accessed June 30, 2009.
328	301	Junk Rafts 3 [http://blog.makezine.com/archive/2006/07/junkboat_fleet_the_miss_r.html], accessed June 30 2009.
328	302	Junk Rafts 4 [http://onearthtravel.com/blog/wp-content/uploads/2008/08/junk-raft.jpg], accessed June 30, 2009.

List of Illustrations in Appendix

PG	FIG	DESCRIPTION + SOURCE
329	303	Junk Rafts 5 [http://chickenjohn.wordpress.com/], accessed June 30, 2009.
329	304	Junk Rafts 6 ibid.
329	305	Junk Rafts 7 [http://c.photoshelter.com/img-get/I0000rwr6tAKUWI4/s], accessed June 30, 2009.
329	306	Junk Rafts 8 [http://4.bp.blogspot.com/_1bKnHq3a-W8/SB6g-E7rR3I/AAAAAAAAAn8/dSl39F0VAZY/S660/CA15316-3000px.jpg], accessed June 30, 2009.
330	307	N55 Floating Platform [http://www.n55.dk/MANUALS/FLOAT_PLAT/FLOAT_PLAT.html], accessed June 30, 2009.
330	308	N55 Floating Platform - Detail ibid.
330	309	N55 Floating Platform 2 ibid.
332	310	Floating Neutrinos [http://paulsorganic.com/mf-pictures/neutrinos%201.jpg], accessed June 30, 2009
332	311	Floating Neutrinos 2 [http://www.floatingneutrinos.com/], accessed June 30, 2009
335	312	Diagram of WLFH [http://floodproofhousing.com/howitworks/publishedarticlesaboutthelandlockedfloatinghouse.html], accessed November 30, 2009.
336	313	WLFH in 'Normal' Position [http://floodproofhousing.com/ourmission.html], accessed November 30, 2009.
336	314	WLFH in 'Floating' Position [http://floodproofhousing.com/ourmission.html], accessed November 30, 2009.
337	315	WLFH System, Axonometric [http://floodproofhousing.com/howitworks/viewthebasicstructuraldesign.html], accessed November 30, 2009.

List of Illustrations in Appendix

PG	FIG	DESCRIPTION + SOURCE
338	316	WLFH System, Plan [http://floodproofhousing.com/howitworks/viewthebasicstructuraldesign.html], accessed November 30, 2009.
339	317	WLFH System, Detail [http://floodproofhousing.com/howitworks/viewthebasicstructuraldesign.html], accessed November 30, 2009.
340	318	WLFH System, Section [http://floodproofhousing.com/howitworks/viewthebasicstructuraldesign.html], accessed November 30, 2009.

List of Acronyms

ABFE	Advisory Base Flood Elevation
ASCE	American Society of Civil Engineers
BF	Base Flood
BFE	Base Flood Elevation
BFP	Buoyant Foundation Project
DFE	Design Flood Elevation
DHS	Department of Homeland Security
EPS	Expanded Polystyrene (Styrofoam)
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FHBM	Flood Hazard Boundary Map
FMA	Flood Mitigation Assistance
GNOCDC	Greater New Orleans Community Data Center
HEAG	Highest Existing Adjacent Grade
HMGP	Hazard Mitigation Grant Program
HPS	Hurricane Protection System
IA	Individual Assistance
ICC	International Code Council
IGS	Innovative Green Solutions
L9W	Lower Ninth Ward
LAGIC	Louisiana Geographies Information Center
LCA	Life Cycle Assessment
LIDAR	LIght Detection And Ranging
LSU	Louisiana State University
MIR	Make It Right
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NOLA	New Orleans, Louisiana
NGS	National Geodetic Survey
NTHP	National Trust for Historic Preservation
PAGP	Public Assistance Grant Program
PDM	Pre-Disaster Mitigation
PRC	Preservation Resource Center
SFHA	Special Flood Hazard Area
SHPO	State Historic Preservation Office
UNESCO-IHE	United National Educational, Scientific, and Cultural Organization - Institute of Higher Education
UNO	University of New Orleans
USGS	United States Geological Survey
USCGS	United States Coast and Geodetic Survey
USACE	United States Army Corps of Engineering
VGP	Vertical Guidance Post

I feel I am slowly forgetting the city I love and was [sic] home to me… homes are in ruins, neighbors are eerily quiet, and there is no life. There are no birds. The homes are scarred with the paint from the writing of rescue workers showing whether bodies were recovered or not. As hard as you try, the paint does not completely come off. Paint does not disguise the painful memory. [1]

- Bridget Dugan, *Loss of Identity in Disaster: How to Say Goodbye to Home*.

fig. 1: Post-Katrina, New Orleans, 2005

01
introduction

Global climate change is predicted to spark catastrophic flooding, posing a serious threat to coastal regions worldwide. Faced with an uncertain future, human beings must re-evaluate their relationship to nature, and particularly water. People in the Netherlands have adapted to these uncertain forces of nature and developed unique methods of living with water.

According to Dutch architect Hans Venhuizen, "amphibious living" is a concept that abandons the need to control water, and is accepting of climatic influence, tides, and seasonal changes in the natural environment.[2] Venhuizen states that "controlling natural conditions does not begin with imposing one's own will on the landscape, but through taking full advantage of the qualities of a dynamic relationship between land and water. . . . It is not a question of living beside water, or living on water; it is not about the illustrative use of water, but rather living with water."[3]

Flexible and multi-layered systems are required to accommodate the changing forces of nature. Amphibious foundations are dynamic systems that operate passively, adapting to changing conditions. Specifically, amphibious foundations allow a house to remain on land during normal, non-flood conditions, but enable the house to rise and float on the water's surface during a flood.

In August of 2005, New Orleans experienced catastrophic flooding as a result of multiple levee failures during and after the passage of Hurricane Katrina (fig. 1). Eighty percent of the city became inundated with water, damaging over half the homes in New Orleans.[4]

Residents were displaced to other parts of Louisiana and the United States, leaving many neighbourhoods abandoned. The slow return of former residents has diminished the unique culture and identity of New Orleans. Elements of the city's character are now at risk of being lost.[5]

Elizabeth English founded the Buoyant Foundation Project (BFP) in 2006 in an effort not only to provide a safe and reliable form of flood protection, but also to encourage the authentic restoration of traditional New Orleans neighbourhoods, especially in the Lower Ninth Ward. The project is specifically designed to preserve traditional, wooden "shotgun" style housing that is prevalent throughout New Orleans, including the Lower Ninth Ward. The BFP serves as a catalyst for the restoration of shotgun housing through retrofitting remaining structures with the buoyant foundation system.[6]

The BFP addresses the need for an alternative form of flood protection in the wake of Hurricane Katrina. The Federal Emergency Management Agency (FEMA) is recommending to homeowners, including those in low-lying areas of South Louisiana, to permanently elevate their homes to comply with the new Base Flood Elevation (BFE) requirements.[7]

The BFP is a flood protection system that provides an alternative to permanent static elevation. It allows a house to remain close to street level while minimizing both property damage and the destruction of neighbourhood character in the event of a flood. The BFP is a flood mitigation strategy that adapts to flood conditions when necessary, and does not inconvenience residents since the home remains close to street level under normal conditions.[8]

It has been more than five years since the storm, and many residents have not returned to their former homes for fear that they will have to face another catastrophic flood or live with the inconvenience of a home permanently raised to a high elevation. The BFP aims to provide a viable alternative in the hope that residents who have remained away for these reasons will return to their former homes, helping to restore the vitality and vibrancy of this unique city.[9]

The following document will address how the BFP can provide a culturally sensitive, technically feasible, economical, sustainable, and resilient form of flood mitigation for the Lower Ninth Ward in post-Katrina New Orleans. The significant challenges causing flooding in New Orleans will be outlined, focusing on three areas: ecology, unnatural disaster, and infrastructure. Each of these critical challenges has resulted in land loss and increased New Orleans' vulnerability to future flooding. The events of Katrina have proven the United States federal hurricane protection system to be an ineffective and unreliable form of flood mitigation for New Orleans. Artificial levee failure caused severe flooding that damaged or destroyed much of the housing in New Orleans.[10] The BFP can provide a consistent form of flood mitigation for residents in the Lower Ninth Ward, one of the most severely damaged — but recoverable — neighbourhoods of the city.[11] The BFP is culturally supportive through aiding in the restoration of a traditional housing typology, the shotgun house. Local and international examples of amphibious architecture outline the project's technical feasibility and design parameters. The BFP will demonstrate how its design is a more cost-effective, sustainable, and resilient solution when compared to permanent static elevation for residents in the Lower Ninth Ward. Lastly, future ambitions for the project will be discussed. Through implementation of the BFP, it is hoped that New Orleans will re-emerge safer, stronger, and more flood resilient.

01 i endnotes

1. Bridget Dugan, "Loss of Identity in Disaster: How to Say Goodbye to Home?" *Perspectives in Psychiatric Care 43* (2007): 45 as quoted in DeMond Shondell Miller and Jason David Rivera, *Hurricane Katrina and the Redefinition of Landscape* (Lanham: Lexington Books, 2008), 6.

2. Bureau Hans Venhuizen, "Amphibious Living," http://www.amfibischwonen.nl/index2-e.html (accessed July 1, 2010).

3. ibid.

4. United States Department of Commerce NOAA/NESDIS, "Hurricane Katrina: A Climatological Perspective, http://www.ncdc.noaa.gov/oa/climate/research/2005/katrina.html, (accessed September 1, 2009) and Christine F Andersen *et al*., *New Orleans Hurricane Protection System : What Went Wrong and Why : A Report* (Virginia: ASCE, 2007), 1.

5. United States Department of Commerce NOAA/NESDIS. 2005, 1.

6. Elizabeth English, "Amphibious Foundations and the Buoyant Foundation Project: Innovative Strategies for Flood-Resilient Housing," (paper presented at the International Conference on Urban Flood Management, Paris, France, November 25-27, 2009), 1-2 (appendices, 412).

7. Elizabeth English, "The Buoyant Foundation Project,"http://www.buoyantfoundation.org (accessed September 1, 2010).

8. ibid.

9. Allison Plyer, "Neighborhood Recovery Rates Resiliency of New Orleanians Shown in Neighborhood Repopulation Numbers," http://www.gnocdc.org/RecoveryByNeighborhood/index.html (accessed July 1, 2010).

10. Andersen *et al*. 2007, 1.

11. Associated Press, "New Orleans' Katrina-Ravaged 9th Ward Can Be Rebuilt, Planners Say," http://www.foxnews.com/story/0,2933,242316,00.html (accessed October 23, 2009).

02

the buoyant foundation project:

challenges

challenges:

i. introduction

ii. ecology:
the deterioration of natural resilience
subsidence
rising sea levels
land loss

iii. unnatural disaster:
hurricane katrina
timeline
aftermath
insufficient temporary shelter
lack of utilities
vestiges of katrina
death toll

iv. infrastructure:
hurricane protection system
artificial levee failure
flood depth and duration

v. summary

vi. endnotes

02

i

challenges

Chapter two outlines the significant challenges the BFP will address. This chapter is divided into three subsections: ecology, unnatural disaster and infrastructure. Each appears in chronological order, outlining the challenges that have plagued New Orleans for centuries to the more recent challenges which occurred as a result of Hurricane Katrina and its aftermath.

The deterioration of natural resilience, subsidence, rising sea levels and land loss are critical ecological challenges that will contribute to future flooding in New Orleans if left unaddressed. Additionally, these challenges must be resolved in a sound and sensitive way, as human intervention itself has accelerated land loss and made New Orleans more vulnerable to flooding. Traditional infrastructure implemented to control flooding has weakened New Orleans' natural resilience and destabilized soil resulting in significant land loss. Rising sea levels due to global warming will also result in future land loss.

Chapter 2 then explores the impact of Hurricane Katrina by examining the timeline, duration of the storm and damages. The impact includes not only ecological and residential damage, but also encompasses lack of essential services, flawed emergency shelter strategies, and, ultimately, loss of human life. For survivors, Katrina resulted in vast displacement that continues to this day. It is also discussed why Katrina can be classified as an "unnatural disaster." The majority of the flood damage was caused by levee failure and could have been prevented if the levees had been properly designed and maintained.

The chapter concludes with a review of the United States Army Corps of Engineers' (USACE) artificial levee system, discussing its design, the failures that occurred during and after Hurricane Katrina, and the severe flooding which resulted, particularly in the Lower Ninth Ward.

02

ii

challenges: ecology

DETERIORATION OF NATURAL RESILIENCE

The Greater New Orleans Area is surrounded by levees. After the Great Mississippi Flood of 1927, the United States Army Corps of Engineers (USACE) "integrated the management of flood control and navigation on the Mississippi River."[12] According to Craig E. Colten, Professor of Geography and Anthropology at Louisiana State University, "[H]uman effort to manage the environment has been an important dimension in shaping the New Orleans landscape, that serves as a visible record of human interaction with the environment. The mighty levees encircling the city serve one fundamental purpose: flood protection, both from high river stages of the Mississippi and hurricane-driven storm surges from Lake Pontchartrain."[13]

However, the infrastructure that was implemented to control flooding has weakened New Orleans' natural resilience and destabilized its soil. This has resulted in significant land loss, exacerbated by rising sea levels due to global warming. Human interventions, and the lack thereof, have created conditions for an "unnatural disaster." Much of the damage that accompanied Katrina could have been prevented by restoration of the shoreline and better design and maintenance of the levees.

The artificial levee system creates a barrier that inhibits the replenishment of land beyond its boundary, creating a static wall of protection. This human intervention actually prevents the functioning of a natural, ecological system of protection that had long existed. Before the Mississippi River was contained by the artificial levee system, fluctuations in water level throughout the year would naturally cause the river to overflow, deposit silt onto the banks, and create a natural levee through soil replenishment (fig. 2).[14]

Roger T. Saucier, in a report by Richard P. McCulloh, Paul V. Heinrich, and Bill Good, Research Associates of Geology at Louisiana State University, further elaborates:

> Prior to the construction of artificial levees, the Mississippi River and its distributaries constructed natural levees via overbank deposition in repeated episodes of flooding. During major floods, waters overflowed channel banks and poured out into the adjacent inter-distributary basins. As the floodwaters left the channels of either the Mississippi River or its distributaries, the expansion of flow from unconfined channels and the baffling effect of the marsh or swamp vegetation caused an abrupt drop in the floodwater velocity. As a result of this decrease in velocity, the sand and silt being carried by the floodwaters settled out adjacent to the channel margins, causing the construction of natural levees along them. These floodwaters carried finer grained sediments, mainly clay particles, beyond the natural levees and out into the inter-distributary basins where they preferentially accumulated.[15]

John McQuaid and Mark Schleifstein, in the report by McCulloh, Heinrich and Good, explain how artificial levees and floodwalls were implemented along the Mississippi:

> Levees and flood walls that protect against flooding from both the Mississippi River and hurricanes are built by the USACE and are maintained by local levee districts [fig. 3]. The USACE and the local districts share the construction cost of hurricane levees, [along] the Mississippi River. . . Local levee districts [will] also build and maintain non-federal, lower-elevation levees with construction money from each district's share of property taxes and state financing. . . . Different factors permit Lake Pontchartrain levees of varying elevations to withstand an 11-1/2 foot storm surge plus several feet of waves.[16]

Figure 4 is a geological map of New Orleans. It was mapped using soil surveys, 1:24 000-scale topographic maps, and Light Detection And Ranging (LIDAR) digital elevation models (DEMs).[17]

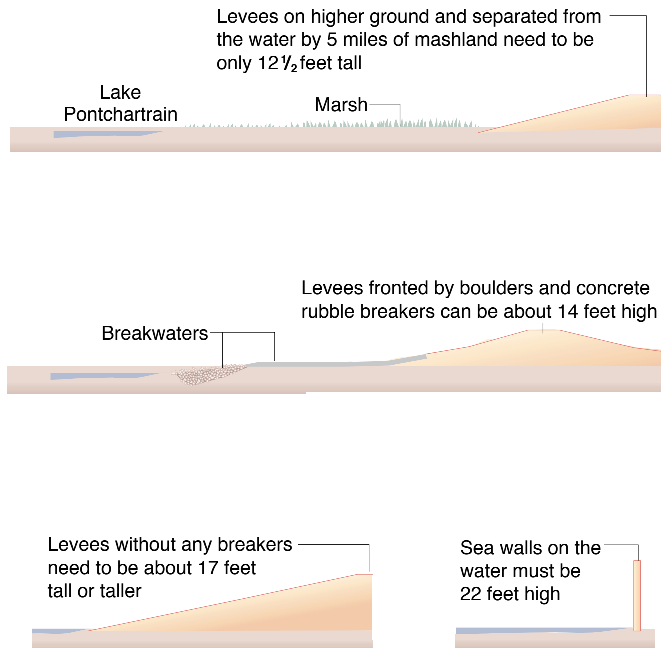


fig. 2: Artificial Levee System, Sections

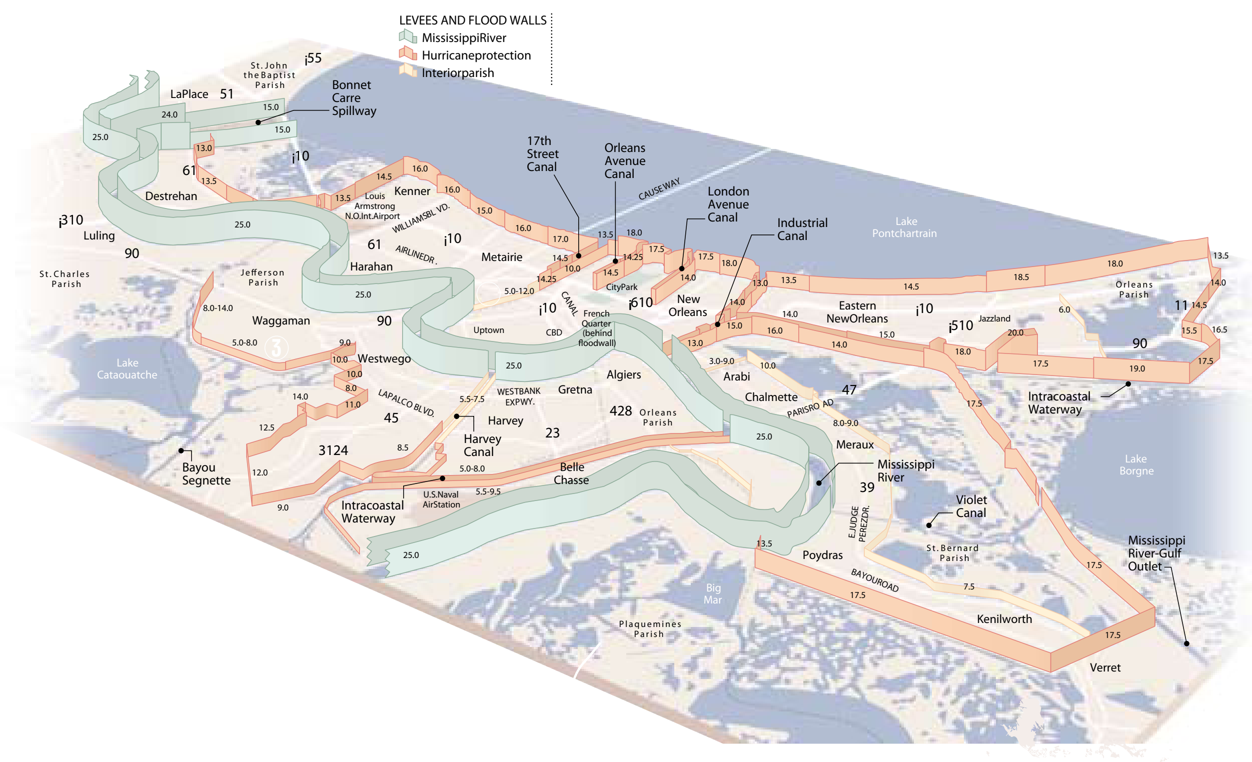
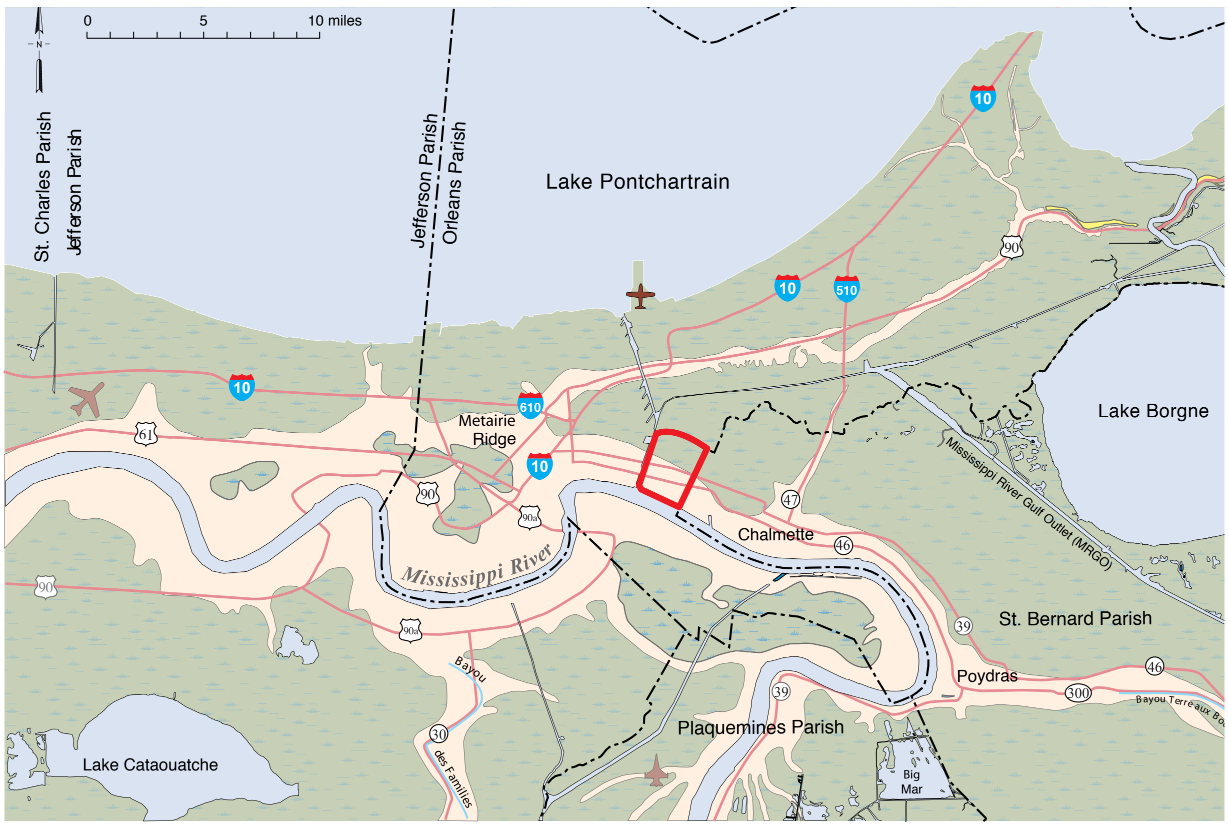


fig. 3: Artificial Levee System



Natural levees Interdistributary basin Lower Ninth Ward
New Orleans Lakefront Airport
Belle Chase Naval Air Station
Louis Armstrong New Orleans International Airport

fig. 4: Natural Levee System

D. E. Frazier and A. Osanik *et al*. explain the distinct geography of New Orleans:

> Jefferson, Orleans, St. Bernard, and Plaquemines parishes all lie within the delta plain of the Mississippi River. One of the major characteristics of river deltas is their network of distributaries. These are streams that fork from the main river channel and distribute the water through a larger and larger area of the delta plain as the river approaches its mouth. Branching off from the modern and abandoned channels of the Mississippi are numerous distributaries, for example, Bayou La Loutre–Bayou Terre aux Boeuf. During a flood, the active deltaic distributaries carry sediment-bearing floodwaters away from the river and out onto the surrounding delta plain. Thus the distributaries, when unencumbered by artificial levees, play a significant role in maintaining the wetlands. These channels radiate outward, in a fan-like network, from the main channel of the Mississippi River.[18]

Frasier and Osanik *et al*. outline how the artificial levee system inhibits the deltaic distributaries from carrying sediment to maintain the wetlands. This lack of sediment is destroying New Orleans' natural defense against hurricanes and flooding (fig. 5). Richard Campanella, Assistant Research Professor of Earth and Environmental Science at Tulane University, also comments on human intervention and its impact on the natural ecosystem. Campanella was a panelist at the Building Resilience Workshop, a conference held in New Orleans in February 2010. He began his talk by showing the correlation between New Orleans' topography and the movement of population after the municipal drainage system was implemented to control flooding. He points out that in the 1700s, the original population centroid (the center of balance on which the population is evenly distributed) was around the St. Peter Street and Royal Street intersection. When the municipal drainage system was installed in the early 1900s, it slowly started to remove water from the sand, silt and clay which began to dry out the land (also known as dessication). As the land dried out, population began to move away from the river and closer to the lake, onto land that was previously uninhabitable. Campanella points out that major parts of New Orleans are now below sea level due to human intervention, not natural occurrences. The pumping infrastructure intended to help manage flooding has resulted in greater problems, destabilizing soil and causing New Orleans to sink — this is also known as subsidence. By the year 2000, modern-day LIDAR and GPS topography assessments show that after 100 years, many areas of the City have dropped 2 to 3 meters below sea level. Campanella continues his talk by posing a question in relation to Dr. Elizabeth English's initial topic question, "What innovations have occurred in response to catastrophic events?" He inverts the question and poses a rhetorical question, "What catastrophic events came off what we thought were innovations? – Innovative solutions have too often spawned disasters." He concludes by offering a lesson that can be learnt from the post-Katrina era; "the more radical the plan the more likely it is to fail."[19]

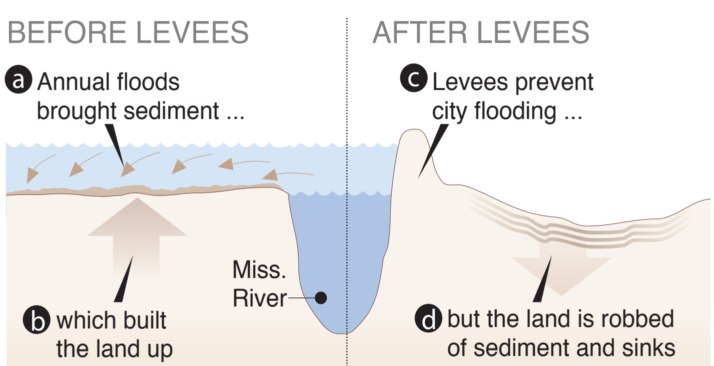


fig. 5: Before and After Artificial Levees

SUBSIDENCE

According to Christine Anderson *et al.*, in a report by the American Society of Civil Engineers (ASCE):

> Large portions of Orleans, St. Bernard and Jefferson parishes are currently below sea level — and they continue to sink. New Orleans is built on thousands of feet of soft sand, silt, and clay. Subsidence, or settling of the ground surface, occurs naturally because of the consolidation and oxidation of organic soil and also the intervention of pumping out local groundwater. In the past, flooding and deposition of sediments from the Mississippi River counterbalanced the natural subsidence, leaving southeast Louisiana at or above sea level. However, because of the major flood control structures built upstream on the Mississippi River and levees built around New Orleans, fresh layers of sediment are not replenishing the ground lost by subsidence.[20]

Figure 6 is a three-dimensional representation that illustrates the natural process of subsidence. It shows how soft sediment beneath Louisiana's coast is sinking, due to water and gases being squeezed out by the soil's own weight.[21]

McCulloh, Heinrich, and Good further explain the soil mechanics processes:

> [Figure 7 shows] schematic cross-sectional diagrams depicting subsidence at subregional and superficial scales in the New Orleans area. As shown in the cross section at the bottom, thick clay-rich layers in the subsurface compact more than sand layers and discrete sand bodies; the clay-rich layers expel water into the more permeable sands over time and further compact by concurrent mechanical rearrangement of the clay particles. In the New Orleans area, the resulting subsidence from this natural process has been accelerated by groundwater pumping that removes water from the sands, which are replenished with water expelled from the clayrich layers. At and near the surface [as show in the magnified portion of figure 7], human-induced alterations of the land greatly accelerate drainage of the upper part of the soil column. When the soil is drained, it and its contained organic matter (peat and organic-rich clay, depicted as black lenses in the [magnified portion of figure 7]) lose a substantial percentage of their original volume and are exposed to atmospheric oxygen. This process may result in a dramatic volume reduction of the organic matter in a short time, which at the surface appears as sinking of the ground. (In the main cross section [of figure 7], black arrows represent a decrease in the thickness of the sedimentary section over time, preferentially in the clay-rich layers. In the [magnified portion of figure 7], blue arrows represent the seepage and flow of water into a man-made excavation—in this case, a drainage canal—and black, dashed arrows represent the downward movement of the ground surface over time from volume loss caused by drainage and oxidation of organic-rich wetland soils).[22]

Anderson, Campanella, McCulloh, Heinrich, and Good highlight how human intervention has accelerated the deterioration of New Orleans' natural resilience. Artificial levees have inhibited fresh layers of sediment from replenishing the ground lost by subsidence. Pumping infrastructure has destabilized soil and also increased the rate of subsidence. The state of Louisiana is currently trying to figure out a way to deposit silt in a controlled fashion to replenish the soil and natural levee system.[23]

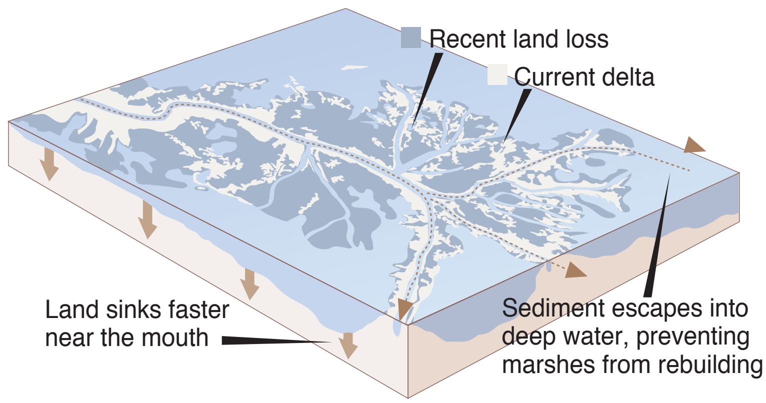


fig. 6: Three-Dimensional Subsidence Diagram

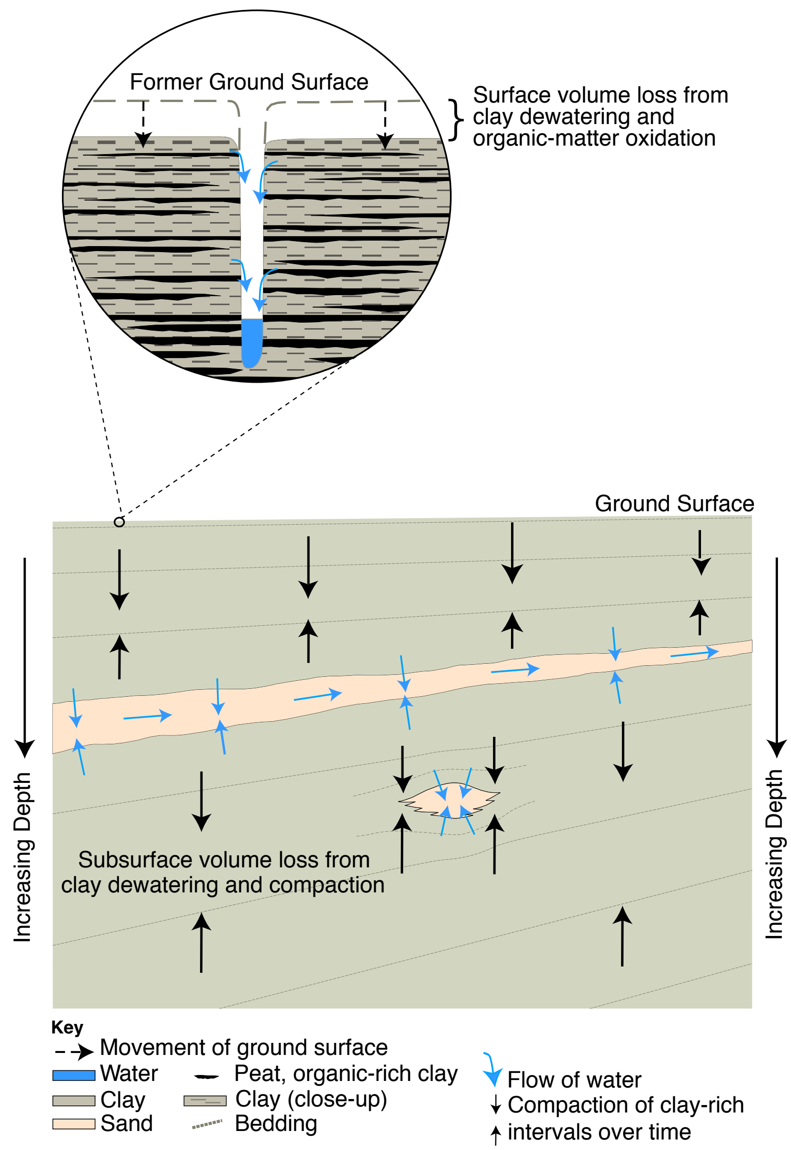


fig. 7: Schematic Cross-Section Diagrams Depicting Subsidence At Submerged and Superficial Scales

RISING SEA LEVELS

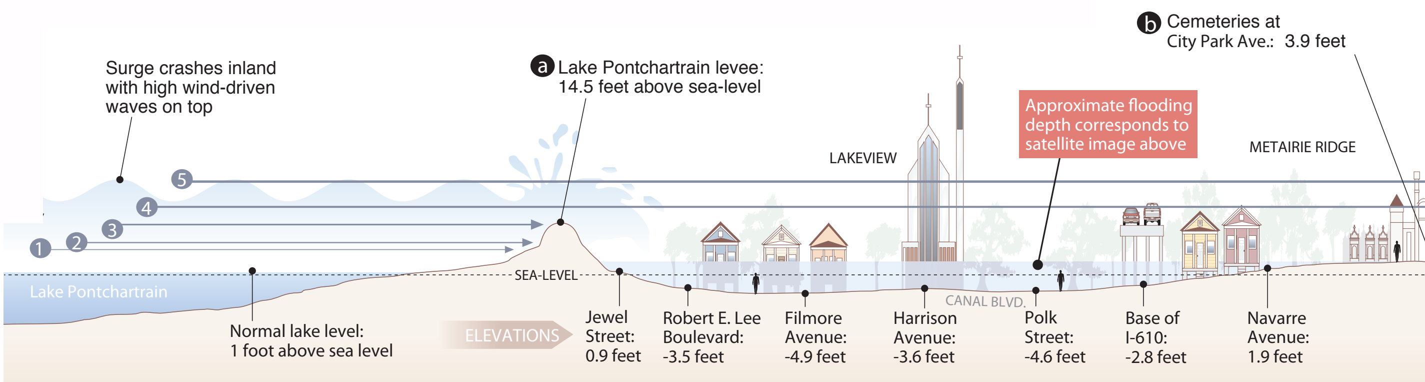
Rising global surface temperatures mean coastal regions will continue to be affected by flooding. Robert Giegengack, Professor of Earth and Environmental Science, and Kenneth R. Foster, Professor of Bioengineering, both from the University of Pennsylvania, assert "the mean surface temperature of the North Atlantic has risen by approximately 0.8 degrees Celsius since the 1930s, with the major part of this increase occurring since 1990. There is thus empirical support for the prediction of an increase in the number and destructiveness of hurricanes as a result of global warming."[24]

New Orleans is a coastal region that is particularly vulnerable to flooding and hurricanes. Craig Colten states that "although described in some cases as the antithesis of nature, cities are not, nor can they be, insulated from interaction with their environment. . . . Reconstructing the responses to these challenges is fundamental to understanding the urbanization and the territory the city now occupies."[25]

As mentioned earlier, global warming has created a twofold issue for Louisiana that stems from rising ocean surface temperatures. First, an increase in ocean surface temperature creates the necessary conditions for hurricanes to form. Second, an increase in ocean surface temperature causes the ice caps to melt, which causes sea levels to rise. This means that the 40% of New Orleans that is below sea level is even more susceptible to flooding.[26]

Figure 8 illustrates "the bowl," displaying the various topographic levels of the city above and below sea-level. Storm surge simply follows the law of gravity and moves to the lowest points.[27] Prior to Hurricane Katrina, after Hurricane Georges, Louisiana State University's (LSU) Water Resources Research Institute, and the Army Corps of Engineers predicted that "when a hurricane even stronger than Georges hits New Orleans, Lake Pontchartrain — a foot higher than sea level — will be the city's biggest threat. Surge water from the Gulf of Mexico, topped by towering waves, will swell the lake above levees and cause widespread flooding."[28]

Figure 9 compares average surge levels by category, overlaid on a cross-section of the city. Figures correspond to maximum surge heights, plus Lake Pontchartrain's +1 sea level. High tides could add as much as two feet, and the surge level could rise even higher in some spots on the shore.[29] (Note: elevations are approximate).



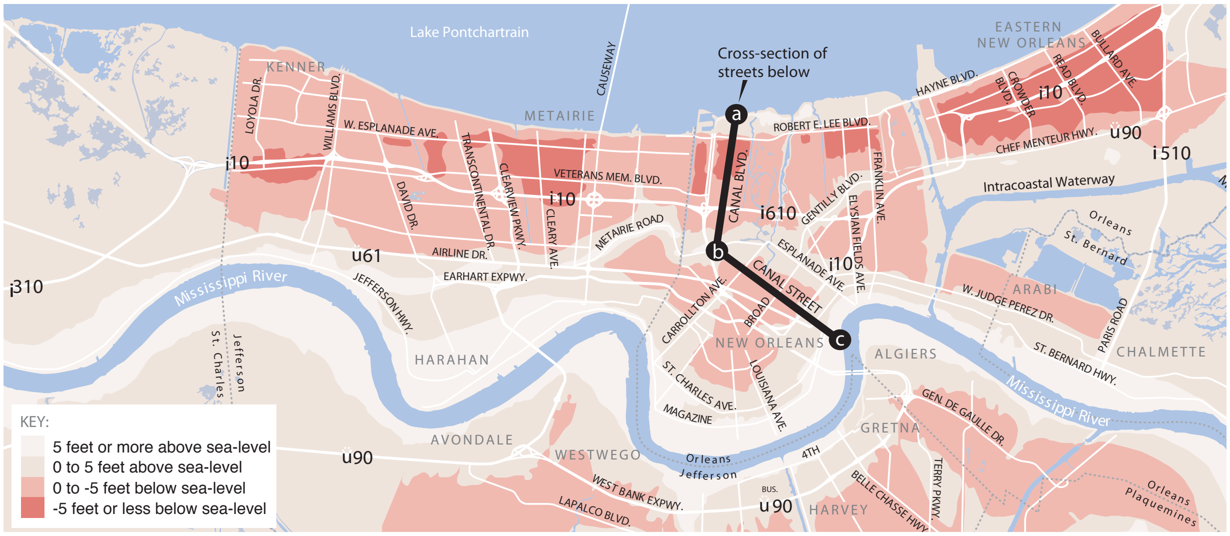


fig. 8: Defining the 'Bowl'

Hurricane Category	Surge and waves at low tide*	Effect on New Orleans
1	7 feet	Lake Pontchartrain's levees stop the low-level surge
2	9 feet	Levees stop the surge, but some waves could find their way over
3	14 feet	Levees stop bulk of surge, but waves could cause considerable flooding
4	19 feet	Levees topped, causing catastrophic flooding
5	24 feet	Entire city submerged including Mississippi River levees

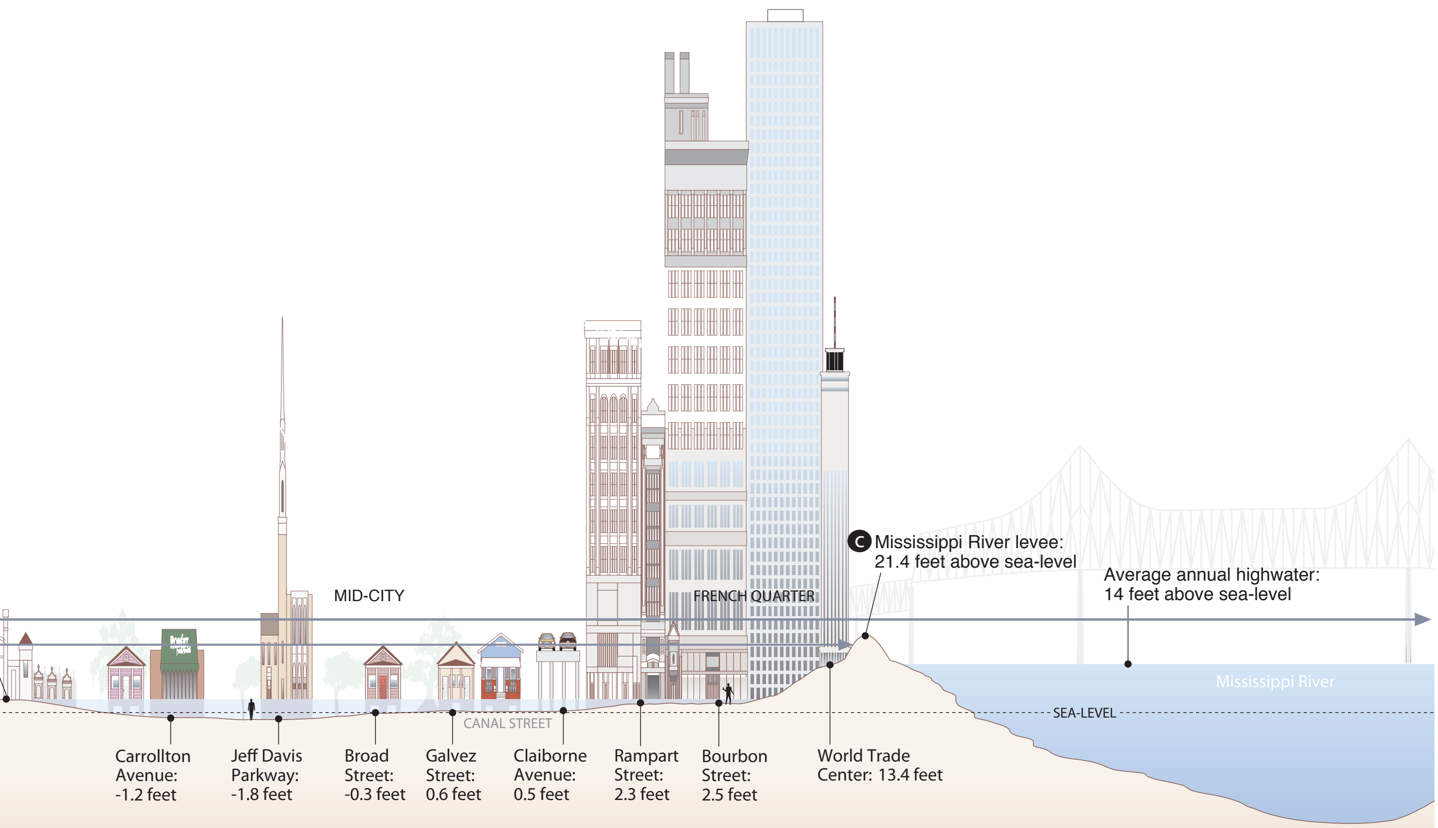


fig. 9: Possible Storm Surge and Inundation

LAND LOSS

A change in coastline resulting from a combination of lost natural resilience, subsidence, and rising sea levels could have dramatic effect in New Orleans. Figures 10 to 13 are hypothetical depictions that compare a change in coastline using 1, 2 and 3.3 foot rises in sea level.

Figure 14 is a graph showing the relative sea level rise, a combination of sea level rise plus the rate of subsidence for Grand Isle from 2002-2007.

Figure 15 displays a larger view of the Louisiana coast, and provides a comparison of the areas of land loss and gain for 1932-2000 and the projected losses from 2000-2050. According to the United States Geological Survey (USGS):

> Coastal Louisiana has lost an average of 34 square miles of land, primarily marsh, per year for the last 50 years. From 1932 to 2000, coastal Louisiana has lost 1,900 square miles of land, an area roughly the size of the state of Delaware. If nothing is done to stop this land loss, Louisiana could potentially lose approximately 700 square miles of land, or about equal to the size of the greater Washington D.C.-Baltimore area, in the next 50 years. Further, Louisiana accounted for an estimated 90% of the coastal marsh land loss in the lower 48 states during the 1990s.[30]

The deterioration of natural resilience, subsidence, rising sea levels, and land loss are critical ecological challenges affecting New Orleans. If left unaddressed, these challenges will result in more damage. An alternative flood-mitigation strategy is required — one that does not disrupt the New Orleans' ecosystem or deteriorate its natural resilience. Innovative flood protection methods are critical for the survival of New Orleans.

fig. 10: 2-Foot Sea-Level Rise, Context

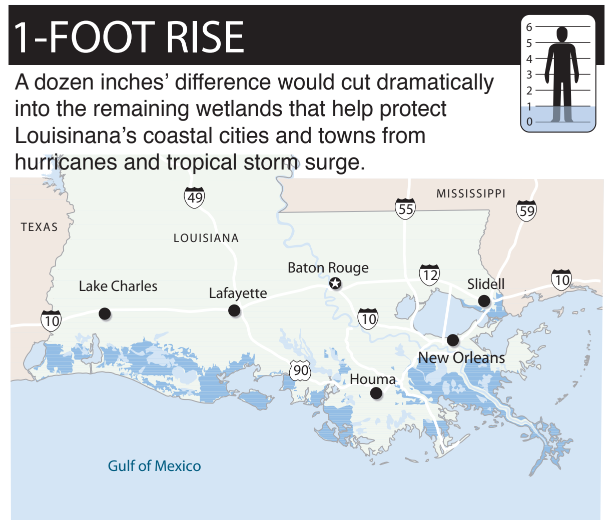


fig. 11: 1-Foot Sea-Level Rise

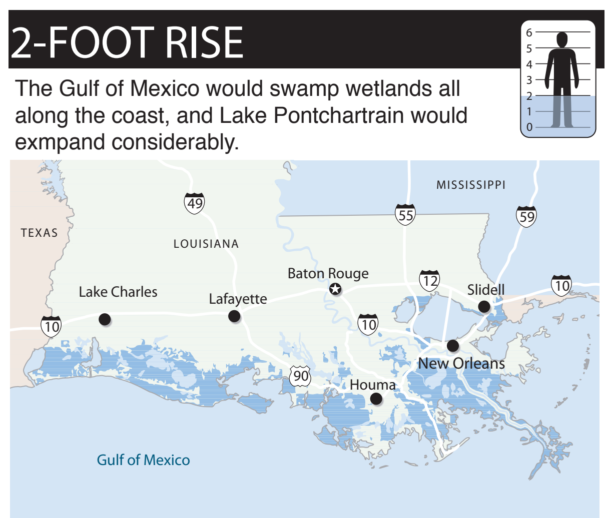


fig. 12: 2-Foot Sea-Level Rise

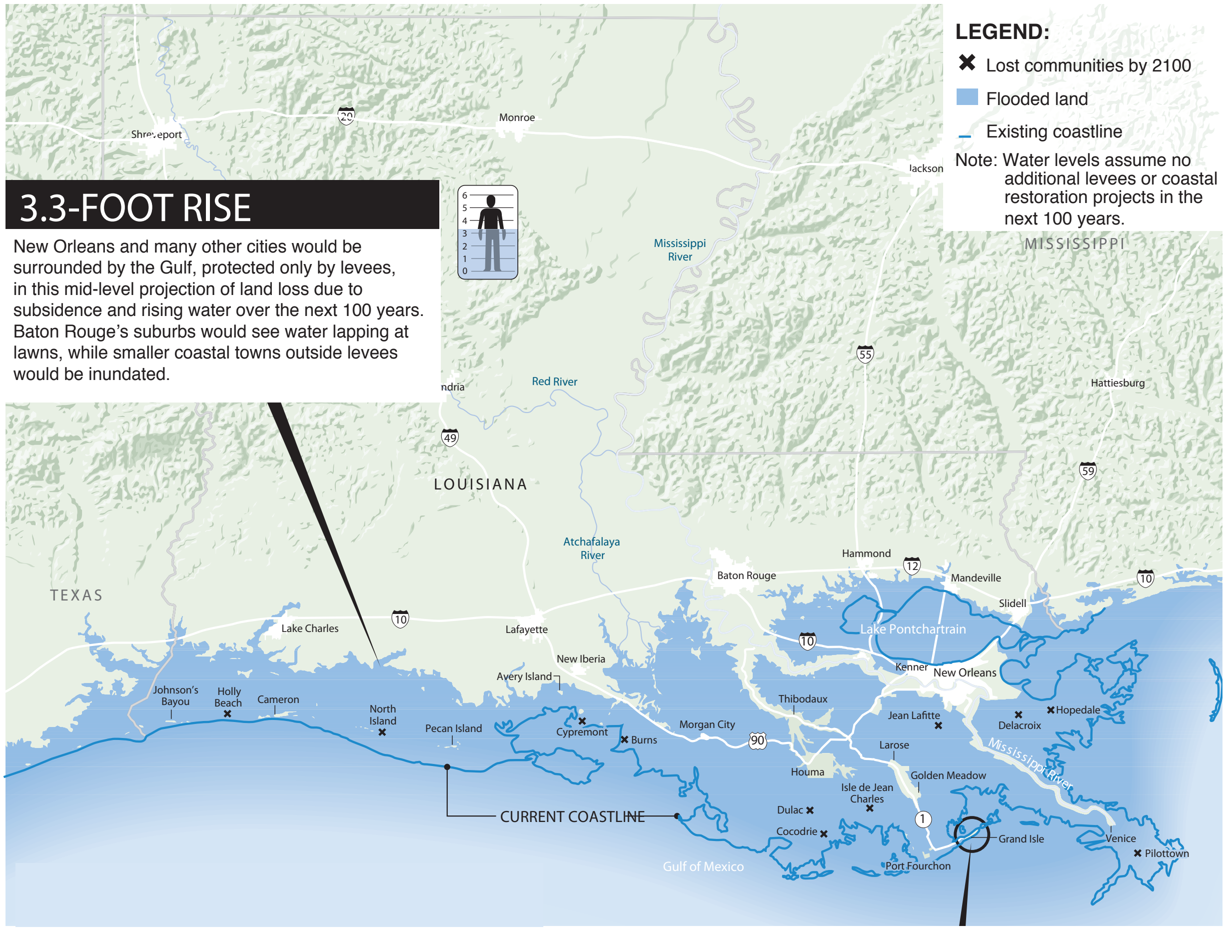
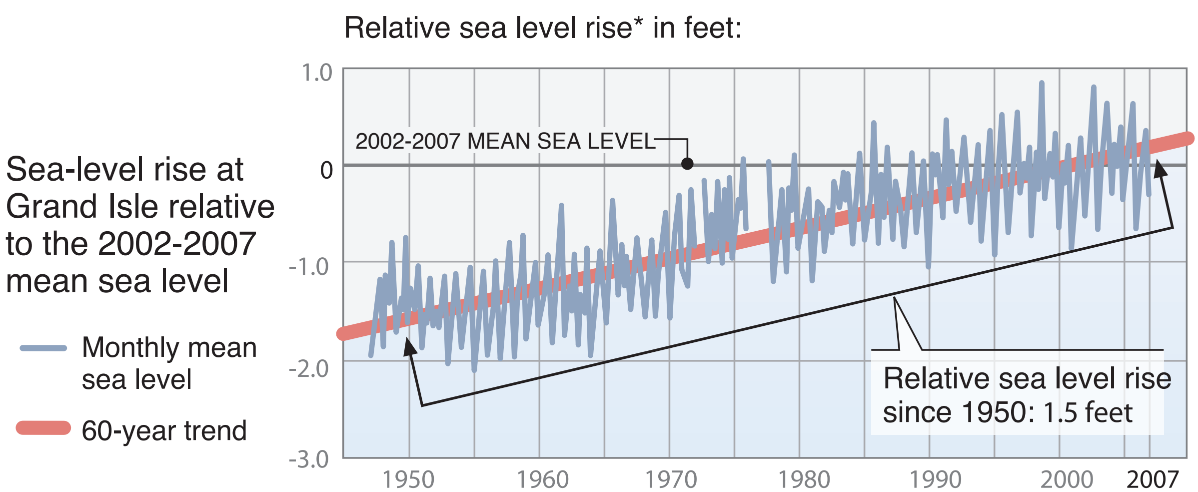
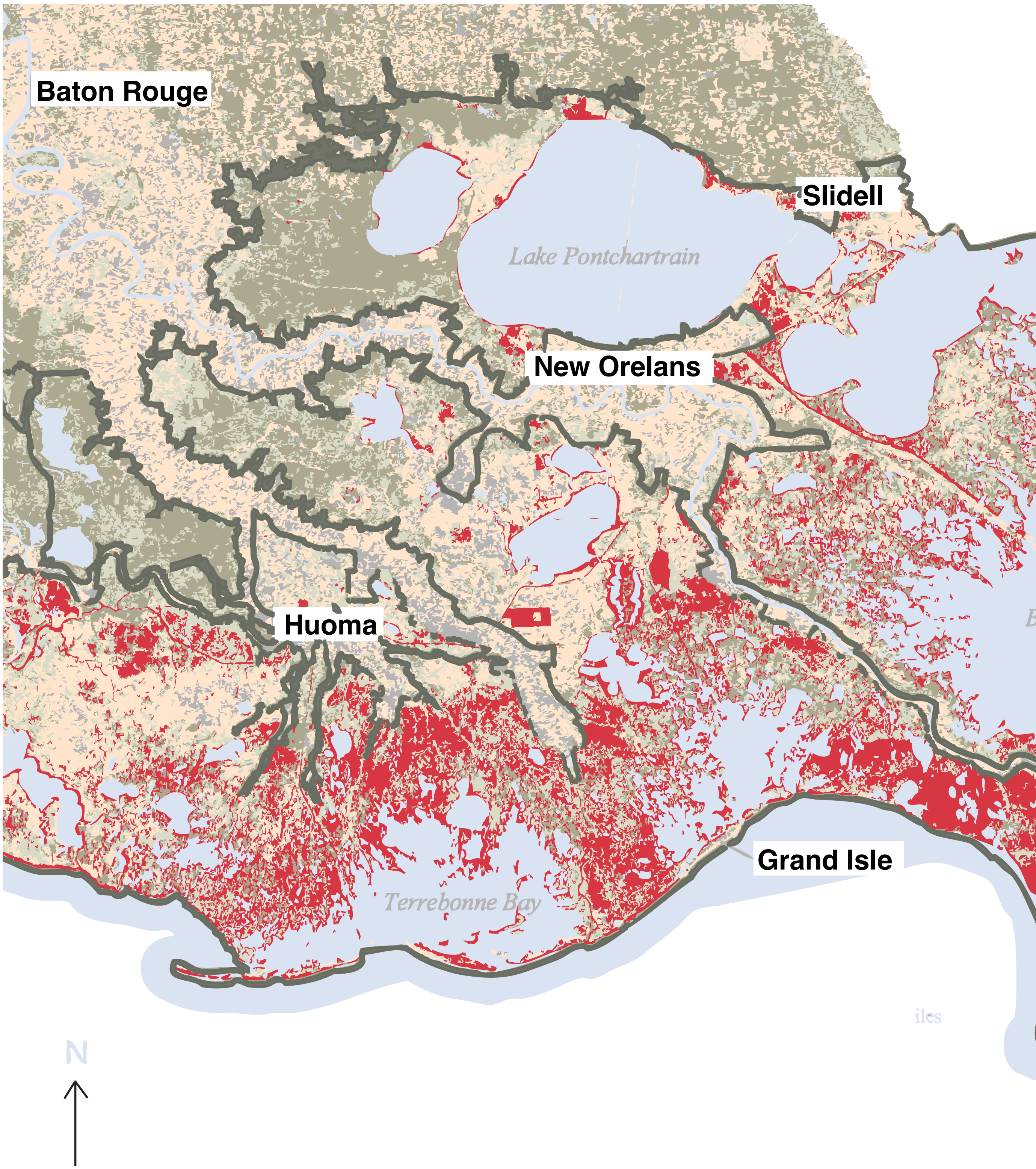


fig. 13: 3.3-Foot Sea-Level Rise



*Sea level rise + subsidence rate = relative sea level rise   Source: NOAA

fig. 14: Sea-Level Rise at Grand Isle Relative to the 2002-2007 mean Sea-Level


Baton Rouge
Slidell
Lake Pontchartrain
New Orelans
Huoma
Grand Isle
Terrebonne Bay
N

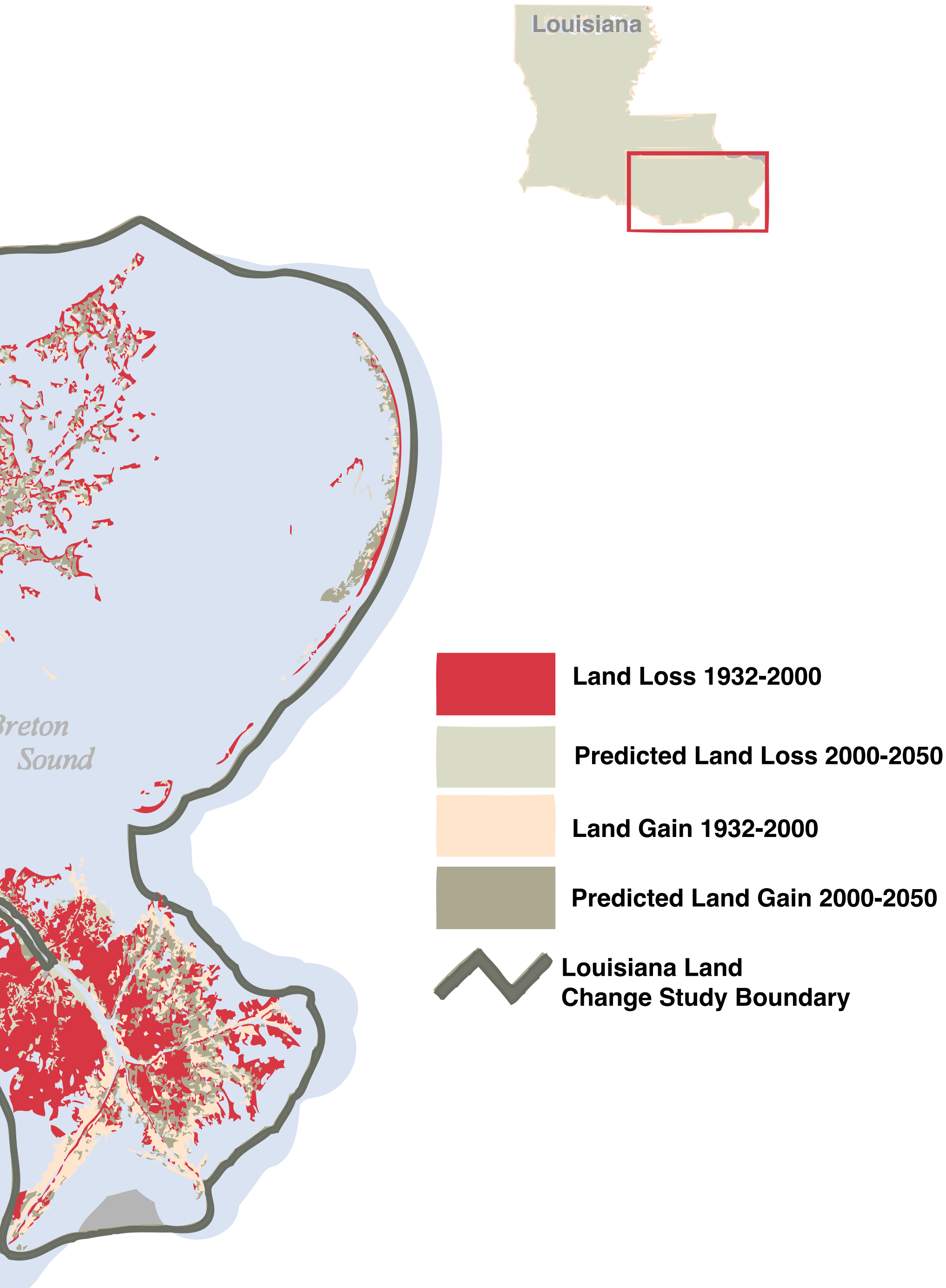


fig. 15: Areas of Land Loss and Gain in South East Coastal Louisiana for 1932-2000 and projected from 2000-2050

02

iii

challenges: unnatural disaster

Saturday August 27, 2005.

By Saturday morning, (the National Hurricane Center was) locked onto southern Louisiana. It was a pretty darned good two-day forecast, and nobody trusts four-to-five-day forecasts anyway, whether it's a hurricane or not. [Barry] Keim gives the first of his many weather briefings to state homeland security and Office of Emergency Preparedness officials late that morning. He was officially 'activated' to duty at the Emergency Operations Center in Baton Rouge at 2 p.m.

In the briefings, a duty that Keim shares with LSU scientist Kevin Robbins and others, 'we take the forecast and localize it with local information, like wave buoy data, local wind speeds, and so on, and tell the elected and appointed officials so they can make decisions.' In this first briefing, 'the forecast was calling for a Category 4 hurricane, and that's enough to get anyone's attention. Nobody dreamed at that time that it would be as bad as it was, but they were very concerned.'[31]

— Thomas Hayden, quoting Barry Keim and Kevin Robbins, in *Storm Experts Feared the Worst: A Diary of a Mad Hurricane*

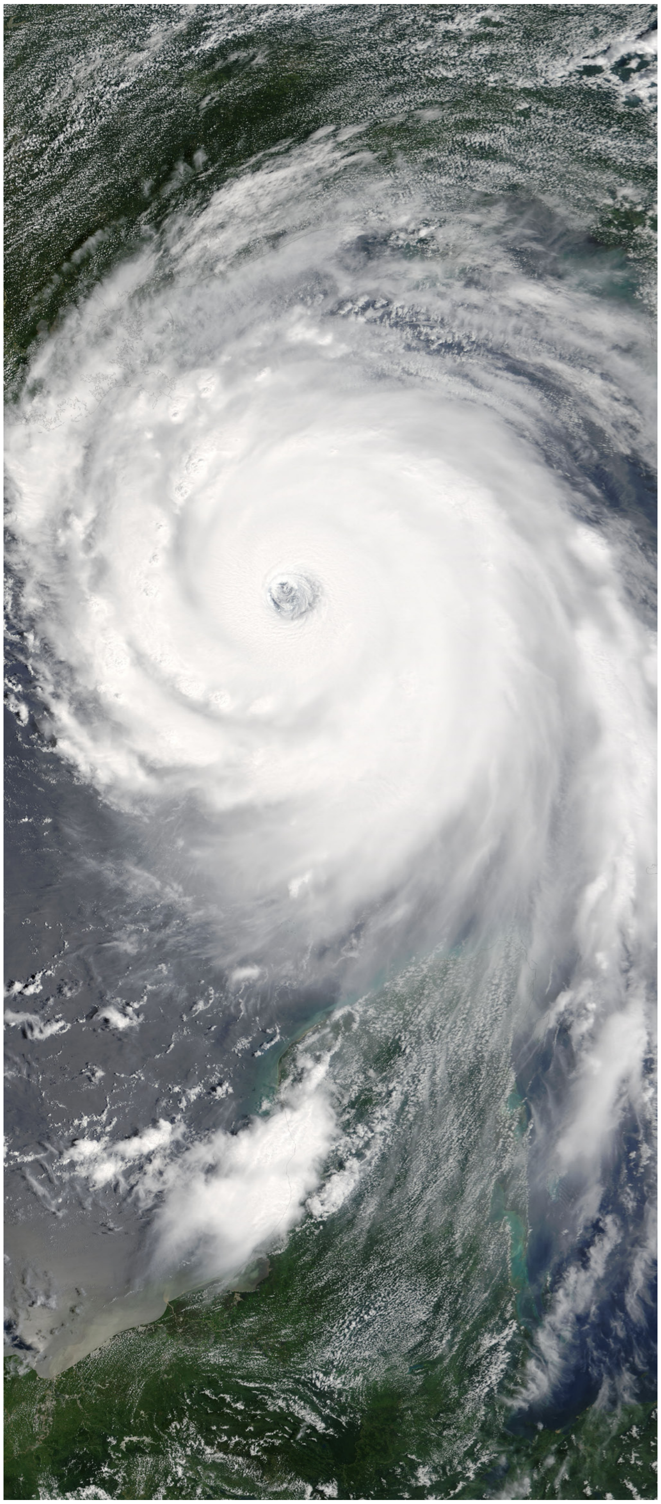


fig. 16: Hurricane Katrina Approaching the Gulf Coast on August 28, 2005, Aerial View

HURRICANE KATRINA

As Hurricane Katrina inundated New Orleans, storm surge from the Gulf of Mexico catastrophically damaged the City's hurricane protection system. Multiple levee failures resulted in the greatest post-hurricane destruction in the history of the United States.[32] According to the Department of Homeland Security (DHS), "[Hurricane Katrina] devastated 90,000 square miles of the Gulf Coast [fig. 16,17]."[33] The National Hurricane Center (NHC) and the National Oceanic and Atmospheric Administration (NOAA) announced that it was "the costliest and one of the five deadliest hurricanes to ever strike the United States."[34]

According to Richard D. Knabb, Jamie R. Rhome, and Daniel P. Brown from the National Hurricane Center:

> [H]urricane [Katrina] then made landfall, at the upper end of Category 3 intensity with estimated maximum sustained winds of 110 kt [127 mph], near Buras, Louisiana at 1110 UTC 29 August. Katrina continued northward and made its final landfall near the mouth of the Pearl River at the Louisiana/Mississippi border, still as a Category 3 hurricane with an estimated intensity of 105 kt. . . . Katrina weakened rapidly after moving inland over southern and central Mississippi, becoming a Category 1 hurricane by 1800 UTC 29 August.[35]

The American Society of Civil Engineers (ASCE) reported "the storm overtopped levees and floodwalls throughout southeast Louisiana and also caused the levees and floodwalls in New Orleans to fail or breech in more than 50 locations. Water rushed into New Orleans and flooded over 80% of the city — more than 10 feet deep in some neighborhoods."[36]

The table in figure 18, compiled after the storm in 2005, displays Hurricane Katrina among the most severe hurricanes to hit the United States in recent history. Estimates of death toll and damage continue to rise, even five years later.[37]

	TROPICAL DEPRESSION	TROPICAL STORM	SAFFIR-SIMPSON HURRICANE INTENSITY SCALE 1	2	3	4	5
Wind speeds (in mph)	Less than 39	39-73	74-95	96-110	111-130	131-155	More than 155
Damage level	None	Minimal	Minimal	Moderate	Extensive	Extreme	Catastrophic
Storm surge	None	Less than 4 feet	4-5 feet	6-8 feet	9-12 feet	13-18 feet	More than 18 feet
Coastal evacuation (depends upon sea level)	--	--	None	None	Several blocks	Up to six miles	5-10 miles
Barometric pressure (in inches)	29.73 (est.)	Less than 29.53	28.94-29.53	28.50-28.91	27.91-28.47	27.17-27.88	Less than 27.17

fig. 17: Saffir-Simpson Hurricane Scale

1900-present	DEADLIEST Storm	U.S. Deaths	STRONGEST (at U.S. landfall) Storm	Category	Minimum air pressure (inches)	COSTLIEST Storm	Cost (billions)
1	Galveston, Texas (1900)	8,000 - 12,000	Florida Keys (1935)	5	26.35	Katrina (2005)	$40
2	Lake Okeechobee, Fla. (1928)	2,500	Camille (1969)	5	26.84	Andrew (1992)	$21.6
3	Katrina (2005)	1,570	Katrina (2005)	3	27.11	Wilma (2005)	$8.4
4	Florida Keys (1935)	408	Andrew (1992)	5	27.23	Charley (2004)	$7.7
5	Audrey in La., Texas (1957)	390	Florida Keys, Texas (1919)	4	27.37	Ivan (2004)	$7.4
6	Miami, Pensacola, Fla.; Miss., Ala. (1926)	372	Lake Okeechobee, Fla. (1928)	4	27.43	Hugo (1989)	$6.6
7	Grand Isle, La. (1909)	350	Donna (1960)	4	27.46	Rita (2005)	$5
8	Florida Keys, Texas (1919)	287	New Orleans (1915)	4	27.49	Frances (2004)	$4.8
9	New Orleans (1915)	275	Carla (1961)	4	27.49	Jeanne (2004)	$3.8
10	Northeastern Texas (1915)	275	Hugo (1989)	4	27.58	Georges (1998)	$3.5

fig. 18: Comparison of the Deadliest, Strongest and Costliest Hurricanes in the United States

TIMELINE

The following images are screenshots taken from NOLA.com (the website of the *New Orleans Times Picayune*), documenting the significant events and times of the storm (fig. 19). They begin on August 28, 2005, the day before Katrina struck the city, and end September 1, 2005, after the storm had subsided.[38]

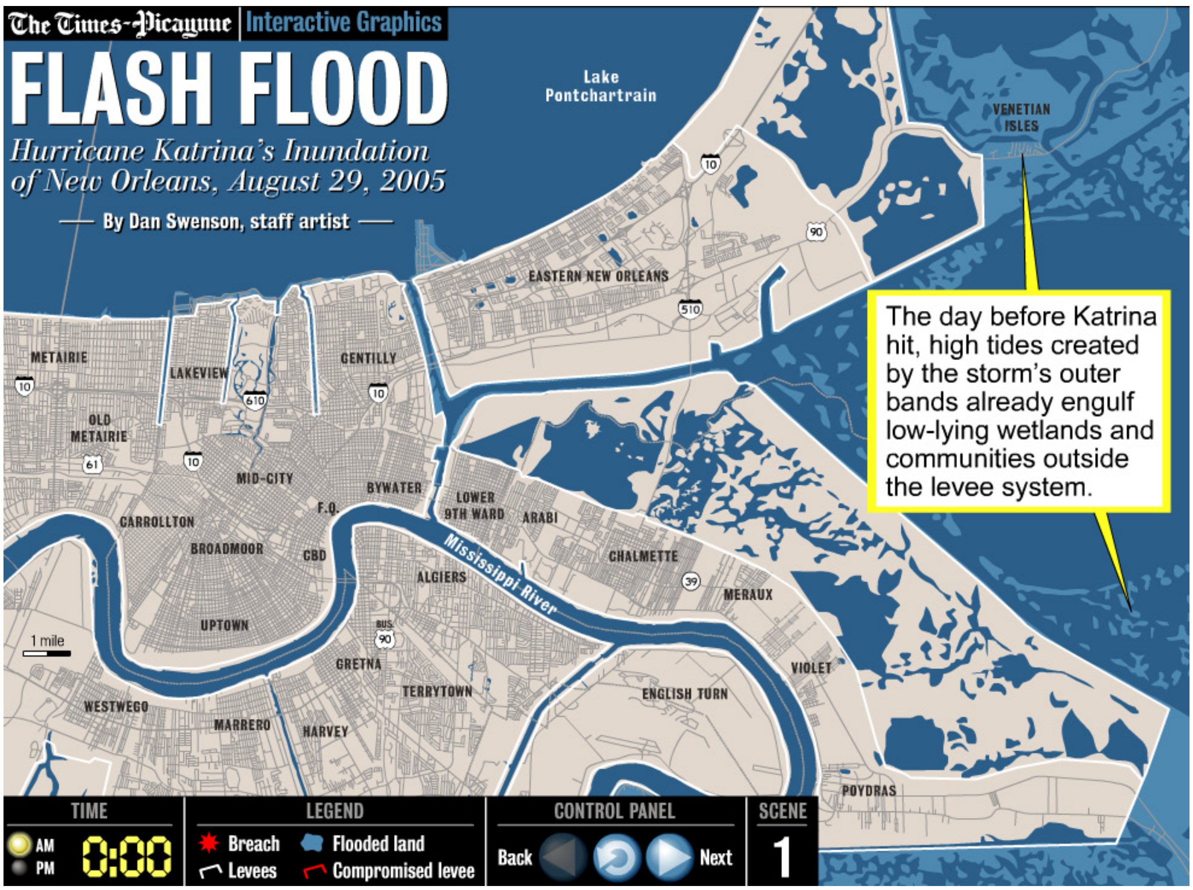
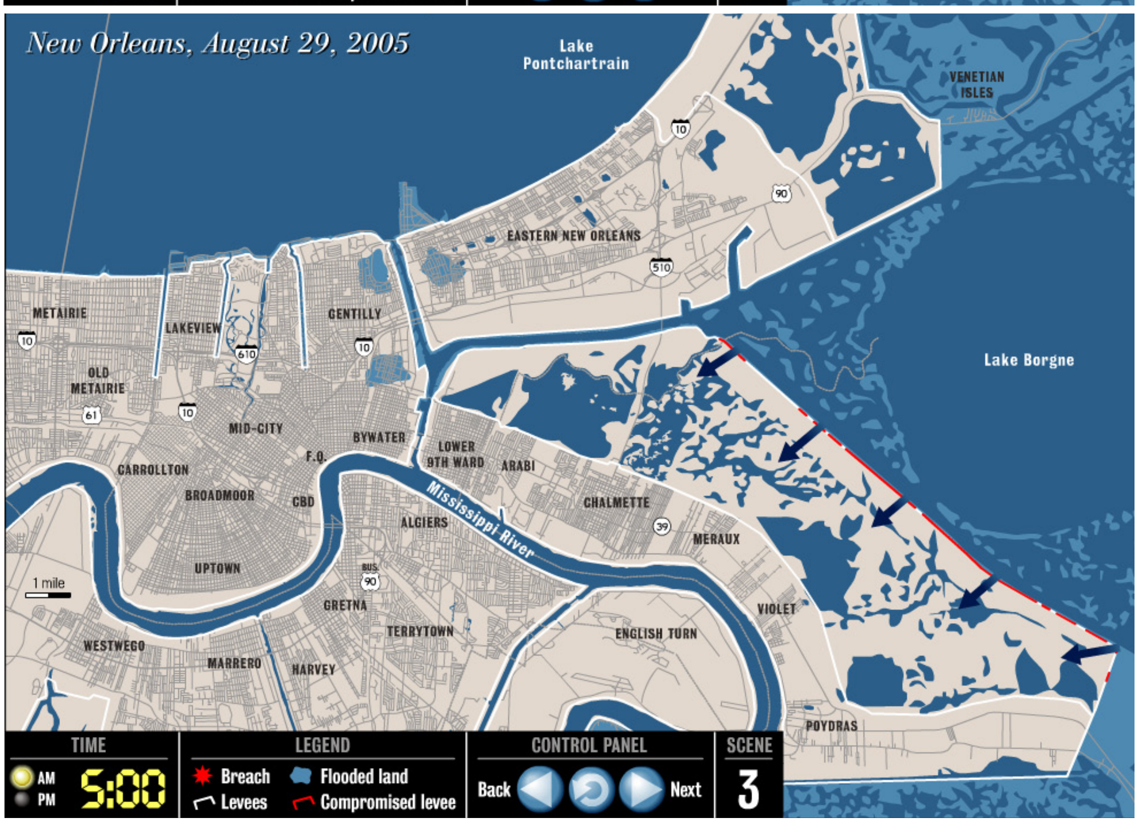
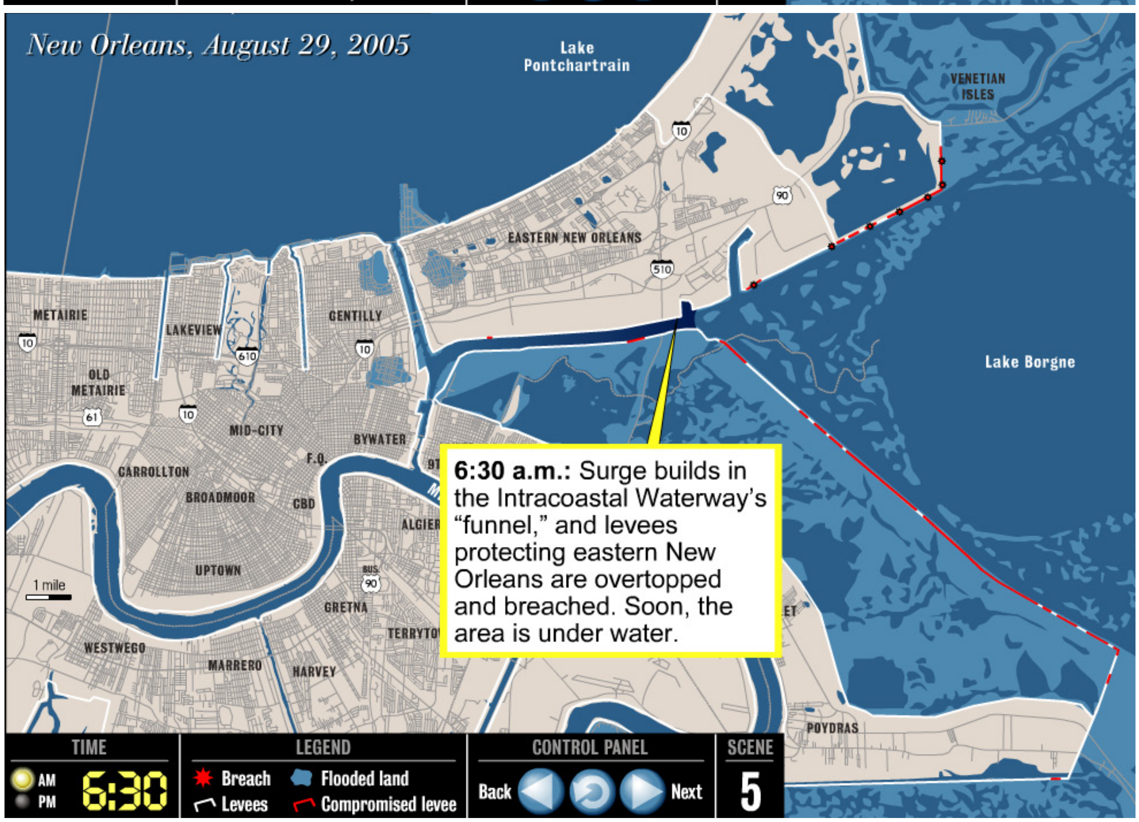


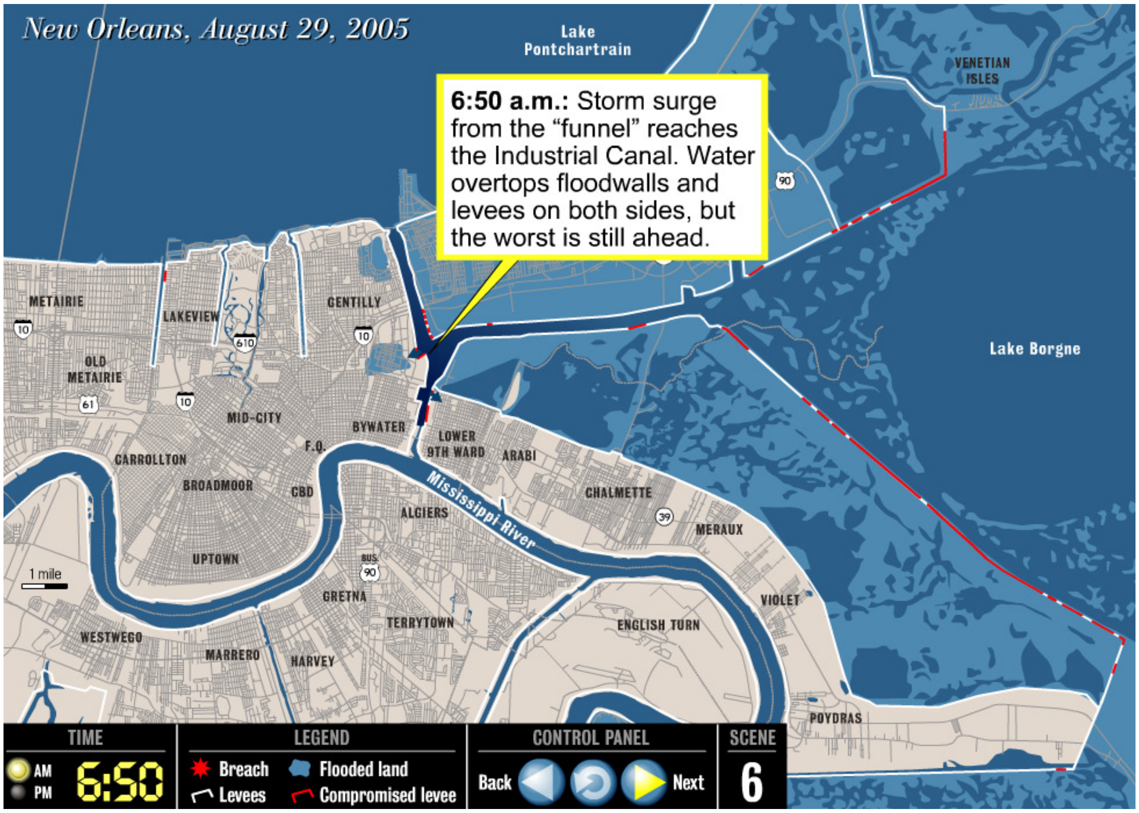
fig. 19: Hurricane Katrina Timeline


New Orleans, August 29, 2005
Lake Pontchartrain
VENETIAN ISLES
EASTERN NEW ORLEANS
METAIRIE
LAKEVIEW
GENTILLY
OLD METAIRIE
MID-CITY
BYWATER
F.Q.
CARROLLTON
BROADMOOR
CBD
ALGIERS
UPTOWN
1 mile
GRETNA
TERRYTOWN
WESTWEGO
MARRERO
HARVEY
Lake Borgne
POYDRAS
4:30 a.m.: Rising water in the Industrial Canal leaks through damaged gates into neighborhoods on both sides of the I-10 High Rise. The flow is minor compared to what is in store for these areas.
TIME
AM
PM
4:30
LEGEND
Breach
Flooded land
Levees
Compromised levee
CONTROL PANEL
Back
Next
SCENE
2

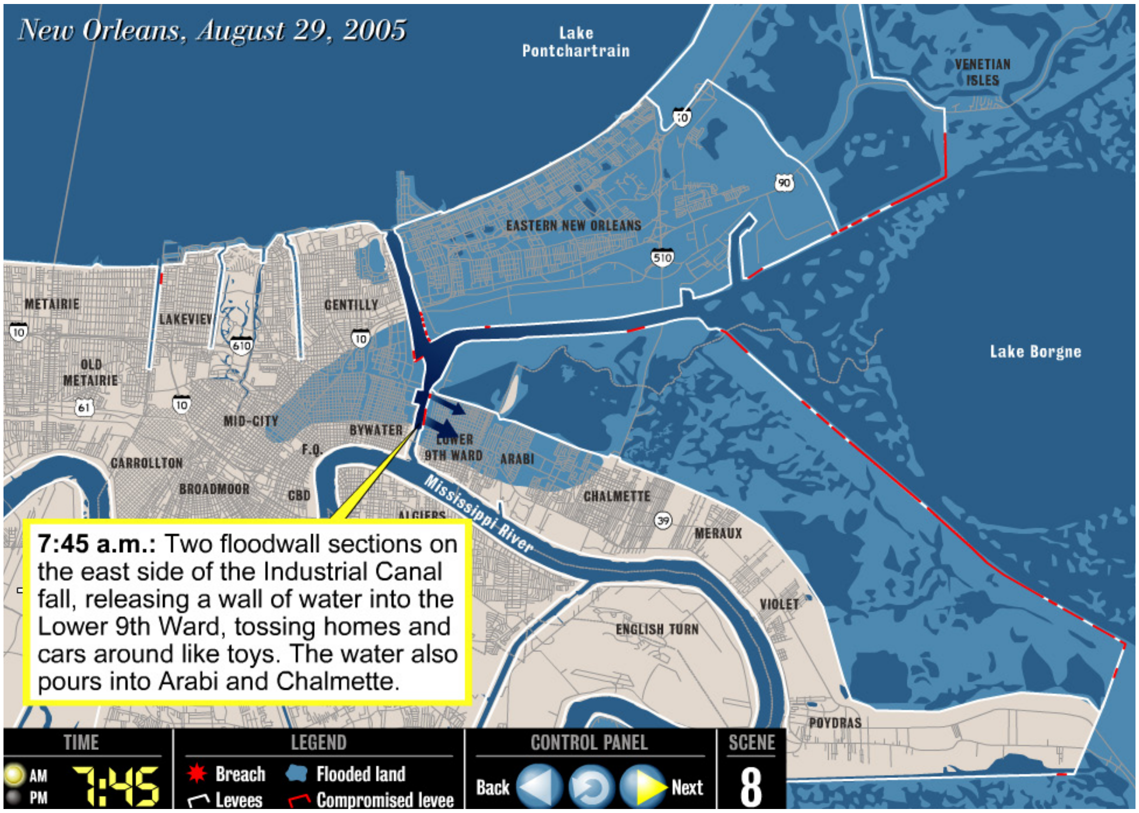

New Orleans, August 29, 2005
Lake Pontchartrain
VENETIAN ISLES
EASTERN NEW ORLEANS
METAIRIE
LAKEVIEW
GENTILLY
OLD METAIRIE
MID-CITY
BYWATER
F.Q.
LOWER 9TH WARD
ARABI
CARROLLTON
BROADMOOR
CBD
Mississippi River
CHALMETTE
MERAUX
ALGIERS
UPTOWN
1 mile
GRETNA
TERRYTOWN
ENGLISH TURN
VIOLET
WESTWEGO
MARRERO
HARVEY
Lake Borgne
POYDRAS
TIME
AM
PM
5:00
LEGEND
Breach
Flooded land
Levees
Compromised levee
CONTROL PANEL
Back
Next
SCENE
3

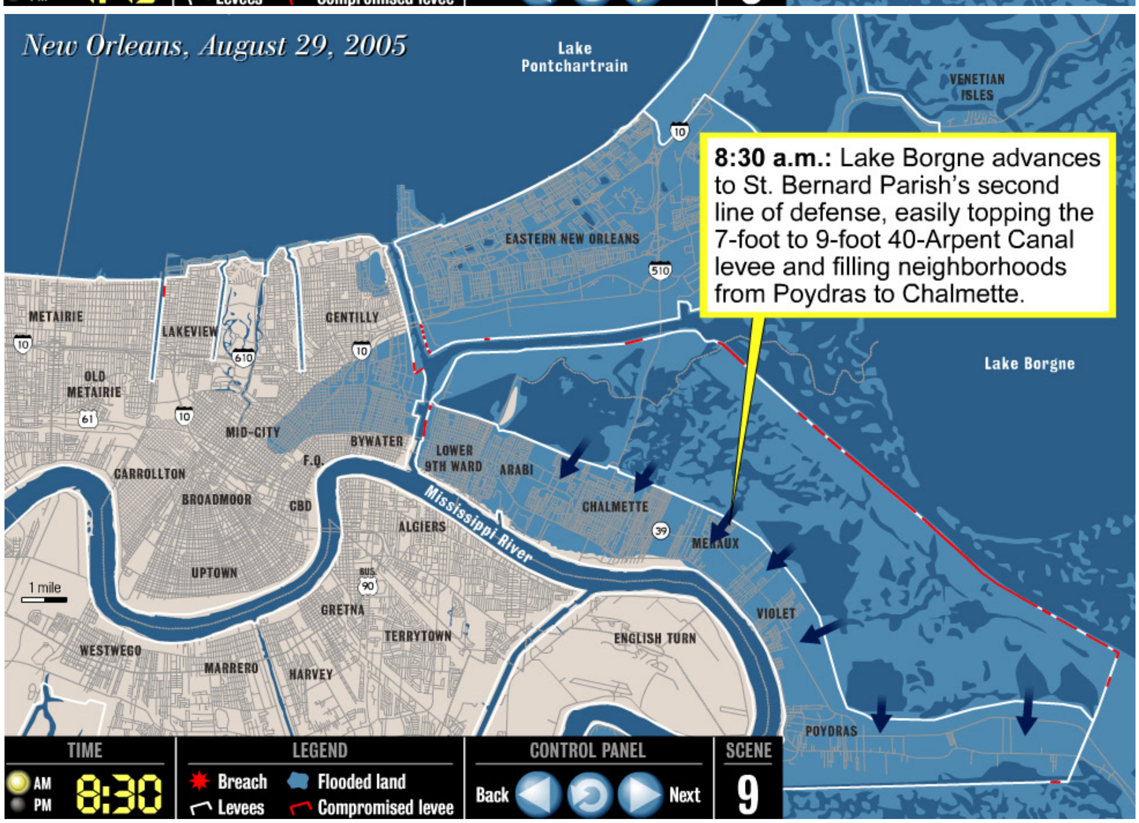

New Orleans, August 29, 2005
Lake Pontchartrain
VENETIAN ISLES
EASTERN NEW ORLEANS
METAIRIE
LAKEVIEW
GENTILLY
OLD METAIRIE
MID-CITY
BYWATER
F.Q.
LOWER 9TH WARD
ARABI
CARROLLTON
BROADMOOR
CBD
CHALMETTE
ALGIERS
Mississippi River
UPTOWN
1 mile
GRETNA
TERRYTOWN
WESTWEGO
MARRERO
HARVEY
POYDRAS
6:10 a.m.: Katrina makes landfall at Buras. A wall of water 21 feet high crosses the Mississippi River and its levees, inundating most of Plaquemines Parish.
NEW ORLEANS
POINTE A LA HACHE
PORT SULPHUR
BURAS
VENICE
Breton Sound
Miss. River
Gulf of Mexico
TIME
AM
PM
6:10
LEGEND
Breach
Flooded land
Levees
Compromised levee
CONTROL PANEL
Back
Next
SCENE
4

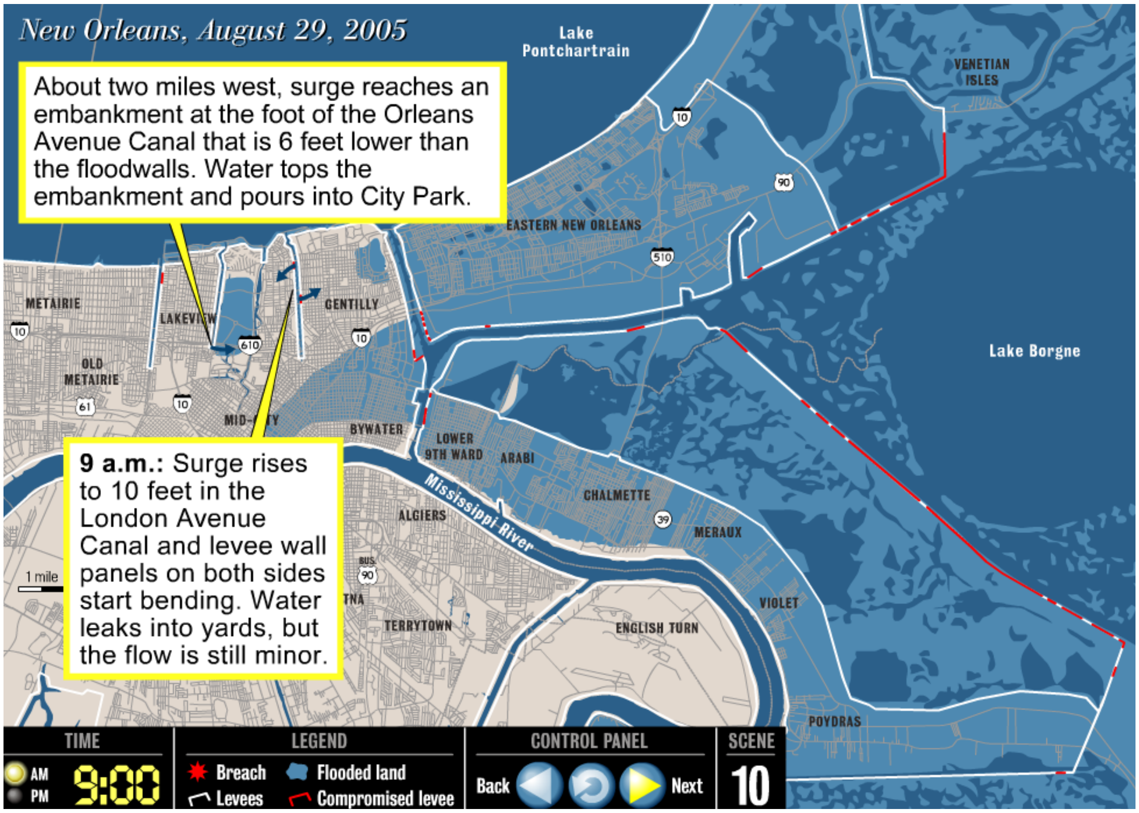

New Orleans, August 29, 2005
Lake Pontchartrain
VENETIAN ISLES
EASTERN NEW ORLEANS
Lake Borgne
METAIRIE
LAKEVIEW
GENTILLY
OLD METAIRIE
MID-CITY
BYWATER
F.Q.
CARROLLTON
BROADMOOR
CBD
UPTOWN
1 mile
GRETNA
WESTWEGO
MARRERO
HARVEY
POYDRAS
6:30 a.m.: Surge builds in the Intracoastal Waterway's "funnel," and levees protecting eastern New Orleans are overtopped and breached. Soon, the area is under water.
TIME
AM
PM
6:30
LEGEND
Breach
Flooded land
Levees
Compromised levee
CONTROL PANEL
Back
Next
SCENE
5


New Orleans, August 29, 2005
Lake Pontchartrain
6:50 a.m.: Storm surge from the "funnel" reaches the Industrial Canal. Water overtops floodwalls and levees on both sides, but the worst is still ahead.
VENETIAN ISLES
Lake Borgne
METAIRIE
LAKEVIEW
GENTILLY
OLD METAIRIE
MID-CITY
BYWATER
F.Q.
LOWER 9TH WARD
ARABI
CARROLLTON
BROADMOOR
CBD
CHALMETTE
ALGIERS
Mississippi River
MERAUX
UPTOWN
1 mile
GRETNA
VIOLET
TERRYTOWN
ENGLISH TURN
WESTWEGO
MARRERO
HARVEY
POYDRAS
TIME
AM
PM
6:50
LEGEND
Breach
Flooded land
Levees
Compromised levee
CONTROL PANEL
Back
Next
SCENE
6

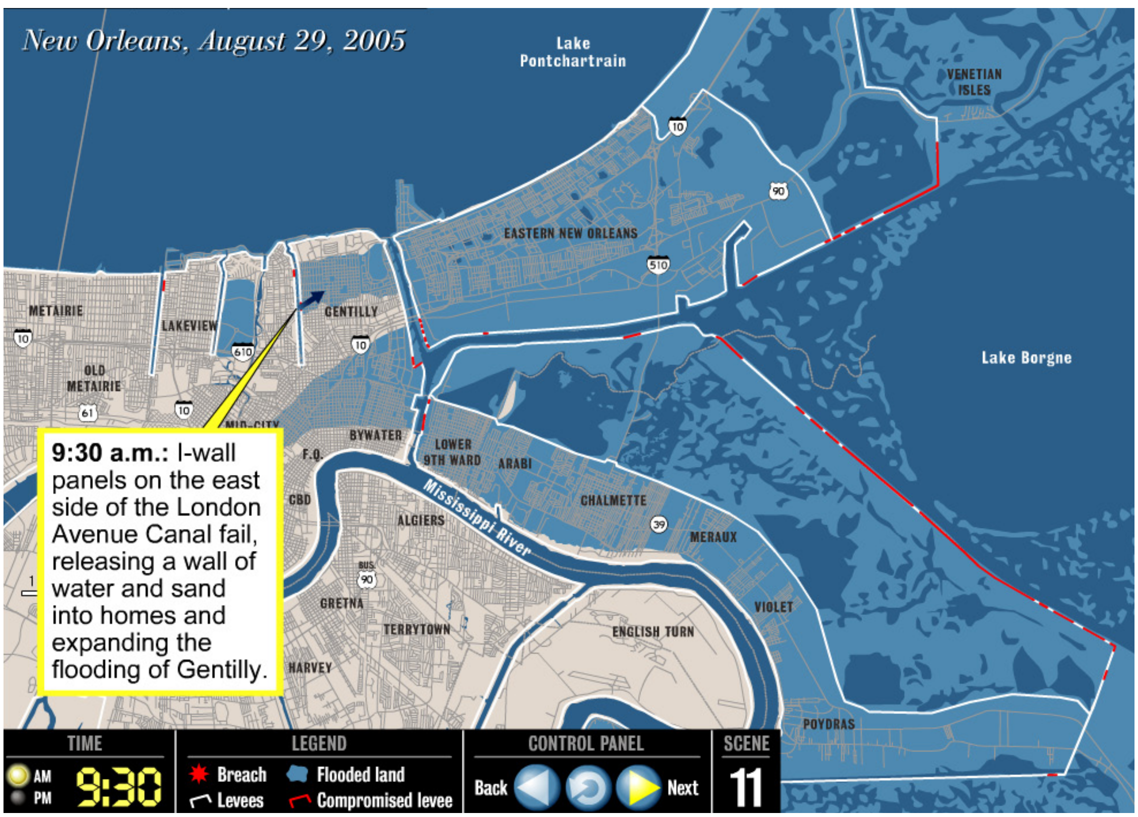

New Orleans, August 29, 2005
Lake Pontchartrain
VENETIAN ISLES
7:30 a.m.: Levee wall panels on the west side of the Industrial Canal breach, flooding the Upper 9th Ward, Bywater and Treme.
Lake Borgne
METAIRIE
LAKEVIEW
GENTILLY
OLD METAIRIE
MID-CITY
BYWATER
F.Q.
LOWER 9TH WARD
ARABI
CARROLLTON
BROADMOOR
CBD
CHALMETTE
ALGIERS
Mississippi River
MERAUX
UPTOWN
1 mile
GRETNA
VIOLET
TERRYTOWN
ENGLISH TURN
WESTWEGO
MARRERO
HARVEY
POYDRAS
TIME
AM
PM
7:30
LEGEND
Breach
Flooded land
Levees
Compromised levee
CONTROL PANEL
Back
Next
SCENE
7


New Orleans, August 29, 2005
Lake Pontchartrain
VENETIAN ISLES
EASTERN NEW ORLEANS
METAIRIE
LAKEVIEW
GENTILLY
OLD METAIRIE
MID-CITY
BYWATER
F.Q.
LOWER 9TH WARD
ARABI
CARROLLTON
BROADMOOR
CBD
CHALMETTE
Mississippi River
MERAUX
VIOLET
ENGLISH TURN
POYDRAS
Lake Borgne
7:45 a.m.: Two floodwall sections on the east side of the Industrial Canal fall, releasing a wall of water into the Lower 9th Ward, tossing homes and cars around like toys. The water also pours into Arabi and Chalmette.
TIME
AM
PM
7:45
LEGEND
Breach
Flooded land
Levees
Compromised levee
CONTROL PANEL
Back
Next
SCENE
8

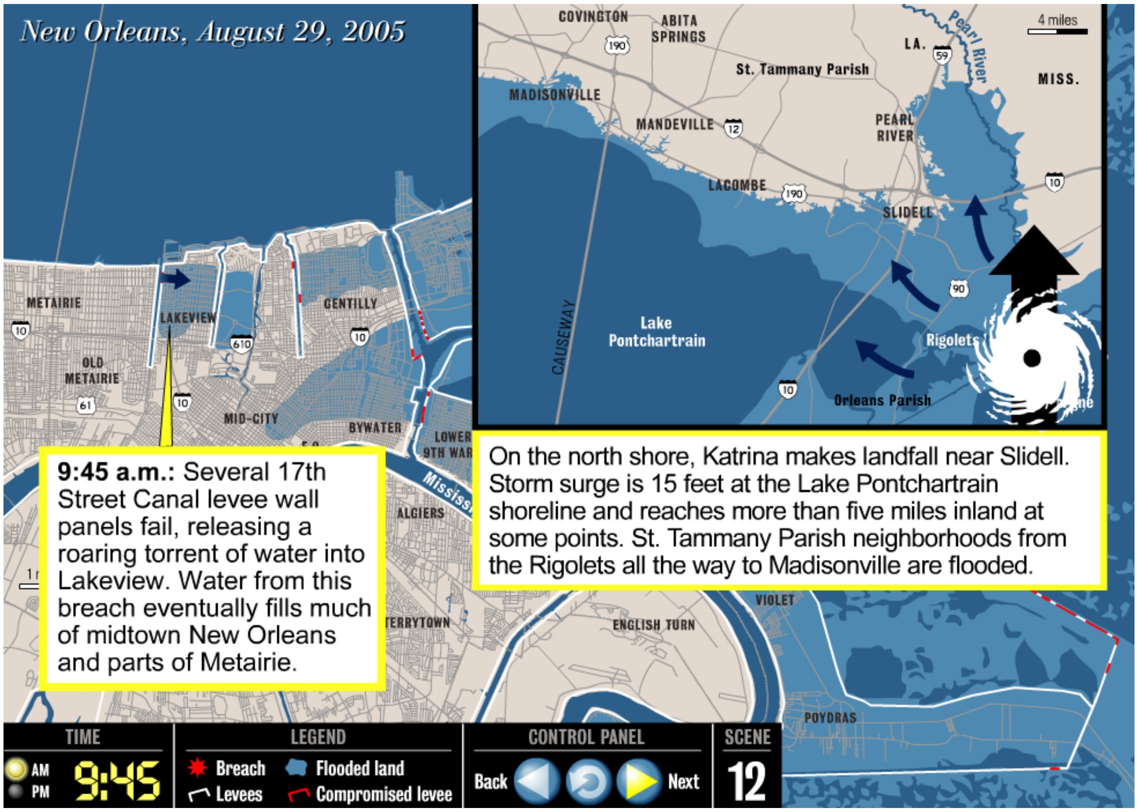

New Orleans, August 29, 2005
Lake Pontchartrain
VENETIAN ISLES
8:30 a.m.: Lake Borgne advances to St. Bernard Parish's second line of defense, easily topping the 7-foot to 9-foot 40-Arpent Canal levee and filling neighborhoods from Poydras to Chalmette.
EASTERN NEW ORLEANS
METAIRIE
LAKEVIEW
GENTILLY
Lake Borgne
OLD METAIRIE
MID-CITY
BYWATER
F.Q.
LOWER 9TH WARD
ARABI
CARROLLTON
BROADMOOR
CBD
CHALMETTE
ALGIERS
Mississippi River
MERAUX
UPTOWN
1 mile
GRETNA
VIOLET
TERRYTOWN
ENGLISH TURN
WESTWEGO
MARRERO
HARVEY
POYDRAS
TIME
AM
PM
8:30
LEGEND
Breach
Flooded land
Levees
Compromised levee
CONTROL PANEL
Back
Next
SCENE
9



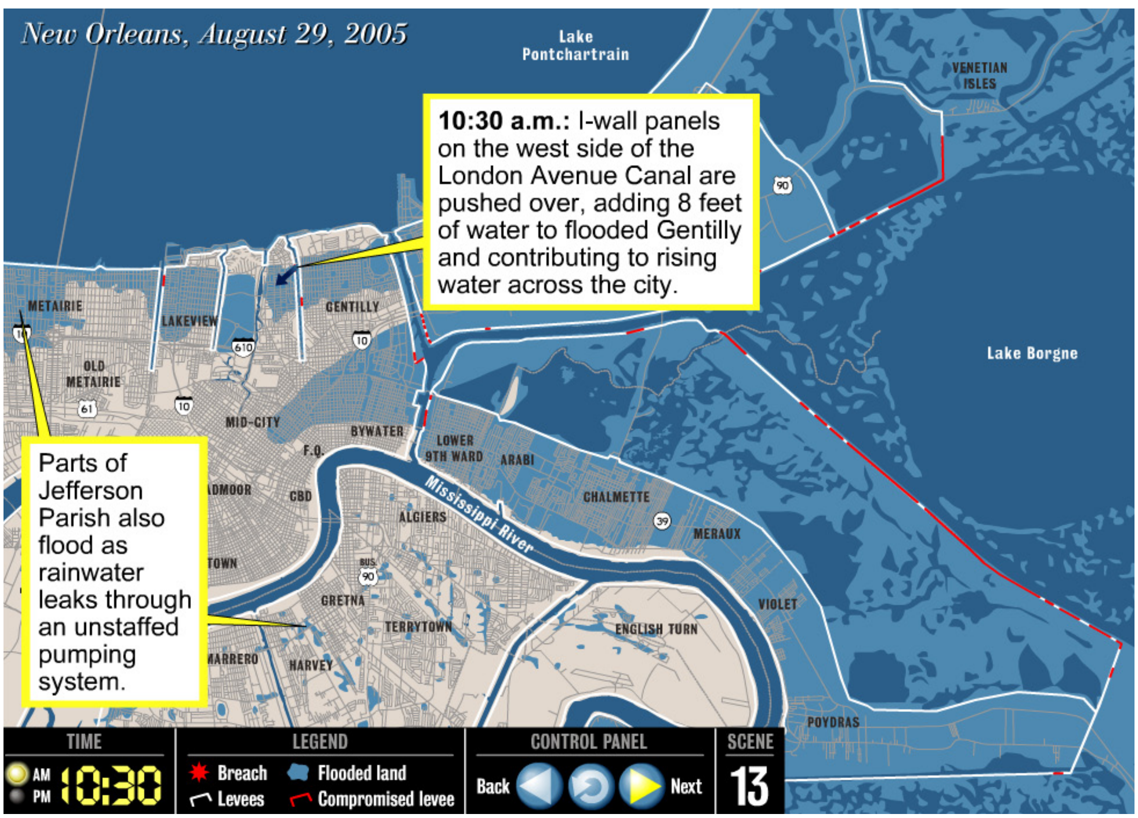
New Orleans, August 29, 2005
About two miles west, surge reaches an embankment at the foot of the Orleans Avenue Canal that is 6 feet lower than the floodwalls. Water tops the embankment and pours into City Park.
9 a.m.: Surge rises to 10 feet in the London Avenue Canal and levee wall panels on both sides start bending. Water leaks into yards, but the flow is still minor.
Lake Pontchartrain
VENETIAN ISLES
EASTERN NEW ORLEANS
METAIRIE
LAKEVIEW
GENTILLY
OLD METAIRIE
MID-CITY
BYWATER
LOWER 9TH WARD
ARABI
CHALMETTE
MERAUX
ALGIERS
Mississippi River
TERRYTOWN
ENGLISH TURN
VIOLET
POYDRAS
Lake Borgne
1 mile
TIME
AM
PM
9:00
LEGEND
Breach
Flooded land
Levees
Compromised levee
CONTROL PANEL
Back
Next
SCENE
10



New Orleans, August 29, 2005
9:30 a.m.: I-wall panels on the east side of the London Avenue Canal fail, releasing a wall of water and sand into homes and expanding the flooding of Gentilly.
Lake Pontchartrain
VENETIAN ISLES
EASTERN NEW ORLEANS
METAIRIE
LAKEVIEW
GENTILLY
OLD METAIRIE
MID-CITY
BYWATER
F.Q.
CBD
LOWER 9TH WARD
ARABI
CHALMETTE
MERAUX
ALGIERS
Mississippi River
GRETNA
TERRYTOWN
HARVEY
ENGLISH TURN
VIOLET
POYDRAS
Lake Borgne
TIME
AM
PM
9:30
LEGEND
Breach
Flooded land
Levees
Compromised levee
CONTROL PANEL
Back
Next
SCENE
11



New Orleans, August 29, 2005
COVINGTON
ABITA SPRINGS
St. Tammany Parish
LA.
Pearl River
MISS.
4 miles
MADISONVILLE
MANDEVILLE
PEARL RIVER
LACOMBE
SLIDELL
Lake Pontchartrain
CAUSEWAY
Rigolets
Orleans Parish
METAIRIE
LAKEVIEW
GENTILLY
OLD METAIRIE
MID-CITY
BYWATER
LOWER 9TH WARD
ALGIERS
TERRYTOWN
VIOLET
ENGLISH TURN
POYDRAS
9:45 a.m.: Several 17th Street Canal levee wall panels fail, releasing a roaring torrent of water into Lakeview. Water from this breach eventually fills much of midtown New Orleans and parts of Metairie.
On the north shore, Katrina makes landfall near Slidell. Storm surge is 15 feet at the Lake Pontchartrain shoreline and reaches more than five miles inland at some points. St. Tammany Parish neighborhoods from the Rigolets all the way to Madisonville are flooded.
TIME
AM
PM
9:45
LEGEND
Breach
Flooded land
Levees
Compromised levee
CONTROL PANEL
Back
Next
SCENE
12



New Orleans, August 29, 2005
Lake Pontchartrain
VENETIAN ISLES
10:30 a.m.: I-wall panels on the west side of the London Avenue Canal are pushed over, adding 8 feet of water to flooded Gentilly and contributing to rising water across the city.
METAIRIE
LAKEVIEW
GENTILLY
OLD METAIRIE
MID-CITY
BYWATER
F.Q.
LOWER 9TH WARD
ARABI
CHALMETTE
MERAUX
Lake Borgne
CBD
ALGIERS
Mississippi River
GRETNA
TERRYTOWN
ENGLISH TURN
VIOLET
HARVEY
POYDRAS
Parts of Jefferson Parish also flood as rainwater leaks through an unstaffed pumping system.
TIME
AM
PM
10:30
LEGEND
Breach
Flooded land
Levees
Compromised levee
CONTROL PANEL
Back
Next
SCENE
13

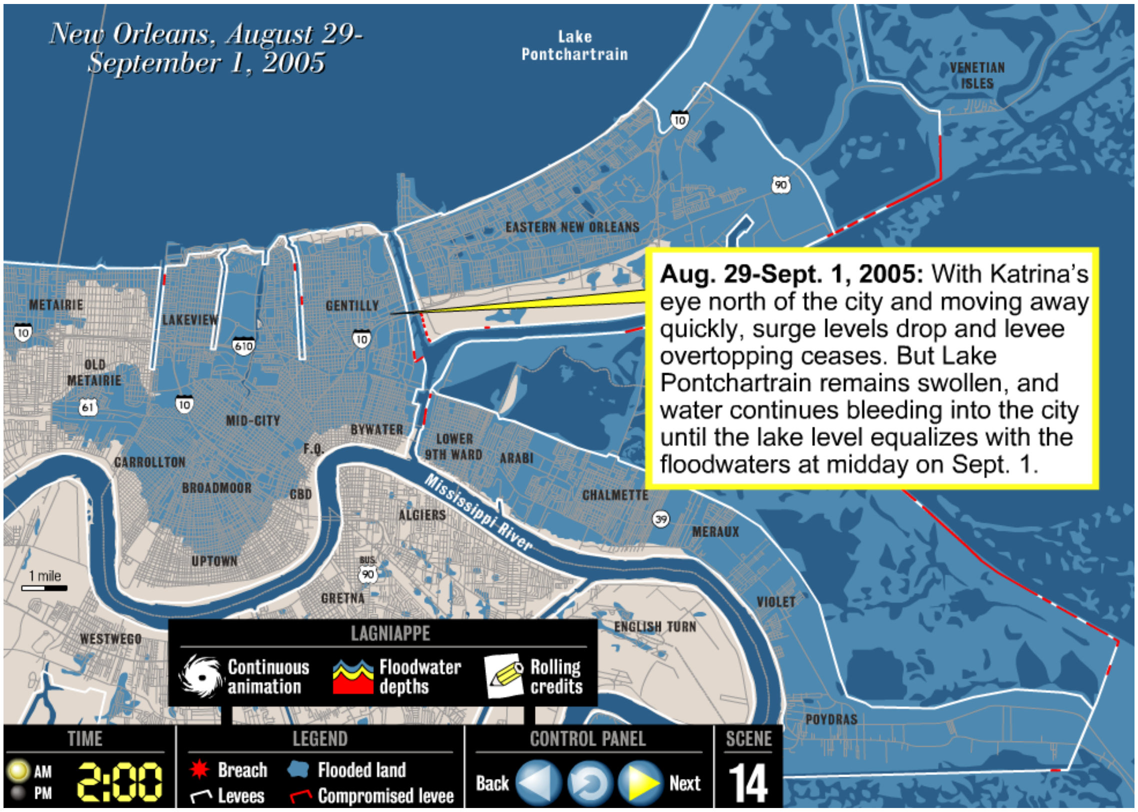

New Orleans, August 29-September 1, 2005
Lake Pontchartrain
VENETIAN ISLES
EASTERN NEW ORLEANS
METAIRIE
LAKEVIEW
GENTILLY
OLD METAIRIE
MID-CITY
BYWATER
LOWER 9TH WARD
ARABI
F.Q.
CARROLLTON
BROADMOOR
CBD
ALGIERS
Mississippi River
CHALMETTE
MERAUX
UPTOWN
GRETNA
VIOLET
1 mile
WESTWEGO
ENGLISH TURN
POYDRAS
Aug. 29-Sept. 1, 2005: With Katrina's eye north of the city and moving away quickly, surge levels drop and levee overtopping ceases. But Lake Pontchartrain remains swollen, and water continues bleeding into the city until the lake level equalizes with the floodwaters at midday on Sept. 1.
LAGNIAPPE
Continuous animation
Floodwater depths
Rolling credits
TIME
AM
PM
2:00
LEGEND
Breach
Flooded land
Levees
Compromised levee
CONTROL PANEL
Back
Next
SCENE
14

fig. 20: Destroyed Neighbouhood, Post-Katrina New Orleans, 2005

fig. 21: Flooded Street, Post-Katrina New Orleans, 2005

AFTERMATH

In New Orleans, the Lower Ninth Ward was one of the neighbourhoods most impacted by Hurricane Katrina. Make It Right (MIR), a non-profit organization founded by actor Brad Pitt, has been active in rebuilding part of New Orleans' Lower Ninth Ward. MIR remarked on the impact of Hurricane Katrina and its aftermath:

> Levee failure created floodwaters that tore houses from their foundations, threw houses on top of cars, and erased blocks upon blocks, leaving many residents homeless [fig. 20, 21]. . . . Neighbors tell stories of devastating heat, desperate attempts to save family members by hacking holes through roofs to provide air and escape from the rising floodwaters, and hours upon hours and days upon days spent on rooftops without drinking water in the relentless sun waiting for help. The wait went on for more than two years later after the storm.[39]

The following pages will discuss some of the major factors that contributed to the devastation caused by Hurricane Katrina, including lack of preparedness, insufficient temporary shelter, and the delayed return of utilities. Figures 22 to 25 depict exterior and interior scenes of the aftermath of Hurricane Katrina in New Orleans.

fig. 22: Rescue Boat, Post-Katrina New Orleans, 2005

fig. 23: US Coast Guard Rescue Boat, Post-Katrina New Orleans, 2005

new orleans post-katrina exterior images

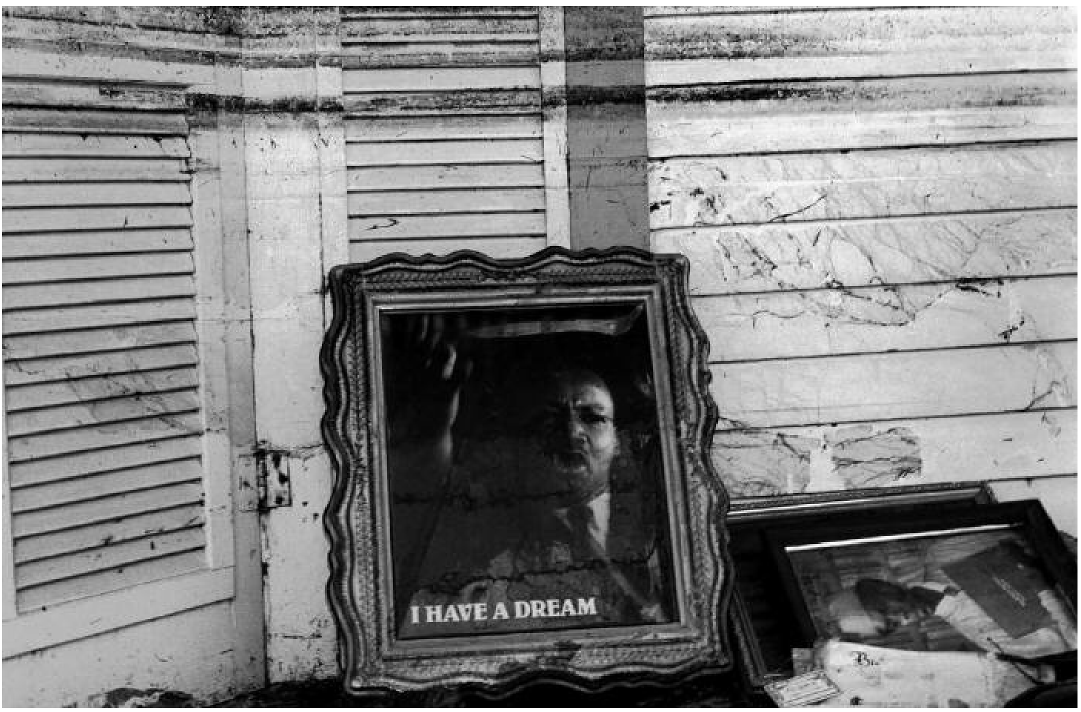


fig. 24: Exterior Photo Montage of Post Katrina, New Orleans

new orleans post-katrina interior images

fig. 25: Interior Photo Montage of Post Katrina, New Orleans

fig. 26: The Superdome, Post-Katrina

fig. 27: People Waiting Outside the Superdome

fig. 28: Inside the Superdome, Post-Katrina

fig. 29: Vacant FEMA Trailers, Post-Katrina

INSUFFICIENT TEMPORARY SHELTER

As a part of the New Orleans' disaster plan, the Louisiana Superdome and the Ernest N. Morial Convention Center were the primary designated shelters for residents in New Orleans who were unable to evacuate from Hurricane Katrina. Ezra Boyd, Brian Wolshon, and Ivor Van Heerden have provided post-Katrina population estimates for these designated emergency shelters: the Superdome had a population of 35,000 and the Convention Center, 19,000 (fig. 26-28).[40] The overcrowded conditions and lack of utilities and basic amenities exacerbated the situation greatly. Plans to provide alternate short-term shelter were equally botched. According to a report by the President's Council on Integrity and Efficiency:

> FEMA purchased 24,967 manufactured homes at a cost of $862.7 million and 1,755 modular homes at a cost of $52.4 million in response to the need for transitional housing to assist displaced evacuees from Hurricanes Katrina and Rita. . . . Most importantly, FEMA had no plans for how the homes would be used before they were purchased. Subsequently, there are currently 17,055 mobile homes and 5,707 travel trailers staged at eight emergency housing sites waiting to be used [fig. 29].[41]

This poor planning and misallocation of resources had significant ramifications for residents of New Orleans. Trailers, and other shelter devices such as tarps, were distributed in strict adherence to overly bureaucratic guidelines and in a manner that was inconsistent with the need. According to Rebekah Green, Lisa K. Bates, and Andrew Smyth, "as of October 2006, only 1.6% of flooded units in the Lower Ninth Ward had received FEMA trailers, far below the 6.3% citywide average."[42] In addition to trailers, FEMA provided heavy-duty blue plastic tarps to protect residential and commercial pitched roofs after Hurricane Katrina.[43] According to FEMA, to qualify for a tarp "the home must have at least 50% of the structural roof remaining (rafters and decking), and it must be an asphalt-shingled pitched roof."[44] This strict requirement about the type of material and pitch of roof disqualified homes that could have continued to function as temporary shelter. Additionally, homes with roofs that were more than 50% damaged, and in greatest need of protection, were disqualified from this minimal service by virtue of being essentially overly destroyed.

LACK OF UTILITIES

As of May 2006, electricity and gas were restored to all neighbourhoods in New Orleans except the Lower Ninth Ward. These utilities were only partially restored in this neighbourhood and the schedule for full restoration had not been determined. The slow return of utilities prolonged the recovery of the Lower Ninth Ward after Hurricane Katrina. In fact, without utilities, residents could not access the FEMA trailer program nor were they permitted to return to their homes. According to the New Orleans Mayor's Office, in a press release issued in June of 2006, "more than one year after Katrina, many Lower Ninth Ward residents still lacked the municipal services necessary for trailer placement. . . . Without these basic utilities [electricity, sewage, and water], homeowners in the Lower Ninth Ward were unable to place FEMA trailers on their properties or reoccupy their homes."[45] Figure 30 is a table of services by Entergy, one of the primary providers for electricity and gas in New Orleans.[46] This table shows that utilities in many parts of the Lower Ninth Ward had not been fully restored for almost a year after the storm. This greatly compromised the recovery of this neighbourhood and inhibited residents from rehabilitating their homes, resulting in further property damage that could have been prevented.

Hurricane Katrina
Entergy Restoration Assessment Summary
May 10, 2006

Zip Code	Electric			Gas			Change Since last report	
	% Power Available	Status	ETA for Green	% Gas Available	Status	ETA for Green	Electric	Gas
70114	100	Green	on	100	Green	on		
70131	100	Green	on	100	Green	on		
70115	98	Green	on	100	Green	on		
70118	98	Green	on	98	Green	on		
70116	98	Green	on	100	Green	on		
70112	100	Green	on	100	Green	on		
70113	100	Green	on	100	Green	on		
70130	99	Green	on	100	Green	on		
70125	95	Green	on	100	Green	on		
70119	98	Green	on	100	Green	on		
70124	96	Green	on	100	Green	on		+9%
70122	97	Green	on	100	Green	on		
70126	95	Green	on	100	Green	on		
70127	95	Green	on	100	Green	on		
70128	96	Green	on	100	Green	on		
70129	92	Green	on	81	Green	on		
70117 (Upper)	95	Green	on	100	Green	on		+6%
70117 (Lower)	82	Green	tbd	50	Amber	tbd	+2%	+50%
Total	96%	Green		97%	Green			+2%

Status Criteria
Green: 75% - 100% Functional
Amber: 25% - 74%
Red: 0% - 24%

Indicates repopulated zip codes.
Indicates partially repopulated zip codes.

Updated: 5/10/2006
70129: Completed work on Feeder backbone in Lake Catherine area. Restoring laterals and transformers upon customer request
70124: (Lake View): Most work completed in Lakeview area near breach except for 2 block area adjacent to breach.
70117 (Lower): Restored gas service to area bounded by Claiborne to River, Industrial Canal to Parish Line also restored electric service to entire area except for several blocks nearest breach.

Devastated areas WITHOUT ETAs include sections:
70117: (Lower 9th Ward): Electric Service - Several block area nearest breach.
70117: (Lower 9th Ward): Gas Service - Claiborne to Florida, Industrial Canal to Parish Line

fig. 30: Hurricane Katrina Entergy Restoration Assessment Summary

fig. 31: Homes Inspected by National Guard

VESTIGES OF KATRINA

The eerie markings depicted in figures 31, 32, and 33 were made by the National Guard and special military units from Louisiana and other states while inspecting homes for survivors. The crews spray painted each house, leaving a permanent record to communicate their findings. They painted an "X" on the front of each home: the upper quadrant indicated the date; the left quadrant recorded the agency ("FL-1" for the first Florida team), or simply the searcher's initials; the right quadrant was used for houses that were not entered ("NE" for No Entry) or other comments about the conditions found; and in the lower quadrant, the number of dead bodies found inside.[47]

DEATH TOLL

In spite of search and rescue efforts, the precise death toll from Hurricane Katrina is still not known. Jed Horne, in his book *Breach of Faith: Hurricane Katrina and the Near Death of a Great American City*, comments on the accepted death toll in May 2006:

> It would never be known exactly how many people died. The best estimate placed the toll at about 1,100, with another 231 lost in Mississippi. Nor was it clear what proportion of the casualties died immediately, leaving the rest to a lingering demise — by drowning, from exposure, from medical conditions that worsened lethally as men, women, and children attempted to wade or swim to dry ground, perched on rooftops awaiting help that never came, or succumbed to infernal temperatures and dehydration in attics where the floods had chased them.[48]

According to Allison Plyer, Chief Demographer at the Greater New Orleans Community Data Center (GNOCDC), as of April 15, 2010, "Hurricane Katrina and the levee failures resulted in the deaths of at least 1,464 Louisiana residents. The major causes of death include: drowning (40%), injury and trauma (25%), and heart conditions (11%). Nearly half of all victims were over the age of 74."[49] Ezra Boyd, PhD candidate at the Louisiana State University (LSU) Department of Geography and Graduate Research Assistant at the LSU Hurricane Public Health Center, confirms approximately 1,500 Louisiana residents died due to Hurricane Katrina and levee failures.[50]

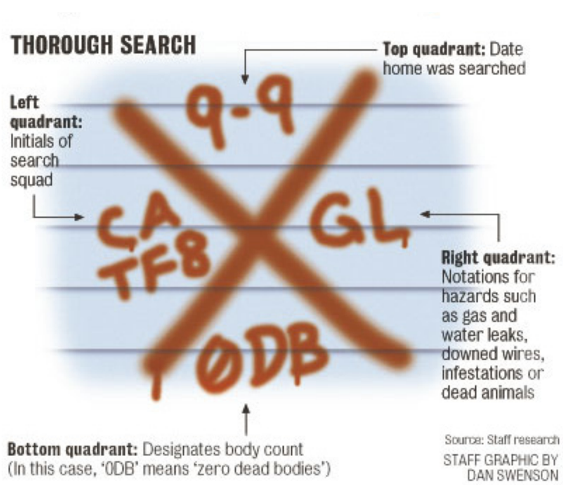


fig. 32: Diagram of markings made by National Guard

fig. 33: Markings made by National Guard on Homes

02

iv

challenges: infrastructure

HURRICANE PROTECTION SYSTEM

The failure of New Orleans' hurricane protection system caused the majority of damage during and after Hurricane Katrina. The American Society of Civil Engineers (ASCE) report explains the New Orleans hurricane protection system: "The USACE is responsible for the design and construction of most of the flood and hurricane protection levees along the Mississippi River and in the New Orleans area. . . . The USACE Hurricane Protection Projects in the New Orleans area are generally grouped into three main units: i) Lake Pontchartrain and Vicinity, ii) West Bank and Vicinity; and iii) New Orleans to Venice."[51]

The USACE designed and built three types of structures in the New Orleans hurricane protection system: the I-Wall, T-Wall and earthen levee (fig. 34, 35). The earthen levee comprises the majority of the USACE hurricane protection system.[52]

The ASCE report explains:

> When an earthen levee is raised with additional earth fill, it can typically only be heightened by increasing the width at the base. In most urban areas of New Orleans, the land has been developed right up to the base of the levee. To raise and widen the levee would require private property to be purchased and buildings to be removed. . . . Where an existing levee was located adjacent to buildings, canals or other structures, the USACE often resorted to using I-walls to avoid impacting adjacent development.[53]

To adequately protect New Orleans from flooding, earthen levees need to be raised to accommodate changes in flood protection criteria, based on updates in meteorological data.[54] However, due to their close proximity to adjacent buildings, there is often insufficient space for lateral expansion. An additional layer of flood protection is required to accommodate floodwaters in the event earthen levees overtop, as observed during Hurricane Katrina. Figure 36 illustrates how earthen levees can be heightened.

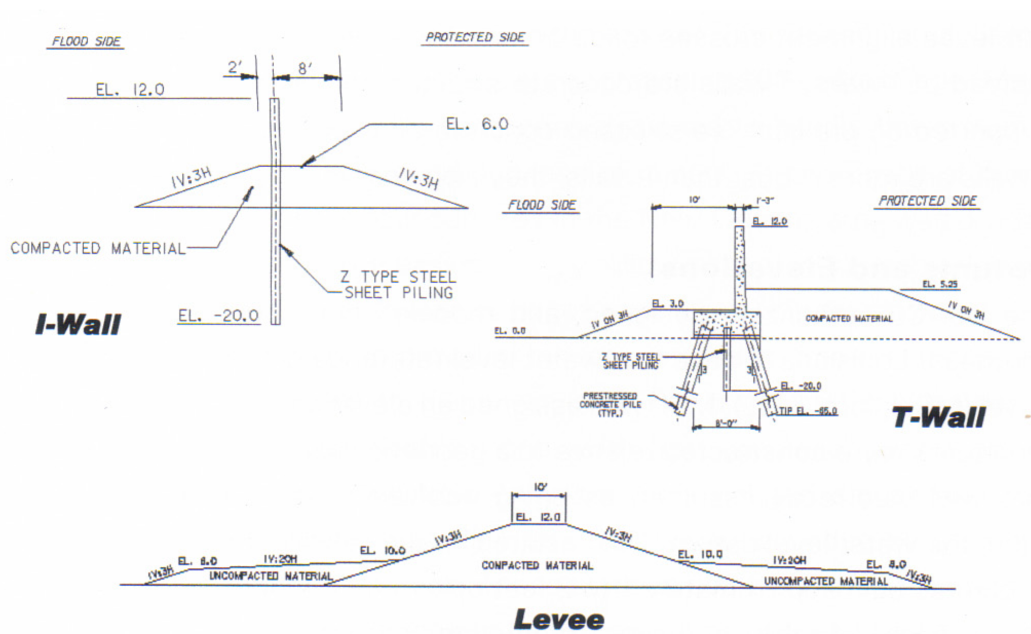


fig. 34: Typical USACE Flood Protection Structures

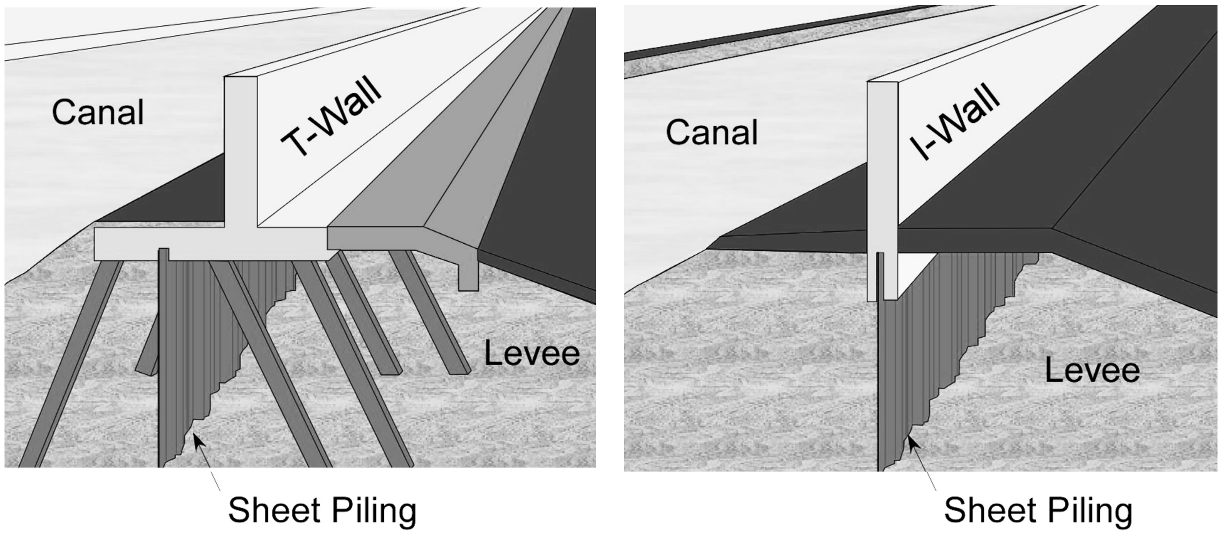


fig. 35: T-Wall and I-Wall, Three-Dimensional Sections

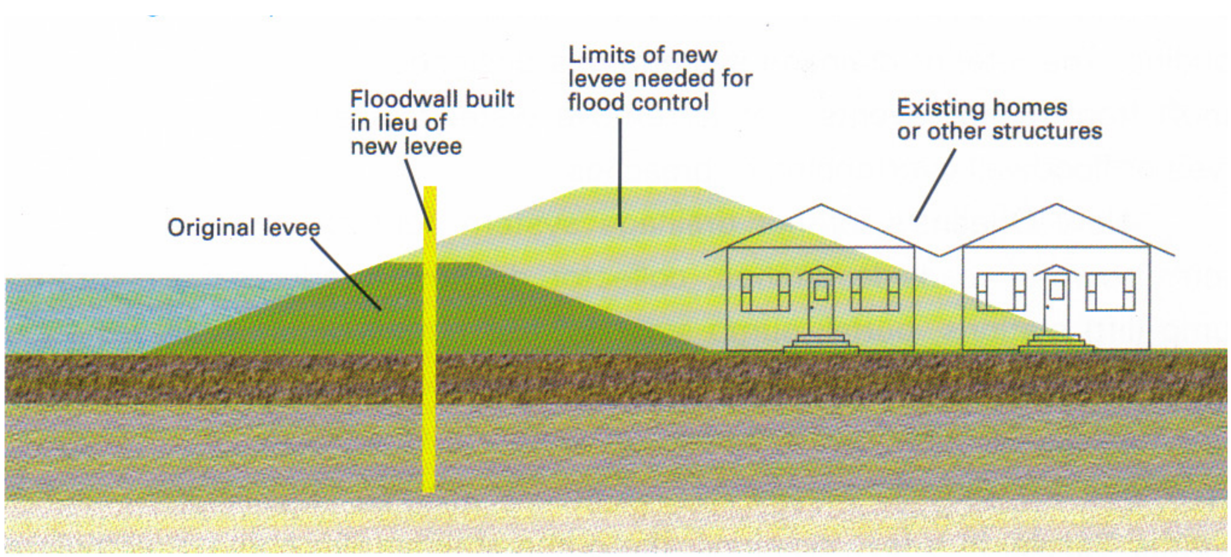


fig. 36: Increasing the Top Elevation of an Earthen Levee

ARTIFICIAL LEVEE FAILURE

Katrina's damage to New Orleans was mainly a consequence of artificial levee failure. Failures at approximately fifty locations in the city's hurricane protection system resulted in the massive, destructive flooding of New Orleans (fig. 37, 38).[55] According to the ASCE report:

> Levees and floodwalls were built around the city and adjacent parishes to protect against flooding. During and after Hurricane Katrina many of those levees and floodwalls were overtopped and several were breached allowing billions of gallons of water from the Gulf of Mexico, Lake Borgne, and Lake Pontchartrain to flow into New Orleans and flood major portions of the city. . . . There were two direct causes of the levee breaches: collapse of several levees with concrete floodwalls (called-I walls) because of the way they were designed, and overtopping, where water poured over the tops of the levees and floodwalls and eroded the structures away. . . . Furthermore, the many existing pump stations that could have helped remove floodwaters were inoperable during and after the storm.[56]

Risk had been increased by the practices of the USACE where the hurricane protection system was poorly designed and constructed. It was also under-maintained because of insufficient government funding. Government funding was allocated but never appropriated to make the necessary improvements to the hurricane protection system.[57]

The ASCE report states: "The Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project was intended to protect St. Bernard, Orleans, Jefferson and St. Charles parishes between Mississippi River and Lake Pontchartrain. The project generally included earthen levees with floodwalls along Lake Pontchartrain, the 17th Street Canal, the Orleans Canal, the London Avenue Canal and the Industrial Canal."[58] The ASCE report further states: "The Lake Pontchartrain and Vicinity Hurricane Protection Project system experienced the worst damage during and after Hurricane Katrina and resulted in the most serious consequences to the city and people of New Orleans. Of the 284 miles of federal levees and floodwalls — there are approximately 350 miles in total — 169 miles were damaged. Levees in USACE's New Orleans to Venice Hurricane Protection Project sustained significant damage caused by powerful floodwaters overtopping and breaching the levees. The levees in the USACE's West Bank and Vicinity Hurricane Protection Project experienced the least amount of damage."[59]

Anuradha Mathur and Dilip da Cunha surmised "the tragedy that struck New Orleans in the wake of Katrina was only immediately caused by a failure to keep Lake Pontchartrain out of the city; its deeper cause lies in a success at keeping the Mississippi within levees. It is a success that has come at the cost of a natural land-building process that the Mississippi once conducted through the agency of its meanders and overflows."[60]

Figure 39 depicts a breached levee in the 17th Street Canal wall in New Orleans, Louisiana. NOAA's National Geodetic Survey (NGS) explains:

> A part of the West End neighbourhood of New Orleans is to the right on the east side of the canal, severely flooded; to the left, west of the canal, is part of Metairie, Louisiana, not flooded…Metal girders and/or plates were later hung along the north side of the Hammond Highway bridge ([see fig. 39] gray bridge at top, with debris in canal on the north/Lake Pontchartrain side) to block the entrance to the canal. The breach in the canal berm and canal wall (lower right) were closed with helicopter-dropped sandbags and trucks dumping fill southward from Hammond Highway. . . . The breach was closed [at the 17th Street Canal wall] Monday, September 5, 2005. An opening was then made in the metal wall to allow city drainage through the canal.[61]

Although failure at the 17th Street Canal caused significant flooding in New Orleans, levee failure at the Industrial Canal was responsible for the much of the flooding in the Lower Ninth Ward neighbourhood. According to the ASCE report, "the failure of the Industrial Canal East Bank north I-wall was likely the source of the earliest flooding (observed at 5:00 am) in the Lower Ninth Ward."[62] Figure 40 is a photo taken at the Industrial Canal, where the levee overtopped and also breached.

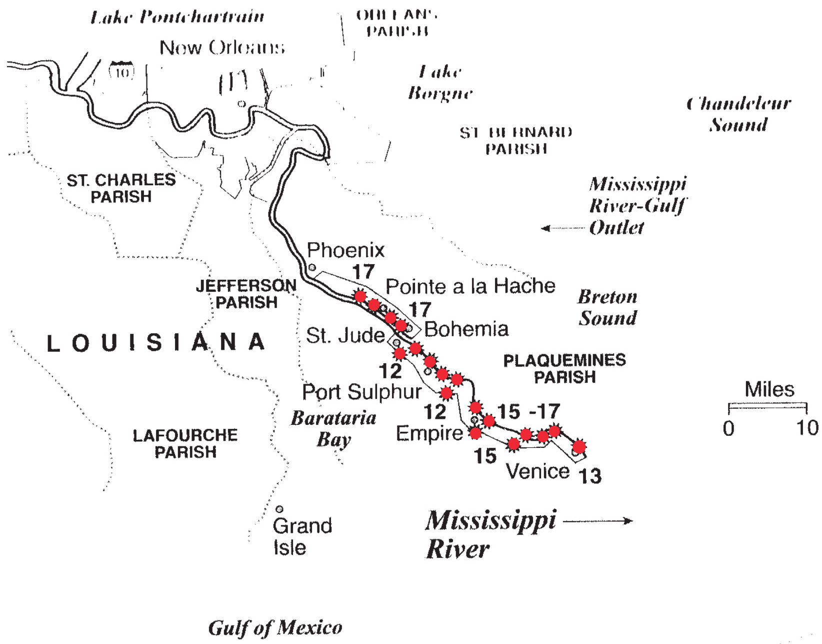


fig. 37: Areas of Levee Failure, Plan View

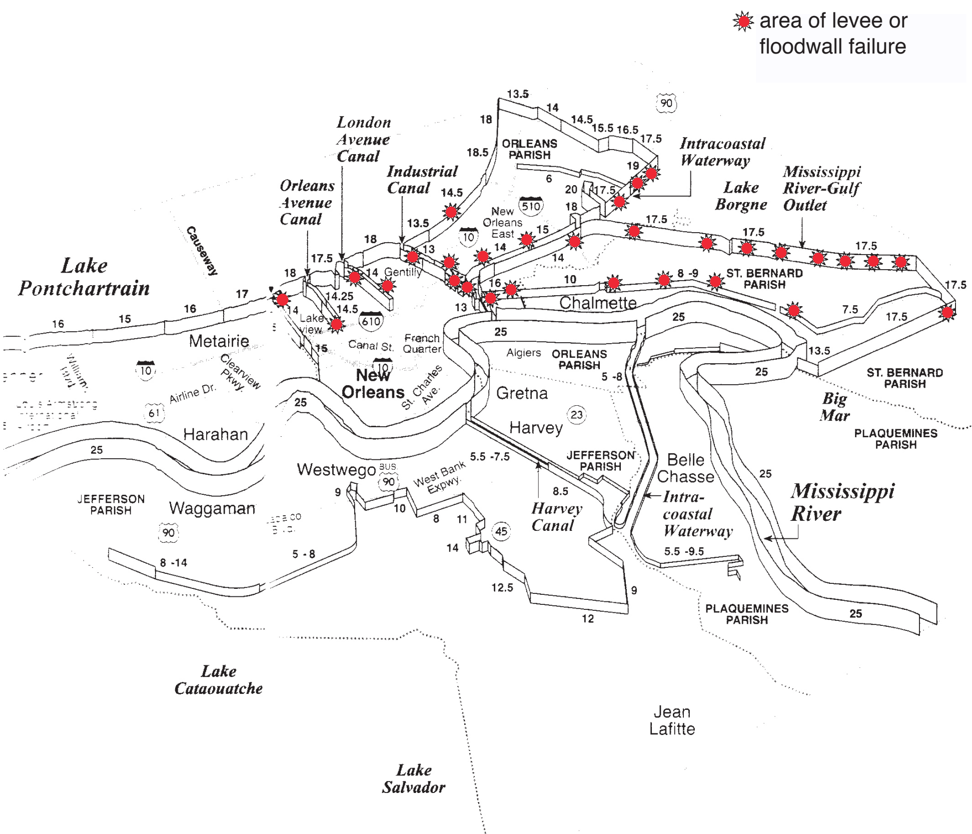


fig. 38: Areas of Levee Failure, Three-Dimensional View

fig. 39: NOLA 17th Street Breach, August 31, 2005.

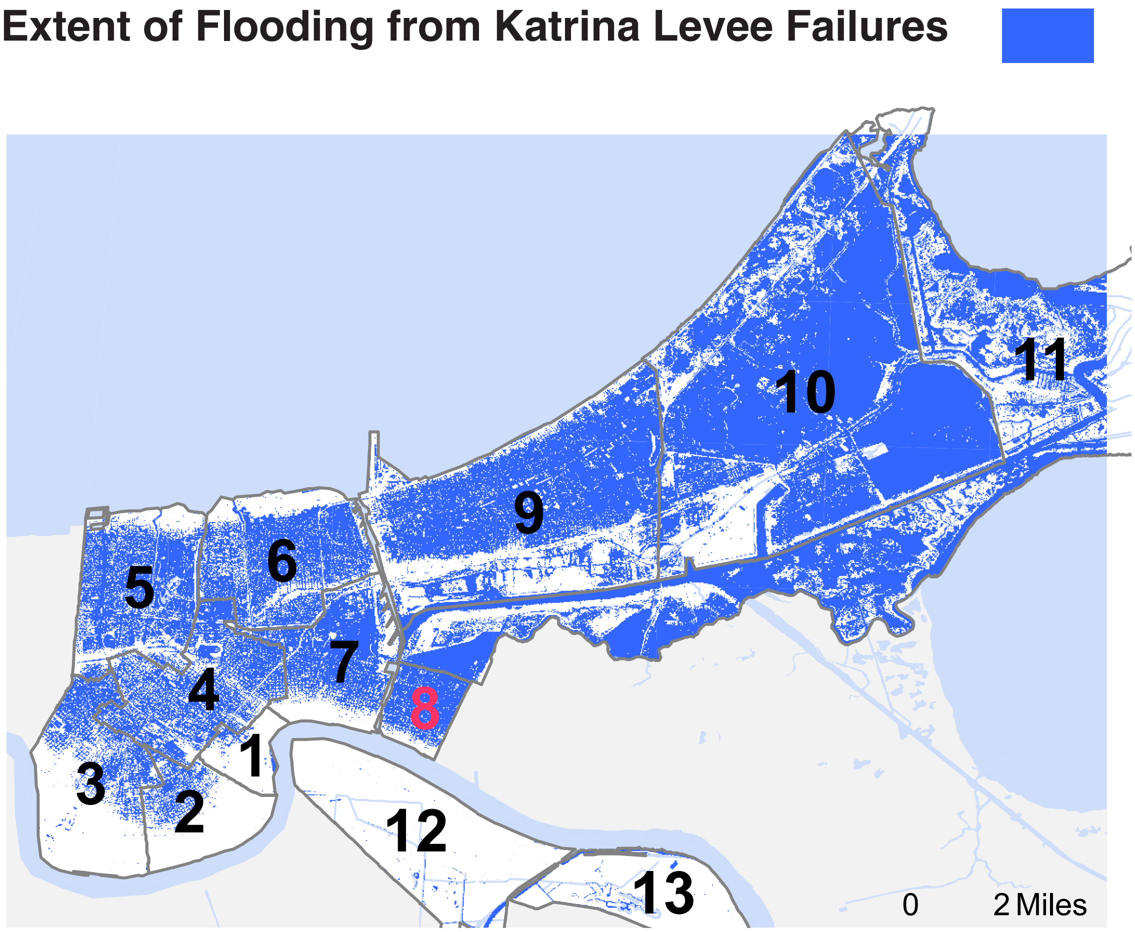
fig. 40: Levee Overtopping at the Industrial Canal

FLOOD DEPTH AND DURATION

As mentioned earlier, New Orleans suffered severe flooding due to multiple levee failures during and after the passage of Hurricane Katrina. Figure 41 illustrates the extent of flooding by district on August 31, 2005, two days after the storm. Figures 42 and 43 are two aerial photographs of New Orleans flooded after Hurricane Katrina. Figure 44 is a diagram comparing New Orleans before the storm and after the storm, outlining the boundary of the highest flood levels. Figure 45 is a photo taken in New Orleans on September 8, 2005, ten days after the storm. According to the ASCE report, "by September 1, 2005, portions of Lakeview, Gentilly, New Orleans East and the Lower Ninth Ward were submerged in more than 10 feet of water (orange and red colored areas). Significant portions of the city stood in water more than 6 feet deep (green and aqua-colored areas) [fig. 46]."[63]

This information is further illustrated in figure 47, where a significant portion of the Lower Ninth Ward stood in more than four feet of water. Figure 48 provides greater detail, displaying the number of days each block remained flooded after Hurricane Katrina. In the Lower Ninth Ward, the area shaded in red remained wet for 23-29 days after the storm, which devastated property. Conversely, the area shaded in light green of the Lower Ninth Ward (the area of focus for the BFP) remained wet for 7-11 days, which resulted in significantly less damage and a greater percentage of salvageable properties.[64]

Extent of Flooding from Katrina Levee Failures



1 Central Business District, French Quarter
2 Central City, East Riverside, Garden District, Irish Channel, Lower Garden District, Milan, St. Thomas, Touro
3 Audubon, Black Pearl, Broadmoor, Dixon, East Carrollton, Fontainebleau, Freret, Hollygrove, Leonidas, Uptown, West Riverside
4 Bayou St. John, BW Cooper, Fairgrounds, Gert Town, Iberville, Mid-City, St. Bernard Area, Seventh Ward, Treme/Lafitte Tulane/Gravier
5 City Park, Lakeshore/Lake Vista, Lakeview, Lakewood, Navarre, West End
6 Dillard, Filmore, Gentilly Terrace, Gentilly Woods, Lake Terrace & Lake Oaks, Milneburg, Pontchartrain Park, St. Anthony Gentilly, UNO
7 Bywater, Desire Area, Desire Development, Florida Area, Florida Development, Marigny, St. Claude, St. Roch
8 Holy Cross, Lower 9th Ward
9 Little Woods, Pines Village, Plum Orchard, Read Boulevard East, Read Boulevard West, West Lake Forest
10 Village de L'Est
11 Lake Catherine, Viavant/Venetian Isles
12 Algiers Point, Behrman, Fischer, McDonogh, Old Aurora, US Naval Support Area, Tall Timbers/ Brechtel, Whitney
13 English Turn

fig. 41: Extent of Flooding from Katrina Levee Failures by District

fig. 42: Post Katrina Aerial Photograph, New Orleans, Louisiana, 2005

fig. 43: Post Katrina Aerial Photograph, New Orleans, Louisiana, 2005

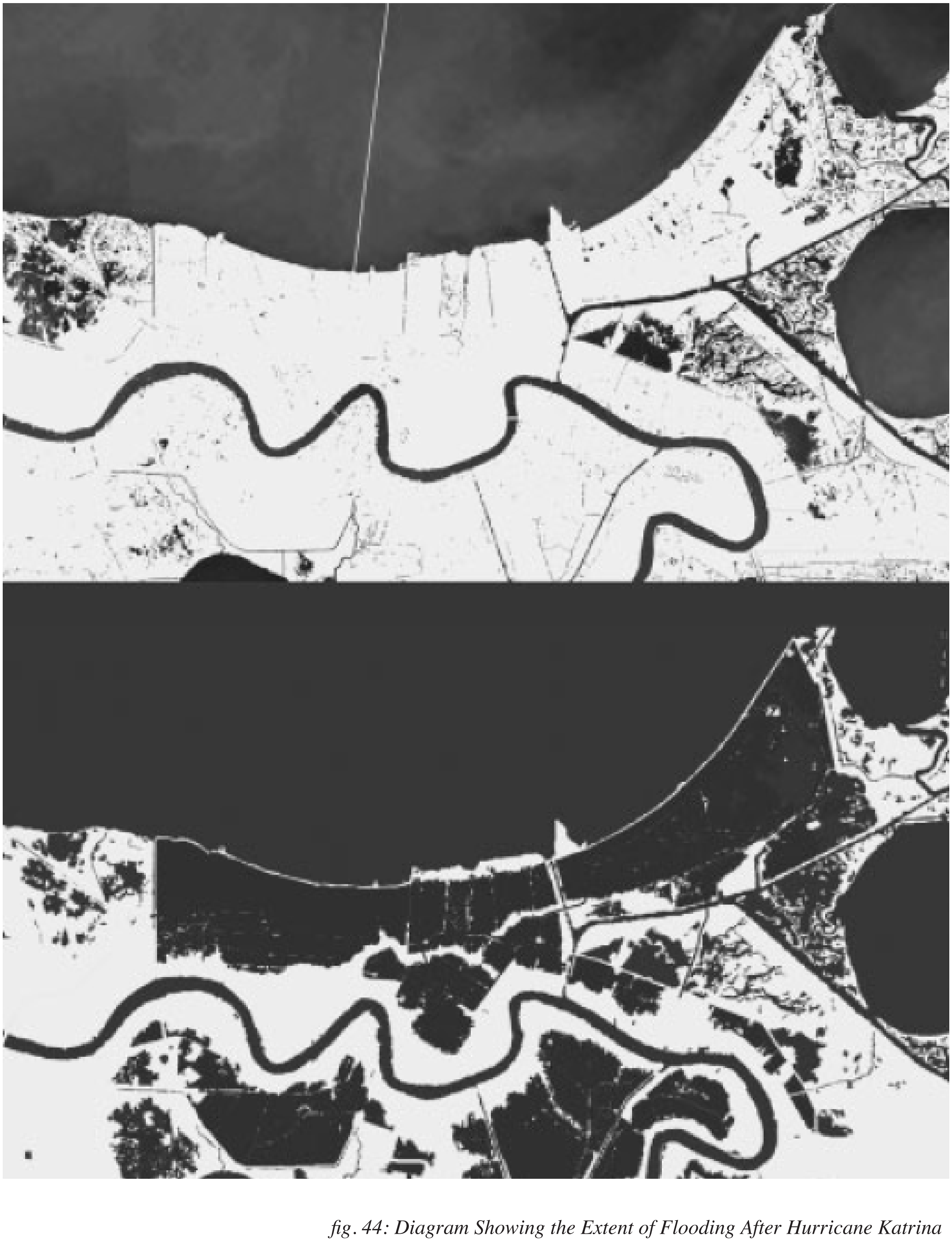


fig. 44: Diagram Showing the Extent of Flooding After Hurricane Katrina

fig. 45: New Orleans House Flooded in the Aftermath of Katrina

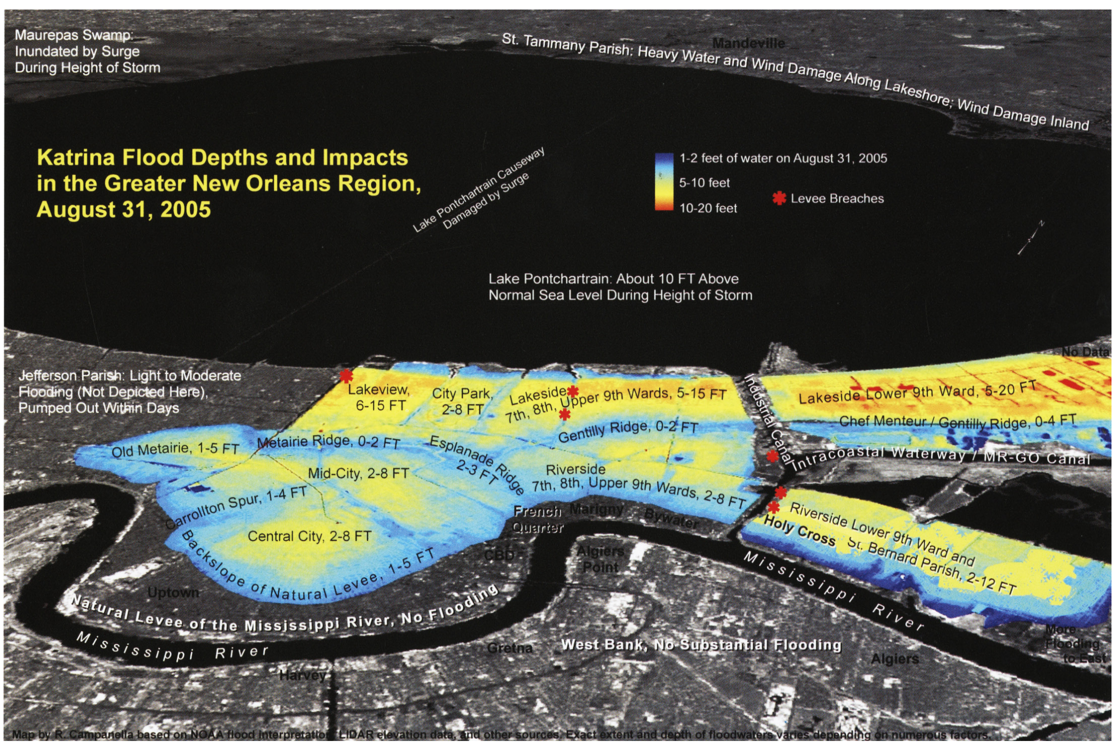
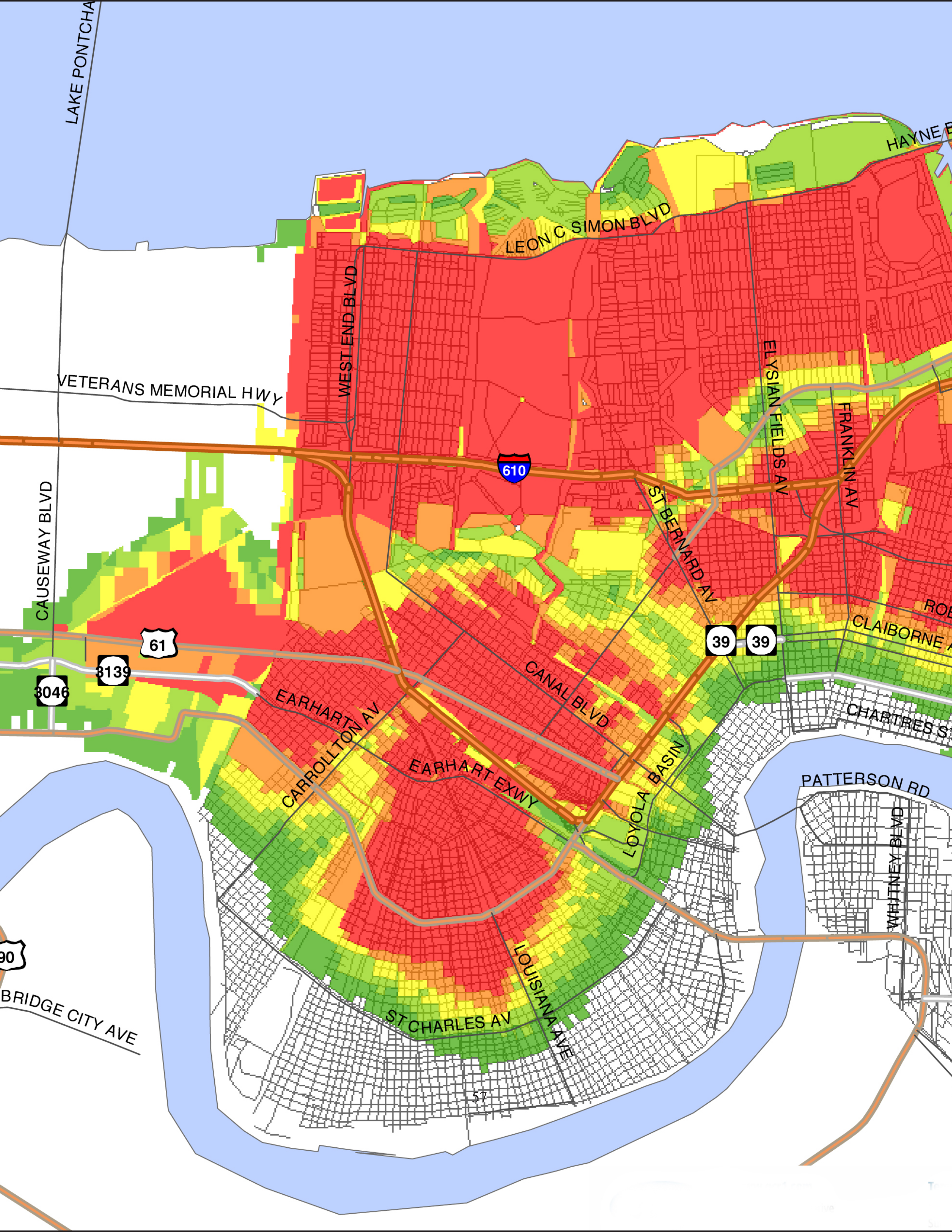


fig. 46: Katrina Flood Depths and Impacts in the Greater New Orleans Region



LEON C SIMON BLVD
WEST END BLVD
VETERANS MEMORIAL HWY
CAUSEWAY BLVD
610
ELYSIAN FIELDS AV
FRANKLIN AV
ST BERNARD AV
61
3139
3046
39
39
CANAL BLVD
EARHART
CARROLLTON AV
EARHART EXWY
LOYOLA
BASIN
PATTERSON RD
WHITNEY BLVD
BRIDGE CITY AVE
ST CHARLES AV
LOUISIANA AVE
57

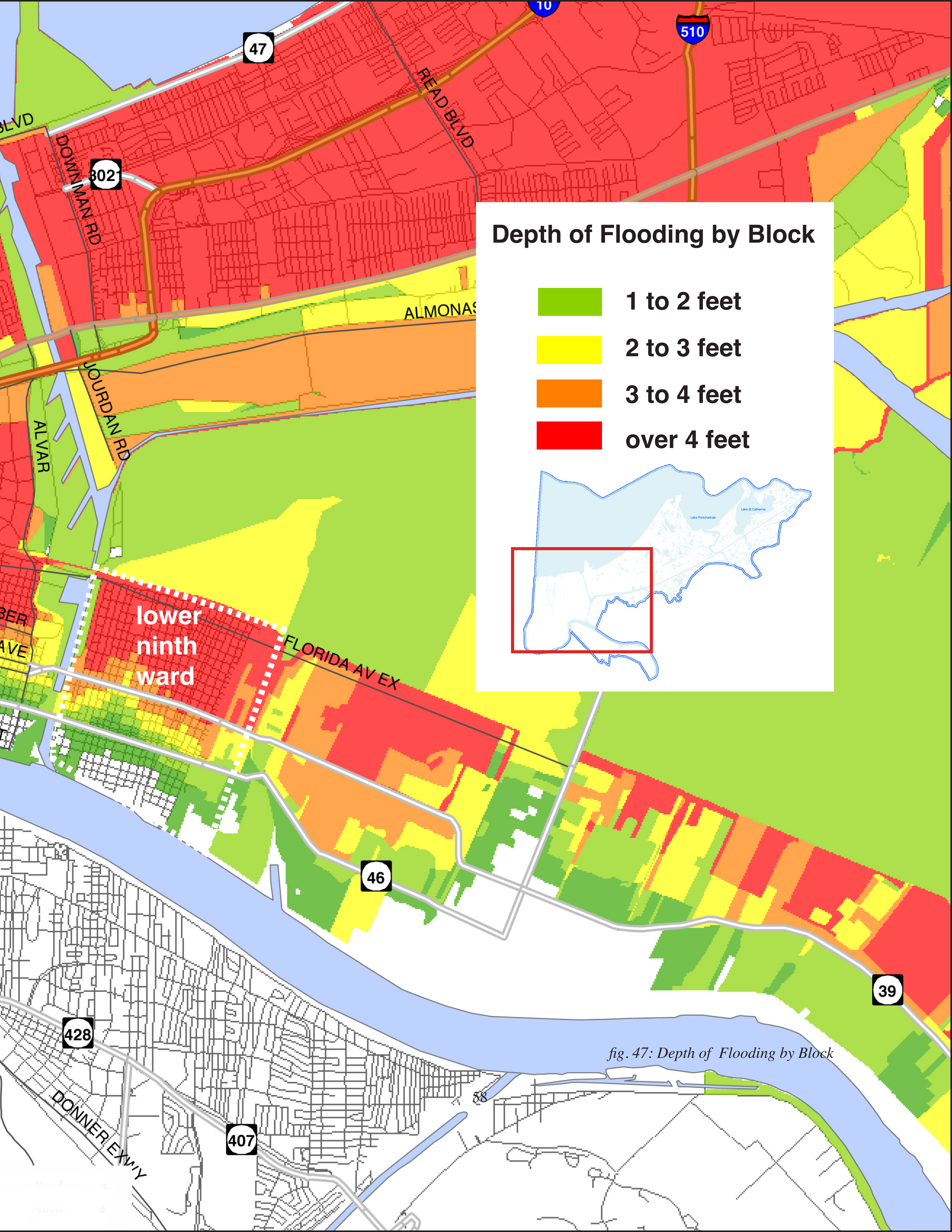
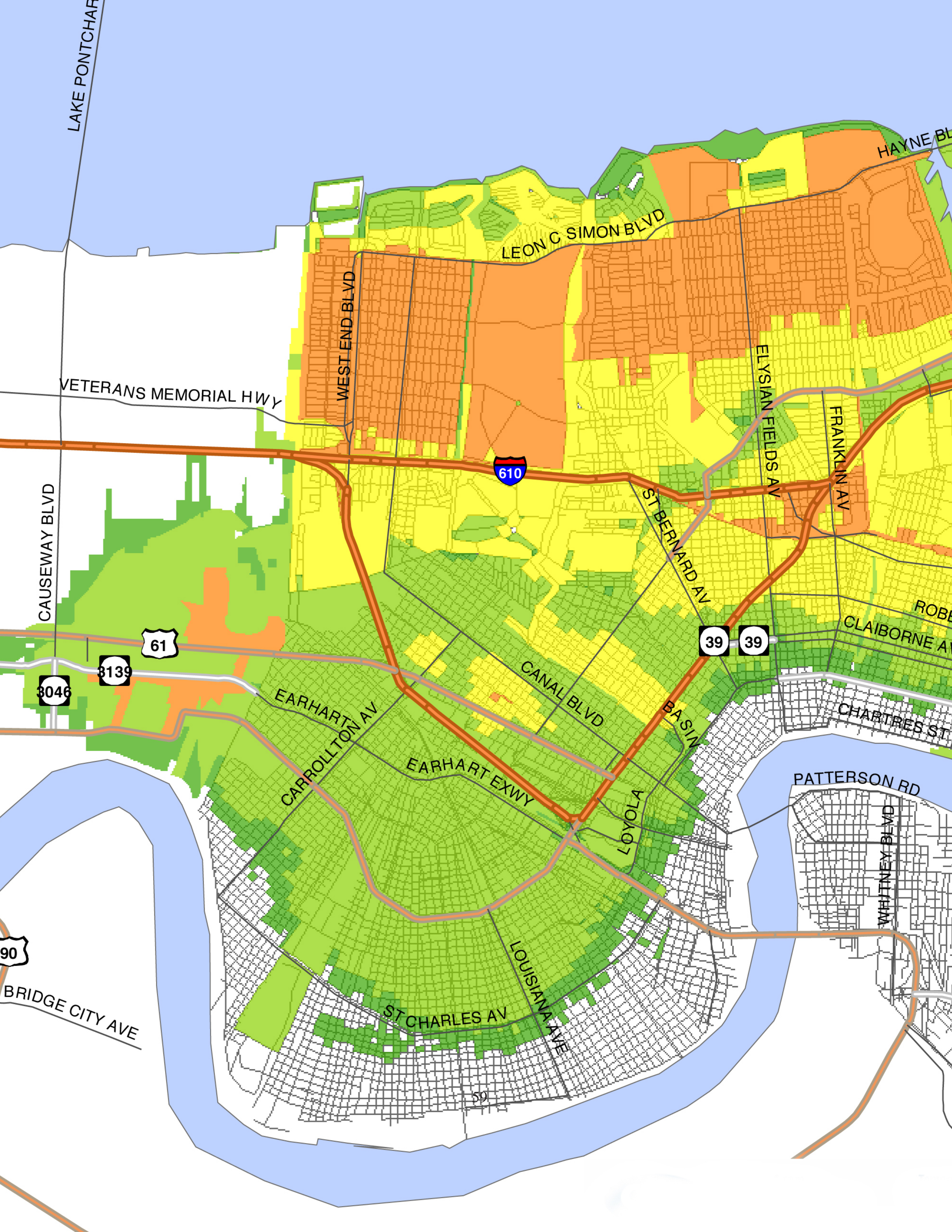


fig. 47: Depth of Flooding by Block


LAKE PONTCHARTRAIN
HAYNE BLVD
LEON C SIMON BLVD
WEST END BLVD
VETERANS MEMORIAL HWY
ELYSIAN FIELDS AV
FRANKLIN AV
610
ST BERNARD AV
CAUSEWAY BLVD
61
3139
3046
39
39
ROBERTSON
CLAIBORNE AV
CANAL BLVD
EARHART
CARROLLTON AV
BASIN
CHARTRES ST
PATTERSON RD
EARHART EXWY
LOYOLA
WHITNEY BLVD
90
BRIDGE CITY AVE
LOUISIANA AVE
ST CHARLES AV

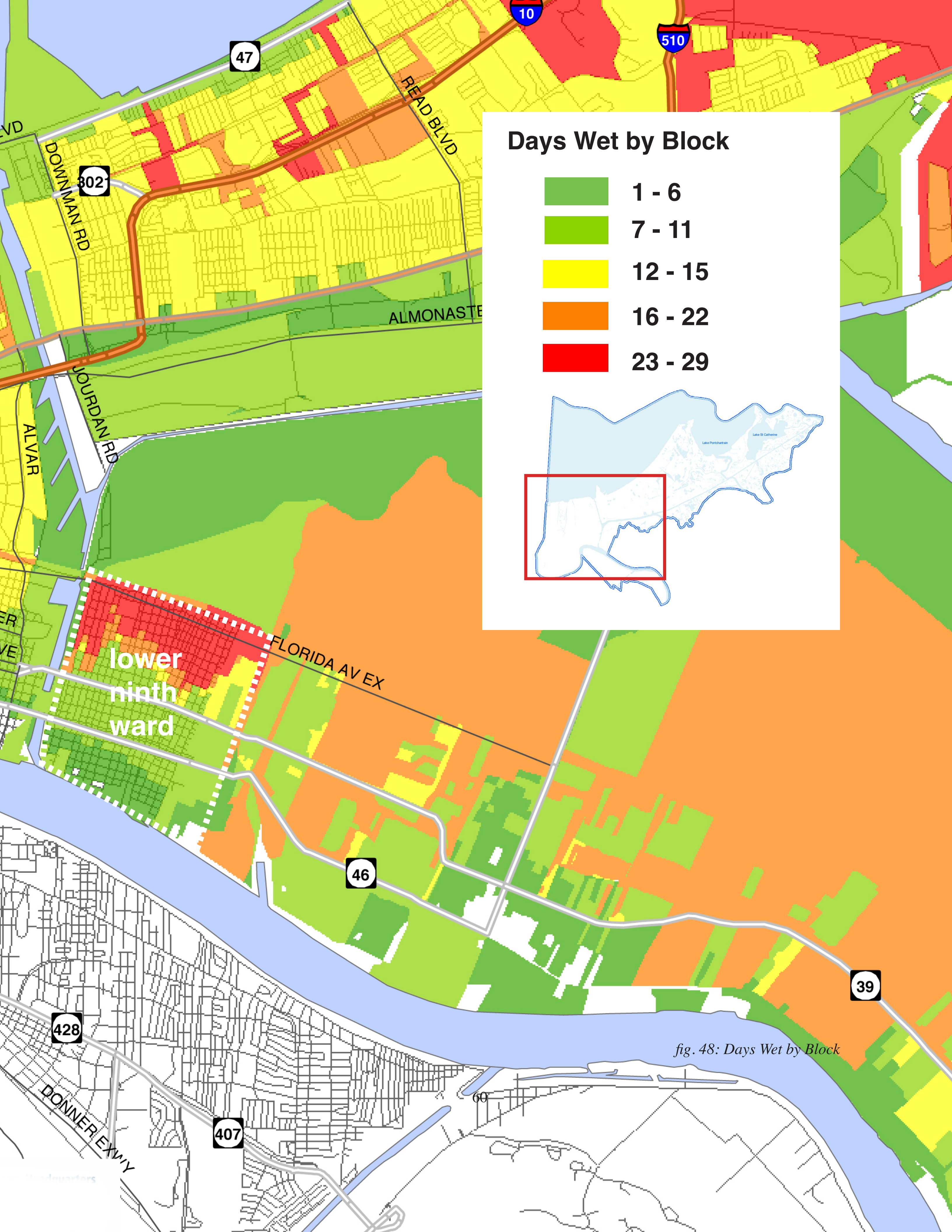


fig. 48: Days Wet by Block

02 V summary

Chapter two has outlined the significant challenges contributing to the need for an alternative flood-mitigation strategy in New Orleans. Infrastructure alone cannot protect the city from future flooding.

The major ecological challenges such as the deterioration of natural resilience caused by the implementation of the artificial levee system, subsidence, rising sea levels, and land loss suggest that future flooding cannot be avoided. This chapter has also explored ways in which human interventions, before and after Katrina, have been unsuccessful. Man-made containment of the Mississippi River has disturbed New Orleans' ecosystem and natural defense. Prior to the implementation of artificial levees, annual floods brought sediments that fortified land and created natural barriers. Artificial levees have inhibited this natural process; land has been robbed of its sediment and is sinking. When combined with all other ecological factors, Louisiana's coastline is particularly vulnerable and sinking at a much faster rate than other parts of the gulf coast.

The tragic event of Hurricane Katrina, and the major infrastructural failure and inundation that resulted, revealed how conventional flood-mitigation strategies, in the form of static barriers and pumping systems, are not sufficient to protect New Orleans from future flooding. An alternative system is required to adequately protect New Orleans from future flooding.

The next chapter will discuss physical and cultural aspects of the Lower Ninth Ward to demonstrate why it is an ideal site for the implementation of the Buoyant Foundation Project.

02 vi endnotes

12. Richard P. McCulloh, Paul V. Heinrich, and Bill Good, "Geology and Hurricane-Protection Strategies in the Greater New Orleans Area," Louisiana Geological Survey at Louisiana State University, Public Information Series No. 11 (2006),7, www.lgs.lsu.edu/deploy/uploads/11strategies.pdf (accessed June 1, 2010).

13. Craig E. Colten, An Unnatural Metropolis: Wresting New Orleans From Nature (Baton Rouge: Louisiana State University Press, 2005), 11.

14. Christine F Andersen *et al*., New Orleans Hurricane Protection System: What Went Wrong and Why: A Report (Virginia: ASCE, 2007), 6.

15. Roger T. Saucier, "Geomorphology and Quaternary Geologic History of the Lower Mississippi Valley," U.S. Army Corps of Engineers Waterways Experiment Station, Volume 1," (1994), 346, in McCulloh, Heinrich, and Good. 2006, 14.

16. John McQuaid and Mark Schleifstein, "Last Line of Defence: Hoping the Levees Hold," The Times-Picayune, June 23-27, 2002, http://www.nola.com/speced/lastchance/tp/index.ssf?/hurricane/content.ssf?/washingaway/nolalevees.html (accessed on June 1, 2010) in McCulloh, Heinrich, and Good. 2006, 31.

17. McCulloh, Heinrich, and Good. 2006, 12.

18. D.E Frazier and A. Osanik, "Recent Peat Deposits-Louisiana Costal Plain," in E.C. Dapples and M.E. Hopkins, eds, "Environments of Coal Deposition," Boulder Colorado Geological Society of America Special Paper 114 (1969), 63-68, in McCulloh, Heinrich, and Good. 2006, 14.

19. Richard Campanella, "Building Resilience Workshop: Implementing Innovative, Sustainable Flood Mitigation Solutions for the Gulf Coast 2010," (appendices, 421), and Sewage and Water Board of New Orleans, "History and Facts: Drainage Overview," http://www.swbno.org/history_drainage_overview.asp (accessed March 1, 2010).

(continued)
Doug MacCash, "Search for New Orleans' Population Centers," *The Times-Picayune*, February 24, 2010, http://www.nola.com/arts/index.ssf/2010/02/search_for_new_orleans_histori.html (accessed March 1, 2010).

20. Andersen *et al*. 2007, 8.

21. McCulloh, Heinrich, and Good. 2006, 10.

22. ibid.

23. Mark Schleifstein, "Coastal Resuscitation," The Times-Picayune, June 23-27, 2002, http://www.nola.com/speced/lastchance/t-p/index.ssf?/hurricane/content.ssf?/washingaway/ futureofcoast_1.html (accessed on June 1, 2010) in McCulloh, Heinrich, and Good. 2006, 31.

24. Robert Giegengack and Kenneth R. Foster, "Physical Constrains on Reconstructing New Orleans," in Eugenie L. Birch and Susan M. Wachter eds., Rebuilding Urban Places after Disaster: Lessons from Hurricane Katrina (Philadelphia: University of Pennsylvania Press, 2006), 23.

25. Colten. 2005, 187.

26. Robert Giegengack and Kenneth R. Foster in Birch and Wachter eds. 2006, 23-26.

27. Louisiana State University's Water Resources Research Institute and Army Corps of Engineers. "Going Under," http://www.nola.com/hurricane/content.ssf?/washingaway/goingunder.html (accessed June 1, 2010).

28. ibid.

29. ibid.

30. McCulloh, Heinrich, and Good. 2006, 28.

31. Thomas Hayden, "Storm Experts Feared the Worst: Diary of a Mad Hurricane," http://www.stormsurge.lsu.edu/paperarticles/USNEWS_Sep17.pdf (accessed June 1, 2010).

32. Andersen *et al*. 2007, 1.

33. The United States Department of Homeland Security, "The 18-Month Anniversary of Hurricane Katrina - Progress Made and Lessons Learned," http://www.dhs.gov/files/programs/gc_1173201764934.shtm (accessed September 1, 2009).

34. Richard D. Knabb, Jamie R. Rhome, Daniel P Brown, "Tropical Cyclone Report: Hurricane Katrina: 23-30 August 2005, " 2005, 1, http://www.nhc.noaa.gov/pdf/TCR-AL122005_Katrina.pdf (accessed June 1, 2010).

35. ibid., 3-4.

36. Andersen *et al*. 2007, 1.

37. Ezra Boyd, "Preliminary Summary Report of Hurricane Katrina Deceased Victim Recovery Locations in Louisiana," presented at the ESRI Gis and Public Health Conference in November 2006. http://proceedings.esri.com/library/userconf/health06/index.html (accessed August 1, 2010).

38. Dan Swenson, "Flash Flood: Hurricane Katrina's Inundation of New Orleans, August 29, 2005," http://www.nola.com/katrina/graphics/flashflood.swf (accessed August 1, 2009).

39. Make It Right, "Work In Progress Lower Ninth Ward Timeline," http://www.makeitrightnola.org/index.php/work_progress/timeline_katrina/ (accessed September 1, 2009).

40. Ezra Boyd, Brian Wolshon and Ivor Van Heerden, "Risk Communication and Public Response during Evacuations: The New Orleans Experience of Hurricane Katrina," Public Performance and Management Review 32, no.3 (March 2008), 454.

41. President's Council on Integrity and Efficiency, "Oversight of Gulf Coast Hurricane Recovery, a Semiannual Report to Congress," April 30, 2006, 124-125. http://www.ignet.gov/pande/hsr/hksemi0406.pdf (accessed September 1, 2009).

42. AHUP (ACORN Housing/University Partnership), "Planning District 7 and 8 Assessment and Needs Analysis," in Rebekah Green, Lisa K. Bates and Andrew Smyth, "Impediments to recovery in New Orleans' Upper and Lower Ninth Ward: One year after Hurricane Katrina," Disasters 31 (2007), 326.

43. A1 Tarps, "Tarp Company Expands Business by Participating in Disaster Relief Efforts," http://www.a1tarps.com/assets/File/pressreleases2007.pdf (accessed June 1, 2010).

44. FEMA, "50,000 New Orleans' Homes Still Eligible For Blue Roofs," http://www.fema.gov/news/newsrelease.fema?id=21820 (accessed January 1, 2010).

45. The New Orleans Mayor's Office, "Situation Report for New Orleans," Press Release 17, June 2006, in Green, Bates and Smyth. 2007, 326.

46. Entergy, "Entergy Facts," http://www.entergy.com/about_entergy/entergy_facts.aspx (accessed Spetember 1, 2010).

47. Richard Campanella, Geographies of New Orleans (Lafayette: University of Louisiana at Lafayette, Center for Louisiana Studies, 2008), 405.

48. Jed Horne, *Breach of Faith: Hurricane Katrina and the Near Death of a Great American City*, 1st ed, (New York: Random House, 2006), 43.

49. Allison Plyer, "News Release: Facts for Features Hurricane Katrina Impact," http://www.gnocdc.org/Factsforfeatures/HurricaneKatrinaImpact/index.html (accessed April 1, 2010).

50. Boyd, 2006.

51. Andersen *et al*. 2007, 17.

52. ibid., 21.

53. ibid.

54. ibid., 20.

55. ibid., 1.

56. ibid., v.

57. ibid., vi-viii.

58. ibid., 18.

59. ibid., 25.

60. Anuradha Mathur and Dilip da Cunha, "Negotiating Fluid Terrain," in Birch and Wachter eds. 2006, 34.

61. National Oceanic and Atmospheric Administration and National Geodetic Survey, "NOLA 17th Street Breach, Aug 31 2005," http://en.wikipedia.org/wiki/File:NOAA_Katrina_NOLA_17th_Street_breach_Aug_31_2005.jpg (accessed September 1, 2009).

62. Andersen *et al*. 2007, 56.

63. Andersen *et al*. 2007, 32.

64. Greater New Orleans Community Data Center, "Days Wet By Block," http://www.gnocdc.org (accessed August 6, 2009)

03

the buoyant foundation project: context

context:

i. introduction

ii. diaspora
spatial redistribution
population density
re-population
future land use
neighborhood recovery

iii. site
site: lower ninth ward
sense of place

iv. the shotgun house
the shotgun house + the bfp
brief history
origins of the shotgun house
defining characteristics
shotgun house typologies in south louisiana
shotgun house typologies by parish
design process
permanent static elevation +
loss of neighbourhood culture

v. summary

vi. endnotes

03 i context

The previous chapter outlined the major ecological challenges affecting New Orleans: the deterioration of natural resilience, subsidence, rising sea levels, and land loss. The chapter also explored ways in which human interventions, before and after Katrina, were unsuccessful: the design of levees, disaster management, emergency shelter strategies, rescue efforts, and rebuilding. Chapter three will focus on how the Buoyant Foundation Project (BFP) provides a culturally sensitive flood mitigation strategy for the Lower Ninth Ward in post-Katrina New Orleans.

This chapter builds upon one of the most critical challenges: the diaspora, its cultural implications, and resettlement. In the aftermath of Hurricane Katrina, New Orleans' residents have been displaced to other parts of Louisiana and the United States, leaving many neighbourhoods under populated and some abandoned. Their slow return has compromised the unique culture and identity of New Orleans.

This chapter then explores the Lower Ninth Ward and its former sense of "place" — examining physical and cultural aspects of the neighbourhood, and discussing the pre-Katrina conditions that contributed to New Orleans' culture. Of particular importance is the shotgun house and its influence on the tight-knit communities created by the spatial arrangement of this housing typology. The BFP serves as a catalyst for the restoration of this housing type, as it provides a retrofit for the foundation, enabling the house to float when there is a flood. A brief history of shotgun housing is provided, discussing the origins and characteristics of the shotgun house, and the four common variations are explained. The variations are then linked to particular parishes in south Louisiana and Henry Glassie suggests a theory about the design process.

Chapter three connects the ongoing ecological and infrastructural risks (discussed in chapter two), the diaspora and stalled process of restoring the Lower Ninth Ward, and the distinct history and culture of the area. The evidence makes it clear that the Lower Ninth Ward is an ideal site for implementation of the BFP.

The chapter concludes with a brief discussion of permanent static elevation, and its negative impact on neighbourhood character by distancing homes from street level and impeding the close relationships made possible by congregating on the front porch. The BFP offers a culturally supportive solution by permitting houses to remain close to street level.

03 ii context: diaspora

DIASPORA

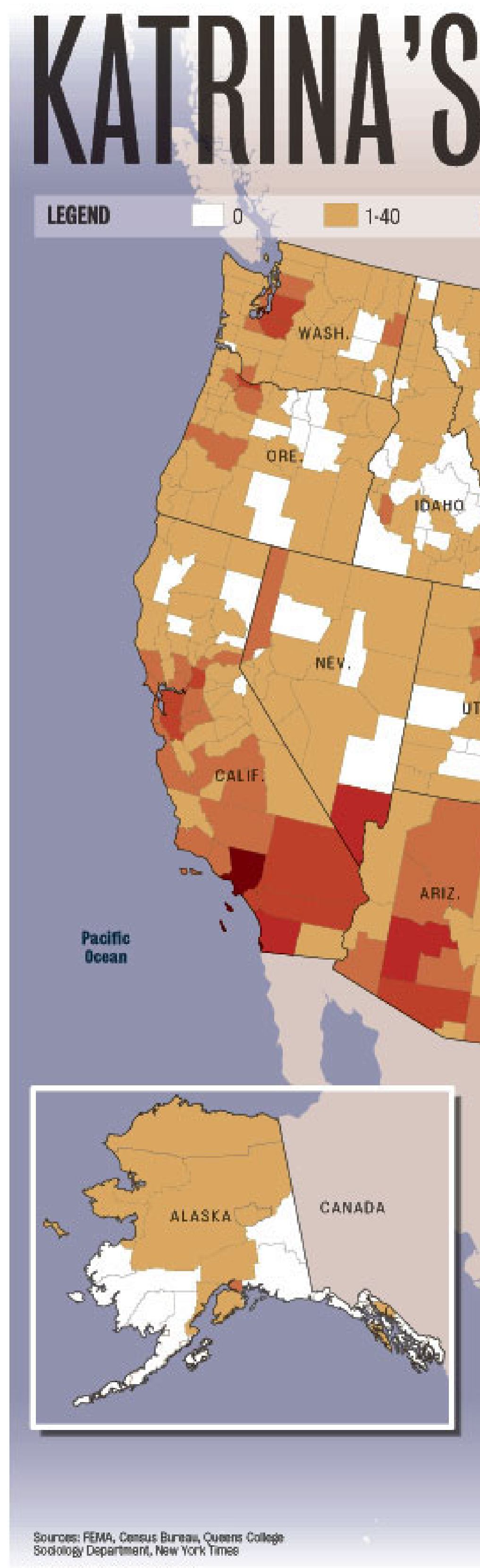
The flooding that accompanied Hurricane Katrina, obliterated neighbourhoods in New Orleans and caused significant damage to housing, rendering numerous dwellings uninhabitable. Residents from New Orleans were scattered all over Louisiana and the United States (fig. 49). According to NOAA, "the flooding of New Orleans, LA following the passage of Katrina was catastrophic, resulting in the displacement of more than 250,000 people, a higher number than during the Dust Bowl years of the 1930s."[65]

SPATIAL REDISTRIBUTION

Figure 50 illustrates the local diaspora in the Louisiana region according to FEMA in 2005. This map illustrates the location of victims by ZIP code at the time they registered with FEMA for Individual Assistance (IA). Both displaced and non-displaced applicants are depicted. Approximately 58 percent of all registered requests for IA originated within Louisiana. Orleans Parish is highlighted and is one of the largest areas for IA applicants, in the range of 8,001-16,000.[66]

POPULATION DENSITY

Figure 51 compares the pre-Katrina (2004), and post-Katrina (2006) populations of Orleans, St. Bernard, Plaquemines and Jefferson parish in Louisiana. According to the ASCE report, "the combined populations of Jefferson, Orleans, St. Bernard and Plaquemines parishes dropped by 44 percent after Hurricane Katrina."[67] Figure 52 is a table showing a comparison of population by parish in 2000 to 2009. Figure 53 shows the specific population density in May 2008. The most devastated parts of the Lower Ninth Ward had a population density of 0-4 persons per acre.[68]



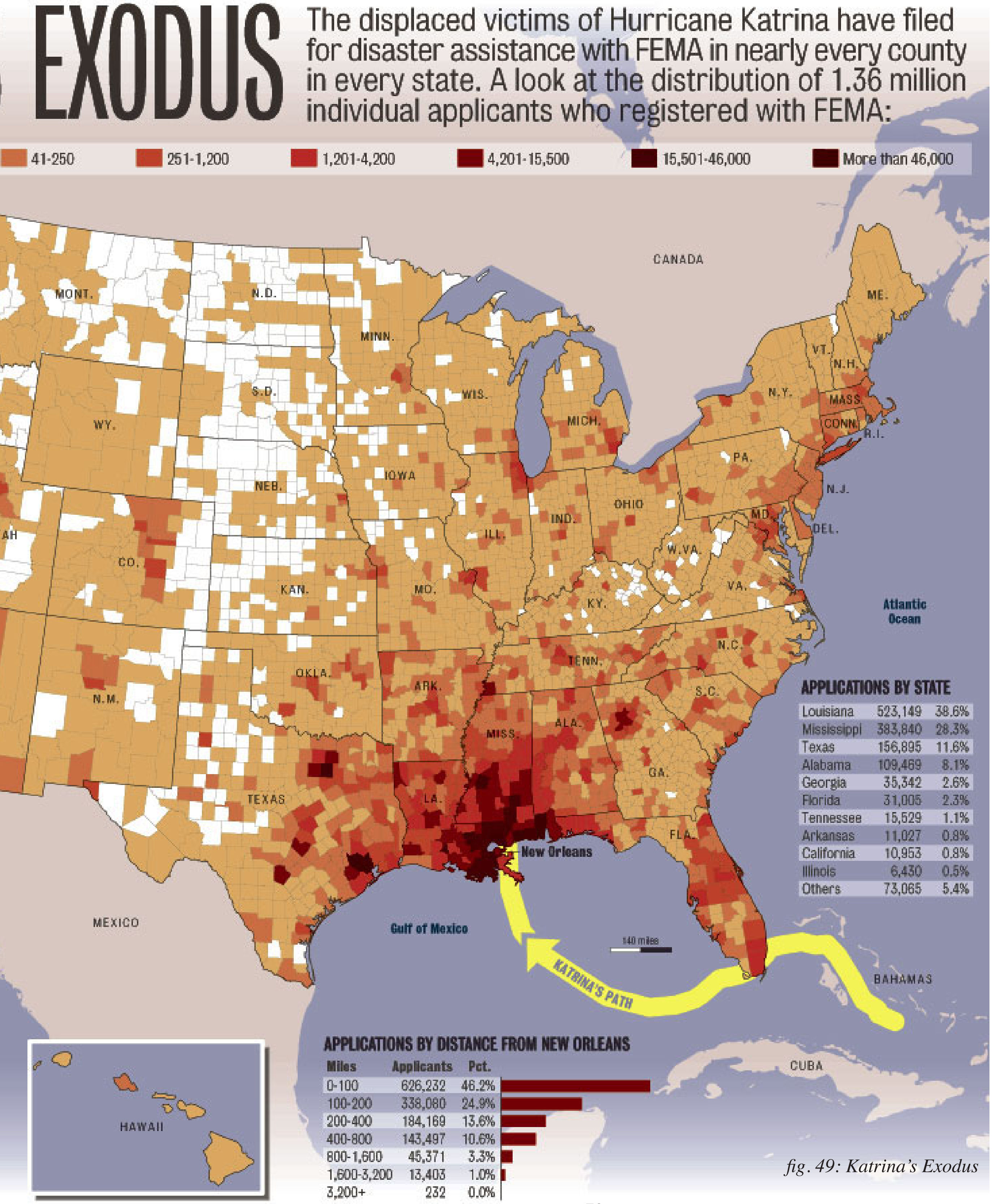


fig. 49: Katrina's Exodus

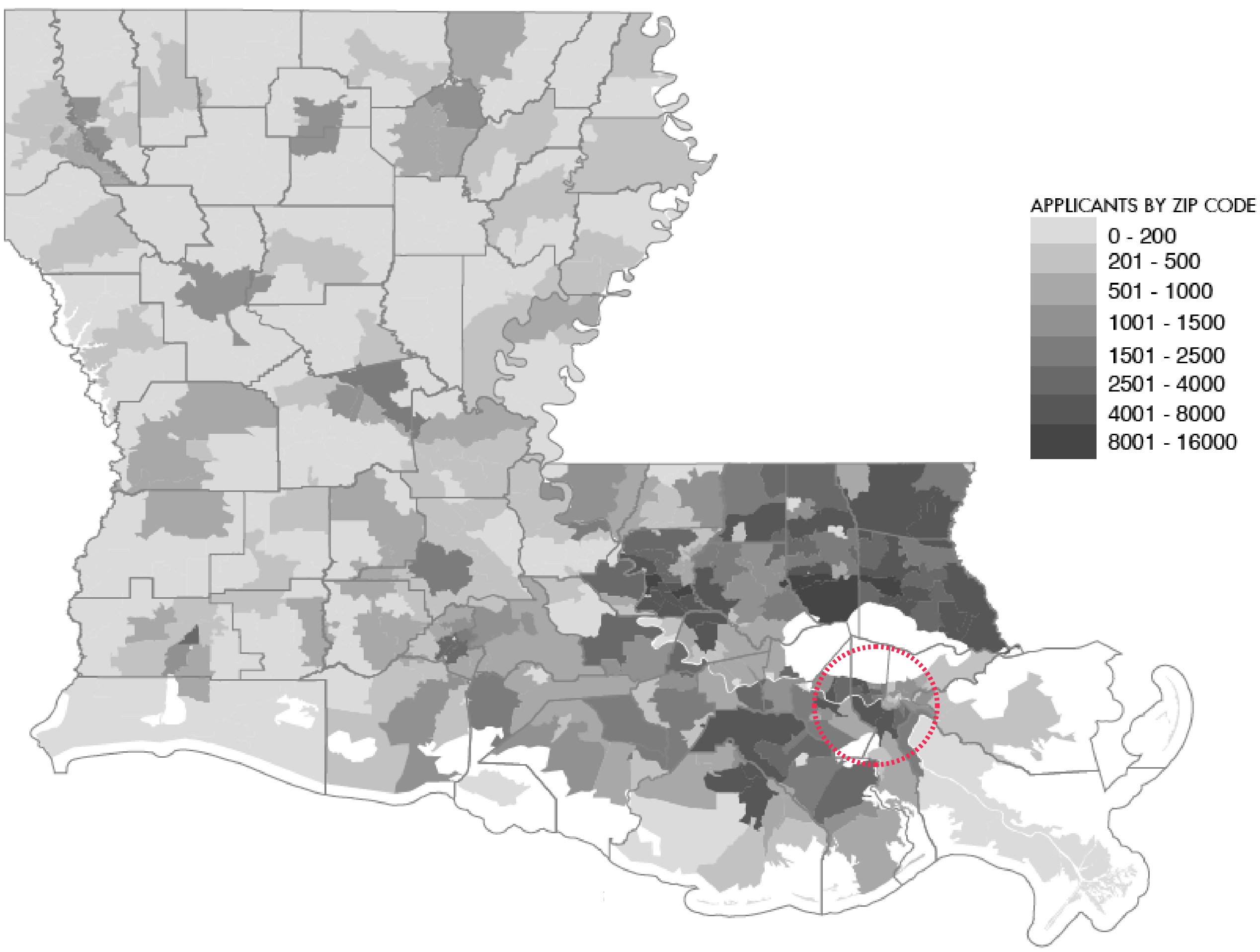


fig. 50: Population Redistribution in Louisiana, September 20, 2005

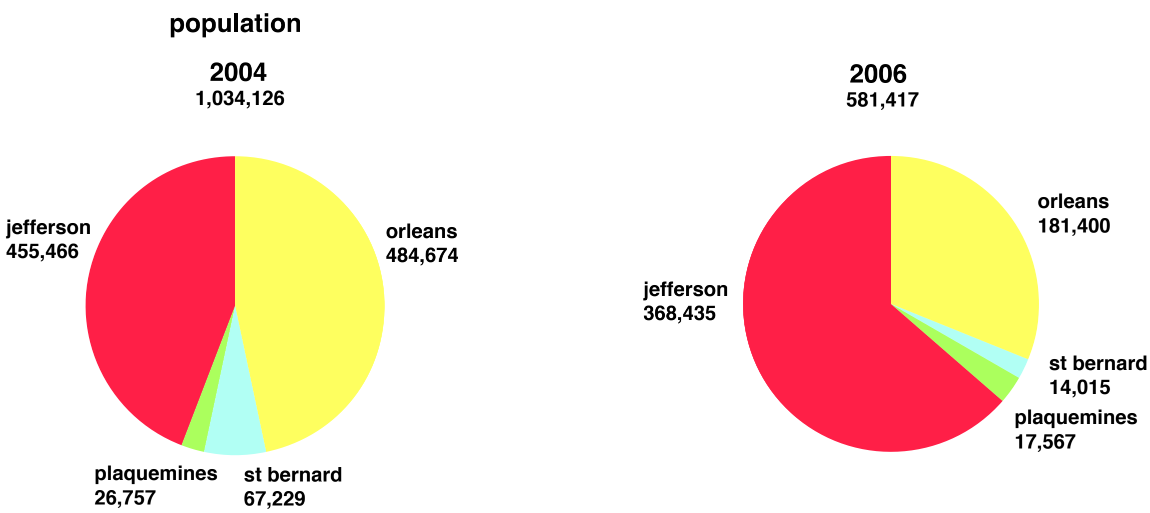
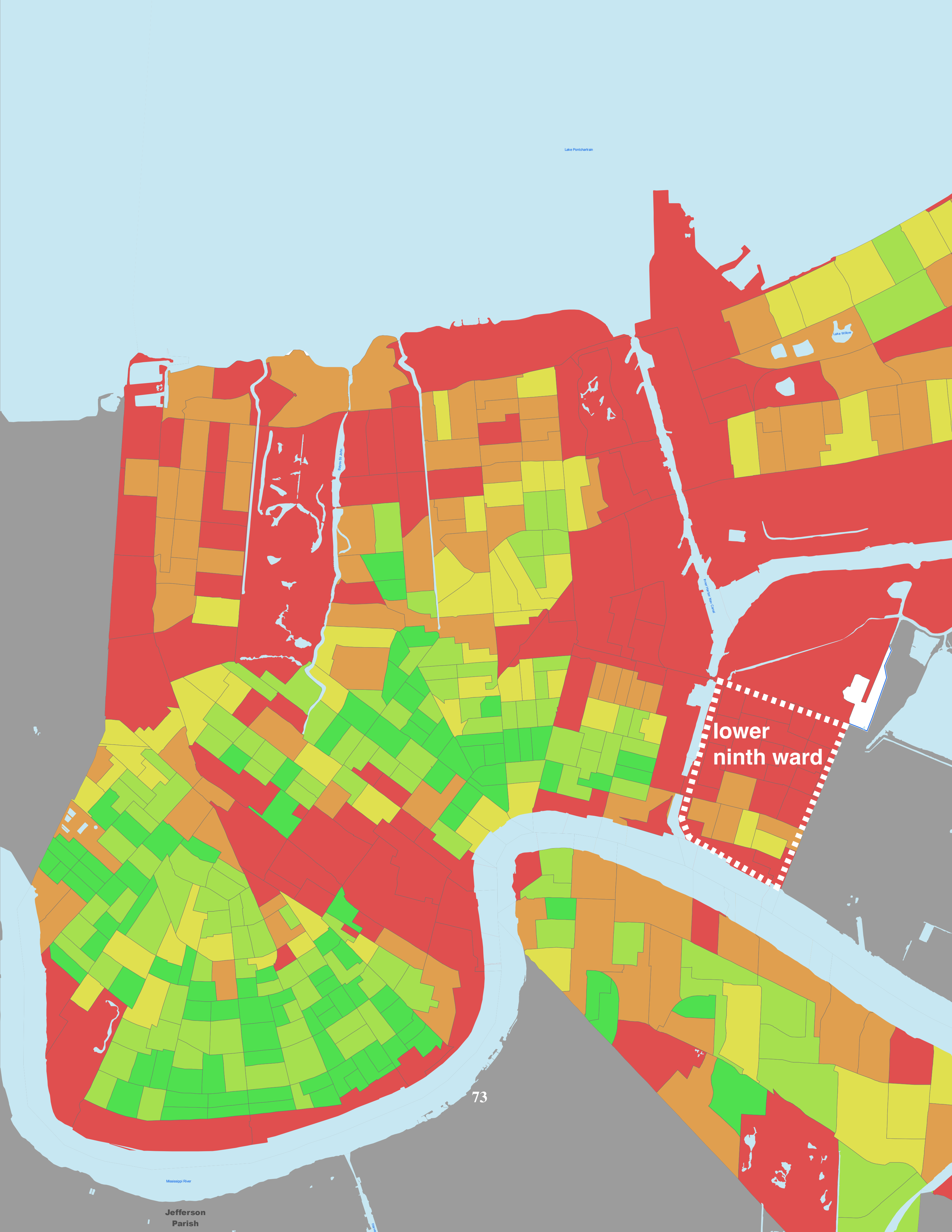


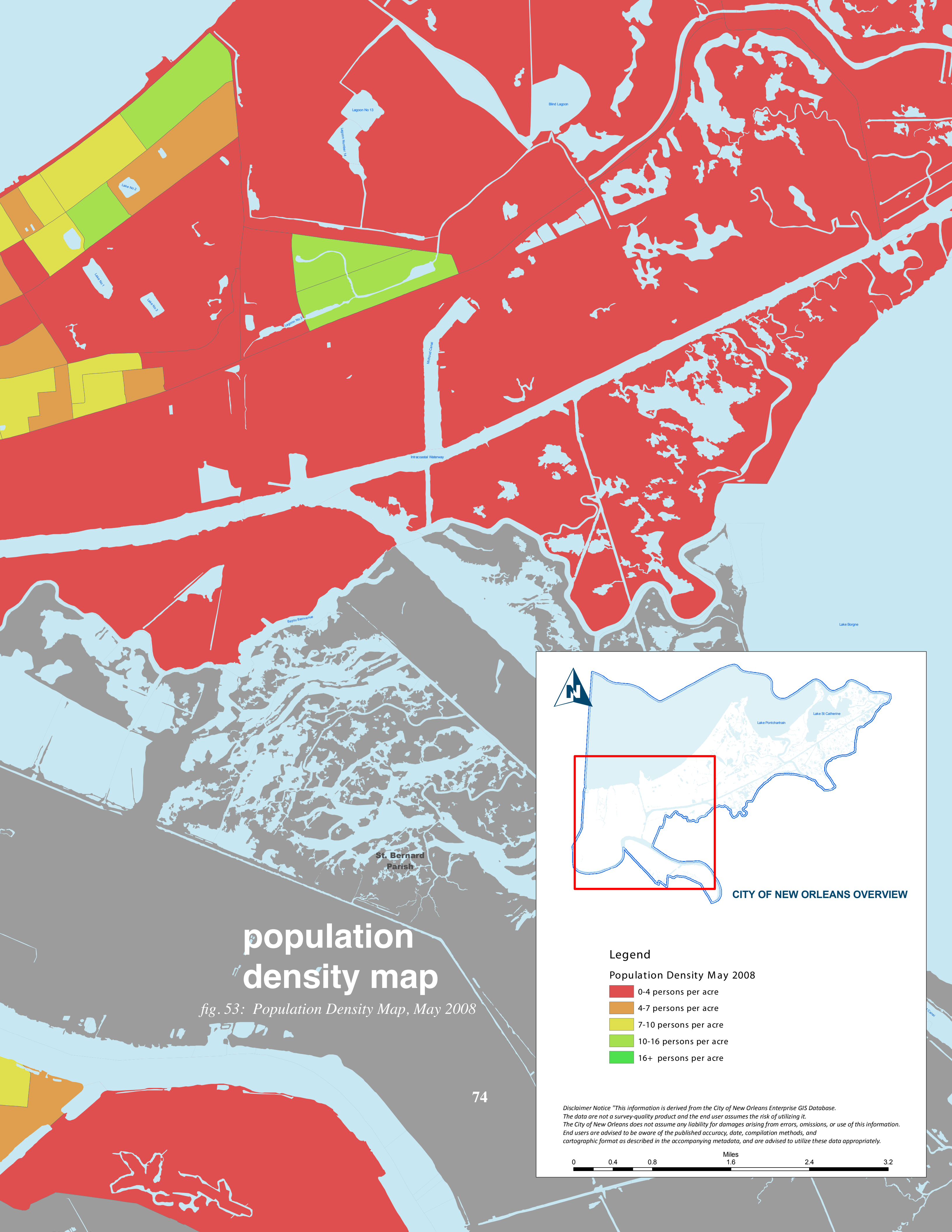
fig. 51: Population Decline Comparison

Total population estimates by parish (2000-2009)

Year	Jefferson	Orleans	Plaque-mines	St. Bernard	St. Charles	St. John	St. Tammany
Census 2000	455,466	484,674	26,757	67,229	48,072	43,044	191,268
July 1, 2001	452,088	477,932	26,852	66,554	48,412	43,575	195,718
July 1, 2002	451,453	472,744	27,119	66,286	48,960	43,955	200,873
July 1, 2003	451,533	467,761	27,644	65,727	49,039	44,452	205,883
July 1, 2004	452,678	461,915	28,602	65,427	49,524	45,046	211,529
July 1, 2005	451,652	455,188	28,549	64,951	50,116	45,597	217,407
July 1, 2006	420,683	208,548	21,293	14,493	51,759	47,697	223,062
July 1, 2007	440,339	288,113	21,353	33,439	51,946	47,910	226,315
July 1, 2008	444,655	336,644	21,138	37,669	51,619	47,438	229,384
July 1, 2009	443,342	354,850	20,942	40,655	51,611	47,086	231,495

fig. 52: Total Population Estimates by Parish 2000-2009


Lake Pontchartrain
Lake Willow
lower
ninth ward
Mississippi River
Jefferson
Parish



population density map

fig. 53: Population Density Map, May 2008

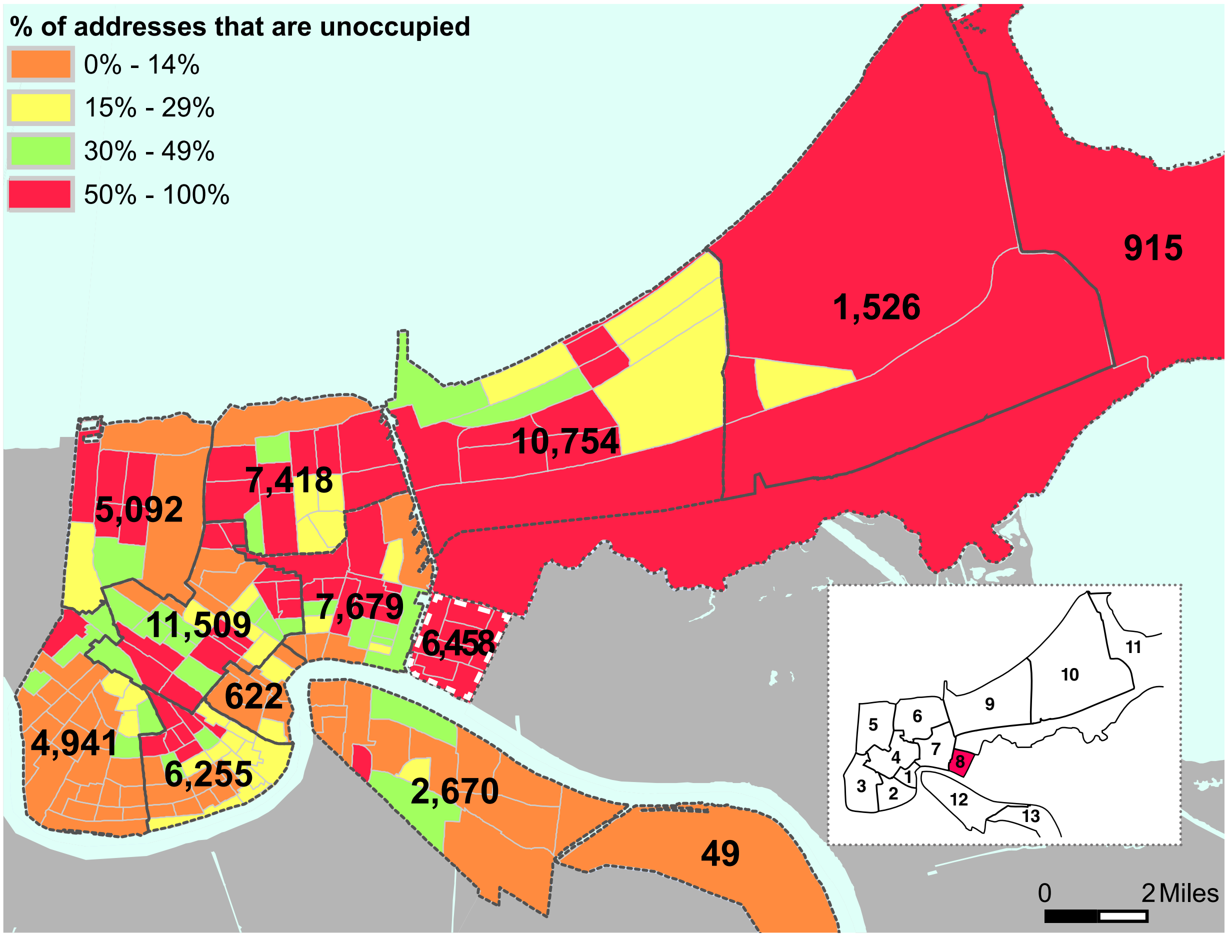


fig. 54: Number of Unoccupied Residential Addresses by Planning District and Percent by Census Tract, March 2009

RE-POPULATION

Tens of thousands of residents from New Orleans were scattered all over Louisiana and the United States. Repopulating the area has met with myriad challenges. The Brookings Institution Metropolitan Policy Program and the Greater New Orleans Community Data Center (GNOCDC) discusses the number of unoccupied residential addresses in New Orleans post-Katrina:

> [S]ince September 2008, the number of unoccupied residential addresses in New Orleans declined from 69,727 to 65,888 by March 2009 [fig. 54]. . . . Planning District 4 has the largest number of unoccupied addresses with 11,509 [see inset diagram in figure 54 for district locations and figure 41 for district legend]. . . . Planning Districts 6, 7, 8 and 9 experienced extensive flooding and each had more than 6,000 unoccupied residential addresses. . . . 'Addresses' are distinguished from 'properties' in that multiple addresses can be located on a single property (e.g. shotgun double). Unoccupied addresses include vacant and no-stat addresses. Vacant addresses have not had mail collected for 90 days or longer. No-Stat addresses include addresses identified by the letter carrier as not likely to receive mail for some time, buildings under construction and not yet occupied, and rural route addresses vacant for 90 days or longer. . . .

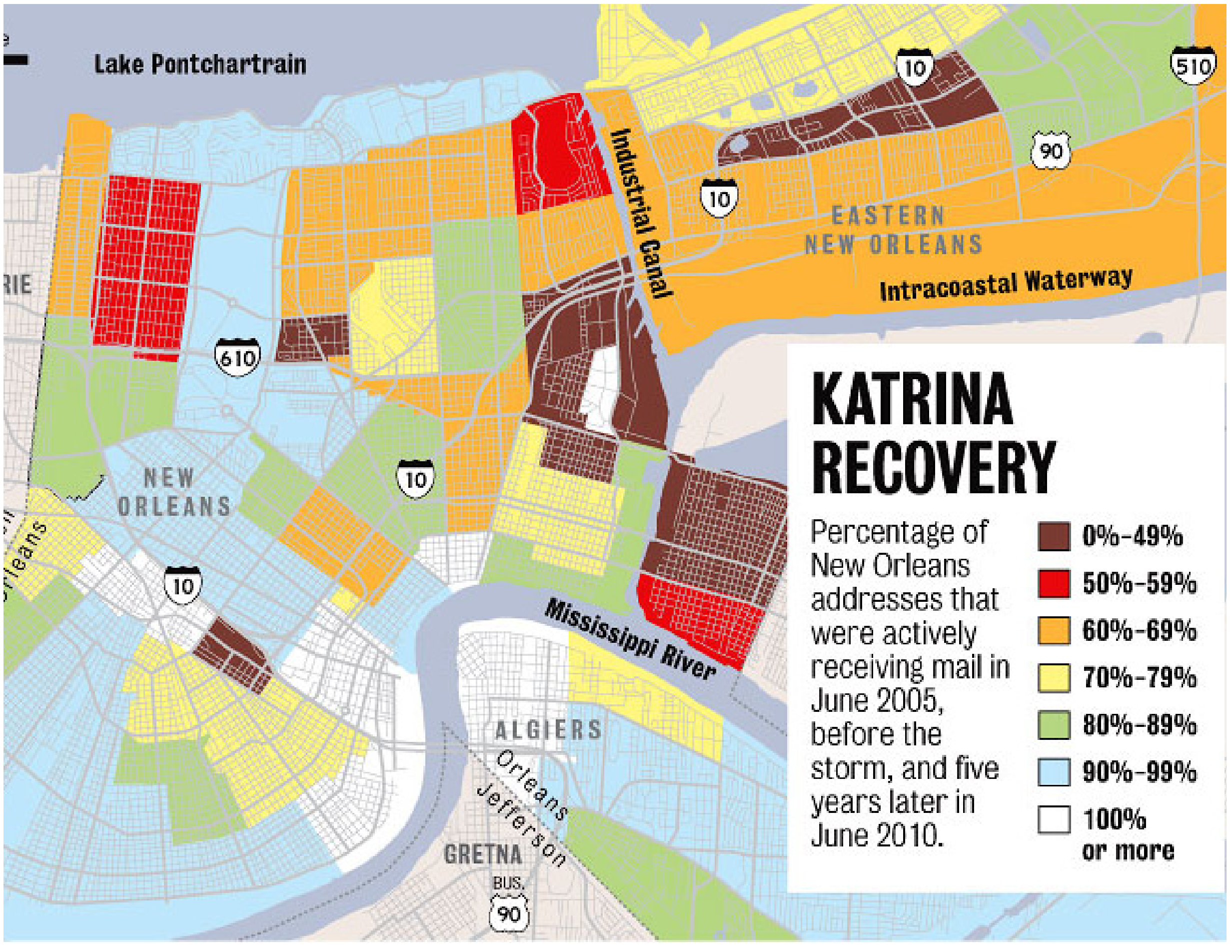
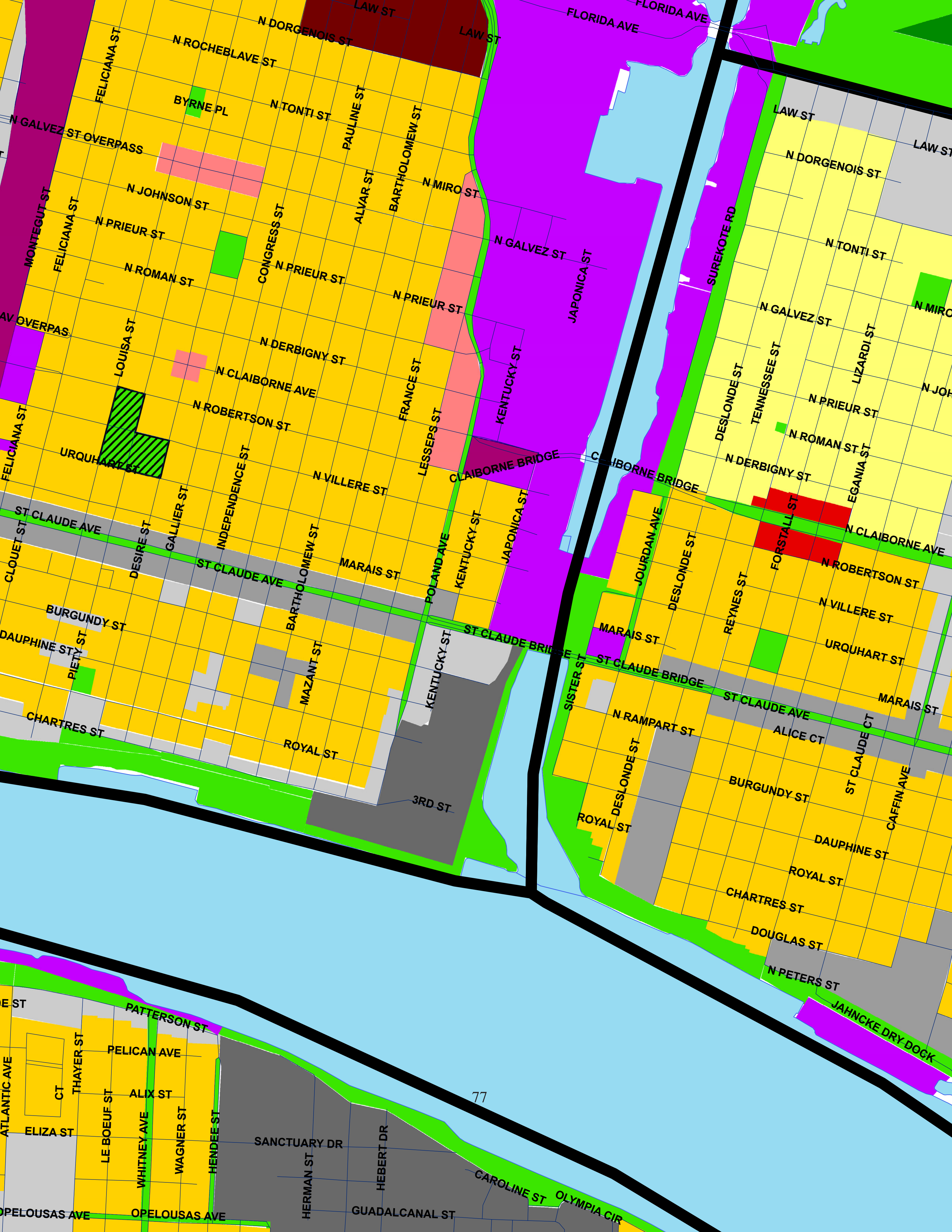
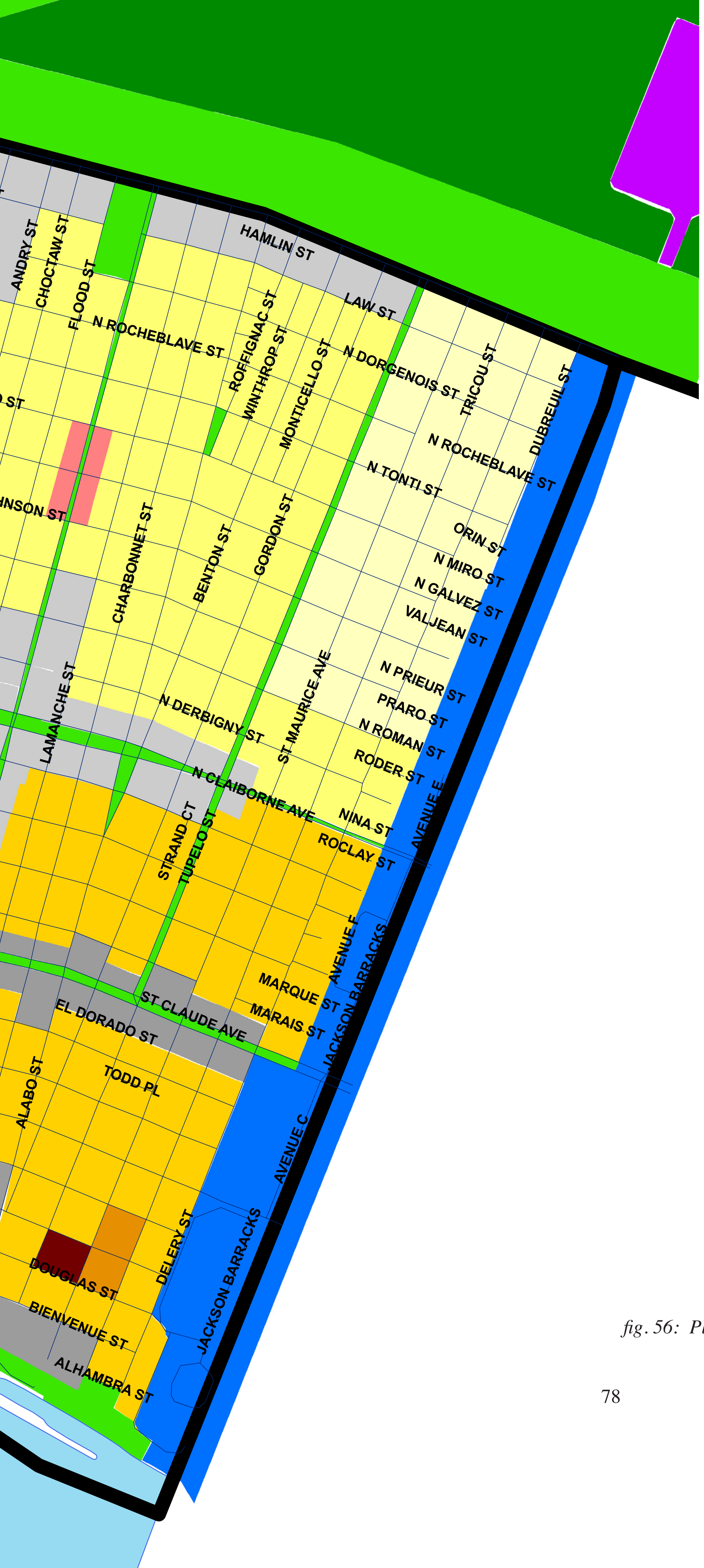


fig. 55: Percentage of New Orleans Addresses Actively Receiving Mail in June 2005 and June 2010

> In the parishes affected by Hurricanes Katrina and Rita, no-stat addresses include heavily damaged homes that have not been re-occupied.[69]

Figure 55 is a current map, showing the percentage change from 2005 to 2010 of active mailing addresses. It that displays that 0-49% of addresses were actively receiving mail in the majority of the Lower Ninth Ward in June 2005, before the Hurricane Katrina, and five years later in June 2010.[70] Figure 56 is a map of the District 8 Working Plan for Future Land Use, issued in January 26, 2010. The majority of the Lower Ninth Ward is expected to remain low density residential.[71]


LAW ST
N DORGENOIS ST
FLORIDA AVE
N ROCHEBLAVE ST
FELICIANA ST
BYRNE PL
N TONTI ST
PAULINE ST
BARTHOLOMEW ST
N GALVEZ ST OVERPASS
N MIRO ST
ALVAR ST
N JOHNSON ST
MONTEGUT ST
N PRIEUR ST
CONGRESS ST
N GALVEZ ST
JAPONICA ST
SUREKOTE RD
N ROMAN ST
N PRIEUR ST
N DERBIGNY ST
LOUISA ST
N CLAIBORNE AVE
KENTUCKY ST
FRANCE ST
N ROBERTSON ST
LESSEPS ST
URQUHART ST
CLAIBORNE BRIDGE
N VILLERE ST
INDEPENDENCE ST
GALLIER ST
ST CLAUDE AVE
DESIRE ST
CLOUET ST
POLAND AVE
MARAIS ST
BURGUNDY ST
DAUPHINE ST
PIETY ST
MAZANT ST
ST CLAUDE BRIDGE
CHARTRES ST
ROYAL ST
3RD ST
DESLONDE ST
TENNESSEE ST
LIZARDI ST
EGANIA ST
FORSTALL ST
JOURDAN AVE
REYNES ST
SISTER ST
N RAMPART ST
ALICE CT
ST CLAUDE CT
CAFFIN AVE
DOUGLAS ST
N PETERS ST
JAHNCKE DRY DOCK
PATTERSON ST
PELICAN AVE
THAYER ST
ATLANTIC AVE
CT
ALIX ST
ELIZA ST
LE BOEUF ST
WHITNEY AVE
WAGNER ST
HENDEE ST
SANCTUARY DR
HERMAN ST
HEBERT DR
CAROLINE ST
OLYMPIA CIR
GUADALCANAL ST
OPELOUSAS AVE



Legend

Future Land Use Categories

- Residential Semi-Rural
- Residential Single-Family (Post-war construction)
- Residential Low Density (Post-war construction)
- Residential Multi-Family (Post-war construction)
- Residential Single-Family (Pre-war construction)
- Residential Low Density (Pre-war construction)
- Residential Medium Density (Pre-war construction)
- Residential Multi-Family (Pre-war construction)
- Neighborhood Commercial
- General Commercial
- Downtown Exposition
- Mixed-Use Low Density
- Mixed-Use Medium Density
- Mixed-Use High Density
- Downtown Mixed-Use
- Mixed-Use Health/Life Sciences Neighborhood
- Mixed-Use Maritime
- Business Center
- Industrial
- Institutional
- Parkland and Open Space
- Cemetery
- Natural Area
- Transportation

fig. 56: Planning District 8: Working Draft of Future Land Use Map

NEIGHBOURHOOD RECOVERY

The Association of Community Organizations for Reform Now (ACORN) is committed to the authentic recovery of the devastated Lower Ninth Ward (fig. 57). Through conducting surveys of its former residents, they have compiled significant data to assist in restoring these neighbourhoods in a manner that residents want. *The People's Plan*, a study by ACORN in conjunction with Cornell and Columbia Universities and the University of Illinois, is a strategic plan of action for the recovery of neighbourhoods in the Lower Ninth Ward. It presents a thorough assessment of the area and its former residents' desires to restore their damaged communities.[72]

Figure 58 charts the type of property damage. According to *The People's Plan*, property damage relates to "collapsed walls, caved roofs or houses that have moved off their foundation. . . . Fifteen teams of university students conducted a survey of the residential housing on 165 blocks in Planning Districts 7 and 8. The survey covered 12% of the building stock in these districts. The teams captured information on the types of residential structures and the recovery activity evident at the time of the survey. . . . [They confirmed that] over 80% of the remaining homes had no structural damage when surveyed in October 2006."[73]

Figure 59 displays the amount of flood damage to homes in the Lower Ninth Ward. When *The People's Plan* report was released in 2006, "flooding was extensive throughout Planning Districts 7 and 8. Homes with some flood damage will typically cost $35,000-$50,000 to repair. . . . [H]eavily flooded homes will likely need to be raised to FEMA guidelines. This procedure will add an additional $20,000-$30,000 in repair cost to the 75% of homes on pier foundations and will be too costly to perform on the 25% of homes on slab foundations."[74]

Figure 60 charts the recovery activity in the Lower Ninth Ward as of October 2006 for Planning Districts 7 and 8. According to the report, "approximately 70% of the homes had been gutted or debris had been removed. . . . Recovery activity was more limited in the heavily damaged northern section of the Lower Ninth Ward, where 40% of the homes surveyed showed some sign of recovery, typically gutting."[75]

Figure 61 displays the results of a survey conducted with former residents of the Lower Ninth Ward inquiring about their desire to return to their former residences. Residents from four neighbourhoods in Districts 7 and 8 (St. Claude, Bywater, the Lower Ninth Ward and Holy Cross) were surveyed. Of the 165 blocks surveyed in Planning Districts 7 and 8, residents expressed an "overwhelming desire to move back to New Orleans (94% Lower Ninth, 100% Holy Cross, 88% St. Claude, and 85% Bywater), but also in their commitment to rebuilding and returning to their pre-Katrina homes."[76]

Many of the residents surveyed were already in the process of reoccupancy. Resident recovery and rebuilding efforts in the District 8 were much slower than District 7.

According to *The People's Plan*, "only 8% and 12% of residents surveyed in the Lower Ninth and Holy Cross, respectively, reported reoccupation in their homes. Close to 80% were in the process of rehabilitating or gutting their former residences. . . . [As one resident of the Lower Ninth Ward said,] 'This neighbourhood isn't known for its schools or education, but the residents of the Lower Ninth are hard working people. We have always worked hard and we will always work hard. We aren't going anywhere.'"[77]

The statement affirms that the Lower Ninth Ward continues to possess a strong sense of community. Former residents have a strong desire to return to their former neighbourhood, ensuring the way of life is not lost. (See page 423 in the appendices for *The People's Plan* full report).

fig. 57: Northern Portion of the Lower Ninth Ward - Post-Katrina New Orleans, 2006

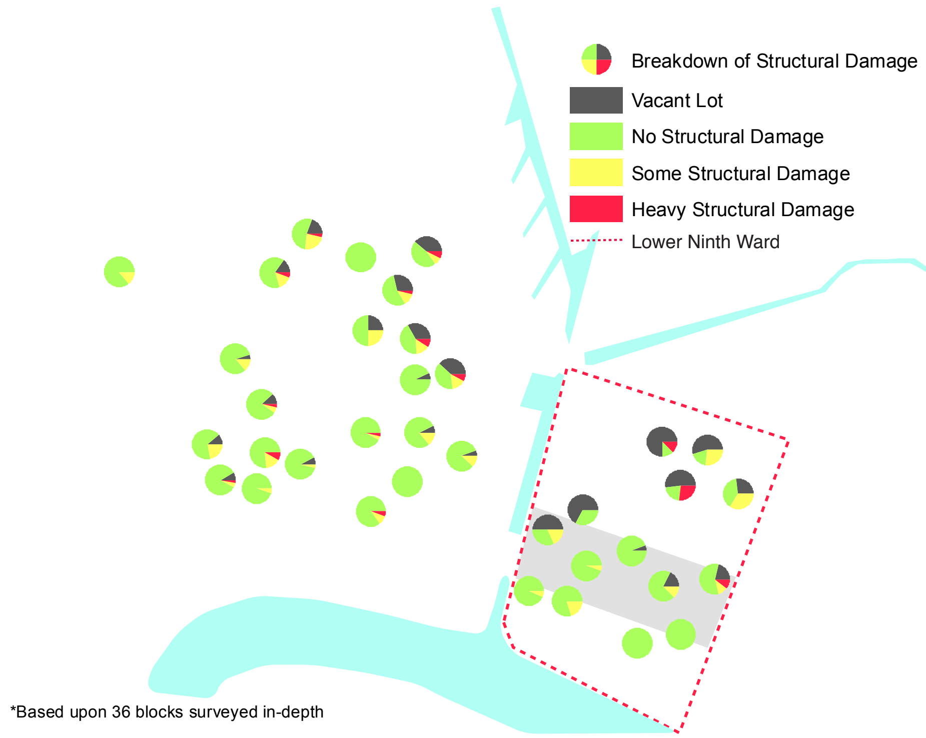


fig. 58: Structural Damage in the Lower Ninth Ward

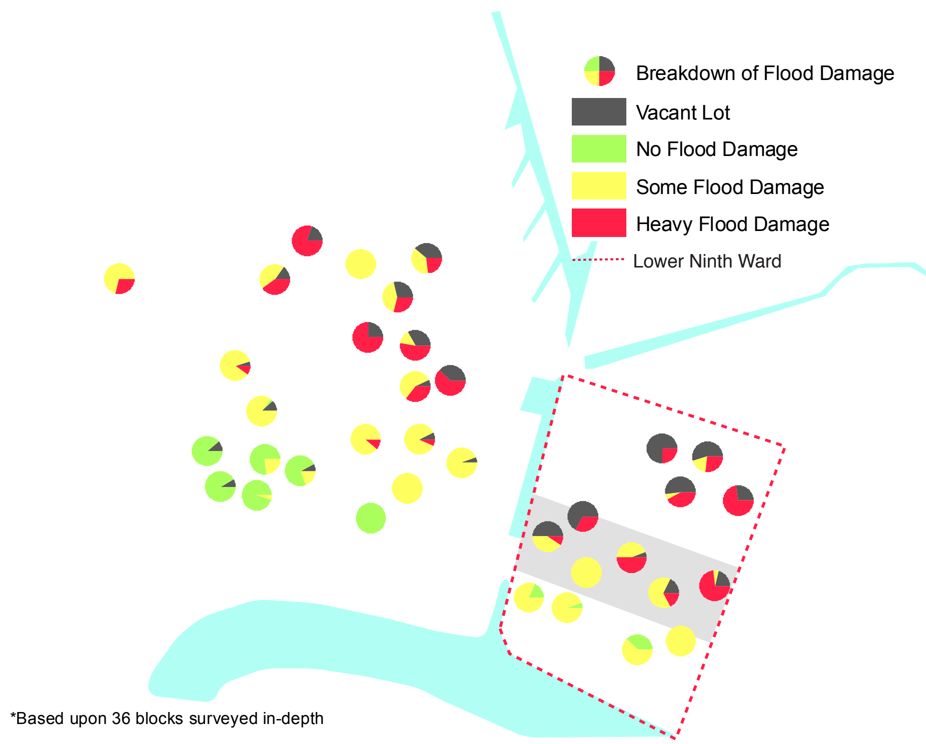
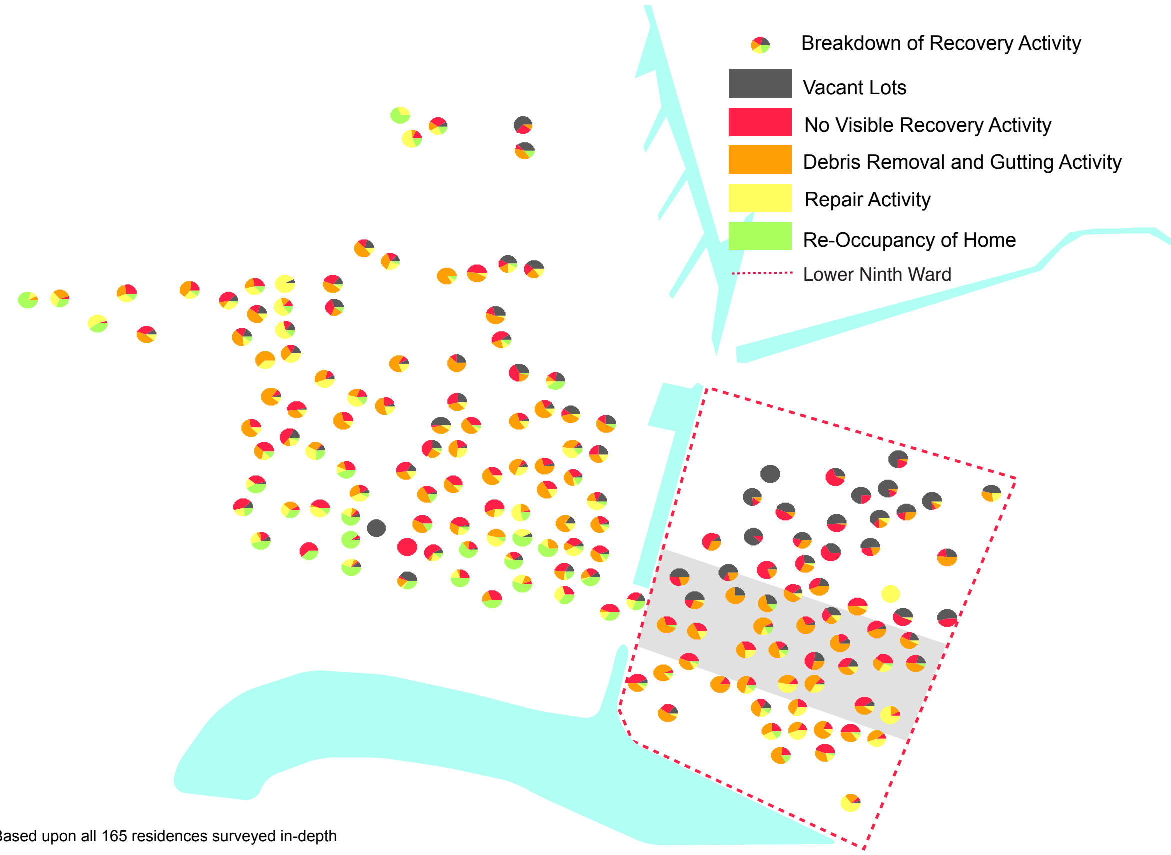
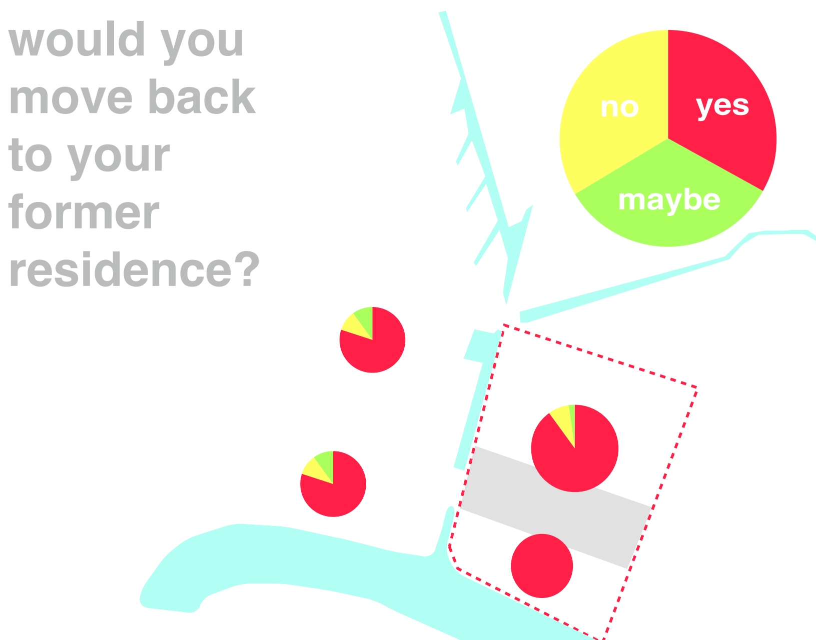


fig. 59: Damage due to Flooding in the Lower Ninth Ward



*Based upon all 165 residences surveyed in-depth

fig. 60: Residential Recovery in the Lower Ninth Ward



*Based upon all 165 residences surveyed in-depth

fig. 61: Desire to move back to the Lower Ninth Ward

03

iii

context:
site

SITE: THE LOWER NINTH WARD

The Ninth Ward is geographically the largest of the 17 Wards that comprise New Orleans (fig. 62). The Ninth Ward is divided into three sections: the Upper Ninth Ward, Lower Ninth Ward, and New Orleans East. The Upper and Lower Ninth Wards are separated by the Industrial Canal. The Lower Ninth Ward contains the neighbourhood of Holy Cross as shown in figure 63. The extent of the Lower Ninth Ward is also the boundary for Planning District 8 (fig. 64, 65).[78]

Prior to Hurricane Katrina, the Lower Ninth Ward was a rich cultural community with tight-knit, family-oriented neighbourhoods. According to Douglas Brinkley, Professor of History at Rice University:

> As one community leader aptly described it, the Lower Ninth Ward had an 'atmosphere of engagement that featured time spent with one another in dialog, in celebration of the music, words and history that make the Lower Ninth Ward so special'. . . . The modern day [pre-storm] Lower Ninth Ward was distinguished in many ways, not least the fact that more residents owned their homes than in any other part of the city. The population is predominantly African American, and their homes were built on land that was, in the Colonial Louisiana of the 19th Century, plantation land. These homes were built and paid for in modern times, thanks to an industrious nature and commitment to independence. . . . Porches and stoops were important places to catch up with one another and talk about everyday life.[79]

Douglas Brinkley highlights some important historical and cultural aspects of the Lower Ninth Ward prior to Hurricane Katrina. A high percentage of owner-occupied homes, among other factors, has strengthened stewardship within this community.

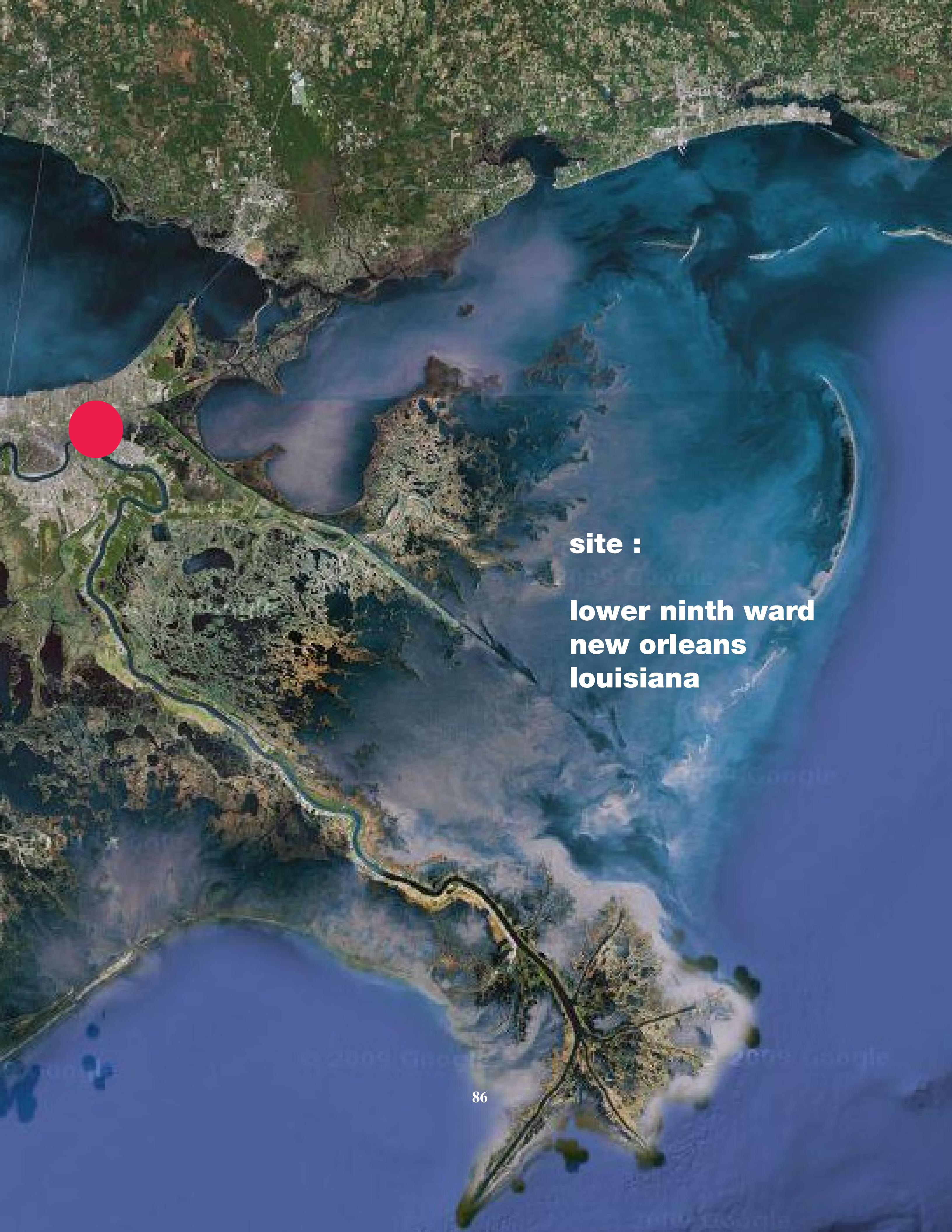
WHY THIS SITE?

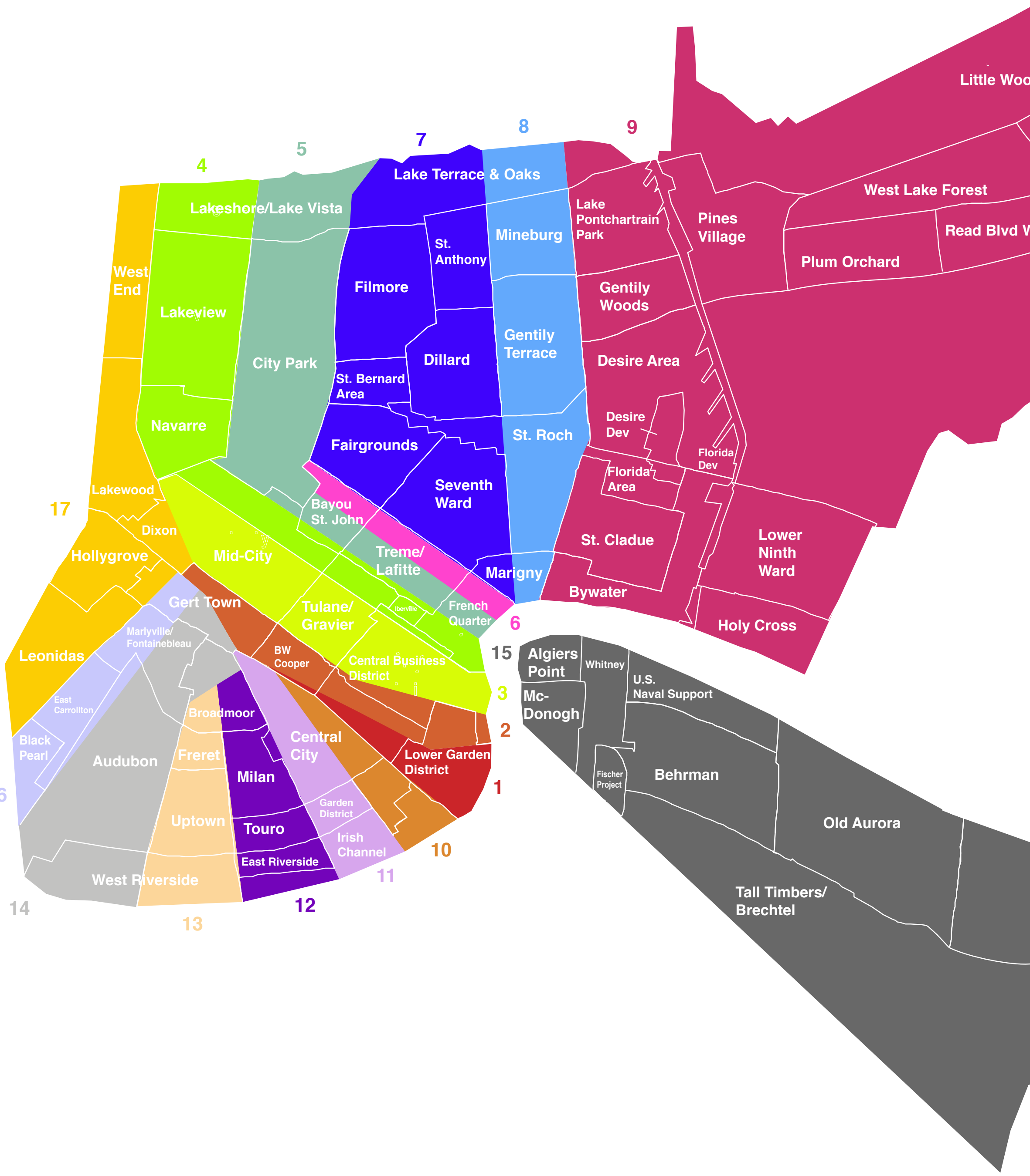
As explained in the following paragraphs, the Lower Ninth Ward is an appropriate site for the BFP for three main reasons: i) it requires an alternative flood-mitigation solution that respects its unique social culture; ii) many homes are salvageable and suitable for retrofit with buoyant foundations; and iii) the Lower Ninth Ward is one of the better locations along the river that should be safe from long-term ecological problems.[80]

The Lower Ninth Ward requires a flood mitigation solution that is respectful of the neighbourhood's social culture. Due to the severe flooding after Hurricane Katrina, FEMA is recommending that homeowners in South Louisiana permanently raise their homes to protect against future flooding. Raising homes high above street level will destroy neighbourhood character by removing the connection of the front porch to the street. (This concept is discussed in greater detail later in the chapter). The BFP supports the local culture because it facilitates the restoration of shotgun housing, a housing type that fostered the tight-knit culture that characterized this neighbourhood before Katrina. The BFP also preserves the relationship of porch to street, allowing residents to continue to live close to street level.[81]

According to *Mission 2010: New Orleans*, a study conducted by MIT students, the Lower Ninth Ward experienced significant damage after Katrina; "82% of the homes had more than $5,200 damage."[82] However, according to New Orleans planners, many of the remaining homes were in better condition than initially reported, and "more than 80% of Ninth Ward structures suffered no terminal structural damage."[83] This information was published in an Associated Press article in 2007 (two years after Hurricane Katrina). The article affirms that many houses in the Lower Ninth Ward are structurally viable. This means that rehabilitating these structures for retrofitting with buoyant foundations is indeed possible for this area (fig. 66).

fig. 62: Aerial View of Southeast Louisiana


site :
lower ninth ward
new orleans
louisiana



4
5
7
8
9
Little Woo
Lakeshore/Lake Vista
Lake Terrace & Oaks
West Lake Forest
Lake Pontchartrain Park
Pines Village
Read Blvd W
West End
St. Anthony
Mineburg
Plum Orchard
Filmore
Gentilly Woods
Lakeview
Gentilly Terrace
City Park
Dillard
Desire Area
St. Bernard Area
Navarre
St. Roch
Desire Dev
Fairgrounds
Florida Dev
Florida Area
Seventh Ward
Lakewood
Lower Ninth Ward
17
Bayou St. John
Dixon
St. Cladue
Hollygrove
Mid-City
Treme/ Lafitte
Marigny
Bywater
Gert Town
French Quarter
6
Tulane/ Gravier
Holy Cross
Marlyville/ Fontainebleau
Leonidas
BW Cooper
15
Central Business District
Algiers Point
Whitney
U.S. Naval Support
East Carrollton
3
Mc-Donogh
Broadmoor
Black Pearl
Central City
2
Audubon
Freret
Lower Garden District
Milan
Behrman
Fischer Project
16
1
Garden District
Old Aurora
Uptown
Touro
Irish Channel
10
East Riverside
West Riverside
11
Tall Timbers/ Brechtel
14
12
13

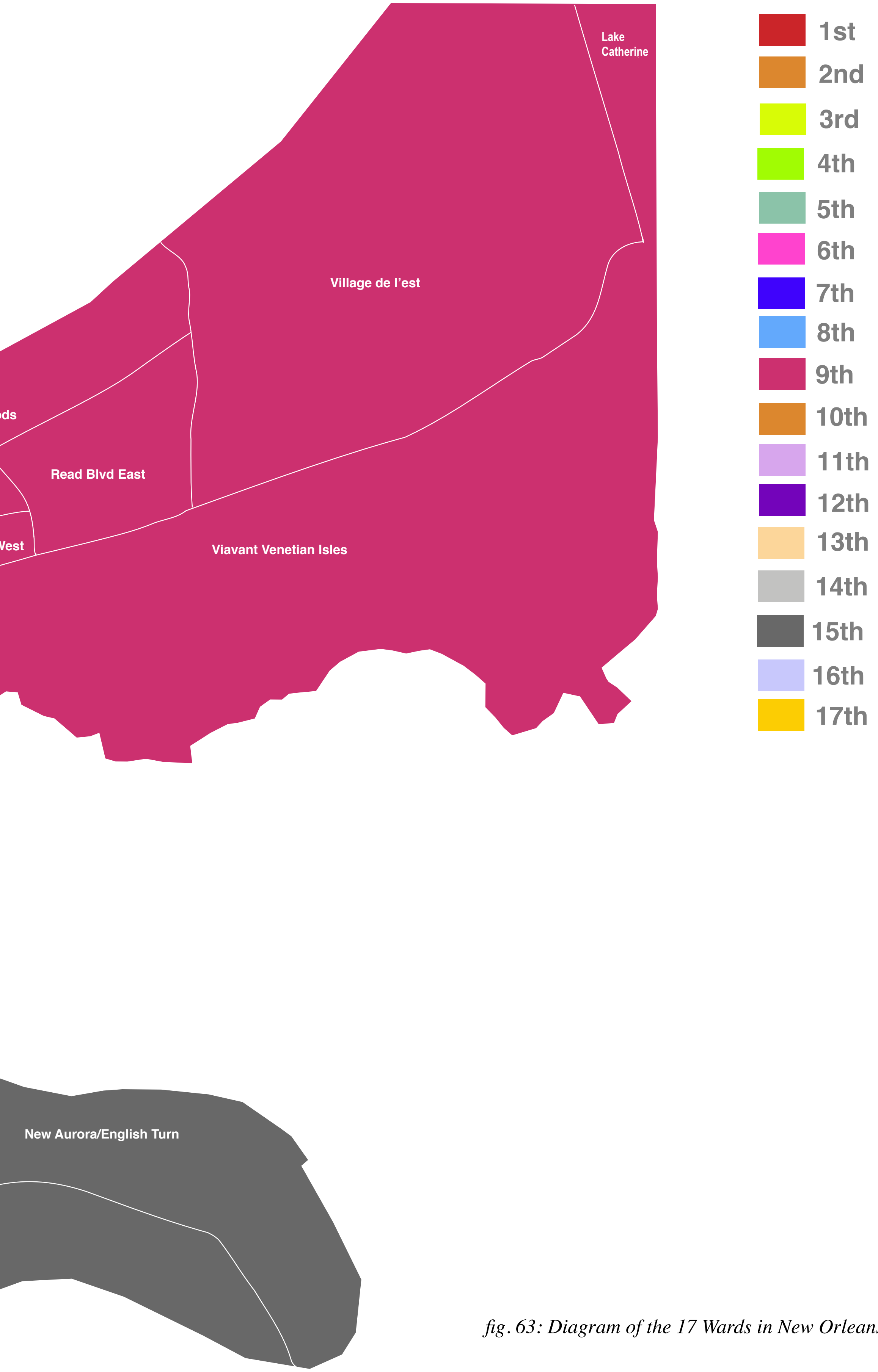
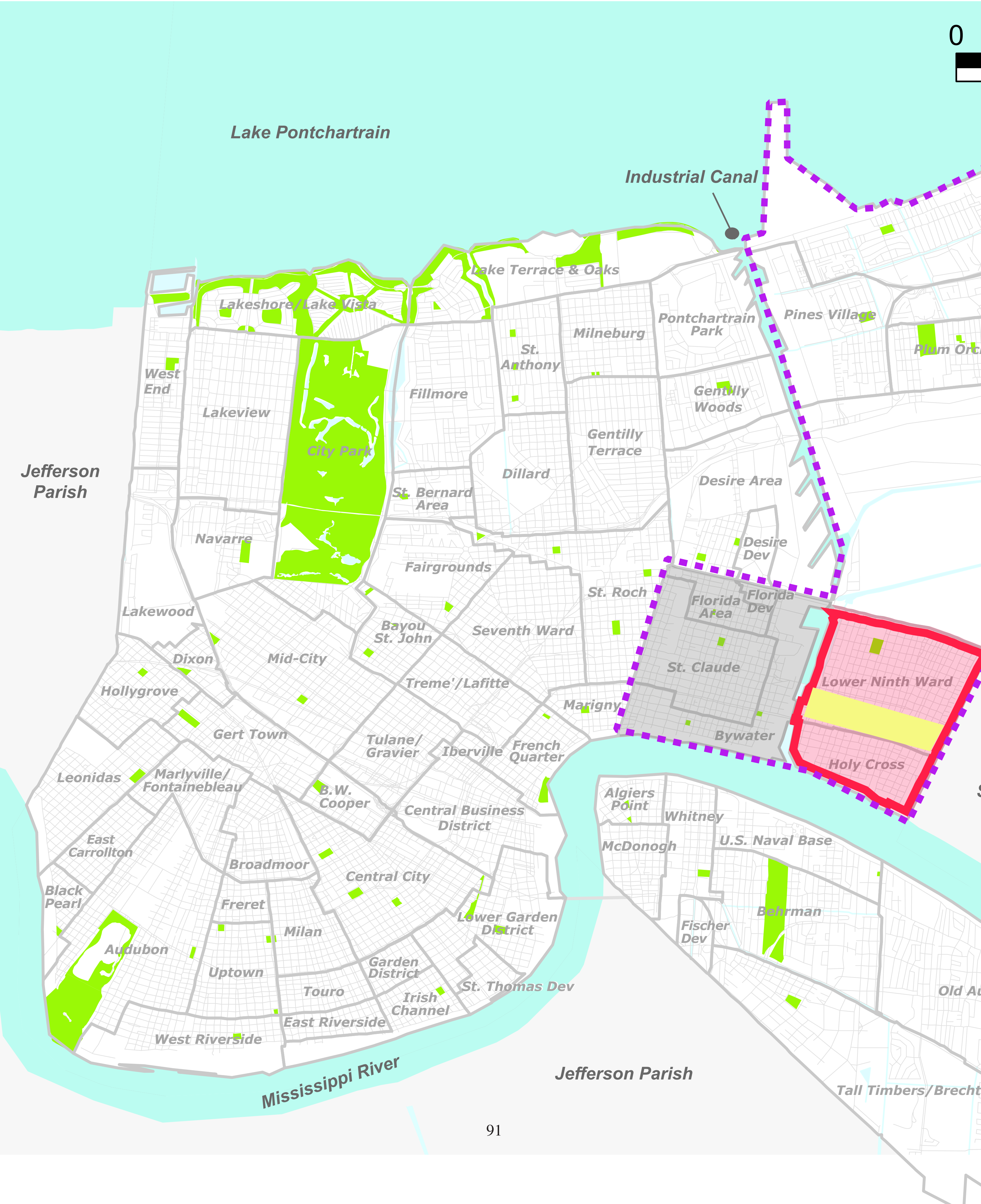


fig. 63: Diagram of the 17 Wards in New Orleans

fig. 64: Partial Aerial View of New Orleans


0
Lake Pontchartrain
Industrial Canal
Lake Terrace & Oaks
Lakeshore/Lake Vista
Pontchartrain Park
Pines Village
Plum Orc
Milneburg
St. Anthony
West End
Lakeview
Fillmore
Gentilly Woods
Gentilly Terrace
City Park
Dillard
Desire Area
Jefferson Parish
St. Bernard Area
Navarre
Desire Dev
Fairgrounds
St. Roch
Florida Area
Florida Dev
Lakewood
Bayou St. John
Seventh Ward
Dixon
Mid-City
St. Claude
Hollygrove
Treme'/Lafitte
Lower Ninth Ward
Marigny
Gert Town
Tulane/Gravier
Iberville
French Quarter
Bywater
Holy Cross
Leonidas
Marlyville/Fontainebleau
B.W. Cooper
Algiers Point
Whitney
Central Business District
East Carrollton
McDonogh
U.S. Naval Base
Broadmoor
Black Pearl
Central City
Freret
Behrman
Lower Garden District
Fischer Dev
Milan
Audubon
Uptown
Garden District
Touro
St. Thomas Dev
Old Au
Irish Channel
East Riverside
West Riverside
Jefferson Parish
Tall Timbers/Brecht
Mississippi River

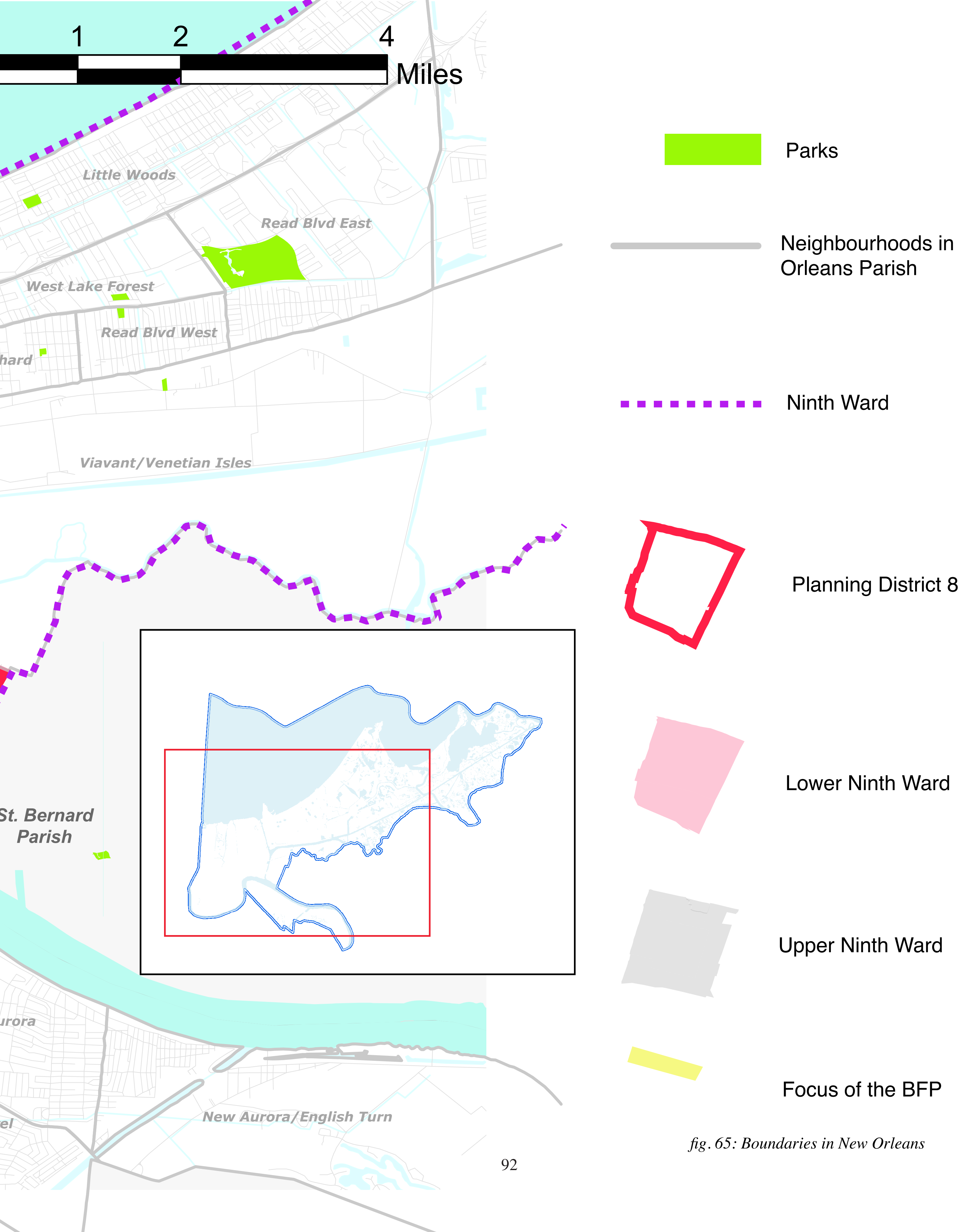


fig. 65: Boundaries in New Orleans

As reported in *Mission 2010: New Orleans*, the Lower Ninth Ward "is one of the better location – that is, more likely to be safe from long-term ecological problems such as sea level rise and subsidence"[84] (as discussed in Chapter Two), which makes it one of the safer locations along the river for displaced residents to return.

According to Bonnie Krenz, a student at MIT and co-author of *Mission 2010: New Orleans,* "[the Lower Ninth Ward has a] subsidence rate, 5 millimeters per year, which is slightly less than those of many of the areas along Lake Pontchartrain, and its average elevation, 0.9 meters above sea level, is much higher than many areas of New Orleans, even higher than the average elevation of New Orleans as a whole, that is exactly sea level."[85]

As discussed in Chapter Two, ecological challenges such as sea level rise and subsidence make coastal Louisiana particularly vulnerable to flooding. As identified by Krenz, the Lower Ninth Ward is a location that will not be as severely affected by these ecological challenges. If effective flood mitigation strategies are implemented, the Lower Ninth Ward can become a more flood resilient neighhourhood.

The following excerpt is from a Fox News broadcast from Monday, January 8, 2007 by Associated Press.

NEW ORLEANS — The predominantly black neighborhoods known as the Ninth Ward can be brought back largely as they existed before Hurricane Katrina flooded them, a survey contends.

The finding contradicts the common perception that the neighborhoods are so damaged that they need to be rebuilt from scratch, said urban planners who conducted the survey.

'The structural integrity of the buildings, even in the most devastated areas, ***are in much better condition than has been reported,****' said Kenneth Reardon, chair of Cornell University's city and regional planning department.*

The survey found that ***more than 80 percent of the Ninth Ward structures "suffered no terminal structural damage****" and that the majority of those structures were built atop piers, making it easier to raise them to meet new flood zone requirements.*

Researchers and structural engineers based their assessment on the inspection of about 3,000 buildings.

Yet, the neighborhoods are being repopulated very slowly because of the bureaucratic and financial hurdles residents face, the survey concluded after interviewing hundreds of residents. Only about 20 percent of the residents have returned home, the survey found.[86]

(emphasis added)

fig. 66: Lower Ninth Ward, Pre and Post Katrina Housing

fig. 67: Mardi Gras, New Orleans

fig. 68: Jazz Festival, New Orleans

SENSE OF PLACE

The BFP supports the recovery of "place" through encouraging the restoration of a physical habitat. By facilitating the rehabilitation of shotgun housing and enabling houses to remain close to street level, the BFP can preserve the former streetscape and neighbourhood character of the Lower Ninth Ward, thus supporting significant cultural drivers that contribute to the unique social culture of New Orleans.

Timothy Cochrane, as quoted in Barbara B. Brown and Douglas D. Perkins, writes, "'Place'. . . means permanence, security, nourishment, a center or organizing principle."[87] John D. Eyles, as quoted in Brown and Perkins, further defines "place" as "a center of felt value, incarnating the experience and aspirations of people. Thus it is not only an arena for everyday life. . . [it also] provides meaning to that life. To be attached to a place is seen as a fundamental human need and, particularly as a home, as the foundation of our identities and ourselves. Places are thus conceived as profound centers of human existence."[88] Keith H. Basso as quoted in Miller and Rivera adds, "senses of place also partake of cultures, of shared bodies of 'local knowledge' with which persons and whole communities render their places meaningful and endow them with social importance."[89]

Before Hurricane Katrina, New Orleans was a city with a strong sense of "place." Roger Abrahams *et al*. outline significant aspects that contribute to New Orleans' cultural identity. According to Abrahams *et al*., prior to Katrina:

> The cultural values of New Orleans include celebrated cuisine, music, architecture, literature and events (Mardi Gras and Jazz Fest) [fig. 67, 68] that fuse Old and New Worlds, North and South Americas, Latin and Protestant worlds and gregariously mix races and identities. In American culture and memory, it is the nation's most interracial and international city; it is a place of tolerance and creativity. New Orleans's cultural values bridge historic and contemporary periods; they relate to the built environment as well as the more immaterial, ephemeral expression of culture.[90]

While living in New Orleans to research his book *Nine Lives*, Daniel Baum wrote a daily online column for *The New Yorker*. He comments that what New Orleanians love about their city is "neither the food nor the music but the intimacy of the neighbourhoods — knowing everybody on the block where you were born, and never leaving."[91]

Elizabeth English lived in New Orleans from 1999 to 2004 while teaching at Tulane University. In her assessment, "New Orleans is famous for its food and its music, but the food and music that you consume in the French Quarter was not generated in the French Quarter, they come from the neighborhoods like the Lower Ninth Ward, or Mid City or New Orleans East — the neighborhoods that are largely lower income, largely black and that have evolved a unique culture. . ."[92]

Famous Lower Ninth Ward resident Fats Domino has made a significant musical contribution that has added vibrancy to New Orleans. Douglas Brinkley discuses Fats Domino's significance to the Lower Ninth Ward in *The Great Deluge: Hurricane Katrina, New Orleans, and the Mississippi Gulf Coast*:

> The most famous Lower Ninth Ward resident at the time of Katrina was undoubtedly the seventy-seven-year old Fats Domino. . . . As his legend grew, the self-reliant Domino stayed wedded to the Lower Ninth Ward. With his colorful neckties, bright pink Cadillac, and brood of children, Fats was the unofficial mayor of the Lower Ninth Ward. . . . He appeared at the yearly New Orleans Jazz and Heritage Festival and occasionally at Mississippi Gulf Coast casinos, but stayed largely out of the limelight. . . . Fats didn't like traveling. He was a homebody.[93]

Figure 69 depicts the Second Line Parade in the Lower Ninth Ward at the 4th Anniversary of Hurricane Katrina on August 29, 2009.

fig. 69: Second Line Parade in the Lower Ninth Ward, Post-Katrina New Orleans

As discussed earlier, residents of New Orleans were forced to vacate their homes during and after Hurricane Katrina and relocate to other parts of the United States. Immediately after the storm, many neighbourhoods were no longer recognizable. Miller and Rivera state, "since the storm, the loss of culture indicative to New Orleans is one of the primary concerns of the city's residents. Culture is significant to the survivors because it has shaped a sense of place."[94]

Many homes, the centers of "felt value," have been destroyed or become uninhabitable. Former residents have left their neighbourhoods in search of refuge. The faith of residents must first be restored before they will return to their homes. The BFP aims not only to provide effective flood protection but also the sense of security that make a community and "place" possible. Through retrofitting and restoring as many homes as possible with the implementation of buoyant foundations, it is hoped that citizens will feel a renewed sense of place. The community's morphology will remain intact, but individual residences will emerge safer and more flood resilient.

03

iv

context: the shotgun house

THE SHOTGUN HOUSE + THE BFP

A goal of the BFP is to encourage the restoration of flood-damaged shotgun houses in the Lower Ninth Ward. Arguably, the area's unique culture can be linked to the Louisiana shotgun house (fig. 70). This housing type plays a major role in the culture of the south.

Elizabeth English believes the Louisiana shotgun house has influenced the tight-knit communities and unique culture of the Lower Ninth Ward. She states:

> Might not restoration of the physical habitat encourage restoration of the culture? Demolition and rebuilding would not reestablish the pre-Katrina neighborhoods, community culture, and culture of community that had flourished there; we would do better if we could 'save the shotgun'. In fact, the shotgun houses themselves are critical players in this project, because the uniqueness of New Orleans culture is, I believe, in no small part due to shotgun house typology. The strong sense of community at the heart of New Orleans cultural life is a direct response to an absence of privacy in a shotgun house that serves to foster social interaction, both within the house and among the houses in a neighborhood of shotguns.[95]

John Michael Vlach is a Professor of American Studies and Anthropology at The George Washington University and Director of the university's Folklife Program. He began his pioneering work in the 1970s, dedicated to the study of shotgun housing and the culture that emanates from it. Vlach would agree with English's view. He states, "since a house as a spatial phenomenon is an important expression of the individual and his group, and because the values upon which culture depends are in many ways derived from house form, the shotgun may represent the continuation of an African life-way, an African culture."[96]

Vlach describes the shotgun housing typology as a "spatial phenomenon." With the absence of separated circulation space, this seemingly dysfunctional "spatial phenomenon" plays a significant role in the unique, tight-knit culture of the Lower Ninth Ward.

The following portion of this chapter outlines the history, origins, defining characteristics and design process of this housing type, which is important to fully understand its influence on the culture Lower Ninth Ward neighbourhood.

BRIEF HISTORY

According to Dell Upton, "[shotgun houses were originally] widely distributed throughout the Caribbean basin. They were brought to the Gulf Coast in the late eighteenth and nineteenth centuries in the course of continual migrations among the French- and Spanish-speaking Caribbean islands and the North American mainland.[97] In Upton's essay, he combines theories from Vlach and Jay Edwards, Professor of Anthropology and Geography at Louisiana State University, about where and when shotgun housing was brought to the Gulf Coast.

Vlach states, "New Orleans should be considered the specific center of shotgun development. This city is the cultural focus of southeastern Louisiana, the region definable by the presence of the shotgun house. The house probably radiated out across the countryside from New Orleans rather than climbing the folk-urban continuum that is assumed to exist in folk architecture."[98]

The shotgun house has been associated with the African-American population since its first appearance in the United States. Vlach remarks, "the American shotgun house is connected directly to Haiti and consequently represents the final product of a set of developments that are ultimately derived from African architecture."[99]

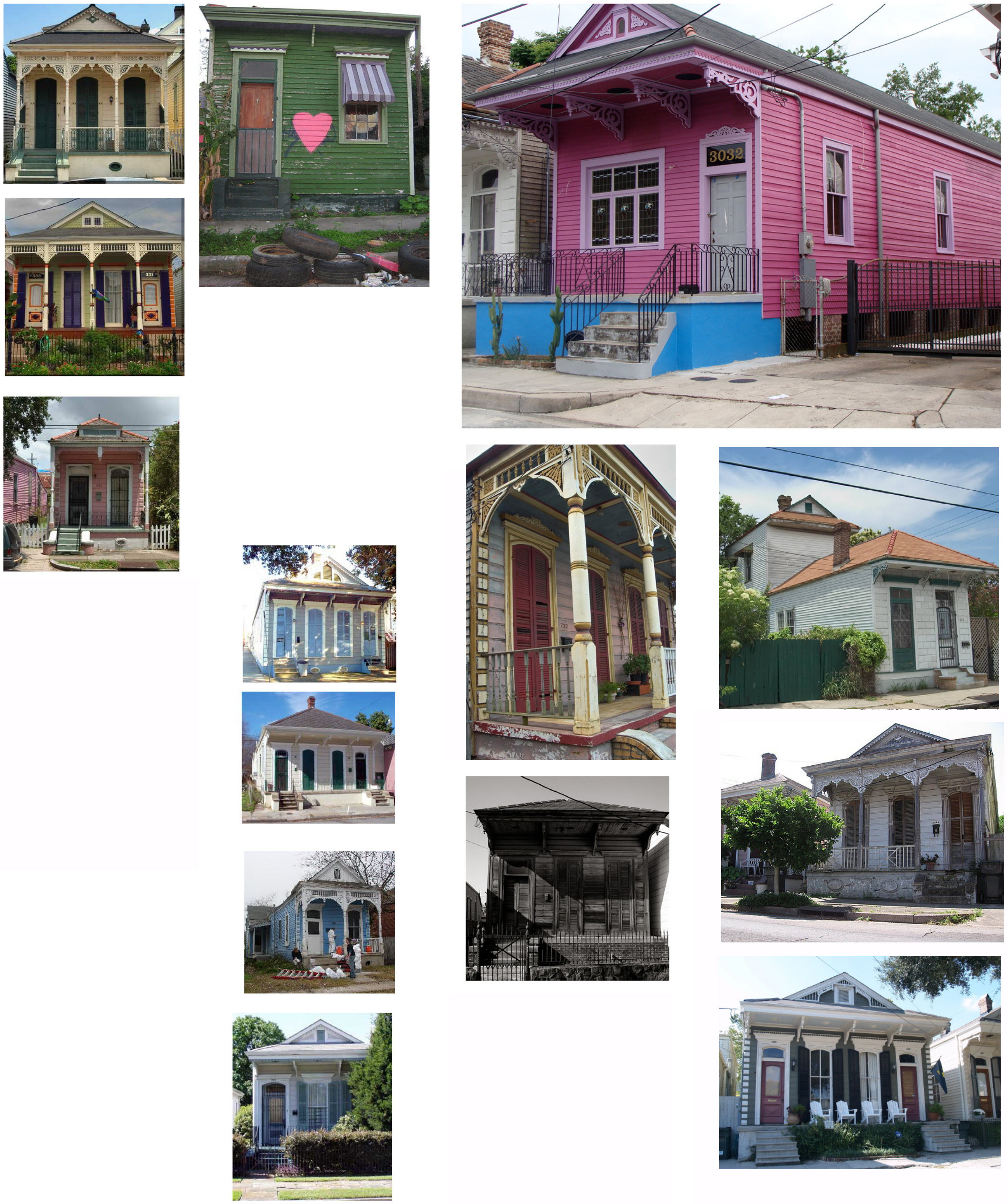


fig. 70: The Louisiana Shotgun House, Montage

fig. 71: Single Shotgun House,
3913 St. Claude Avenue, Upper Ninth Ward

fig. 72: Brightly Painted Shotgun Houses

ORIGINS OF THE SHOTGUN HOUSE

According to Jay Edwards of LSU, "theories of the origins of the shotgun lie deeply enmeshed in larger cultural debates on race and authority in the city. Some see the shotgun as a response to constrained urban lots while others see the building type inextricably linked to the city's substantial nineteenth-century African American population."[100]

Edwards describes how the origins of the shotgun houses are not apparent architecturally, and to fully understand their design one must understand the culture from which they originated. Dell Upton supports Edward's view: "The significance of shotgun houses in New Orleans and on the Gulf Coast lies in the specifics of where, when, and for whom they were built. Their simple presence means little — it is their place in the larger mix of local, regional, national and international practices that is significant. To reproduce shotgun houses in great numbers seventy years after they lost their place in the local repertoire would create a picture-post card New Orleans, not a living landscape."[101]

Dell Upton explains that shotgun houses cannot be merely reproduced, despite the efforts to rebuild in post-Katrina New Orleans – their significance lies within their cultural legacy.

DEFINING CHARACTERISTICS

Figure 71 is a photo of a single shotgun house located at 3913 St. Claude Avenue, between Alvar and Bartholomew streets in the Upper Ninth Ward. The photo was taken by Michael Eastman in spring of 2005, a few months before Hurricane Katrina.[102] Figure 72 displays the various types of ornamentation on shotgun façades.

There are many definitions of a basic shotgun house. According to Virginia McAlester *et al*., Adviser Emeritus of the National Trust for Historic Preservation, “the [basic] shotgun house is a narrow rectangular domestic residence, usually no more than 12 feet (3.5 m) wide, with doors at each end [fig. 73]. It was the most popular style of house in the Southern United States from the end of the American Civil War (1861–65), through to the 1920s.”[103]

According to Vlach, “The shotgun house is a one-room-wide, one-storey-high building with two or more rooms, oriented perpendicularly to the road with its front door in the gable end. These are the essential features of the house; they are found in all examples. Other aspects such as size, proportion, roofing, porches, appendages, foundations, trim and decoration have been so variable that the shotgun form is difficult to identify.”[104]

The basic single shotgun house typically consists of three to five rooms that are lined up one behind the other, with no hallways.[105] According to the Preservation Alliance of Louisville and Jefferson Co., the common spatial arrangement of a basic single shotgun house is “typically a living room first, then one or two bedrooms, and finally a kitchen in the back [fig. 74, 75].”[106] McAlester *et al*. state: “The rooms are well-sized, and have relatively high ceilings for cooling purposes, as when warm air can rise higher, the lower part of a room tends to be cooler. The lack of hallways allows for efficient cross-ventilation in every room.”[107] According to Vlach, the term “shotgun house” originated because one could fire “a shotgun through the house — in the front door and out the back — without doing any damage because the doorways are all in a line. Hence the house is called a shotgun and a straight alignment of doors is assumed. While it does happen that doors sometimes fall into a line, a zig-zag pattern is more common [fig.74].”[108]

fig. 73: Shotgun Interior

According to Wikipedia, shotgun houses “typically have a wooden frame structure and wood siding, although some examples exist in brick.”[109] In New Orleans, the house is usually raised two to three feet off the ground on masonry piers.[110] The Bywater Neighbourhood Association, states: “[Rooms] usually have some decoration such as moldings, ceiling medallions or elaborate woodwork.”[111]

The front porch is another common and significant element of shotgun house typology, particularly in New Orleans. According to Vlach, “front porches are particularly common on shotgun houses. Most often the roof is extended by projecting the gable some distance beyond the front wall, but there are a number of ways that the porch may be attached.”[112]

Another important feature of shotgun typology is the placement of the front door. “The most notable and distinguishing characteristics of the shotgun,” according to Vlach, “are the placement of its front door and its orientation, for these features overtly violate the standard canon for American folk building. The usual folk house has its door on the long side and the building runs parallel to the road. The perpendicular orientation of the shotgun with its frontward-facing gable and gable door signals an abrupt departure from the common pattern.”[113]

All shotgun houses have one door in the front (two doors for double shotguns) and almost all have a door in the back. A modified version of the shotgun house, the “camelback,” is a shotgun in which the rear section is two stories high. What is essential to this form is that the front portion of the house is one storey high. A double shotgun also emerged that fuses two single shotgun houses together side by side. The double shotgun can also have a “camelback,” thus becoming a “double camelback.”[114]

Figures 76 and 77 are two block plans of neighbourhoods in New Orleans. The New Orleans city layout’s narrow lot divisions fashioned the development of a house with one room aligned behind another to conserve space.[115]

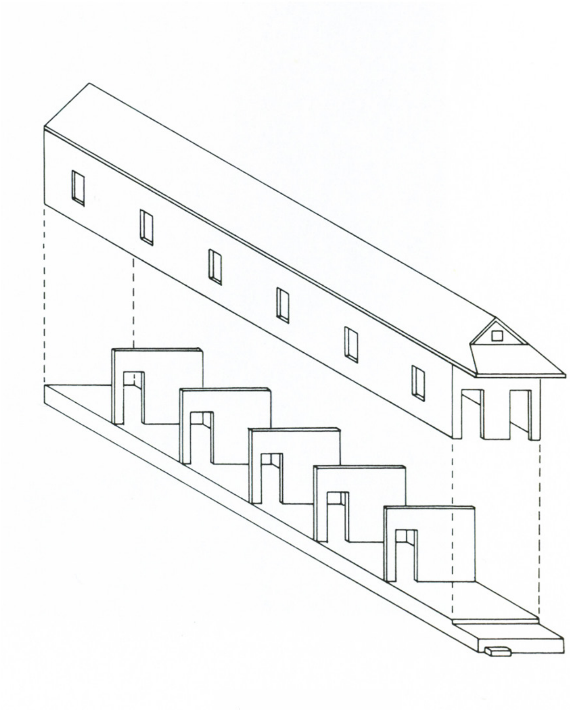


fig. 74: Shotgun House, Room Assembly

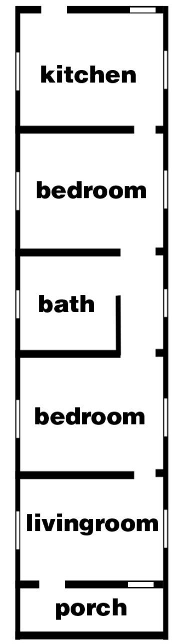


fig. 75: Shotgun House - Typical Plan

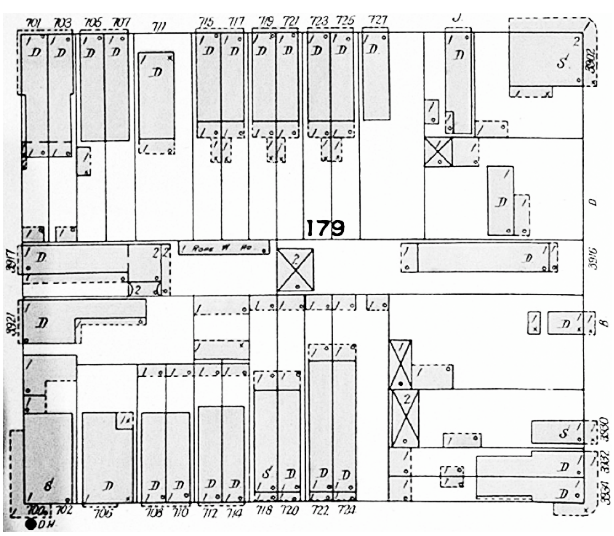


fig. 76: New Orleans Block Plan with Shotgun and Double Shotguns in 1908

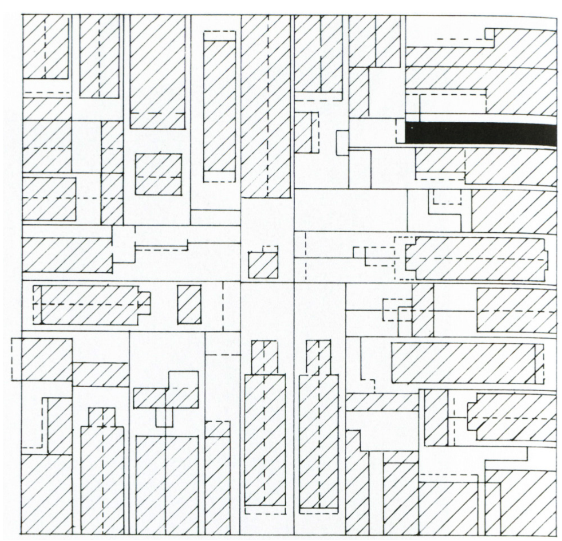


fig. 77: New Orleans Block Plan with Shotgun and Double Shotguns - (Date Unknown, Post 1908)

single shotgun

Figures 78 to 81 illustrate the differences between the four most common typologies of shotgun housing. Figure 82 illustrates some of the various floor plan layouts that can be found in Louisiana, transcribed from Vlach's fieldwork as documented in the second volume of his doctoral dissertation. A single shotgun's plan is normally one room wide with a door and a window or just a door in the front façade (fig. 78).[116]

double shotgun

The double shotgun house is essentially two single shotguns joined together. It typically has four openings in the front facade, two doors and two windows. On a block of typical 30-foot lots, a range of three to 14 feet can be found between shotgun houses, be they single or double. The close spacing of this type creates a strong street front definition in a block of shotguns. The double shotgun forms a two-family house with a common party-wall separating the units that run the length of the house.[117] According to Vlach, this type "requires less land per household than the traditional shotgun, and was used extensively in poorer areas because it could be built with fewer materials and use less land per occupant. It was first seen in New Orleans in 1854 [fig. 79]."[118]

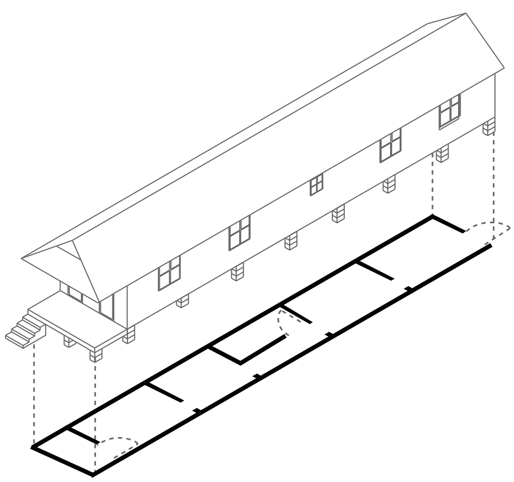


fig. 78: Single Shotgun House, 3D View and Plan

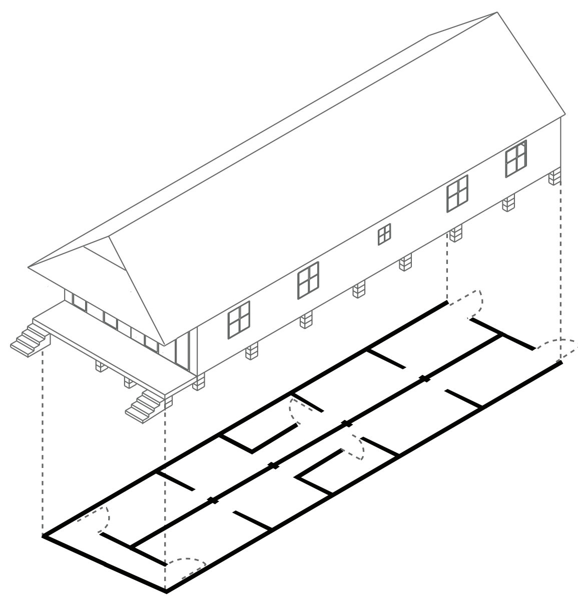


fig. 79: Double Shotgun House, 3D View and Plan

shotgun typologies in south louisiana

camelback shotgun

The camelback shotgun house is essentially a single shotgun house with a partial second story containing additional rooms, usually sitting at the rear portion of the house. Similar to the traditional single shotgun house, the only difference in the floor plan is the presence of a stair leading up to a second floor that may contain one to four rooms. This type was created to avoid additional taxes based on the area of the front facade. The city placed a higher tax value on two-storey houses, but the camelback, because its façade at street front is a single storey was regarded and taxed as a one-storey building (fig. 80).[119]

double camelback shotgun

The double camelback shotgun house, similar to the single camelback, has additional rooms added vertically at the rear of the house and, like the double shotgun, merges two single shotguns laterally. This typology is the least common in New Orleans, however it is the most economic choice and can accommodate larger families on a modest lot (fig. 81).[120]

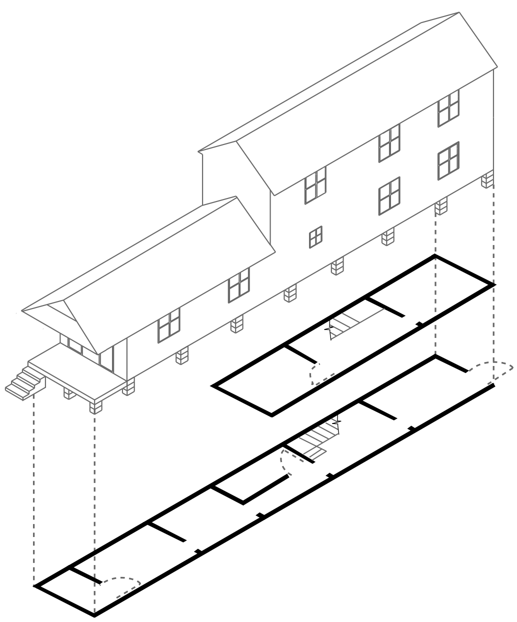


fig. 80: Camelback Shotgun House, 3D View and Plan

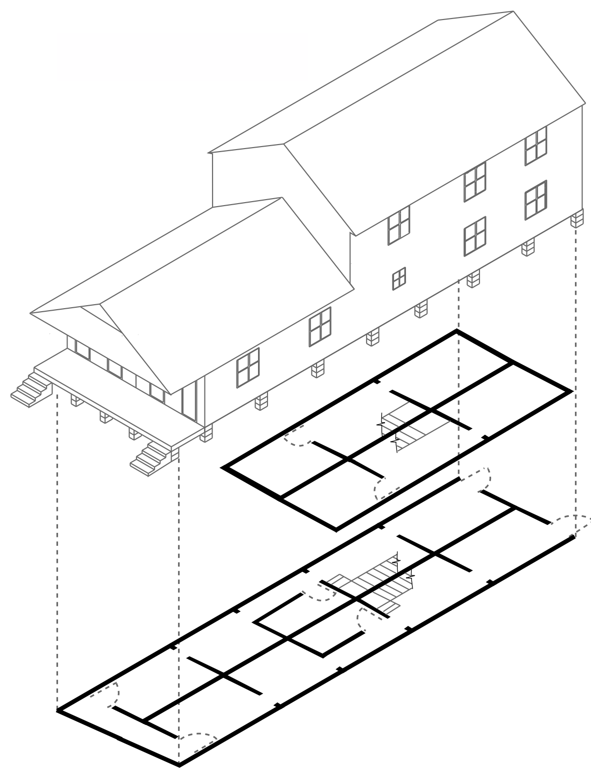


fig. 81: Double Camelback Shotgun House, 3D View and Plan

shotgun typologies in south louisiana


KITCHEN 12'X 9'
LIVING ROOM 12'X 12'
PORCH 13' X 6-1/2'
13' x 30
POINT COUPEE PARISH
KITCHEN 14' x 13'
LIVING ROOM 14' x 13'
PORCH 14' x 5.5'
14' x 34'
IBERVILLE PARISH
BEDROOM 7' x 6'
BEDROOM 6' x 6'
KITCHEN 13-1/2" x 12"
LIVING ROOM 13-1/2" x 13"
PORCH 14-1/2' x 6'
14-1/2' x 38'
ASSUMPTION PARISH
KITCHEN 15-1/2' X 9-1/2'
BEDROOM 15-1/2' X 13-1/2'
LIVING ROOM 15-1/2' X 13-1/2'
PORCH 16-1/2' X 6'
16-1/2' X 45'
MADISON PARISH
CLAIBORNE
BOSSIER
WEBSTER
CADDO
BIENVILLE
DE SOTO
RED RIVER
NATCHITOCHES
SABINE
VERNON
BEAUREGARD
CALCASIEU
CAMERON
KITCHEN 12' X 14-1/2'
BEDROOM 12' X 14-1/2'
BEDROOM 12' X 14-1/2'
LIVING ROOM 12' X 14-1/2'
PORCH 6' X 4'
13' X 64'
ORLEANS PARISH
BATH 6-1/2' x 8'
BATH 6-1/2' x 8'
KITCHEN 12-1/2' X 12-12'
KITCHEN 12-1/2' X 12-12'
BEDROOM 12-1/2' X 14'
BEDROOM 12-1/2' X 14'
LIVING ROOM 12-1/2' X 13'
LIVING ROOM 12-1/2' X 13'
24' X 43
ORLEANS PARISH
KITCHEN 12-1/2' X 8
BEDROOM 8' X 10-1/2'
LIVING ROOM 12-1/2' X 10-1/2'
PORCH 13-1/2' X 6'
13-1/2' X 37'
WEST BATON ROUGE PARISH
BATHROOM 6'X 6-1/2'
KITCHEN 16' X 9-1/2'
BEDROOM 16' X 9-1/2'
LIVING ROOM 16' X 9-1/2'
PORCH 17' X 6'
17' X 44"
TERREBONNE PARISH

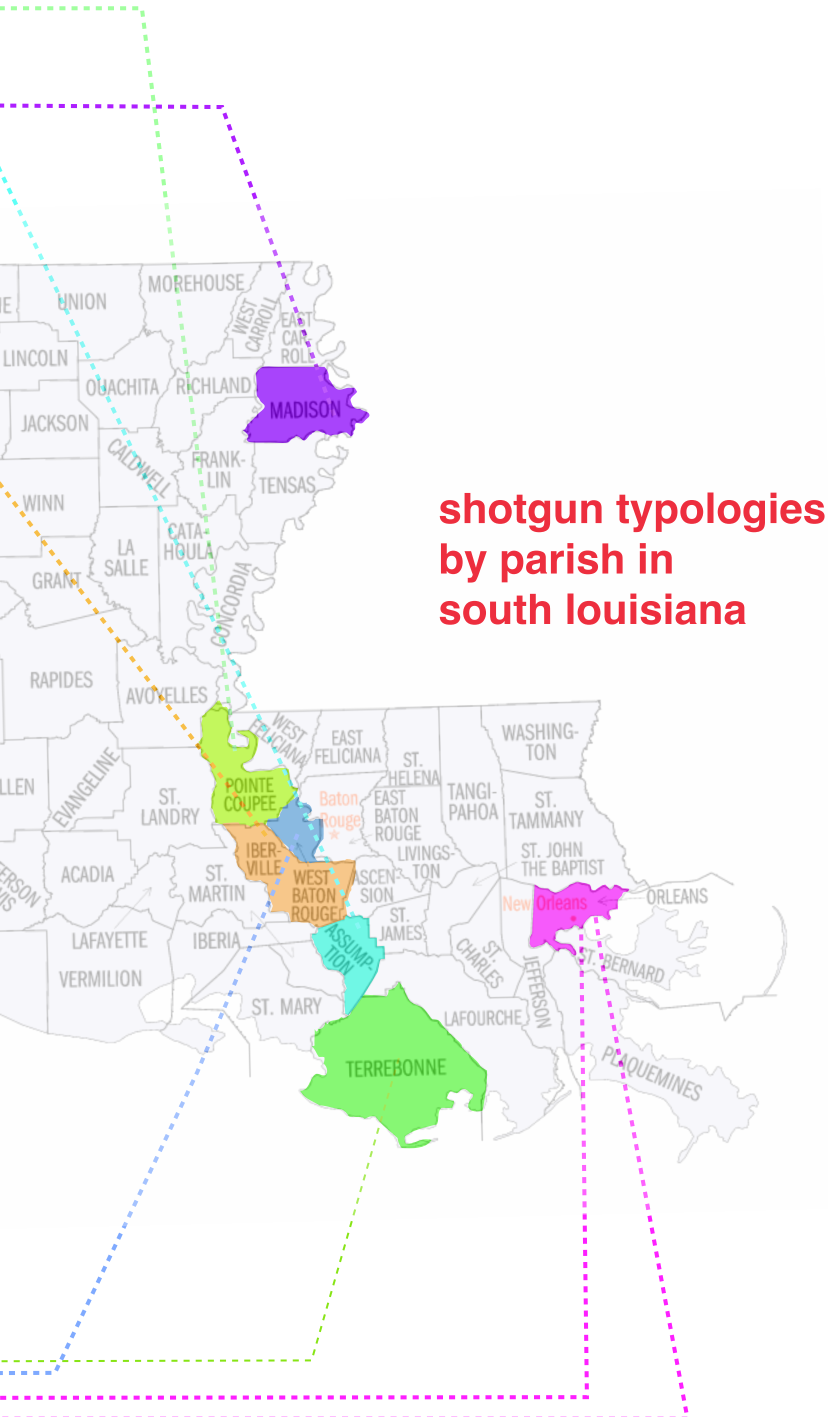


fig. 82: Shotgun Typologies by Parish in Southern Louisiana

SHOTGUN TYPOLOGIES BY PARISH

Figure 82 is a comparison of various shotgun house plans from different parishes across Louisiana. The original plans were transcribed from hand drawings in the second volume of Vlach's doctoral dissertation, entitled *Sources of The Shotgun House: African and Caribbean Antecedents for Afro-American Architecture*. Volume Two comprises measured plans of various types of shotgun housing based on his field work. His study was conducted in 1973 in Louisiana, Port-Au-Prince, Haiti and Ile Ife, Nigeria, highlighting the African and Caribbean contribution to this traditional American housing type.[121]

In an article entitled *Reinnovating the African-American Shotgun House*, Sheryl Tucker states, "the shotgun form grew out of traditional values African society placed on the continuity of the extended family and reverence for one's ancestors. The lives of family and clan members were so interwoven with each other that the boundaries between self, family and community were ambiguous."[122] This particular housing type expresses social values and cultural traditions of generations of African-Americans, where its restoration plays a vital role in preserving the culture of New Orleans.

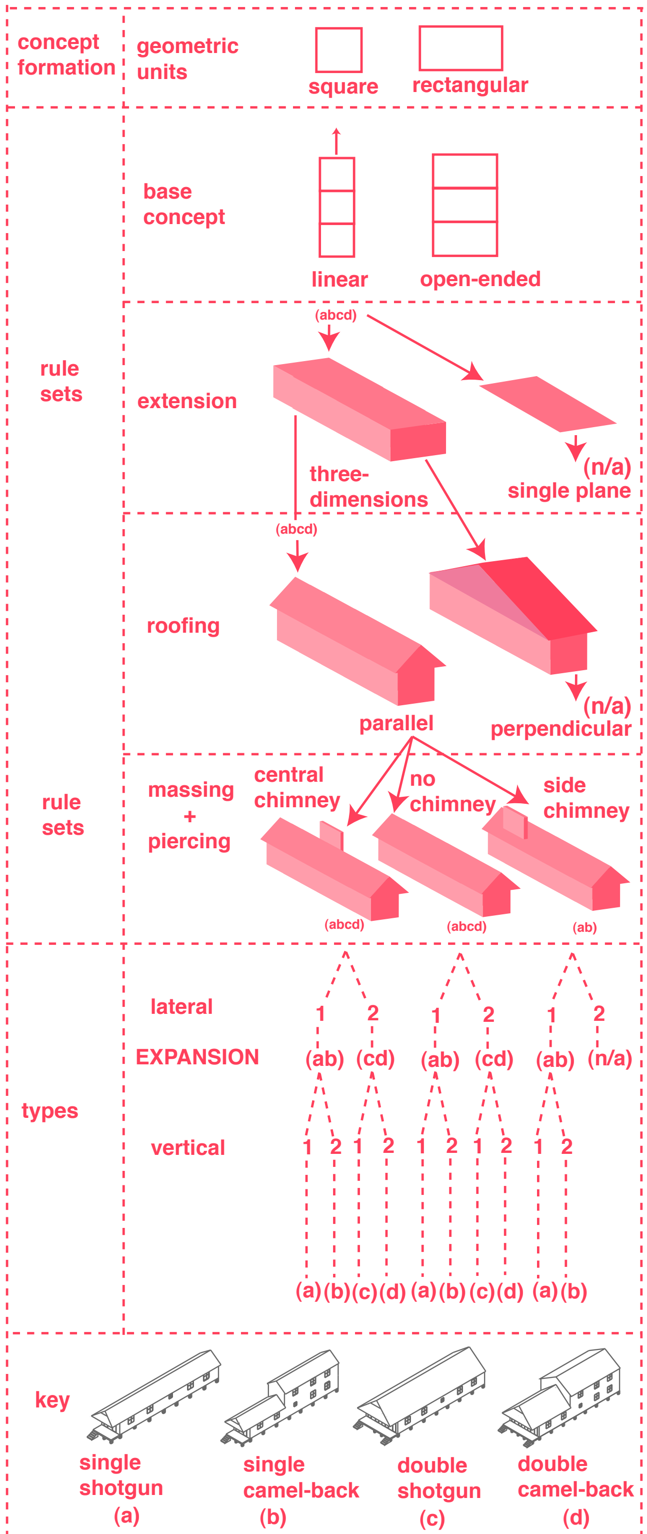
DESIGN PROCESS

The design process for shotgun houses, illustrated in figure 83, was adapted from a diagram originally published in the first volume of Vlach's doctoral dissertation. Vlach quotes Henry Glassie, a world-renowned folklorist and emeritus College Professor of Folklore at Indiana University Bloomington with specializations in vernacular architecture. Glassie presents an analysis of the shotgun building process in which four sets of rules are used to transform architectural concepts from ideas to tangible artifacts. The base design concept is a linear arrangement of volumes that instead of being a complete whole, incorporates the immediate option to add extra units. The linear string of volumes is "then extended three dimensionally and given a roof axis," explains Glassie, but the building axis is not determined by the rules for roofing. The ridge line of a shotgun house is always parallel to the building's length which is already determined by the base concept (fig. 83). Glassie further elaborates:

> Next rules for massing and piercing are used to locate chimneys, doors and windows. The building is then complete but may be expanded further by either lateral or vertical doubling of structure. Chimneys may be massed centrally or to the side, but do not affect avenues of movement through the house because the base units are large enough not to be blocked off by a fireplace. . . . Rules for piercing are highly variable because the house façade has only a single element as its base. . . . The front of a shotgun may be pierced in many ways. It may have one or two doors, a door and window, or a door and two windows. The arrangement of openings can be balanced or asymmetrical. The vertical or lateral doubling rules can both be used in shotgun houses, although when the vertical option is followed, it is only used for [the rear] portion of the house.[123]

This theory summarizes a potential process for shotgun house design, however as stated earlier, its design is primarily driven by historical and cultural evolution.

shotgun house design process



the 4 shotgun types have units that are both square and rectangular

the 4 shotgun types are both linear and open ended

the 4 shotgun types are ONLY 3 dimensional

the 4 shotgun types ONLY have a roof axis that runs parallel to the house

the 4 shotgun types may have a central chimney or no chimney

ONLY the single and single camel-back shotgun styles may have side chimneys

doubling a single shotgun creates a double shotgun, where two side chimneys would merge centrally

doubling a single camel-back creates a double camel-back, where two side chimneys would merge centrally

fig. 83: Shotgun House Design Process

fig. 84: An Elevated Double Shotgun House

PERMANENT STATIC ELEVATION +
LOSS OF NEIGHBOURHOOD CULTURE:

The current flood mitigation strategy recommended by the United States federal government agency FEMA for residential neighbourhoods is permanent, raised static elevation. The BFP provides a form of flood mitigation that is an alternative to that by offering a culturally supportive solution that promotes the authentic restoration of shotgun residences in New Orleans Through retrofitting existing shotgun residences with the proposed buoyant foundation system, houses will remain close to street level, preserving the original neighbourhood character. Permanent static elevation destroys neighbourhood character by elevating houses off street level, thus removing the close relationship between the front porch and the street (fig. 84). The ability for residents to sit on the front porch and talk to their neighbours as they pass by on the street is compromised. The porch is no longer a place of social encounter, which is a major cultural driver in traditional New Orleans neighbourhoods. The BFP is a solution that preserves the original neighbourhood character by allowing houses to remain close to street level.[124]

English recounts the neighbourhood character of the Lower Ninth Ward before Katrina. She states:

> [W]hat developed in these neighborhoods was a very, very, very strong sense of community. The neighbors on the block became like a little village, raised each other's children, and went to each other's house for food all the time. I hear about the kids growing up, and whosever house they were, wherever they were at dinner time, that's where they ate dinner, because it was all like one big family. When these neighborhoods were first settled, the people who built the houses usually gave the houses to their children and then if they had more than one child who wanted to live nearby, then they would buy a house that became available on the block. There would be whole families that lived very close to one another. So, there is a very, very strong sense of community that developed that I think is related to the form of the shotgun house, and that that's why the vernacular architecture and the culture that evolved there is unique.[125]

The goal of the BFP is to aid in the restoration of the Lower Ninth Ward, in a way that will allow for these tight-knit communities to form once again. "The strong sense of community at the heart of New Orleans cultural life is a direct response to an absence of privacy in a shotgun house that serves to foster social interaction, both within the house and among the houses in a neighborhood of shotguns,"[126] English suggests. She believes that one of the fundamental aspects about New Orleans, particularly the Lower Ninth Ward, is the shotgun house and the culture that developed in these neighbourhoods.

03

V

summary

This chapter has focused on physical and cultural aspects of the context in which the Buoyant Foundation Project (BFP) will be implemented.

The chapter began with the post-Katrina situation and discussed the slow recovery in the Lower Ninth Ward neighbourhood in comparison to other neighborhoods in New Orleans, due in part to diaspora, due in part to abnormally slow restoration of services.

The cultural vibrancy and significance of this particular neighbourhood prior to Katrina was then discussed, highlighting its strong sense of community and "place." Homeownership was high, and residents have expressed a strong desire to return to their former neighbourhood and resume their lives. Additionally, research demonstrated that after Katrina the homes of the Lower Ninth Ward were in large part repairable. The BFP is a flood-mitigation solution that could best fulfill residents' wishes and facilitate the restoration of shotgun housing.

The Lower Ninth Ward is an extremely tight-knit neighbourhood, which was cultivated by a particular housing typology: the New Orleans shotgun house. The general lack of interior privacy created by the absence of separated circulation space, coupled with the utilization of the front porch as a social realm, has fostered a culture of social interaction. In addition, the modest spatial configuration forces utilization of all available space, including the exterior spaces. The porch serves as an extension of the living room, where it becomes a space for neighbourhood encounters and social interaction.

The BFP enables the authentic restoration of the Lower Ninth Ward, where houses sit close to the ground, retaining the relationship of resident to street thus reinforcing the unique social culture of this neighbourhood and ultimately restoring its sense of place.

The following chapter will give a thorough overview of a "solution" to the challenges discussed in the previous chapters. The BFP will be explained in detail, giving a chronology of the project's evolution to date and highlighting the major milestones in the project's development.

03 vi endnotes

65. United States Department of Commerce NOAA/NESDIS, “Hurricane Katrina - A Climatological Perspective,” (2005): 2, http://www.ncdc.noaa.gov/oa/climate/research/2005/katrina.html (accessed September 1, 2009).

66. Louisiana Geographic Information Center, “Louisiana Hurricane Impact Atlas, Volume 1” (2005):13, http://lagic.lsu.edu/hurricanes.htm. (accessed October 4 2009).

67. Anderson *et al*. 2007, 9

68. United States Census Bureau, Population Division, “County Total Population and Estimated Components of Population Change: April 1, 2000 to July 1, 2009,” in a compilation by the GNO Community Data Center, http://www.gnocdc.org (accessed June 1, 2010).

69. Brookings Institution, “The New Orleans Index: Tracking the Recovery of New Orleans and The Metro Area,” Metropolitan Policy Program (2009): 20 http://www.gnocdc.org (accessed September 1, 2009).

70. ibid.

71. Greater New Orleans Community Data Center, “Planning District 8: Working Draft of Future Land Use Map,” https://www.communications-mgr.com/projects/1371/docs/District%20 8_012610_11x17.pdf], accessed February 1, 2010.

72. ACORN, Cornell University, University of Illinois, Columbia University and NSF. “The People’s Plan for Overcoming the Hurricane Katrina Blues: A Comprehensive Strategy for Building a more Vibrant, Sustainable and Equitable 9th Ward,” 3 http://www.rebuildingtheninth.org/ (accessed January 15, 2010) (appendices, 423).

73. ibid., 9

74. ibid.

75. ibid., 13

76. ibid.

77. ibid., 14

78. “Ninth Ward of New Orleans,” http://en.wikipedia.org/wiki/Ninth_Ward_of_New_Orleans (accessed September 1, 2009).

79. Douglas Brinkley, as quoted in Thomas Darden, “Rebuilding a Sustainable Lower Ninth Ward,” MIR Annual Report 2007, 6 http://www.makeitrightnola.org/index.php/about/detail/financials/ (accessed September 1, 2009).

80. Bonnie Krenz, “Downsizing by District, Mission 2010: New Orleans,” http://web.mit.edu/12.000/www/m2010/finalwebsite/solutions/vision.html (accessed January 15, 2010).

81. Elizabeth English, “Amphibious Foundations and the Buoyant Foundation Project: Innovative Strategies for Flood-Resilient Housing,” (paper presented at the International Conference on Urban Flood Management, Paris, France, November 25-27, 2009), 1 (appendices, 412).

82. Krenz, 2010.

83. Associated Press, “New Orleans’ Katrina-Ravaged 9th Ward Can Be Rebuilt, Planners Say,” http://www.foxnews.com/story/0,2933,242316,00.html (accessed October 23, 2009).

84. Krenz, 2010.

85. ibid.

86. Associated Press. 2007.

87. Timothy Cochrane, “Place, People and Folklore: An Isle Royale Case Study,” *Western Folklore 46* (1987), 1-20, as quoted in DeMond Shondell Miller and Jason David Rivera, *Hurricane Katrina and the Redefinition of Landscape* (Lanham: Lexington Books, 2008), 11.

88. John D. Eyles, *The Geography of Everyday Life,* in D. Gregory and R. Walford (eds.), Horizons in Human Geography (New Jersey: Barnes and Noble, 1989), 102-117, as quoted in Brown and Perkins, “Disruptions in Place Attachment,” in Altman and S.M. Low (eds), *Place Attachment*, (New York: Plenum Press, 1992) in Miller and Rivera. 2008, 11.

89. Keith H. Basso, *Wisdom Sits in Places: Landscape and Language Among the Western Apache* (New Mexico: University of New Mexico Press, 1996) xiii-xiv, in Miller and Rivera. 2008, 11.

90. Roger D. Abrams *et al*., *Blues for New Orleans: Mardi Gras and America’s Creole Soul* (Philadelphia: University of Pennsylvania Press, 2006) in Randall F. Mason, “Promoting Cultural Preservation,” in Eugenie L. Birch and Susan M. Wachter eds., Rebuilding Urban Places after Disaster: Lessons from Hurricane Katrina (Philadelphia : University of Pennsylvania Press, 2006), 262.

91. Dan Baum, “Letter From New Orleans, The Lost Year: Behind the Failure to Rebuild,” The New Yorker, August 21, 2008, http://www.newyorker.com/archive/2006/08/21/060821fa_fact2 (accessed October 23, 2009).

92. Elizabeth English, Interviewed by Charlotte Garson, *French Public Radio Station in Breaux Bridge*, LA, August 2008 (appendices, 384).

93. Douglas Brinkley, *The Great Deluge: Hurricane Katrina, New Orleans, and the Mississippi Gulf Coast* (New York: William Morrow, 2006), 259.

94. Miller and Rivera. 2008, 61.

95. English, 2009, 2 (appendices, 412).

96. John Michael Vlach, *Sources of the Shotgun: African and Caribbean Antecedents for Afro-American Architecture, Volume 1*. Doctoral Dissertation. (Bloomington: Indiana University, 1975), 10-11.

97. John Michael Vlach, “The Shotgun House: An African Architectural Legacy,” in John Michael Vlach and Dell Upton (eds), *Common places: Readings in American Vernacular Architecture,* (Athens: University of Georgia Press, 1986); and Jay D. Edwards, “The Origins of Creole Architecture,” *Winterthur Portfolio 29* (1994): 155-89; and “Cultural Syncretism in the Louisiana Creole Cottage,” *Louisiana Folklore Miscellany 4* (1978-80): 9-40, as quoted in Dell Upton, “Understanding New Orleans’s Architectural Ecology,” in Birch and Wachter. 2006, 281.

98. John Michael Vlach, *By the Work of Their Hands: Studies in Afro-American Folk Life* (Charlottesville: University of Virginia Press, 1992), 187.

99. Vlach. 1992, 211.

100. Jay D. Edwards, “Shotgun: The Most Contested House In America,” *Buildings & Landscapes: Journal of the Vernacular Architecture Forum 16* (2009): 1.

101. Dell Upton, “Understanding New Orleans’s Architectural Ecology,” in Birch and Wachter. 2006, 286-287.

102. Maria C Montoya. “Katrina Adds Poignancy to a Picture of a Shotgun House Hanging in the White House,” August 30, 2009. http://www.nola.com/living/index.ssf/2009/08/katrina_adds_poignancy_to_a_pi.html (accessed September 1, 2009).

103. Virginia McAlester *et al*., *A Field Guide to American Houses*. (New York: Knopf), 1997, 90, as quoted in “Shotgun House,” http://en.wikipedia.org/wiki/Shotgun_house (accessed September 1, 2009).

104. Vlach. 1975, 29.

105. “Shotgun House,” http://en.wikipedia.org/wiki/Shotgun_house (accessed September 1, 2009).

106. “The Shotgun House: Urban Housing Opportunities,” Preservation Alliance of Louisville and Jefferson Co., 1980 as cited in “Shotgun House,” http://en.wikipedia.org/wiki/Shotgun_house (accessed September 1, 2009).

107. Virginia McAlester *et al*. 1997.

108. Vlach. 1975, 31.

109. “Shotgun House,” http://en.wikipedia.org/wiki/Shotgun_house (accessed September 1, 2009).

110. Personal Communication with Elizabeth English, January 2010.

111. “Shotgun House,” http://bywater.org/about-bywater/architecture/shotgun-house/ (accessed on October 23, 2009).

112. Vlach. 1975, 31.

113. ibid., 32.

114. Vlach. 1975, 44.

115. Steven Holl, *Pamphlet Architecture Number 9: Rural & Urban House Types in North America*. (New Jersey: Princeton Architectural Press, 1998), 34.

116. John Michael Vlach, “Shotgun Houses,” *Natural History 86* (1977): 51.

117. Holl. 1998, 36.

118. John Michael Vlach, “Shotgun Houses,” *Natural History 86* (1977), 51-57, as quoted in “Shotgun House,” http://en.wikipedia.org/wiki/Shotgun_house (accessed September 1, 2009).

119. Holl. 1998, 37.

120. “Shotgun House,” http://en.wikipedia.org/wiki/Shotgun_house (accessed September 1, 2009).

121. Vlach. 1975, Volume 2.

122. Sheryl G. Tucker, “Reinnovating the African-American Shotgun House,” *Places 1* (1995): 66.

123. Henry Glassie as quoted in Vlach. 1975, 34-37.

124. English. 2009, 2 (appendices, 412).

125. English and Garson. 2008, (appendices, 384).

126. English. 2009, 3 (appendices, 412).

04

the buoyant foundation project: a solution

a solution:

i. introduction

ii. the BFP:
definition of buoyant foundations
why use buoyant foundations?
how it works
1315 lamanche street

iii. policy:
role of FEMA + the NFIP
assembly steps
phase 1 + phase 2

iv. legislation:
base flood elevation
advisory base flood elevation
flood zones
flood zones A and V
flood zones zones B, C and X
flood zones + BFEs
flood insurance coverage

v. summary

vi. endnotes

04

i

a solution: the buoyant foundation project

Chapter four discusses the Buoyant Foundation Project (BFP) as a solution to the challenges outlined in Chapters Two and Three. The BFP was conceived as an alternate flood mitigation strategy for shotgun homes, which are a common housing typology in the Lower Ninth Ward of New Orleans. The BFP is currently the only strategy that simultaneously resolves the technical, safety, and socio-cultural aspects of flood protection. It is the goal of the BFP to provide the Lower Ninth Ward with safer and more flood-resilient homes while protecting the culture and way of life.

This chapter begins by introducing the mission of the BFP and then discusses why it is a more effective flood-protection solution than permanent static elevation. A diagrammatic streetscape is provided, comparing non-elevated homes, permanently elevated homes, and homes on buoyant foundations during a flood. This illustrates the BFP's efficacy. A thorough review of the BFP's components is then given, and it is explained how the system operates during dry and flooded conditions. This is followed by a brief discussion of a shotgun house at 1315 Lamanche Street in the Lower Ninth Ward, New Orleans, that maybe available to the BFP to retrofit with a buoyant foundation. The role of FEMA and the NFIP is then discussed. A summary of FEMA's interaction with the BFP throughout the evolution of the project from 2007 to the present is provided.

The chapter concludes with a brief review of government policy, which further explains the involvement of FEMA and the NFIP with the BFP.

04

ii

a solution: project

DEFINITION OF BUOYANT FOUNDATIONS

Elizabeth English founded the Buoyant Foundation Project (BFP) in 2006 as a non-profit research initiative. According to English:

> The mission of the BFP, founded in 2006, is to support the recovery of New Orleans' unique and endangered traditional cultures by providing a strategy for the safe and sustainable restoration of traditional housing. Flood-proofing the city's traditional elevated wooden shotgun houses by retrofitting them with buoyant (amphibious) foundations avoids the destruction of neighborhood character that results from permanent static elevation high off the ground. Buoyant foundations provide increased safety and resilience in cases of extreme flooding and support the restoration of both the physical and the social structures of pre-Katrina New Orleans neighborhoods.[127]

The BFP is the first modern engineered initiative for retrofitting existing shotgun houses in order to preserve a culturally significant housing type in New Orleans. The flooding caused by failure of the hurricane protection system proved government measures to be inadequate. Homeowners in low-lying areas in South Louisiana are required to elevate their homes to comply with the new Advisory Base Flood Elevations (ABFEs). This concept is discussed in greater detail later in this chapter. The United States federal government is recommending that homeowners in particular areas permanently raise their homes, in some cases 12-15 feet above street level, to protect their homes from flooding.[128]

English comments:

> Permanently elevating houses . . . may be FEMA's solution to the problem of flooding but it creates new problems, such as difficult access to living areas, loss of neighborhood character and increased vulnerability of the structure to wind damage. With permanent static elevation, even if a house is raised to the BFE or higher, it can still flood in an extreme event. In the meantime, residents must live with daily inconvenience and a reduced quality of life in the hope of avoiding flooding in a future event that is statistically very rare indeed.[129]

In response to the catastrophic flooding in New Orleans and the new BFE legislation, English sought an alternative solution. She conceived of the BFP as a solution that would enable homes to rise during flooded conditions but remain at street level under normal conditions, allowing residents to maintain their former way of life and preserving the character of their neighbourhoods. English founded the BFP as an initiative to aid in the authentic recovery of New Orleans and to support the restoration of the traditional ways of life in New Orleans that were disrupted by Katrina.[130]

English defines a buoyant foundation as:

> [A] buoyant foundation is a type of amphibious foundation that is specially designed to be retrofitted to an existing south Louisiana shotgun house. It allows the house to sit just above the ground like a normal elevated house under normal conditions, but to rise up and float safely on the water when there is a flood. It has a structural subframe that attaches to the underside of the house and supports the flotation elements, or buoyancy blocks. Extensions of the structural subframe attach to the tops of vertical guidance poles near the corners of the house that telescope out of the ground to provide resistance to lateral forces from wind and flowing water. When flooding occurs, the flotation blocks lift the house, with the structural subframe transferring the forces between the house, blocks and poles. The vertical guidance poles keep the house from going anywhere except straight up and down on top of the water.[131]

Figures 85 and 86 depict a house on a buoyant foundation under normal conditions and during flooded conditions. During normal conditions the house sits at a height only slightly above its pre-katrina elevation, and during a flood it simply floats up to whatever height is necessary, up to a maximum of perhaps 25 feet.[132]

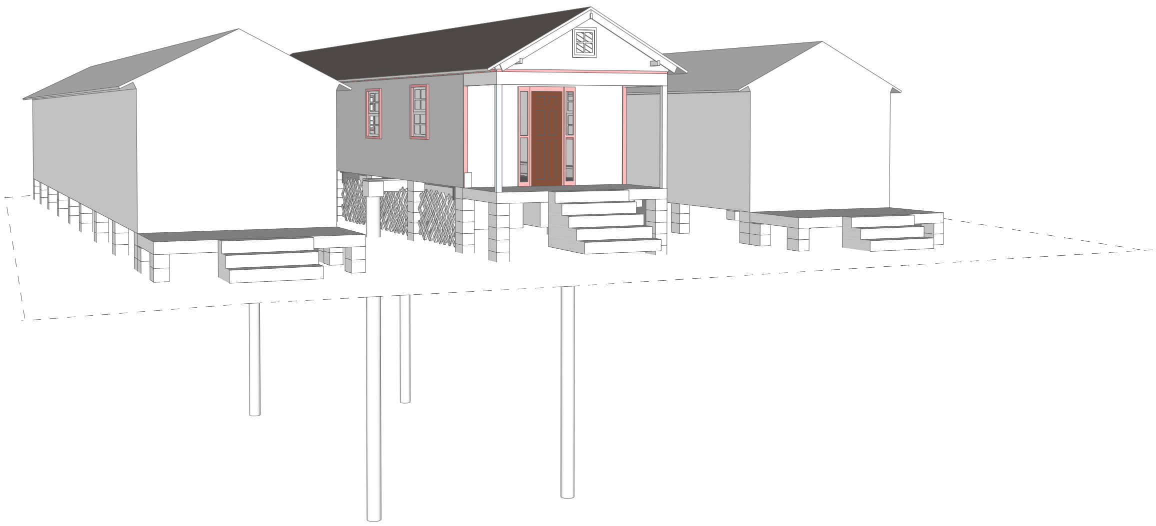


fig. 85: Shotgun House on Buoyant Foundations - Normal Position

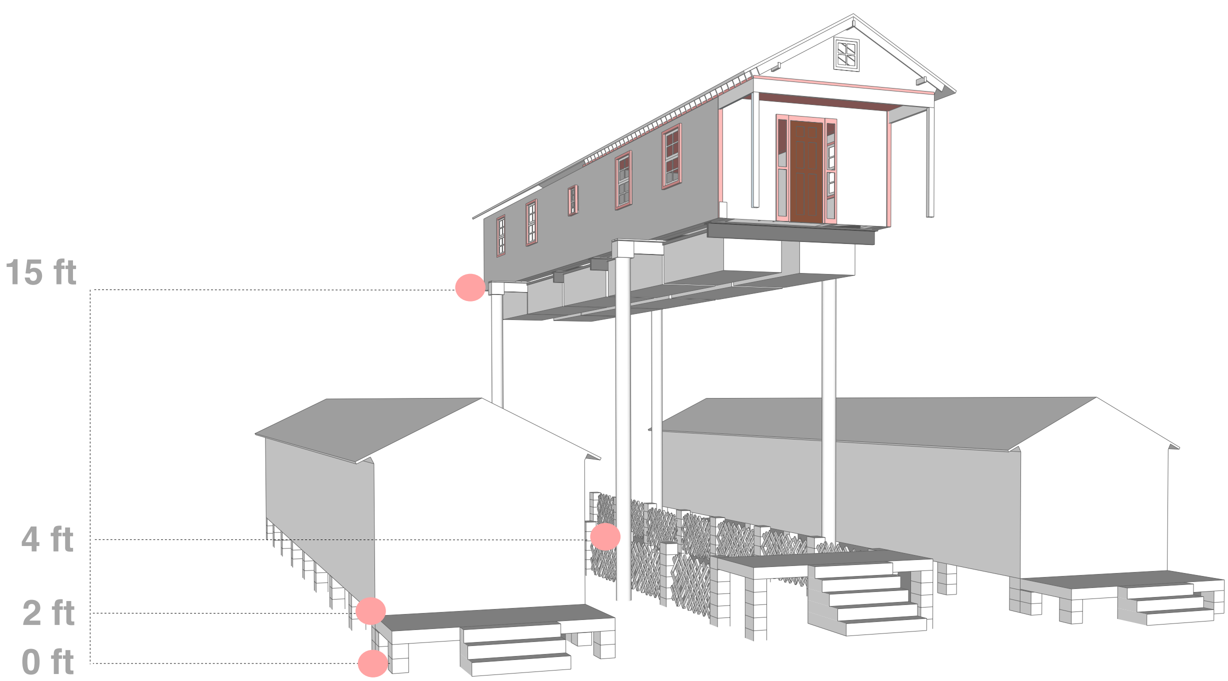


fig. 86: Shotgun House on Buoyant Foundations - Extended Position

WHY USE BUOYANT FOUNDATIONS

The BFP is the only flood mitigation strategy that simultaneously resolves technical, safety and socio-cultural issues. Currently, the flood-protection method recommended by FEMA and the NFIP is permanent static elevation. This strategy disrupts neighbourhood character and way of life by removing the front porch from its close relationship to the street. Permanent static elevation is insufficient protection in extreme flooding.[133] Other significant problems with permanent static elevation include:

- *Permanent static elevation is much more expensive than installing a buoyant foundation.*
- *Access is difficult due to the increased number of stairs needed to reach the elevated home. This is inconvenient for daily use and is problematic for elderly & disabled.*
- *There is greater risk of wind damage in a future hurricane.*
- *It creates a "gap-toothed" effect in the neighborhood streetscape where houses are raised to varying elevations depending on the owner's choice of height.*
- *Homes lose relationship to the street by being raised high above street level.*
- *There is loss of neighborhood character due to the varying elevations of each house and separation of porches from street level.*[134]

Figures 87 is a diagram that displays three identical single shotgun houses during flooded conditions: before static elevation, with static elevation, and using a buoyant foundation. The house on the buoyant foundation is the only house that is protected from extreme flooding. Figure 88 is a diagram that draws a comparison of three possible streetscapes, where the streetscapes illustrate flood conditions i) before static elevation; ii) with static elevation; and iii) using buoyant foundations. The houses in the pre-Katrina scenario, close to street level with little flood protection, are inundated. Some of the houses that are permanently elevated are flooded, illustrating that this solution is not always effective since flood levels may exceed elevation height. Aesthetically, the statically elevated streetscape is visually undesirable because of its "gap-toothed" effect of mismatched building heights.[135] Conversely, the BFP offers an alternative solution that adapts to changing water levels, ultimately providing the homeowner with a safer, more reliable form of flood protection. The major advantages of using a buoyant foundation compared to permanent static elevation are that:

- *It facilitates restoration instead of demolition and new construction, which promotes energy conservation, economic growth, and socio-cultural sustainability.*
- *The house remains close to the ground under ordinary non-flood circumstances.*
- *It elevates a house to exactly what is required to stay above water, even if the flood level is high above BFE.*
- *In a high wind event, with no flooding, it remains close to the ground and is therefore less susceptible to hurricane wind damage.*
- *It alleviates loss of elevation due to soil subsidence and elevated sea level.*
- *The house looks essentially the same as before Katrina.*
- *The original traditional architecture is preserved .*
- *The neighbourhood retains its original character.*[136]

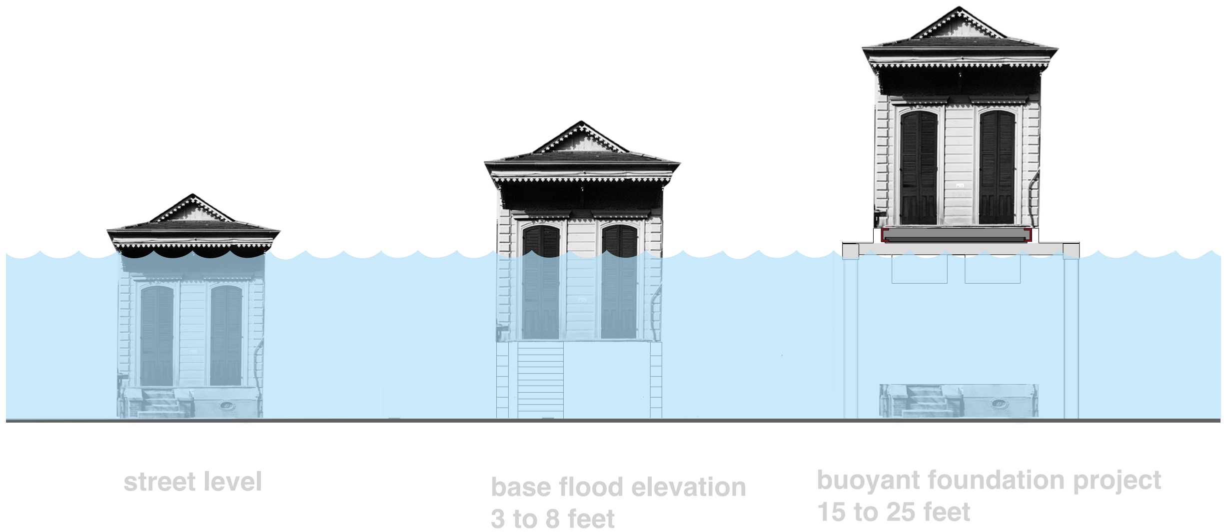


fig. 87: Static Elevation versus Amphibious Foundations During a Flood

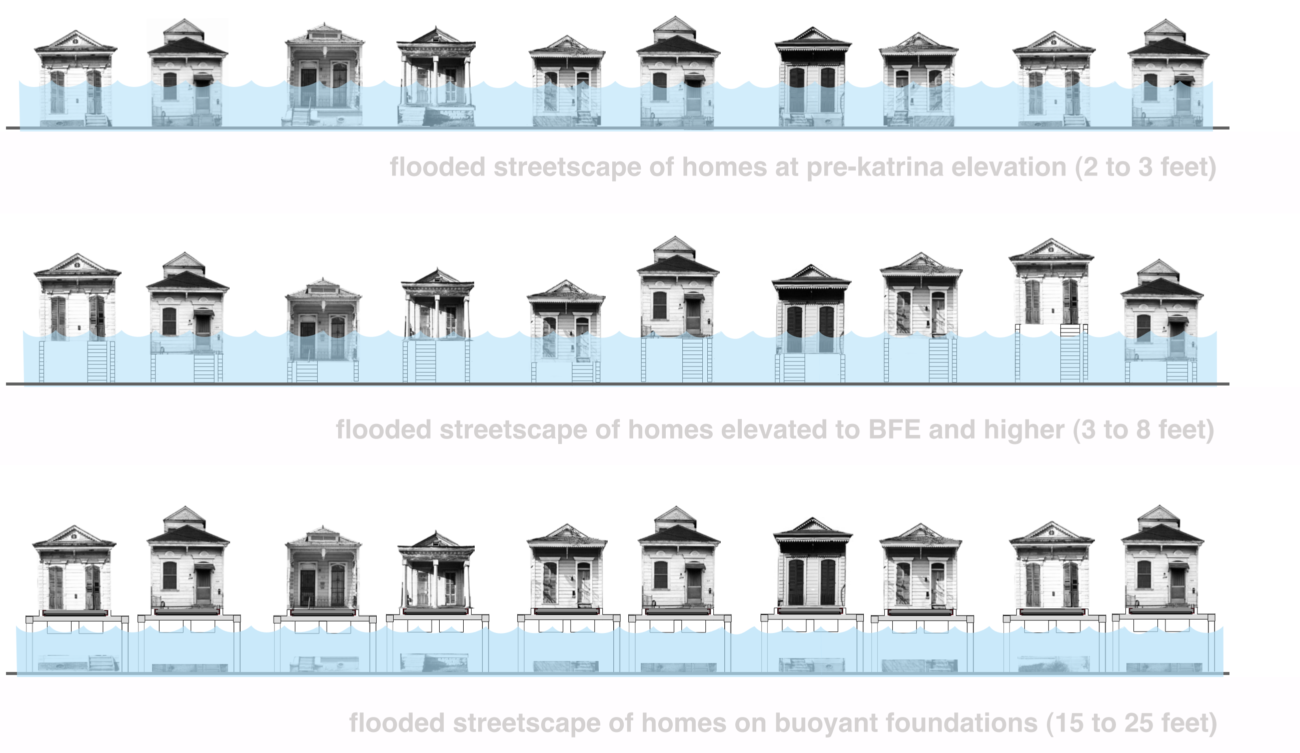


fig. 88: Streetscape Comparison Diagram During a Flood

HOW IT WORKS

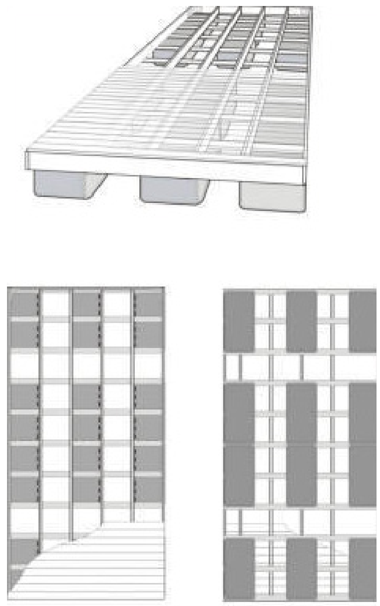


fig. 89: A Floating Dock System

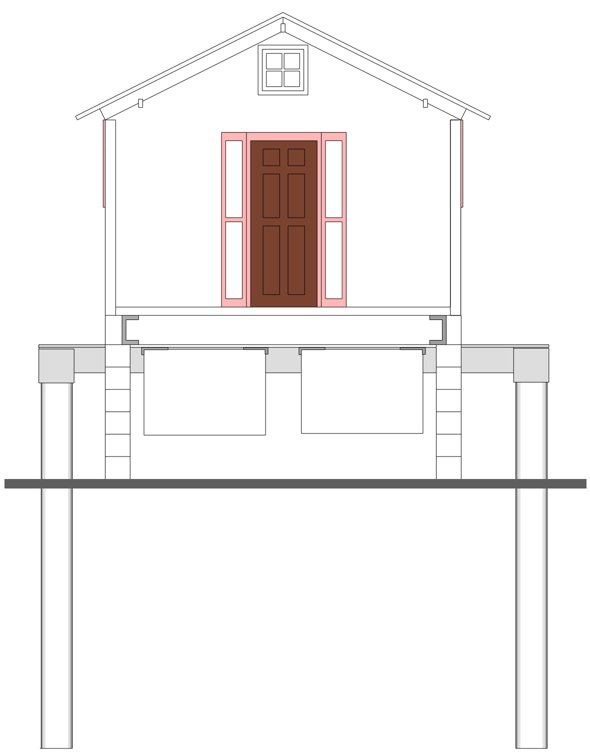


fig. 90: BFP Section

Elizabeth English discusses how a floating dock can inform the BFP when designing a passive floating structure. She states:

> A look at floating docks [fig. 89] and houseboats suggests that there may be an alternative approach [to permanent static elevation], one that would allow a house to remain close to the ground under normal conditions but rise as much as necessary, even if far above the BFE, when flooding occurs.[137]

English further explains how buoyant foundations work:

> It basically works like a floating dock. A steel frame that holds the flotation blocks is attached to the underside of the house. There are four 'vertical guidance' posts not far from the corners of the house. The tops of the posts are attached to the steel frame. The posts telescope out of the ground, allowing the house to move up and down. Utility lines have either self-sealing 'breakaway' connections or long, coiled 'umbilical' lines. When flooding occurs, the flotation blocks lift the house, with the steel frame transferring the forces between the house and the blocks. The vertical guidance posts keep the house from going anywhere except straight up and down on top of the water. The entire system works completely passively. After the buoyant foundation system has been installed, the house remains supported on its original piers except when flooding occurs.[138]

Buoyant foundations work passively by adapting to changing water levels during a flood. The major components that make up this system are flotation blocks, telescoping vertical guidance posts, structural subframe and self-sealing or umbilical connections for utilities. Figure 90 is a sectional drawing of a shotgun house with a buoyant foundation installed, showing the buoyancy blocks under the house and the vertical guidance posts that telescope out of the ground. Figure 91 is an exploded axonometric drawing of a shotgun house with buoyant foundations installed, exposing and identifying the major components of the system.

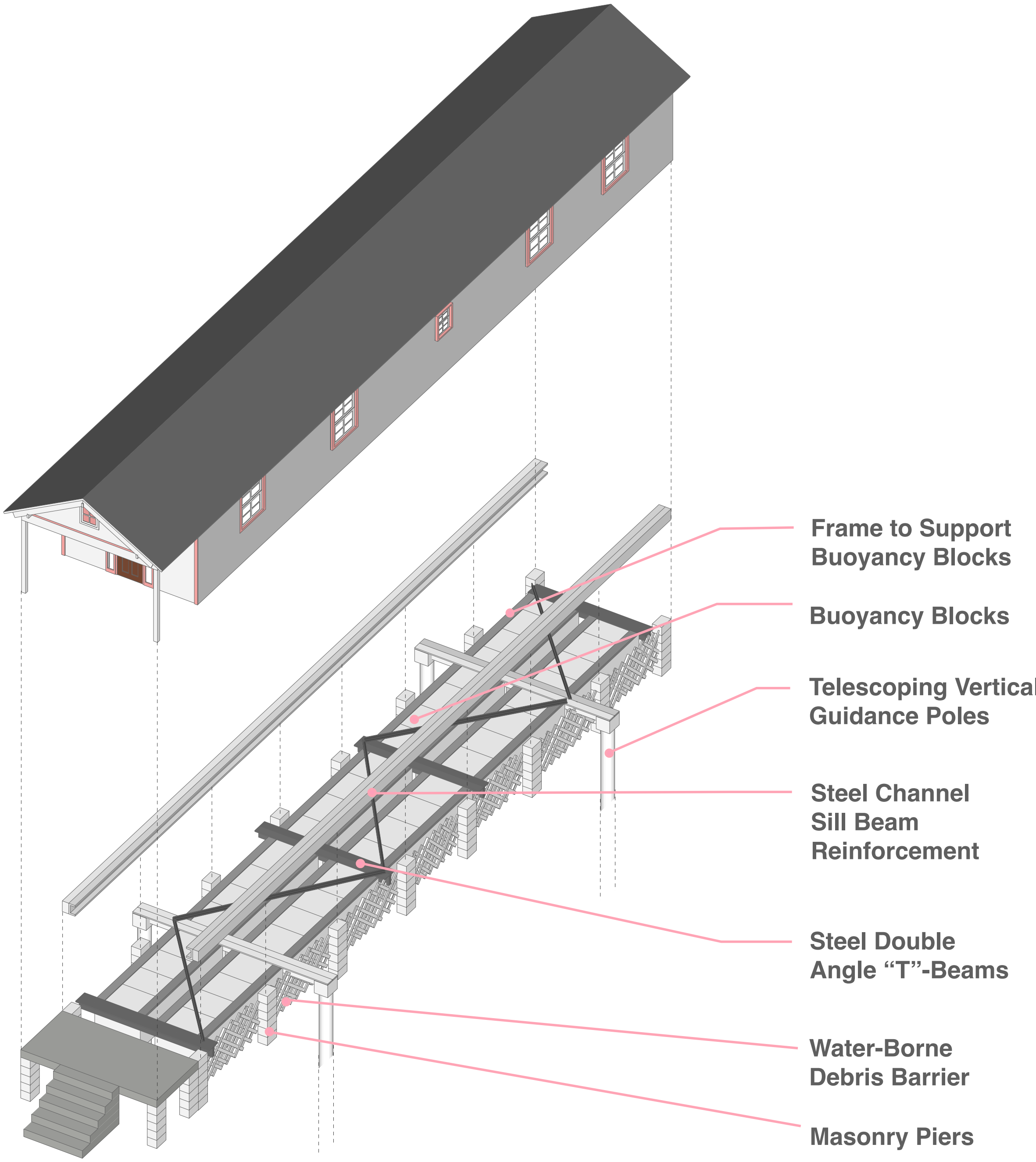


fig. 91: Buoyant Foundation System, Exploded Axonometric

prototype house for possible retrofit with BFP

site: 1315 lamanche street
lower ninth ward
new orleans

fig. 92: 1315 Lamanche Street, Shotgun House

fig. 93: Aerial View of 1315 Lamanche Street


north villere
north villere
lamanche street
1315
lamanche street
lamanche street
urquhart street
charbonnet street

1315 LAMANCHE STREET

Three areas have been identified in the Lower Ninth Ward (fig. 94) where aid organizations are concentrating their efforts. Make It Right (MIR) has concentrated its efforts on rebuilding in the northern portion of the Lower Ninth Ward, north of North Claiborne Avenue.[139] In the southern portion, south of St. Claude Avenue, the Preservation Resource Center (PRC) and Global Green are providing assistance to help residents rebuild housing authentically and to preserve the neighbourhood's cultural heritage.[140] Neighbourhoods to the north and south are being helped, but the "middle zone" south of North Claiborne Avenue and north of St. Claude Avenue has been neglected. This area has been selected by the BFP because there is an abundance of recoverable shotgun houses that could be suitable for retrofit with buoyant foundations. In 2007, planners found that "more than 80% of the Ninth Ward structures suffered no terminal structural damage."[141]

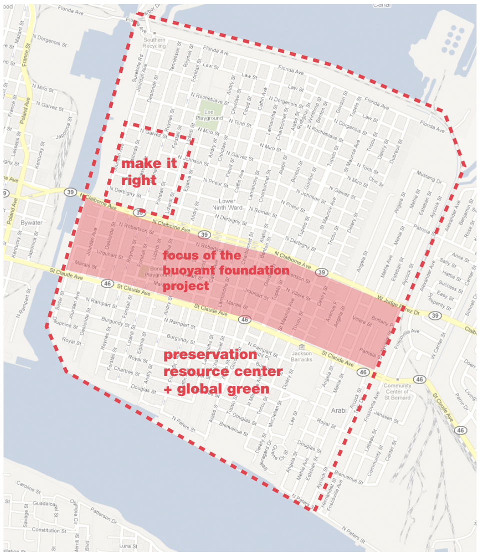


fig. 94: Three Areas of Focus of Aid Organizations in the Lower Ninth Ward

The BFP has access to a shotgun house at 1315 Lamanche Street (fig. 92, 93) and may use it to retrofit with a buoyant foundation. 1315 Lamanche Street is situated south of North Claiborne Avenue and north of St. Claude Avenue in the "neglected" portion of the Lower Ninth Ward. Figures 95-98 are renderings of the existing house at 1315 Lamanche Street. They were created by graduate student Andre Arseneault at the University of Waterloo, School of Architecture, for the course ARCH 684-016, entitled "Amphibious Architectures: The Buoyant Foundation Project and Alternative Flood Mitigation Strategies in Post-Katrina New Orleans," held at the University of Waterloo School of Architecture in the spring term of 2009. Figures 99 and 100 were transcribed from sketches and photos provided by Elizabeth English and Ezra Boyd. They show a plan and elevation drawing with approximate dimensions of the shotgun house at 1315 Lamanche Street.

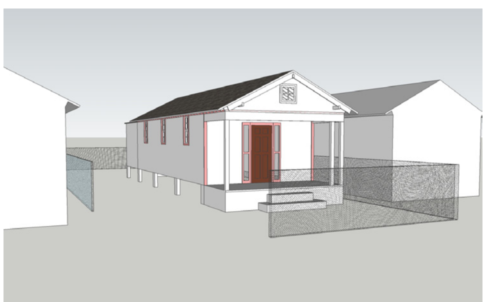


fig. 95: Conceptual Rendering of 1315 Lamanche Street, Existing Condition, Three-Quarter View

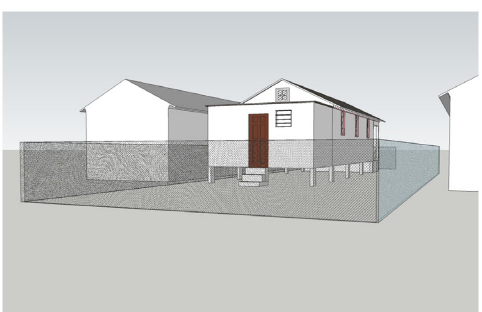


fig. 96: Conceptual Rendering of 1315 Lamanche Street, Existing Condition, Back View with Addition (to be removed)

As mentioned in previous sections, the Lower Ninth Ward, because of its proximity to the Industrial Canal levee breach, was one of the most severely damaged neighbourhoods in New Orleans.[142] The slow restoration of utilities inhibited FEMA trailer placement, causing a lag in rebuilding and restoration in the Lower Ninth Ward behind other neighbourhoods. Poverty, the scale of the devastation, government policies, and inaction were also contributing factors.[143] The BFP aims to help the Lower Ninth Ward recover by providing a reliable flood mitigation strategy to homeowners so that they may feel safe to return to their former residences.

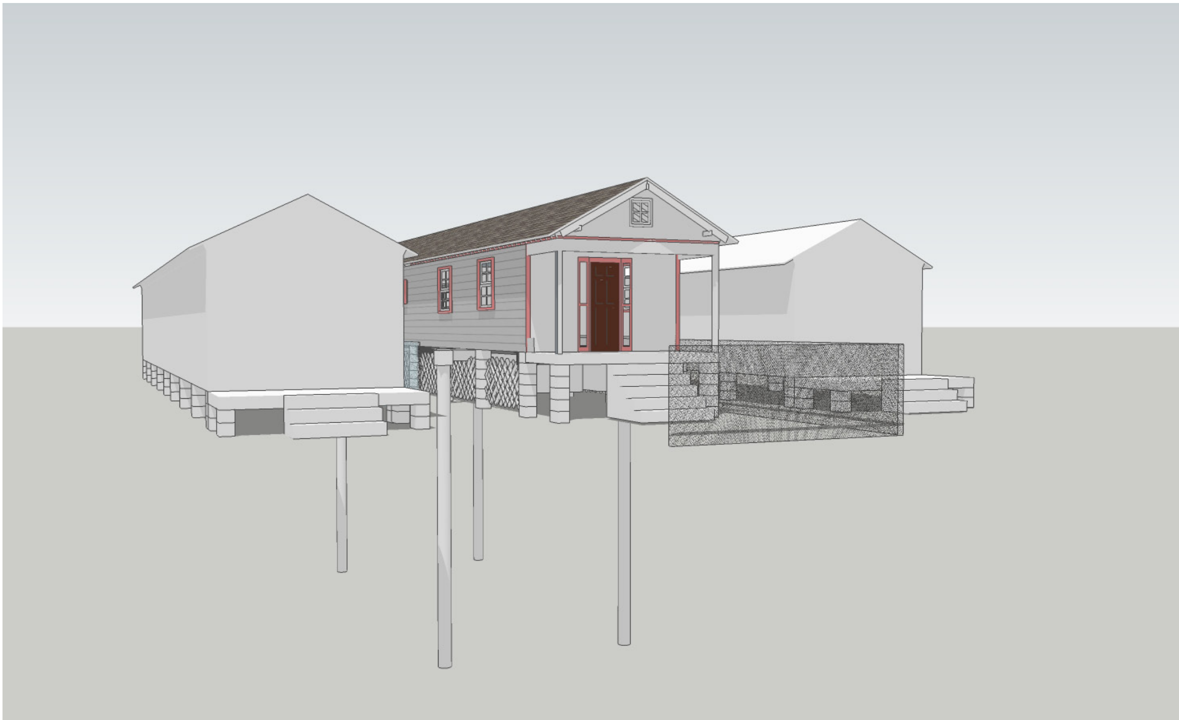
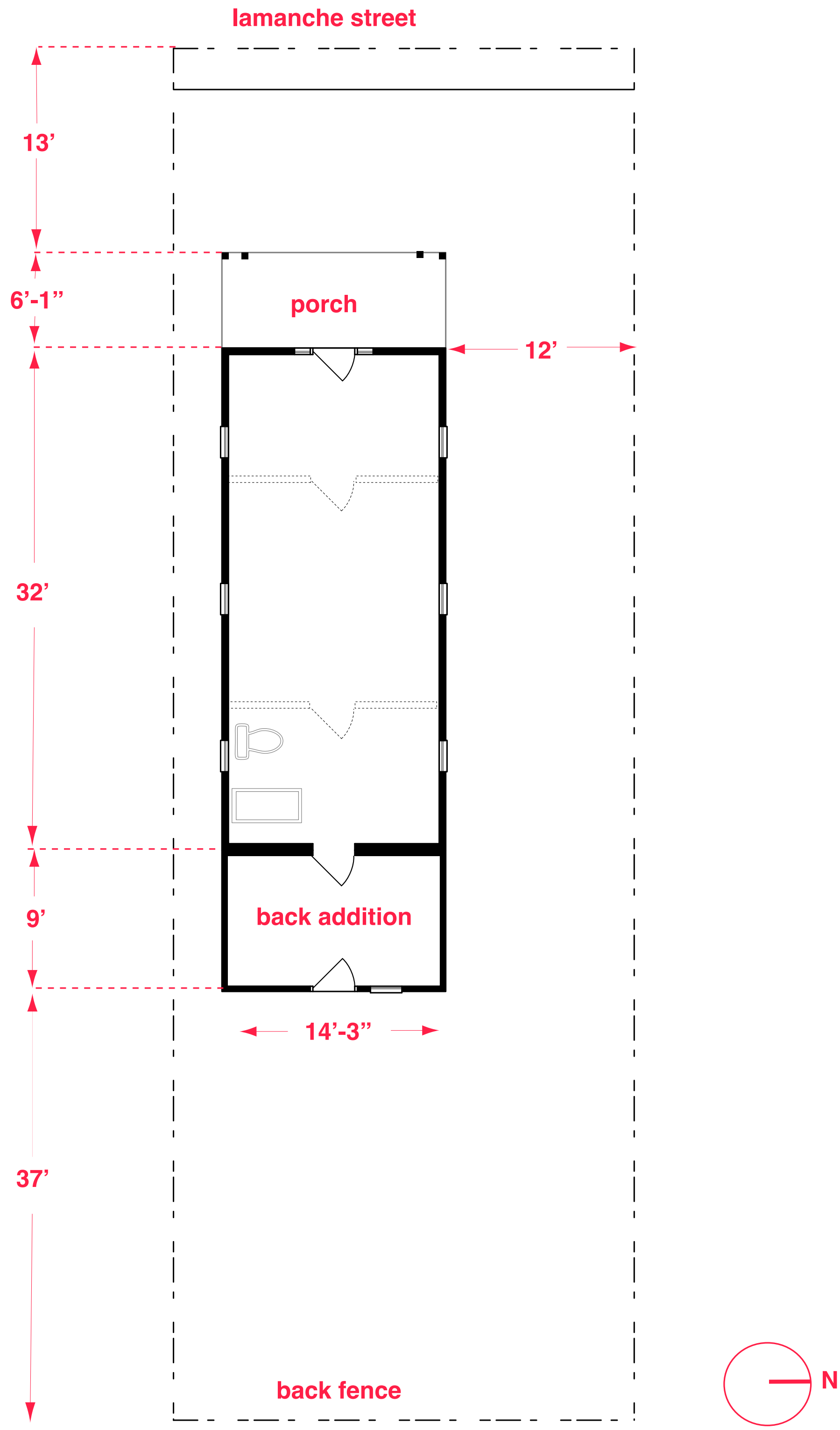


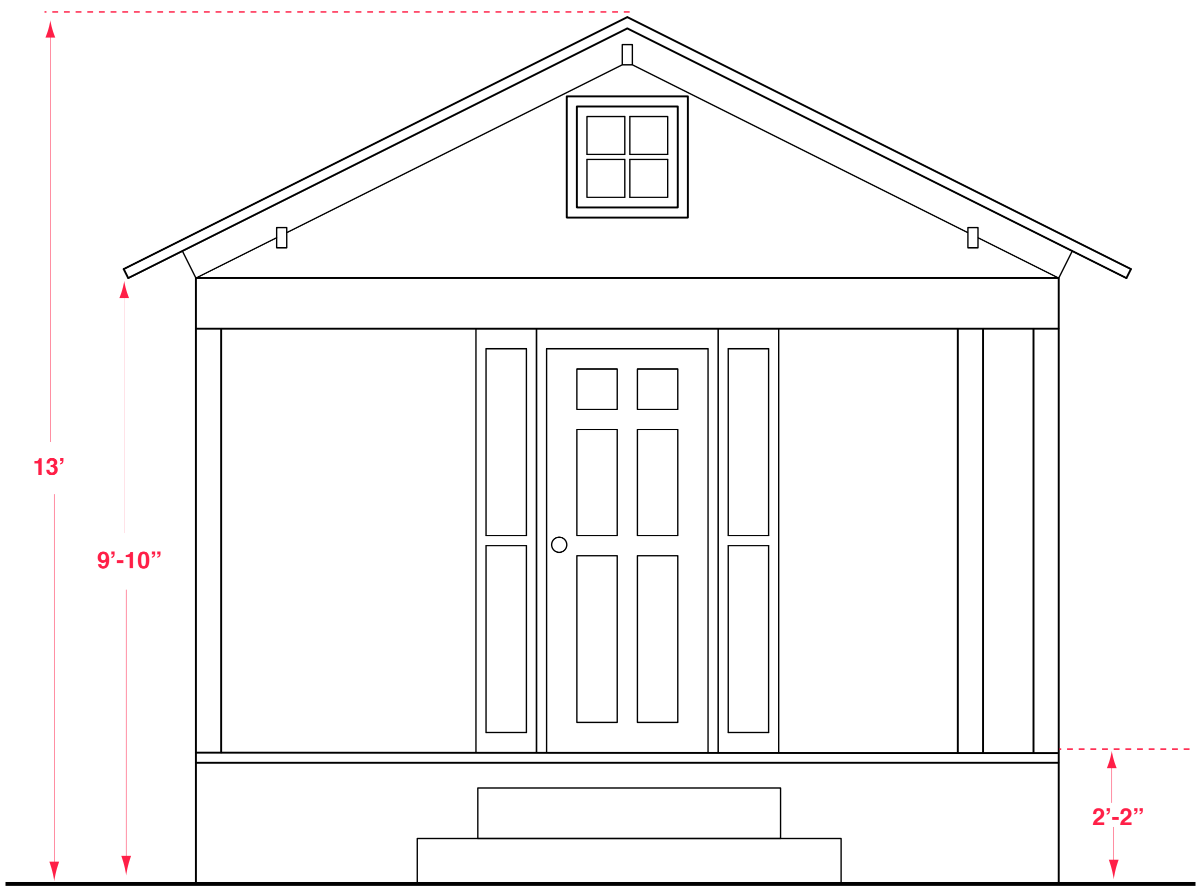
fig. 97: Conceptual Rendering of 1315 Lamanche Street Retrofit with the Buoyant Foundation System

fig. 98: Conceptual Rendering of 1315 Lamanche Street Retrofit with the Buoyant Foundation System, Fully Extended



1315 lamanche street - plan

fig. 99: 1315 Lamanche Street, Plan



1315 lamanche street - elevation

fig. 100: 1315 Lamanche Street, Elevation

04

iii

a solution: policy

ROLE OF FEMA + THE NFIP

In 2007, Elizabeth English received a letter from Ross Richardson, Branch Chief of DHS/FEMA (fig. 101) expressing his concerns that the Buoyant Foundation Project was not in compliance with NFIP regulations. Richardson states, ". . . the local floodplain management regulations must be met in order for the entity to continue to participate in the NFIP. Communities/parishes must issue permits with the proper requirements whether it is NFIP related or other building code requirements. . . . We have concerns about a concept being promoted and publicized that would jeopardize a community's good standing in the NFIP."[144]

In 2008, other negative reaction by the Louisiana Home Builders Association was voiced on a televised interview with Jon Luther, executive vice president of the local home builders association, as part of a Fox News broadcast about the BFP (see page 455 in appendices for the full broadcast entitled, "The Buoyant Foundation Project Movie"). Jon Luther stated that strict new codes were established for rebuilding homes demolished or damaged after Katrina. Homes must be elevated off the ground, and he said that floating homes would not fit that criterion. He observes, "I would venture to say that FEMA and the NFIP would have a very hard time evaluating a house that's floating on water to know whether or not it would be a good risk to insure for flood insurance" (appendices, 455). English responds that since there has been no precedent for this in the United States, it is no surprise that FEMA, the NFIP and the ICC are reluctant to accept this new method.[145]

In spring 2009, the BFP proposed a two-phase installation sequence to satisfy the objectives of FEMA and NFIP. Phase 1 complies with NFIP regulations that call for buildings to be "properly elevated and meet specific foundation and anchoring requirements." Phase 2, conversion to a Buoyant Foundation by adding buoyancy and vertical guidance, could be installed at a later time, after completing a thorough testing program leading to the granting of compliance. The separation of installation into these phases resolved issues with FEMA, whereby phase 1's 'Non-Permanent Static Elevation to BFE' adequately addressed Ross Richardson's concerns.[146]

Bhola Dhume, deputy director of the Department of Safety and Permits for the City of New Orleans, encouraged English to go ahead with the project's two-phase installation strategy. He also encouraged marketing the project as a more economical approach than permanent static elevation. Nelson Savoie, acting chairperson of the City of New Orleans Department of Safety and Permits, also agreed that if the project met BFE requirements, and was adequately supported on a code-compliant foundation, then it could be permitted by the City of New Orleans.[147]

In fall 2009 MIR's FLOAT House was completed in the Lower Ninth Ward. The completion of an amphibious house in the Lower Ninth Ward would suggest that FEMA made the choice not to discourage MIR from constructing the project. MIR's FLOAT House employs an amphibious foundation and is the first such house in the United States to receive an occupancy permit. The FLOAT House complies with the building code in the two areas of concern to FEMA: the house meets BFE requirements under static conditions; and it is supported structurally under static conditions in a way that meets all local codes.[148]

In December 2009, Brett Schweinberg, a writer for the Tri-Parish Times Newspaper, conducted an interview with Earl Armstrong, a public information officer for FEMA, regarding his views on buoyant foundations after the FLOAT House had been built and occupied (appendices, 340), (fig. 102, 103). Schweinberg reports on his contact with Armstrong regarding NFIP approval of buoyant foundations. Armstrong states, "Depending on the type of structure, different National Flood Insurance Program (NFIP) regulations may apply as to the eligibility for flood insurance coverage for floating structures. There may be circumstances where a structure that is primarily land-based, but was built on platforms to allow for sporadic flotation, could be ruled eligible for flood insurance. In such cases, however, several entities may share a role

LETTER FROM FEMA, Friday, September 28, 2007

Dr. English:

Thanks for your time this morning discussing this concept and LSU's involvement in promoting it per the website, www.buoyantfoundation.org. As discussed, we have major concerns that this type of development does not meet minimum National Flood Insurance Program (NFIP) criteria (44 CFR Part 60.3) in which local governments must adopt in order to participate in the program and make flood insurance available.

You stated that you were aware that "the concept is not approved by FEMA" and that flood insurance would not be available. As we discussed, the local floodplain management regulations must be met in order for the entity to continue to participate in the NFIP. Communities/parishes must issue permits with the proper requirements whether it is NFIP related or other building code requirements.

Structures, as defined in the local floodplain management ordinance, must be properly elevated and meet specific foundation and anchoring requirements. Requirements will vary depending on the specific site situation. These requirements and NFIP supporting information can be found on our website, www.fema.gov.

We have concerns about a concept being promoted and publicized that would jeopardize a community's good standing in the NFIP. With that in mind, I would highly recommend that LSU withholds any information to the public until the recommended concept meets all local regulatory requirements.

Sincerely,
Ross Richardson

Ross K Richardson CFM
Branch Chief
DHS/FEMA RVI-IM-CM
800 N. Loop 288
Denton TX 76209
(940) 898-5210 office
(940) 368-6972 cell
(940) 898-5195 fax
ross.richardson@dhs.gov
Be FloodSmart, go to www.floodsmart.gov or www.fema.gov

fig. 101: Letter from FEMA, Friday September 28, 2007

in deciding whether such a structure can [be] covered by flood insurance."[149]

Armstrong points out that although FEMA and the NFIP may chose to allow houses on amphibious foundations if they meet the BFE of three feet under static elevation, it is also up to the community to decide if the structures meet building code and floodplain management requirements to issue a building permit. Armstrong adds that there may be additional costs for structures on floatable foundations, and the insurance premium may be exceptionally high. These factors may be deterrents, but are not impossible to overcome. MIR was able to obtain a building permit for the FLOAT House which is in a community adjacent to the area of focus for the BFP.[150]

The Association of State Floodplain Managers (ASFPM) 34th Annual National Conference was held on May 16-21, 2010, in Oklahoma City. During the conference, English met with several FEMA representatives, who cautiously agreed that the implementation of amphibious foundations could be allowed as long as they met all BFE and local code regulations and had the support of the local department of permits and safety. This was not only a significant advancement since the BFP's first conversation with FEMA in 2007; it was, in fact, a major breakthrough in the future acceptability of amphibious architecture in the United States. The need for the BFP's two-phase testing program is obviated in light FEMA's acknowledgement of the acceptability of amphibious foundations within a specified set of limits.[151]

LETTER FROM TRI-PARISH TIMES, Monday, December 14, 2009.

Dear Ms. English:

We met last week at the make it right house for an interview for the Tri-Parish Times. I'm mailing you from home to let you know what FEMA told me last week. I've attached their email below.

From what I gather from their e-mail, you should be a go in the 9th ward to build floating houses as long as they meet the BFE of 3 feet. Any additional flood protection after that is considered gravy, and it sounds like you shouldn't have too many problems. My article explains some of the skepticism and legal issues in my area. The piece will be in print next week and should be online shortly. I'll be sure to send you the link to that once it's up.

Thanks again for your time,

Brett D Schweinberg
b.schweinberg@gmail.com

fig. 102: Letter from Tri-Parish Times, Monday December 14, 2009.

LETTER FROM FEMA, Friday, December 11, 2009

Brett,

You had asked about NFIP coverage for floating structures. I hope this information helps.

Depending on the type of structure, different National Flood Insurance Program (NFIP) regulations may apply as to the eligibility for flood insurance coverage for floating structures.

NFIP regulations specifically exclude buildings located entirely in, on, or over water from flood insurance coverage eligibility, if such structures were constructed or substantially improved after September, 1982.

There may be circumstances where a structure that is primarily land-based, but was built on platforms to allow for sporadic flotation, could be ruled eligible for flood insurance. In such cases, however, several entities may share a role in deciding whether such a structure can covered by flood insurance.

These include the local community, which may decide that these structures do not meet required building codes or floodplain management requirements to issue a building permit. It can also be the case that, although the structure is eligible to be insured, the actual cost of an insurance premium could be extraordinarily high. This might be the case, for example, with floating structures where the lowest floor elevation of the structure would actually be several feet below the Base Flood Elevation (BFE) that flood insurance rates are partly determined by. In both scenarios, a floating structure, while eligible for flood insurance, may not be able to obtain it for reasons having nothing to do with NFIP regulations.

FEMA and the NFIP continue to actively work with our state, local and private sector partners to help protect against the threat of our nation's leading disaster threat, flooding.

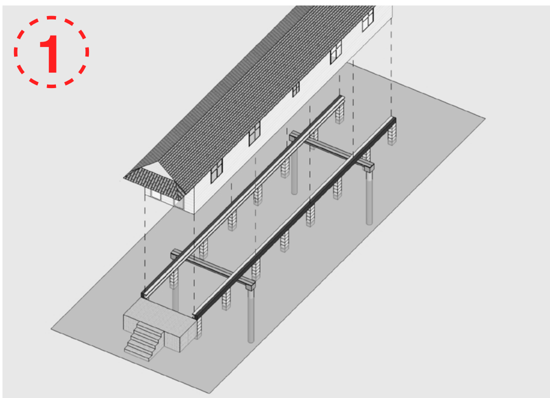
Earl Armstrong
Public Information Officer
Federal Emergency Management Agency Region VI
800 N. Loop 288
Denton, Texas 76209
940-898-5275
earl.armstrong@dhs.gov

fig. 103: Letter from FEMA, Friday December 11, 2009.

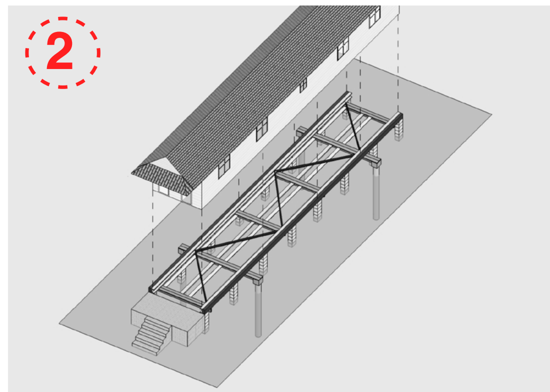
ASSEMBLY STEPS:

Figure 104 illustrates the assembly process for homeowners. As mentioned previously, in spring of 2009, a two-phase testing program was developed to comply with FEMA and NFIP legislation. The first phase included the required components to provide static elevation to the BFE in compliance with FEMA and the NFIP regulations. It did not include components beyond what were required for static elevation to BFE (fig. 105).[152]

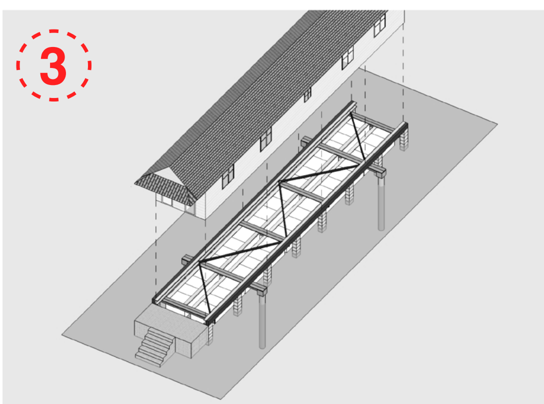
The second phase added the 'amphibious' components, including the addition of the buoyancy blocks, the telescopic guidance posts and modification of utility connections to accommodate the rising and falling of the structure. These are elements that are not necessary for static elevation but allow the house to behave amphibiously (fig. 106). Because of the recent change in FEMA's interpretation, which is that occasional flotation may now be deemed compliant with the NFIP, separation into the two phases will no longer be required.[153]



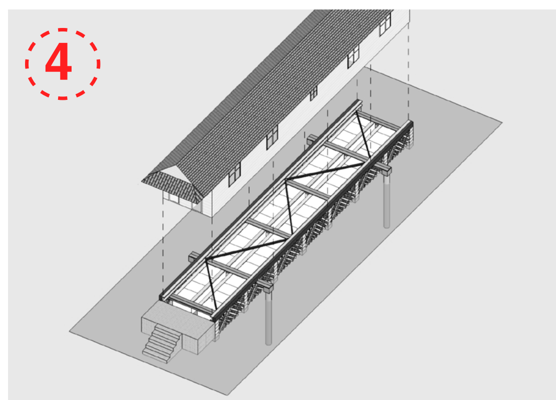
Put in vertical guidance posts and attach channels to inside surfaces of sill beams



Add T-beams and secondary angles to support buoyancy blocks



Add buoyancy blocks



Add protective screen to keep waterborne debris from settling underneath house

fig. 104: Assembly Process

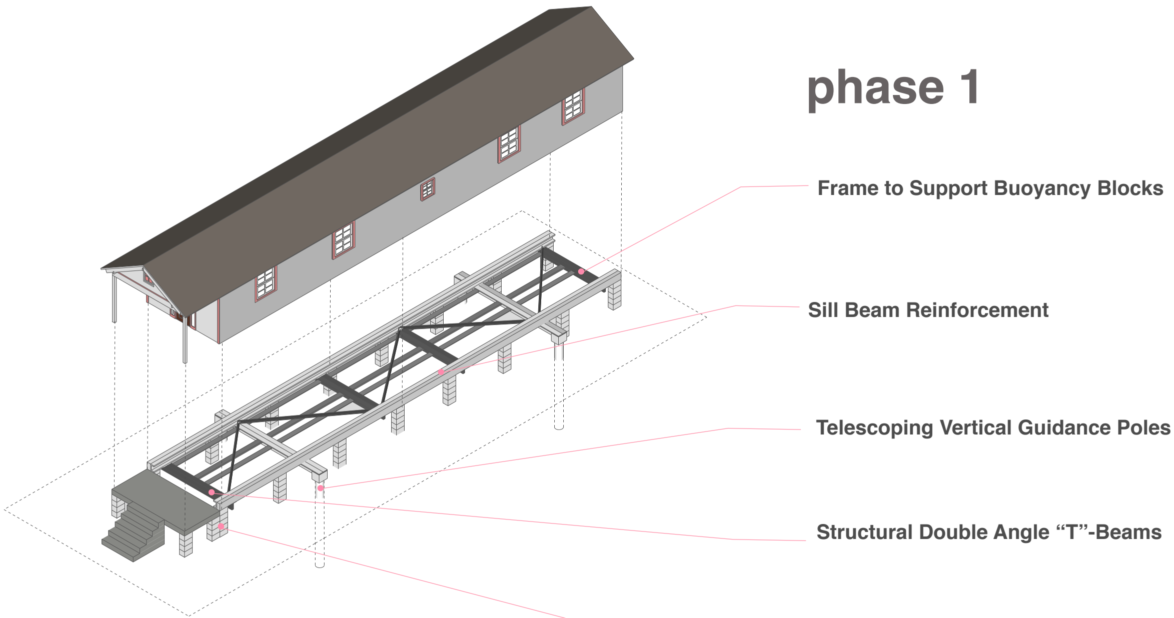


fig. 105: Components for Static Elevation to BFE, Diagram (Previously Phase 1)

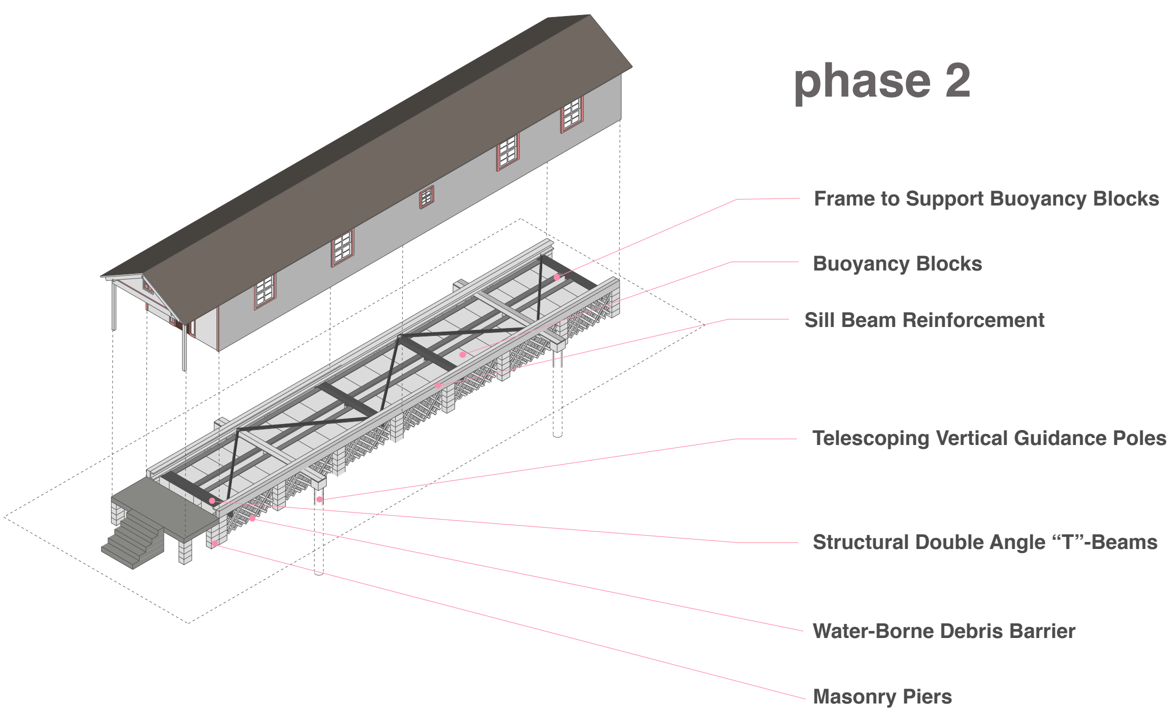


fig. 106: Addition of Buoyancy Components and Vertical Guidance, Diagram (Previously Phase 2)

04
iv
a solution: legislation

fig. 107: An Elevated House in New Orleans

fig. 108: Flood Level Exceeded BFE

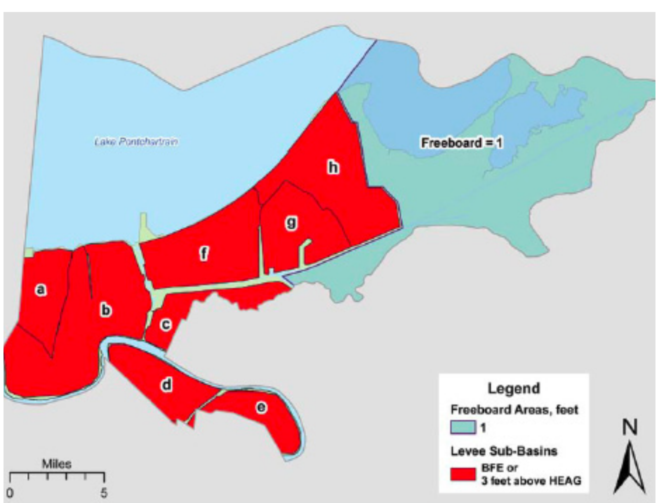


fig. 109: ABFE Guidance and Levee Sub-Basin Locations for Orleans Parish

BASE FLOOD ELEVATION

In the aftermath of Hurricane Katrina, new base flood elevations have been recommended for buildings in low-lying areas of South Louisiana. The United States federal government recommends that residents in these areas permanently elevate their homes to comply with these new regulations (fig. 107).[154]

FEMA defines Base Flood Elevation (BFE) as "the computed elevation to which floodwater is anticipated to rise during the base flood. Base Flood Elevations (BFEs) are shown on Flood Insurance Rate Maps (FIRMs) and on the flood profiles. The BFE is the regulatory requirement for the elevation or flood proofing of structures. The relationship between the BFE and a structure's elevation determines the flood insurance premium."[155]

Figure 108 is a photograph of a house in New Orleans after Hurricane Katrina, displaying the flood level and how it far exceeded what was thought to be a sufficient BFE for that neighbourhood.

BFEs are derived from the Base Flood (BF), which is defined by FEMA as "the flood having a one percent chance of being equaled or exceeded in any given year. This is the regulatory standard also referred to as the '100-year flood.' The base flood is the national standard used by the NFIP and all federal agencies for the purposes of requiring the purchase of flood insurance and regulating new development."[156] BF was the original standard used by the NFIP prior to the implementation of BFEs.

ADVISORY BASE FLOOD ELEVATION

Areas that had BFEs prior to Hurricane Katrina now being assigned Advisory Base Flood Elevations (ABFEs).[157] FEMA explains ABFEs as "[a]n interim product (in place of pre-Katrina BFEs) to assist communities in their rebuilding efforts while new Flood Insurance Rate Maps (FIRMs) are being completed. In many areas, the flood elevations caused by hurricanes Katrina and Rita exceeded the BFEs on the current effective FIRMs for the Gulf Coast Parishes of Louisiana."[158] FIRMs were last issued in 1984. Since Katrina, new figures incorporating the last 35 years are being used to calculate new BFEs. Prior to Hurricane Katrina, no base flood elevations or depths were required for the Lower Ninth Ward since it was in a zone protected by levees. However, as Katrina displayed, levees may not always withstand severe inundation.[159] According to FEMA:

> After Hurricanes Katrina and Rita struck the Gulf Coast, FEMA conducted a new flood frequency analysis and determined that the current base flood elevations, or BFEs, for many communities impacted by the hurricane are too low. The analysis took into account data from Hurricane Katrina, as well as additional tide and storm data from other events that have occurred over the past 25 years. . . . ABFEs [fig. 109] are significantly higher than the Base Flood Elevations (BFEs) shown on pre-Katrina flood maps, and extend farther inland than the Special Flood Hazard Areas [SFHAs] on the existing maps.[160]

Figure 110 is an example of map provided by the National Oceanic and Atmospheric Administration (NOAA) in 2006, illustrating an example of storm surge inundation by Hurricane Katrina in Mississippi. Flooding in this area, as with many other areas along the Gulf coast, "extended beyond the limits of the mapped 100-year floodplain [SFHAs]."[161]

Currently, as shown in figure 111, the ABFE for the Lower Ninth Ward is "three feet above the Highest Existing Adjacent Grade (HEAG) at the building site."[162] FEMA defines the HEAG is as "the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure."[163]

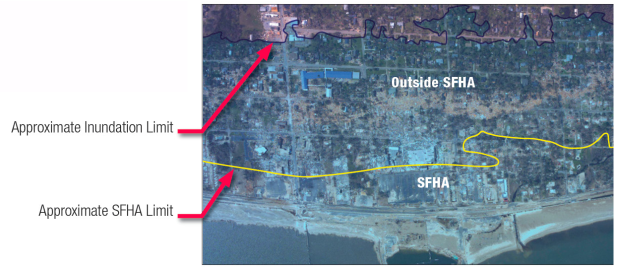


fig. 110: Flooding Beyond the Special Flood Hazard Area

According to FEMA, "in order to be eligible for FEMA funding for certain mitigation and recovery projects, communities are required to adhere to the elevation requirements established by ABFEs."[164] The following FEMA programs now require using ABFEs (in addition to NFIP):

1. Public Assistance Grant Program — Provides funds for the repair, replacement and restoration of public facilities.

2. Hazard Mitigation Grant Program (HMGP) — Provides grants to fund mitigation projects after a disaster strikes to enable mitigation measures to be implemented during the recovery process.

3. Flood Mitigation Assistance (FMA) program — Provides grants to mitigate future flood damages for structures insured under the NFIP.

4. Pre-Disaster Mitigation (PDM) program — Awards nationally competitive grants to fund hazard mitigation projects.

5. Executive Order 11988 Floodplain Management — Requires Federal agencies to consider floodplain implications for all Federal construction projects.[165]

MAPS FOR ADVISORY PURPOSES ONLY - NOT FOR INSURANCE RATING PURPOSES

For insurance rating purposes, refer to the currently effective Flood Insurance Rate Map (FIRM), available from your local government or the FEMA Map Service Center (1-800-358-9616/ http://msc.fema.gov)

For more information on these advisory maps, please see http://www.fema.gov/hazard/flood/recoverydata/katrina/katrina_la_index.shtm

fig. 111: Hurricane Katrina Surge Inundation and Advisory Base Flood Elevation Map for Orleans Parish, Louisiana

LEGEND

State Boundary

Parish Boundary

PID Elev. Vertical Control Point[1]

Levee

Flood Advisory Related Data

Advisory Base Flood Elevation (ABFE) Zone, including Flood Zone Type (AE, or VE), and elevation (in feet)[2]

3 ft Above HEAG Criterion Applies

Hurricane Katrina Related Data

Preliminary Indoor High Water Mark[2,3]

Preliminary Outdoor High Water Mark[2,3]

Preliminary Debris High Water Mark[2,3]

Limit of Katrina Surge Inundation[3]

Notes:

[1] Measured in feet relative to the North American Vertical Datum of 1988.

[2] Measured in feet relative to the National Geodetic Vertical Datum of 1929 (NGVD29). To conver of 1988 in Orleans Parish, subtract 0.2 feet.

[3] Inundation limits estimated from surveyed, surge-only High Water Marks. Local wave effects (w these elevations.

HOW TO READ THIS MAP

In levee-protected areas, **the Advisory Base Flood Elevation (ABFE) to be used for rebuilding at a particular property is the higher of these two options:**

(1) Current, effective Base Flood Elevation (BFE) shown on the community's Flood Insurance Rate Map (FIRM), or
(2) 3 feet above Highest Existing Adjacent Grade (HEAG) at the building site. The HEAG is defined as the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

Using the best-available data, FEMA has mapped the areas of the Parish where each of these two options should be applied:

– In green-shaded areas, FEMA recommends that the first floor of the building (including basement) be elevated 3 feet above HEAG at the building site.

– Outside of green-shaded areas, FEMA recommends that the first floor of the building (including basement) be elevated at or above the BFE shown on the community's FIRM. FEMA has provided the current BFEs on the map above in yellow and black text (for example, "**EL 1.5 ft**"). The zone or area where each BFE applies is outlined in yellow; these zone boundaries are the same as those shown on the FIRM. If the FIRM does not have a BFE for a particular area, no elevation will be listed on the map above. In those cases, buildings should be elevated to 3 feet above HEAG.

Anywhere in the Parish, the Community Floodplain Administrator may determine a site-specific ABFE rather than rely on the information mapped above. Using detailed topographic data for the site, the Floodplain Administrator can determine what elevation corresponds with 3 feet above HEAG and compare it to the FIRM BFE. Again, FEMA's guidance is that buildings should be elevated to **whichever of those two elevations is higher at the site.**

For more information on how the ABFE guidance was determined for this Parish, please see: ***http://www.fema.gov/pdf/hazard/flood/recoverydata/orleans_parish04-12-06.pdf.***

FLOOD ZONES

According to FEMA, flood zones are, “geographic areas that the FEMA has defined according to varying levels of flood risk. These zones are depicted on a community’s Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map [FHBM]. Each zone reflects the severity or type of flooding in the area.”[166] FEMA has identified these particular zones for use in the National Flood Insurance Program (NFIP). Each flood zone indicates the degree of flood-risk for that particular land area.[167] Figure 112 shows a FIRM for the Lower Ninth Ward. It indicates that Lamanche Street (the proposed site for a full-scale BFP retrofit in the Lower Ninth Ward) falls under zone B.

ZONES A and V

FEMA defines flood zones A and V as: “Areas subject to inundation by the 1-percent-annual-chance flood event generally determined using approximate methodologies. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.”[168] Zones A and V differ in that Zone V is a coastal area subject to wave action, which is displayed in figure 113.

fig. 112: FEMA Flood Zone Plan, Lower Ninth Ward

ZONES B, C, and X

According to FEMA, flood zones B, C, and X are "areas identified in the community FIS [Flood Insurance Study] as areas of moderate or minimal hazard from the principal source of flood in the area. However, buildings in these zones could be flooded by severe, concentrated rainfall coupled with inadequate local drainage systems. . . . Flood insurance is available in participating communities but is not required by regulation in these zones. (Zone X is used on new and revised maps in place of Zones B and C)."[169] Zones B and X are areas between the limits of 100 to 500 year flood and Zones C and X are above the 500 year flood level (fig. 113).

Zone A	The 100-year or base floodplain. There are six types of A Zones: **A** The base floodplain mapped by approximate methods, *i.e.,* BFEs are not determined. This is often called an unnumbered A Zone or an approximate A Zone. **A1-30** These are known as numbered A Zones (*e.g.,* A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format). **AE** The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones. **AO** The base floodplain with sheet flow, ponding, or shallow flooding. Base flood depths (feet above ground) are provided. **AH** Shallow flooding base floodplain. BFEs are provided. **A99** Area to be protected from base flood by levees or Federal Flood Protection Systems under construction. BFEs are not determined. **AR** The base floodplain that results from the decertification of a previously accredited flood protection system that is in the process of being restored to provide a 100-year or greater level of flood protection.
Zone V and VE	**V** The coastal area subject to a velocity hazard (wave action) where BFEs are not determined on the FIRM. **VE** The coastal area subject to a velocity hazard (wave action) where BFEs are provided on the FIRM.
Zone B and Zone X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods. B Zones are also used to designate base floodplains of lesser hazards, such as areas protected by levees from the 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile.
Zone C and Zone X (unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level. Zone C may have ponding and local drainage problems that don't warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood and protected by levee from 100-year flood.
Zone D	Area of undetermined but possible flood hazards.

fig. 113: Flood Insurance Rate Map Zones Defined by the NFIP

FLOOD ZONES + BASE FLOOD ELEVATIONS

FEMA recommends:

> In all areas where flooding is a concern, inside and outside the Special Flood Hazard Area (SFHA), FEMA requires the lowest floor must be elevated so that the bottom of the lowest horizontal structural member is at or above the Design Flood Elevation (DFE).
>
> In flood zones V and A, use a DFE that results in freeboard (elevate the lowest floor above the BFE) [fig. 114].
>
> In flood zones V and A, calculate design loads and conditions (hydrostatic loads, hydrodynamic loads, wave loads, floating debris loads, and erosion and scour) under the assumption that the flood level will exceed the BFE [fig. 114].
>
> In an A zone subject to waves and erosion (i.e., Coastal A zone), use a pile or column foundation [fig. 114].
>
> Outside the SFHA (in flood zones B, C, and X), adopt flood-resistant design and construction practices if historical evidence or a review of the available flood data shows the building could be damaged by a flood more severe than the base flood [fig. 115].[170]

Freeboard is defined as, "[A]n added safety factor expressed in feet that many communities add to their BFEs to account for uncertainty or provide an increased level of protection. . . . For example if the current BFE at a location is 14 feet above sea level and the community adopts a 3 foot freeboard, new and substantially improved and damaged buildings would have to have their lowest floors elevated to 17 feet above sea level."[171] Freeboard is illustrated in figure 114 and is particularly important for areas vulnerable to flooding (zones A and V).

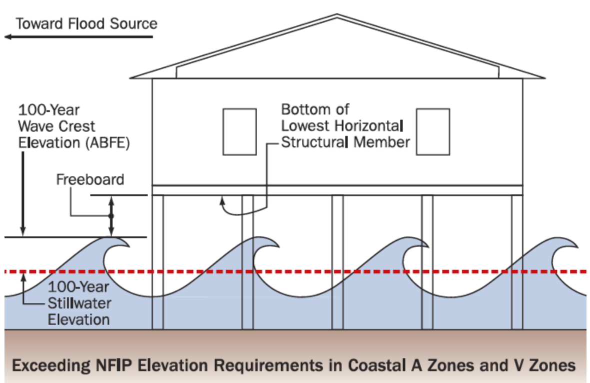


fig. 114: Recommended Construction in Zones A and V

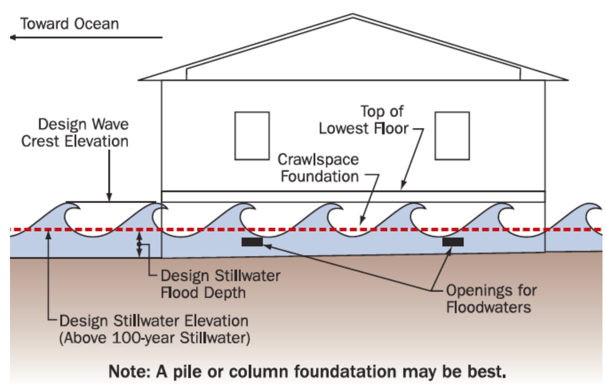


fig. 115: Recommended Construction in Zones B, C and X

FLOOD INSURANCE COVERAGE

Figure 116 is a table that compares 2006 housing damage estimates in the Lower Ninth Ward based on homes that were, according to FEMA, fully insured, partially insured and not insured prior to Hurricane Katrina. Within the FEMA 100 year floodplain (zone A), 52% of damaged homes were uninsured compared to 48% fully insured. Outside the FEMA 100 year floodplain (zone B), 70% of damaged homes were uninsured compared to 30% fully insured.[172] Insuring a home, regardless of where it is situated, does not guarantee that the coverage will be sufficient, especially during such unforeseeable circumstances as Hurricane Katrina. The only true "insurance" is a reliable flood-protection system, such as could be provided by the BFP.

Housing Unit Damage Estimates as of February 12, 2006
Lower 9th Ward Planning District Total Housing Damage

	Owner-Occupied Housing Units			
	Insurance Status			
	Hazard & Flood	Hazard Only	No Insurance	Owner Subtotal
Homes with flood damage				
Homes in FEMA 100 yr. fl plain				
Minor Damage	3	2	1	6
Major Damage	12	4	13	29
Severe/Destroyed	567	216	396	1,179
Subtotal	*582*	*222*	*410*	*1,214*
Homes outside 100 yr. fl plain				
Minor Damage	5	19	14	38
Major Damage	95	125	82	302
Severe/Destroyed	422	493	501	1,416
Subtotal	*522*	*637*	*597*	*1,756*
Homes with no flood damage (generally wind damage)				
Minor Damage	-	-	1	1
Major Damage	2	1	1	4
Severe/Destroyed	-	-	-	-
Subtotal	*2*	*1*	*2*	*5*
TOTAL	**1,106**	**860**	**1,009**	**2,975**
Census 2000:				3,671
Percent:				81%

	SBA Median Verified Loss:	N
FEMA Damage Level:		
Major:	$ 95,857	72
Severe:	$ 114,915	573

fig. 116: Damage to Owner-Occupied Housing Units in the Lower Ninth Ward, Post-Katrina

04 V summary

This chapter has discussed the Buoyant Foundation Project (BFP) as an alternative solution for flood mitigation in New Orleans.

Prior to Katrina, residents in the Lower Ninth Ward were not required to purchase flood insurance because they were in a "levee protected" area. This was misleading to homeowners, and provided a false sense of security to those who decided not to insure their properties in accord with government legislation. Fifty-two percent of the damaged homes in the Lower Ninth Ward situated within the designated floodplain area did not carry flood insurance, nor did 70% of the damaged homes outside of the designated floodplain area in the Lower Ninth Ward. These homes may have survived undamaged had they been fitted with buoyant foundations. In reality, even if base flood elevations (BFE's) are raised, and insurance is purchased, the current flood mitigation strategy in New Orleans is inadequate and will not provide sufficient protection in an extreme flood.

As discussed at the beginning of the chapter, the BFP provides an alternative solution to permanent static elevation, while addressing the technical feasibility, safety and socio-cultural aspects of flood protection simultaneously. The BFP aims to retrofit existing shotgun houses in New Orleans with buoyant foundation systems comprised of the core elements: buoyancy elements, vertical guidance posts, a steel substructure that attaches these elements to the house, and accommodation of the utility connections. The system works passively, enabling the house to remain close to street level during normal conditions and to float whenever there is a flood. Prior to June 2010, a two-phase installation schedule was designed to comply with FEMA and NFIP regulations; however, it is no longer needed in light of the recent completion of an amphibious home in the Lower Ninth Ward and subsequent meetings with FEMA officials that indicate a changing perspective towards amphibious construction in New Orleans.

The BFP is a small-scale intervention that could provide another layer of flood protection to supplement traditional infrastructural methods currently in place in New Orleans. The BFP can improve flood protection for individual properties in low-lying areas of New Orleans. The BFP could supplement insurance programs to give more adequate protection to houses during unforeseeable extreme floods.

04 vi endnotes

127. Elizabeth English, "Building Flood Resilience with Amphibious Architecture, ChaRisMa: 1st Waterloo Conference on the Characteristics, Risk and Management of Natural Hazards, December 2, 2010, http://www.buoyantfoundation.org (accessed December 3, 2010) (appendices, 397).

128. Elizabeth English, "Amphibious Foundations and the Buoyant Foundation Project: Innovative Strategies for Flood-Resilient Housing," (paper presented at the International Conference on Urban Flood Management, Paris, France, November 25-27, 2009), 2 (appendices, 412).

129. ibid.

130. ibid.

131. ibid., 6.

132. Elizabeth English, Interviewed by Charlotte Garson, *French Public Radio Station in Breaux Bridge*, LA, August 2008 (appendices, 384).

133. English. 2009, 2 (appendices, 414).

134. Elizabeth English. "The Buoyant Foundation Project," http://www.buoyantfoundation.org (accessed September 1, 2010).

135. ibid.

136. ibid.

137. English. 2009, 2 (appendices, 412).

138. English. 2010 (appendices, 397).

139. Make It Right, "About Make It Right: Our History," http://www.makeitrightnola.org/index.php/about/detail/our_history/ (accessed September 1, 2009).

140. "Help Holy Cross," http://www.helpholycross.org/ (accessed September 1, 2009).

141. Associated Press, "New Orleans' Katrina-Ravaged 9th Ward Can Be Rebuilt, Planners Say," http://www.foxnews.com/story/0,2933,242316,00.html (accessed October 23, 2009).

142. Andersen *et al*. 2007, 56.

143. Allison Plyer, "News Release: Facts for Features Hurricane Katrina Impact," http://www.gnocdc.org/Factsforfeatures/HurricaneKatrinaImpact/index.html (accessed April 1, 2010).

144. Ross R. Richardson, "Letter From FEMA, Friday, September 28, 2007," (see figure 101)

145. Jon Luther in Fox News Broadcast, "The Buoyant Foundation Movie," (appendices, 455).

146. ibid.; and Ross R. Richardson, "Letter From FEMA, Friday, September 28, 2007," (see figure 101)

147. Personal Communication with Elizabeth English, January 2010.

148. ibid; appendices, 340.

149. Brett D Schweinberg, "Letter From Tri-Parish Times, Monday, December 14, 2009," (see figure 101) and Earl Armstrong "Letter From FEMA, Friday December 11, 2009," (see figure 102).

150. Earl Armstrong "Letter From FEMA, Friday December 11, 2009," (see figure 103).

151. Personal Communication with Elizabeth English, March 2010.

152. ibid.

153. Elizabeth English. "The Buoyant Foundation Project," http://www.buoyantfoundation.org (accessed September 1, 2010).

154. English. 2009, 2 (appendices, 412).

155. Federal Emergency Management Agency, "Base Flood Elevation,"http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/base_flood_elevation.shtm (accessed September 30, 2009).

156. Federal Emergency Management Agency, "Base Flood," http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/base_flood.shtm (accessed September 30, 2009).

157. Federal Emergency Management Agency, "Advisory Flood Elevations and Disaster Assistance," ABFE_FAQ.pdf, http://www.fema.gov/news/newsrelease.fema?id=23283 (accessed September 30, 2009).

158. Federal Emergency Management Agency, "Flood Recovery Guidance: Frequently Asked Questions", FRG_Addendum_FAQ's_092107.pdf. http://www.docstoc.com/docs/9245904/INTRODUCTION-ADVISORY-BASE-FLOOD-ELEVATIONS-%28ABFEs%29 (accessed September 30, 2009).

159. Federal Emergency Management Agency, "FEMA Recovery Guidance: Questions and Answers about the Advisory Flood Elevations," http://www.fema.gov/hazard/flood/recoverydata/katrina/katrina_la_qa_afe.shtm (accessed September 30, 2009).

160. Federal Emergency Management Agency, "Advisory Flood Elevations and Disaster Assistance," ABFE_FAQ.pdf, http://www.fema.gov/news/newsrelease.fema?id=23283 (accessed September 30, 2009).

161. Federal Emergency Management Agency, "Designing for Flood Levels Above the BFE," www.fema.gov/library/file?type=publishedFile&file=fema549_apndx_e_ra8.pdf&fileid=143da3a0-0316-11dc-a1f1-000bdba87d5b fema549_apndx_e_ra8.pdf (accessed September 30, 2009).

162. Federal Emergency Management Agency, Flood Recovery Guidance: Advisory Base Flood Elevations for Orleans Parish, Louisiana. http://www.fema.gov/pdf/hazard/flood/recoverydata/orleans_parish04-12-06.pdf (accessed October 23, 2009).

163. Federal Emergency Management Agency, “Highest Adjacent Grade,” http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/highest_adj_grade.shtm (accessed October 23, 2009).

164. ibid.

165. ibid.

166. Federal Emergency Management Agency, “Definitions of FEMA Flood Zone Designations,” http://www.msc.fema.gov/webapp/wcs/stores/servlet/info?storeId=10001&catalogId=10001&langId=-1&content=floodZones&title=FEMA%20Flood%20Zone%20Designations (accessed October 23, 2009).

167. Federal Emergency Management Agency, “Flood Zones: NFIP Policy Index,” http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/flood_zones.shtm (accessed October 23, 2009).

168. Federal Emergency Management Agency, “Zone A: NFIP Policy Index,” http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/zone_a.shtm and Federal Emergency Management Agency, “Zone Z: NFIP Policy Index,” http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/zone_v.shtm (both accessed October 23, 2009).

169. Federal Emergency Management Agency, “Answers to Questions about the NFIP: Flood Hazard Assessments and Mapping Requirements,” http://www.fema.gov/business/nfip/fhamr.shtm#79 (accessed October 23, 2009).

170. Federal Emergency Management Agency, “Designing for Flood Levels Above the BFE,” www.fema.gov/library/file?type=publishedFile&file=fema549_apndx_e_ra8 pdf&fileid=143da3a0-0316-11dc-a1f1-000bdba87d5b fema549_apndx_e_ra8.pdf (accessed September 30, 2009).

171. Federal Emergency Management Agency, “FEMA Recovery Guidance: Questions and Answers about the Advisory Flood Elevations,” http://www.fema.gov/hazard/flood/recoverydata/katrina/katrina_la_qa_afe.shtm (accessed September 30, 2009).

172. U.S. Department of Housing and Urban Development’s Office of Policy Development and Research, “Current Housing Unit Damage Estimates, Hurricanes Katrina, Rita and Wilma,” http://www.huduser.org/publications/destech/GulfCoast_HsngDmgEst.html (accessed September 1, 2009). Calculations: 52% = (222 + 410) / 1214; 48% = 582 / 1214; 70% = (637+597) / 1,756; 30% = 522 / 1,756.

05

the buoyant foundation project : technical feasibility

technical feasibility:

i. introduction

ii. pointe coupee parish:
amphibious fishing camps
dry in september, flooded in february

iii. maasbommel:
amphibious housing in the netherlands
location
floating + amphibious
construction
financials
the future of maasbommel

iii. LSU hurricane center prototype
construction of prototype at LSU

iv. noah's ark project:
amphibious house in lakeview, new orleans
amphibious foundation system
flexible utilities

v. FLOAT house:
amphibious house in the lower ninth ward, new orleans
power + usage
shading
mechanical + natural ventilation
materiality

vi. LIFT house:
amphibious housing in dhaka, bangladesh
how it works
construction timeline

vii. analysis
technical feasibility summary
analysis
comparative analysis
application + improvements for the BFP

viii. summary

ix. endnotes

05 i technical feasibility

Chapter 5 discusses the technical feasibility of the Buoyant Foundation Project (BFP) in relation to local and international examples of amphibious housing.

Six pertinent and completed projects have been selected: Amphibious Fishing Camps in Point Coupee Parish, Louisiana; Amphibious Housing in Maasbommel, Netherlands; LSU Prototype in Baton Rouge, Louisiana; Noah's Ark Project in Lakeview, New Orleans; FLOAT House in the Lower Ninth Ward, New Orleans; and LIFT House in Dhaka, Bangladesh. The amphibious houses in Maasbommel inspired the initial concept of using amphibious foundations to provide flood protection in New Orleans. The amphibious fishing camps in Point Coupee Parish provide an example of a technically feasible system using similar components, particularly buoyancy blocks and vertical guidance posts. This precedent confirmed that BFP's proposed system could work and be cost effective. The LSU prototype was a full-scale, built demonstration of the buoyant foundation system. The Noah's Ark Project in Lakeview, FLOAT House, and LIFT House were recently completed. They may help with regulatory and political hurdles, and are useful examples of amphibious systems for new construction. The Noah's Ark Project in Lakeview is believed to be the first modern fully-engineered home built with an amphibious foundation in the United States and second in the world only to the houses in Maasbommel. The FLOAT House was the first fully permitted amphibious house in the United States. The LIFT House is believed to be the first modern fully engineered amphibious house constructed outside of the United States and the Netherlands. It is student designed and constructed and implements sustainable materials. In this discussion, each project is fully documented, and will appear chronologically based on the date of construction.

A summary and analysis conclude the chapter, highlighting the projects' significant contributions or future influence on the BFP. A tabular summary compares particular factors of each project's technical feasibility. Factors such as date of completion, architect, challenges, maximum elevation during flooding, buoyancy system, major building materials and cost can be visually compared and cross referenced among the six examples and the BFP.

05

ii

technical feasibility: pointe coupee parish


raccourci
old river

pointe coupee parish, louisiana

fig. 117: Partial Aerial View of Pointe Coupee Parish

fig. 118: Pointe Coupee Parish Key Map

fig. 119: Old River, Key Map

fig. 120: Permanent Static Elevated Fishing Camp in Raccourci Old River

fig. 121: Fishing Camp on Amphibious Foundation in Raccourci Old River

POINT COUPEE PARISH,
AMPHIBIOUS FISHING CAMPS

Parish administrator, Owen J. Bello, Pointe Coupee Parish, Louisiana (fig. 117, 118) comments on Raccourci Old River as follows:

> [Raccourci Old River is] One of the oldest settlements in the entire Mississippi Valley, a community steeped in history and tradition. . . . Situated at the apex of Louisiana's 'French Triangle', Pointe Coupee Parish, with a recorded history dating from the time of the Iberville exploration in 1699, has a fascinating Creole culture embodying elements of the French, African and other nationalities who having called this place 'home' for nearly three centuries. . . . Pointe Coupee has a resident population of nearly 25,000, . . . Surrounded by the Mississippi, Atchafalaya and Lower Old Rivers and blessed with the oxbow lakes called False River and Raccourci-Old River, Pointe Coupee Parish is a paradise for sportsmen, including hunters, anglers, boaters and [water] skiers.[173]

According to the Louisiana Sportsman Magazine, "Old River is a 12 mile long, 4,000 acre oxbow lake near the town of Morganza Louisiana [fig.119]. Flooding from the nearby Mississippi River affects the water levels on Old River and in turn affect the fishing conditions. In the spring of 1997 many camps were flooded when the Mississippi River levels were extremely high."[174] It is important to note that flooding is common to this area where annual fluctuations in the Mississippi River often flood the fishing camps in spring.[175] To mitigate future flooding, residents designed and built permanently raised camps (fig. 120), camps on amphibious foundations (fig. 121) and hybrids, combining both strategies (fig. 122).

Elizabeth English describes the local phenomena of these amphibious fishing camps:

> In rural areas of south Louisiana, there have been clusters of amphibious housing functioning reliably for over thirty years. Raccourci Old River in Point Coupee Parish is one such location. The lake that is called Old River was once a part of the Mississippi River, and remains connected to the Mississippi at one end; thus the water level in Old River rises and falls with the Mississippi's spring floods. Unhampered by building codes in these rural areas, local residents and vacationing fishermen devised an amphibious foundation system that has been keeping their homes and fishing camps dry for over three decades. Large blocks of EPS (expanded polystyrene, or styrofoam) are secured underneath the home which has been raised to an elevation 3 - 4 ft above the ground. . . .

fig. 122: Dry in September

fig. 123: Floating in February

fig. 124: Detail of Amphibious Foundation

fig. 125: Fishing Camp on Amphibious Foundation in Raccourci Old River

> Long poles or pipes are sunk into the ground near the corners of the house. When flooding occurs, the EPS blocks raise the house [fig. 123]. Sleeves that have been placed around the poles and attached to the structural frame of the home are able to slide up and down, allowing the home to rise and fall with the level of flooding [fig. 124].[176]

DRY IN SEPTEMBER, FLOODED IN FEBRUARY

Adaptations of the fishing camps with amphibious foundations have been made entirely at the initiative of the individual homeowners (fig. 125). The NFIP does not provide insurance to homes on amphibious foundations, however, this strategy has been effective and homeowners have not needed to make claims. Repetitive claims from this area, made by homeowners with non-elevated, non-amphibious homes, are common.[177]

The amphibious fishing camps at Pointe Coupee Parish were among some of the first examples upon which English and her Louisiana State University (LSU) undergraduate mechanical engineering students based their early research. These systems typically cost approximately $5,000 or less to implement on an existing structure.[178]

The reliable performance of these amphibious structures in a highly flood-prone area suggests that amphibious foundations could be appropriate for implementation in the Lower Ninth Ward, where the threat of flooding is rare but the consequences are severe. The goal of the BFP is to engineer an amphibious foundation system, similar to those implemented by residents of Pointe Coupee Parish, making it code compliant and visually appropriate for an urban context. The the possibility of integrating more sustainable materials such as thermoplastic timber and recycled water bottles is also being researched. The photos on the following pages (fig. 126, 127) document amphibious fishing camps in Old River, Pointe Coupee Parish, in September and February. Each spring, when the Mississippi River floods, the amphibious fishing camps rise up and float safely above the floodwaters, and descend when the floodwaters recede.

fig. 126: Montage of Fishing Camps on Amphibious Foundations, Dry in September

fig. 127: Montage of Fishing Camps on Amphibious Foundations, Floating in February

05 iii technical feasibility: maasbommel

fig. 128: Aerial View of Maasbommel, Netherlands


maasbommel,
netherlands

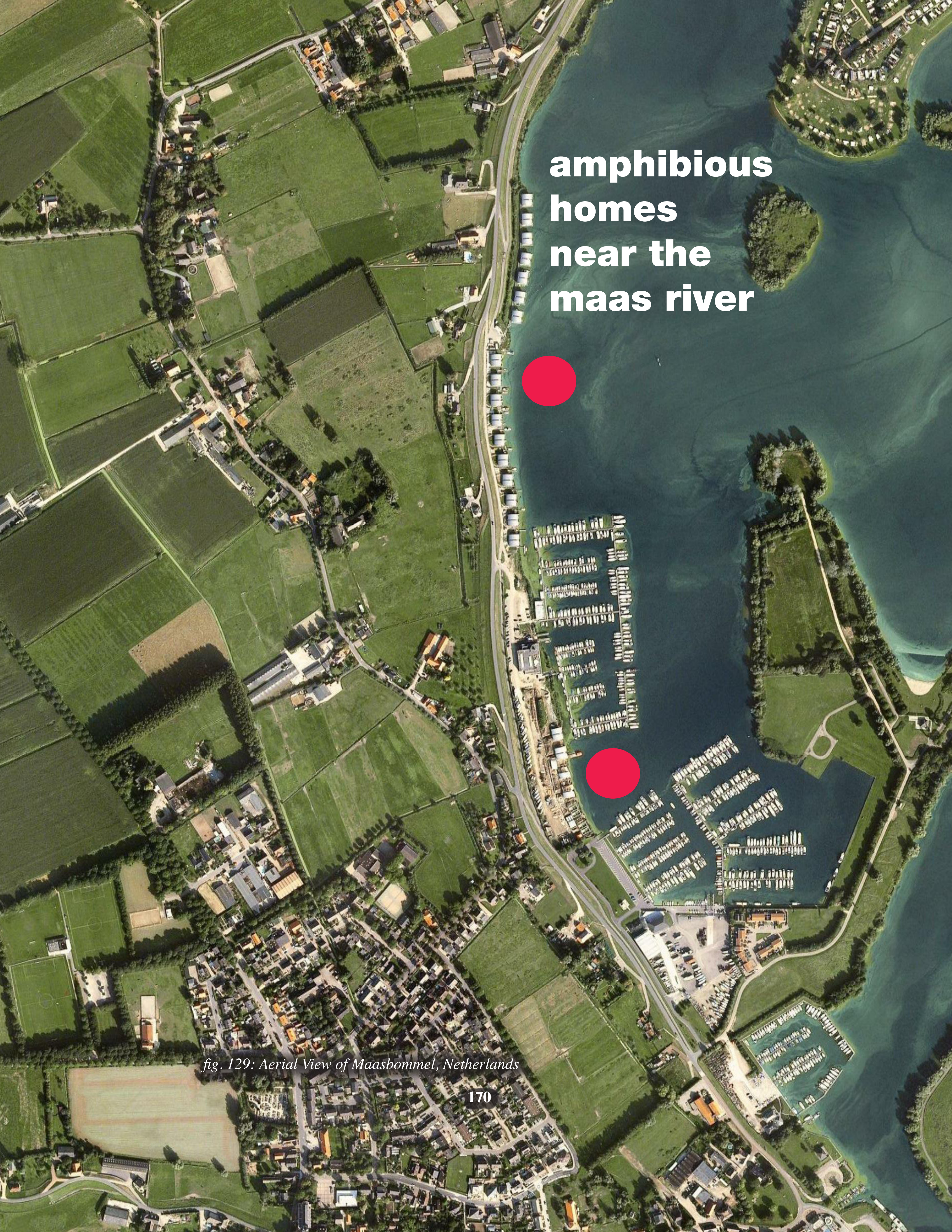


fig. 129: Aerial View of Maasbommel, Netherlands

MAASBOMMEL
AMPHIBIOUS HOUSING, NETHERLANDS

Two-thirds of the Netherlands would be flooded without the protection of dikes (fig. 128-130). Large portions of the country are situated below sea level, which makes them extremely vulnerable to floods after even minor fluctuations in water level. However, through centuries of innovations, the Dutch have created land from water. They have constructed a landscape of polders protected by dikes alongside the river and sea, and have integrated pumping systems to remove water and keep it out.[179]

Local architects in the Netherlands have created flood-proof housing to keep residents safe from flooding and protect homes from water damage. The first development of amphibious housing was near the Maas River in Maasbommel (fig. 131-133). The amphibious houses adjust to rising and falling water levels similarly to the way the BFP can accommodate severe flooding.

fig. 130: Two-Thirds of the Netherlands Protected

fig. 131: Maasbommel, Site

fig. 132: Maasbommel

fig. 133: Maasbommel

LOCATION

The Dutch town of Maasbommel is part of the municipality of West Maas en Waal, in Province of Gelderland, Netherlands (fig. 134, 135). The amphibioius project is situated outside the dike ring in a recreational area that is particularly vulnerable to flooding.[180]

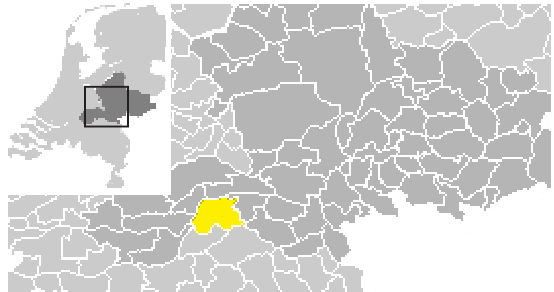


fig. 134: Municipal Boundary of West Maas en Waal

FLOATING + AMPHIBIOUS

Grer Krengen of Factor Architecten designed 36 amphibious and 14 floating houses at Maasbommel for Dura Vermeer, a Dutch building development and construction company. Figure 136 shows a comparison between the two types of housing at Maasbommel. Chris Zevenbergen is an engineer and environment director of Dura Vermeer and is also an Associate Professor at UNESCO-IHE in Delft. Sections of a floating house (type a) and an amphibious house (type b) highlight the relationship between the structure, land and water. Figure 137 depicts the foundation system for each type, and demonstrates how each type behaves under normal conditions and flooded conditions.[181]

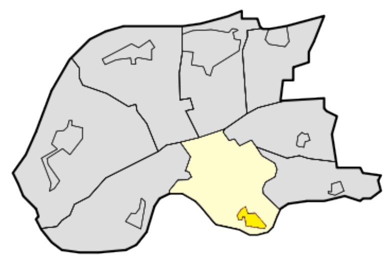


fig. 135: Town of Maasbommel and Municipal Boundary

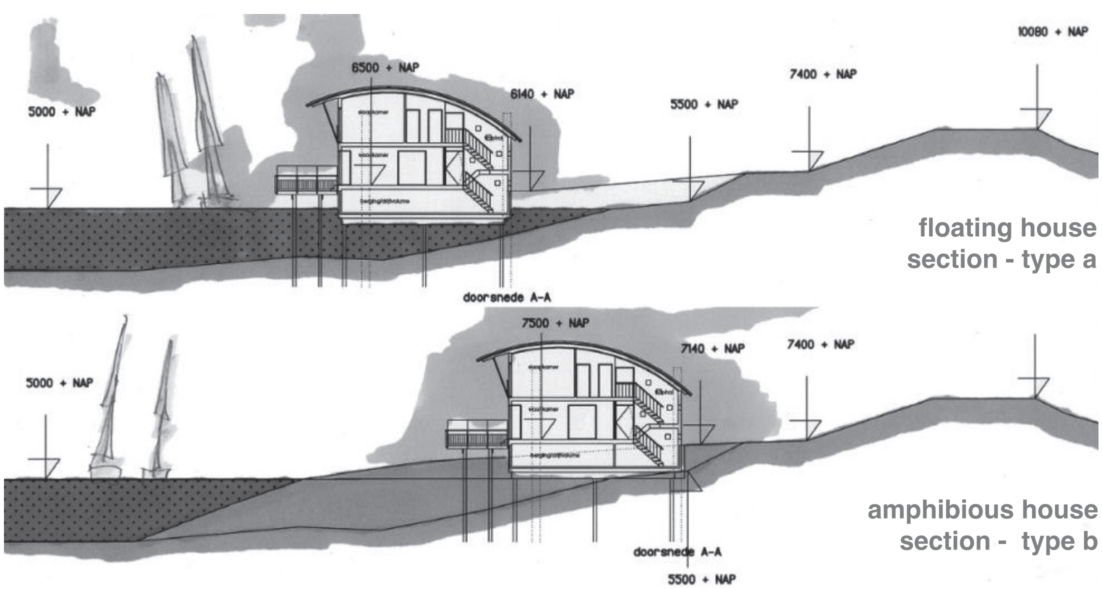


fig. 136: Site Sections, Maasbommel

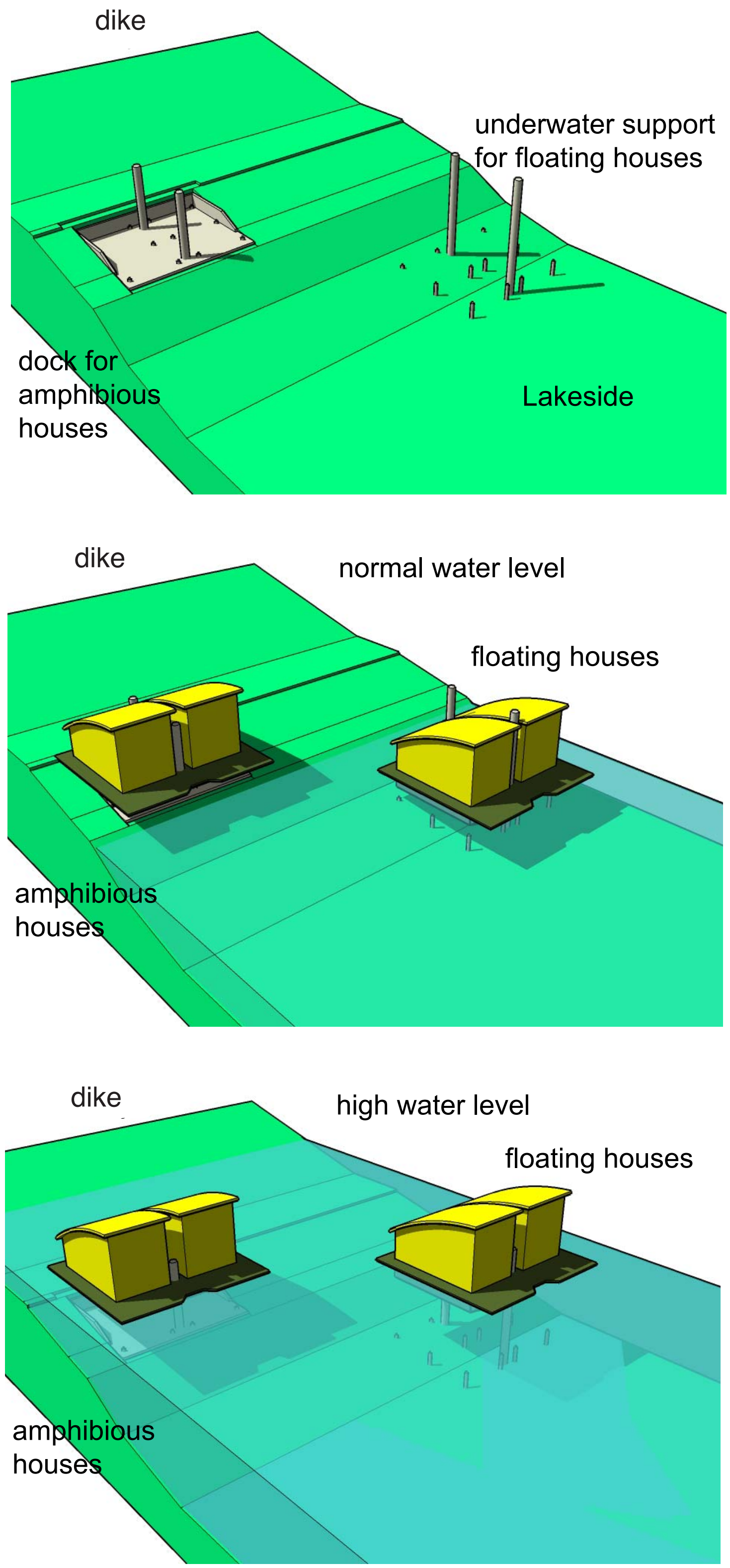


fig. 137: Fixed and Floating Position, Maasbommel

concrete box is measured out on the concrete workspace on site

concrete walls of each box are reinforced with steel

the box is ready to be moved to its final place near the water

all components are ready to receive the first concrete box foundation for the amphibious house

fig. 138: Construction Process of Amphibious Homes at Maasbommel - Foundation Structure

CONSTRUCTION

The next two figures, 138 and 139, display the construction sequence for the amphibious houses at Maasbommel. In figure 138, large hollow reinforced concrete boxes that serve as buoyancy elements are fabricated on site. Andrew Eames, writer from the *Telegraph*, states that Maasbommel's amphibious system is comprised of a "70-ton concrete box, like the hull of a ship, [that] forms the basement on which the wooden superstructure (two-storey, two or three bedroom) is built. These boxes come in semi-detached pairs, connected by a deck. Each pair is set into a niche in the river bank and held there by a couple of giant steel pillars, driven deep into the ground."[182] As mentioned by Eames, two houses share a single platform for stability. Figure 139 are photos of the upper portion of the house that is constructed from lightweight, wood-frame construction to ensure optimal buoyancy. Two fifteen-foot steel vertical guidance posts penetrate through the shared platform and are located between the houses (fig. 140, 141). The vertical guidance posts can accommodate a change in water level of 5.5 meters and ensure that the houses do not float away. When the guidance posts are in place, the concrete boxes are hoisted into position and the houses are constructed overtop of them. Water, gas, electrical and sewage are connected using flexible pipes and ducts, which are designed to function even when the houses rise a whole storey. The roof arrives in portions that are assembled on site and hoisted overtop of the pre-fabricated timber frame houses. The interiors are split-level, bright and naturally ventilated, with a modern design aesthetic. The bedroom and living room balconies open to views of the Maas River.[183]

FINANCIALS

Each individual unit has a 700 square footprint (approximately) and sold for $420,000, which is high for the Netherlands. Zevenbergen states that "the cost of building the flood-proof bases and bunkers of the buildings is cheaper than building foundations on dry land, as a great deal of money has to be spent in Holland to keep the dry land dry."[184]

THE FUTURE OF MAASBOMMEL

Jonathan Glancey, writer for the *Guardian Co*., states:

> [T]he solution is to build amphibious houses, new towns and extensions of existing cities on flood plains and riverbanks. Floating houses, Zevenbergen says, 'could make up 40 percent of the shortfall in land suitable for development [in Holland] over the next 50 years.' . . . The Maasbommel project may yet be extended on a grand scale: there are plans for a new floating town of 12,000 homes near Schiphol airport, which could include floating schools, hospitals and shops. Concrete [reservoirs] beneath the buildings will store flood water for reuse, and Zevenbergen says that in times of national emergency, the land 'can be flooded safely; the government recognizes you cannot stop floods from happening, you can only control the impact.' . . . The floating city is at the feasibility study stage, but Zevenbergen expects construction to begin in 2010 [fig. 142].[185]

In Glancy's article, Zevenbergen points out how land that is currently not suitable for development in the Netherlands can be used for amphibious buildings that will be reliable structures in times of emergency.[186] Figures 143-145 are more photographs of the amphibious houses at Maasbommel. Figures 146-157 are the working drawings for Maasbommel and further indicate the construction methods and materials.

the box is hoisted into its place

the prefabricated roof is assembled on site

the roof is hoisted on top of the prefabricated wooden-frame houses

the first large scale amphibious housing project in the Netherlands

fig. 139: Construction Process of Amphibious Homes at Maasbommel - Structure of House

fig. 140: Vertical Guidance Post Connection

fig. 141: Vertical Guidance Post Detail

fig. 142: Floating City, Conceptual Rendering

fig. 143: Maasbommel

fig. 144: Maasbommel

Pim Bosman
Dura Vermeer

Ger Kengen
Owner of
Factor Architecten
and Architect of
Maasbommel

Michiel Louman
Former Regional
Manager at
Dura Vermeer

fig. 145: Dura Vermeer and Kengen Architect

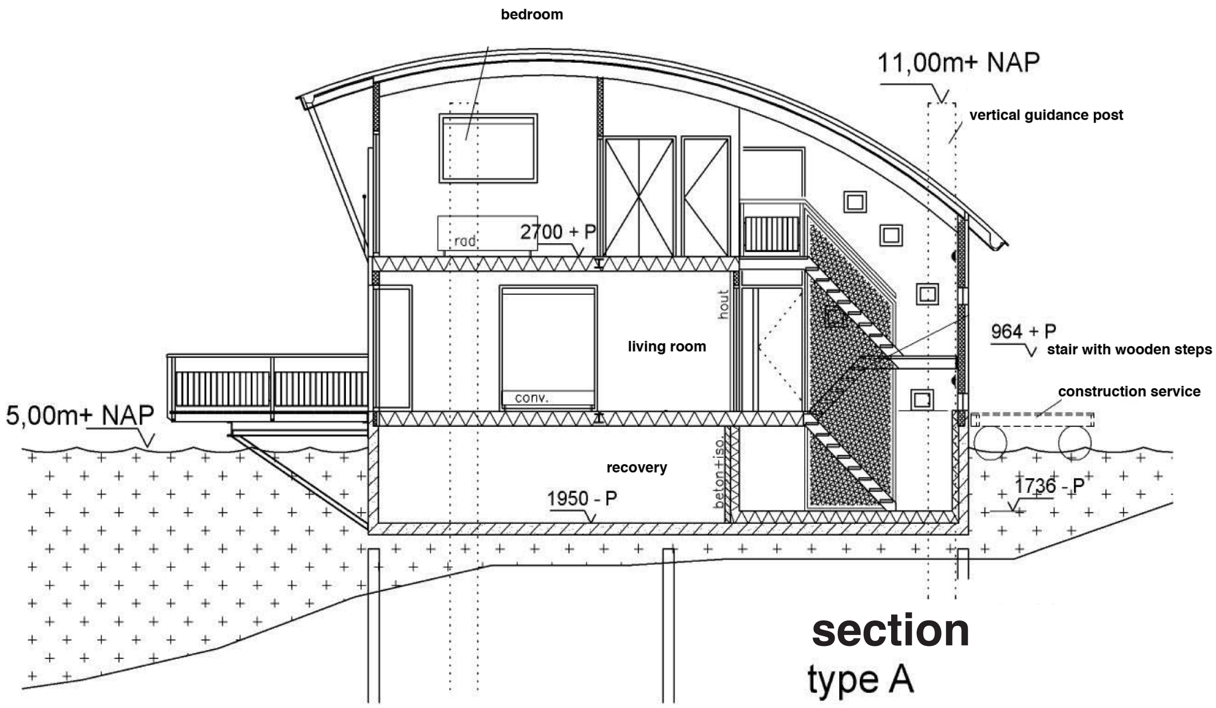


fig. 146: Section, Type A

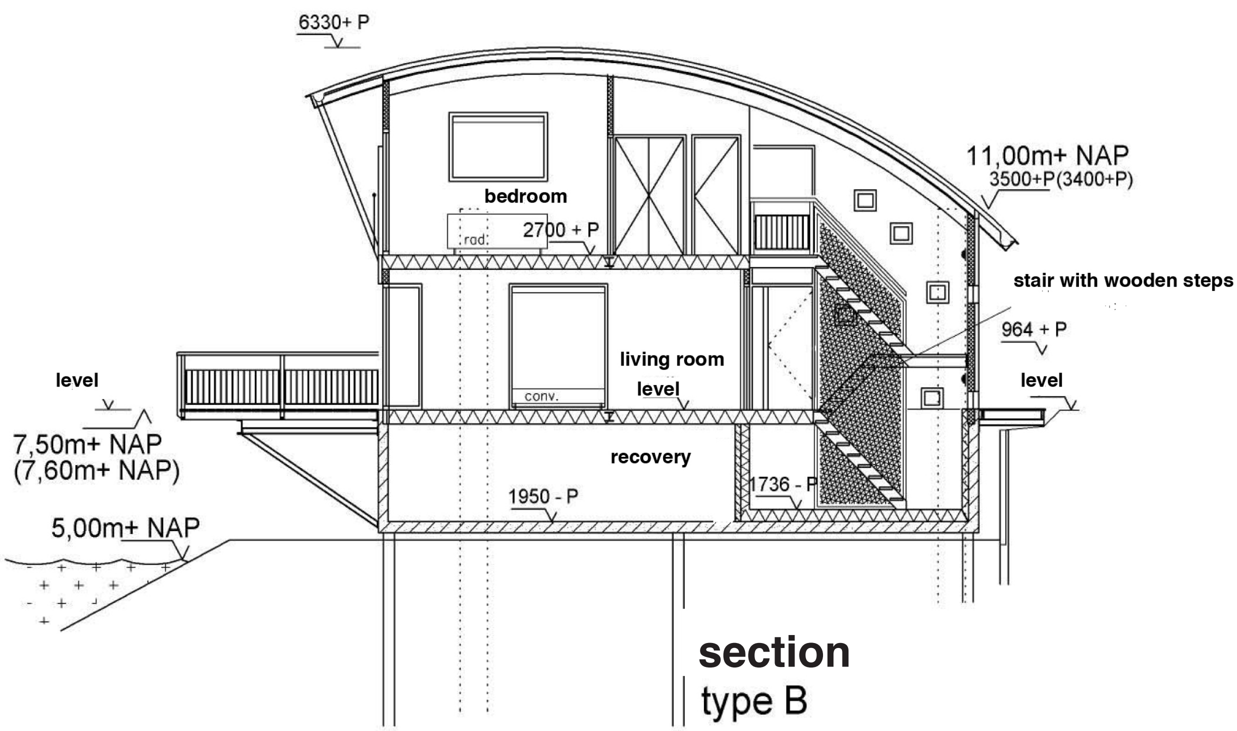


fig. 147: Section, Type B

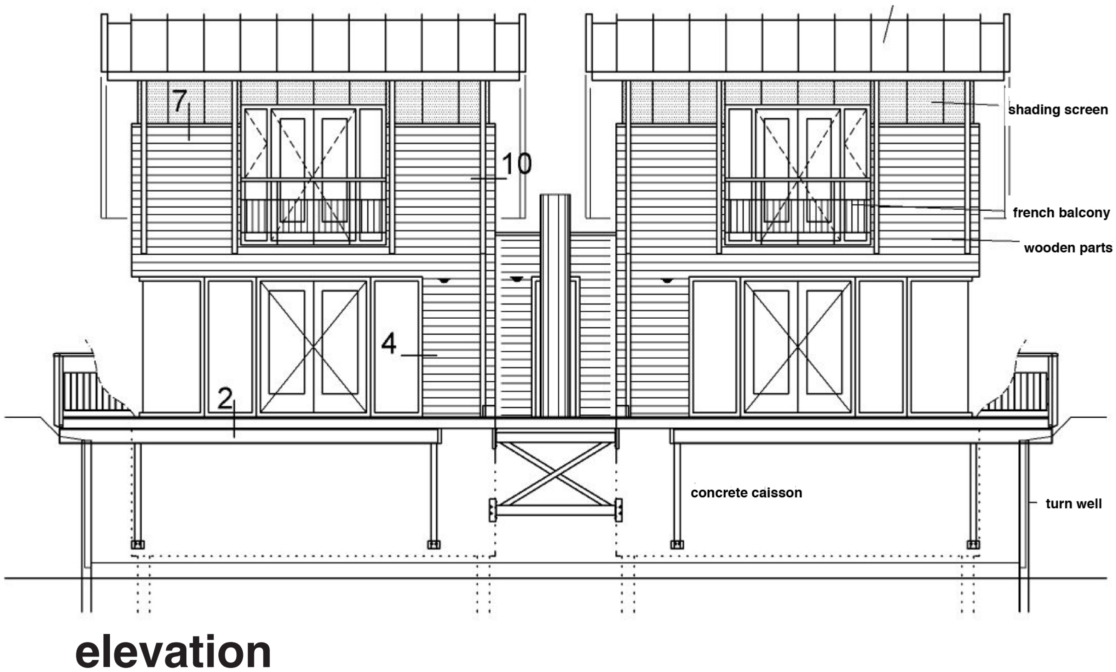


fig. 148: Elevation

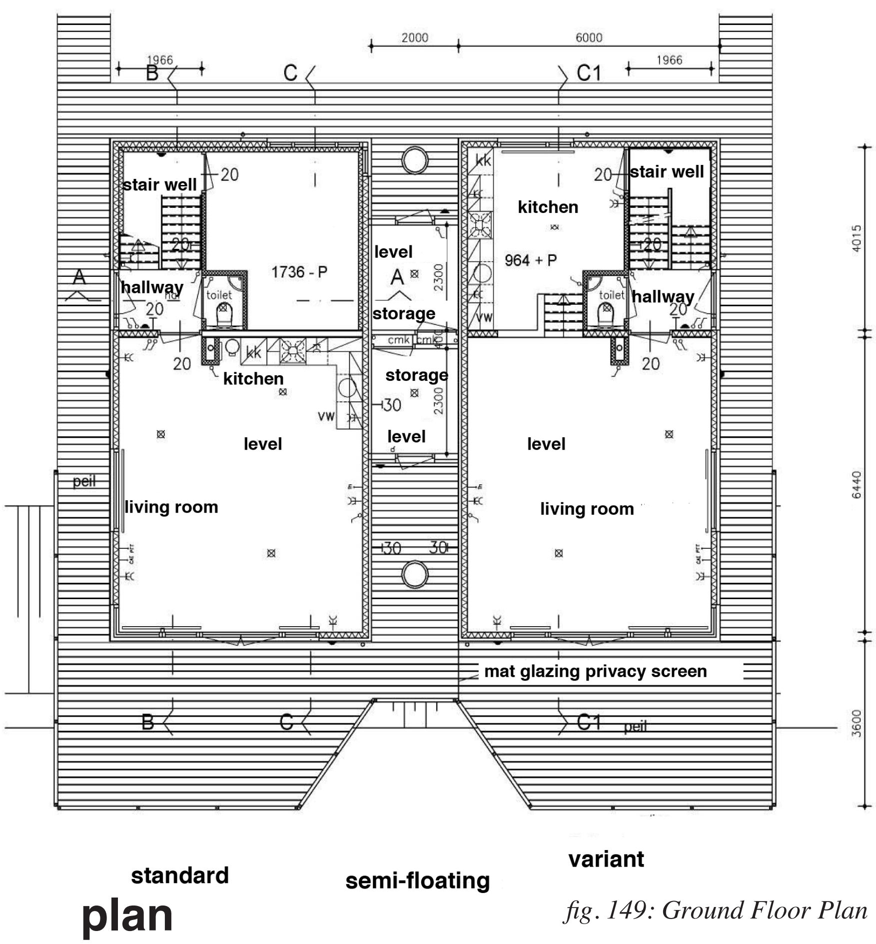
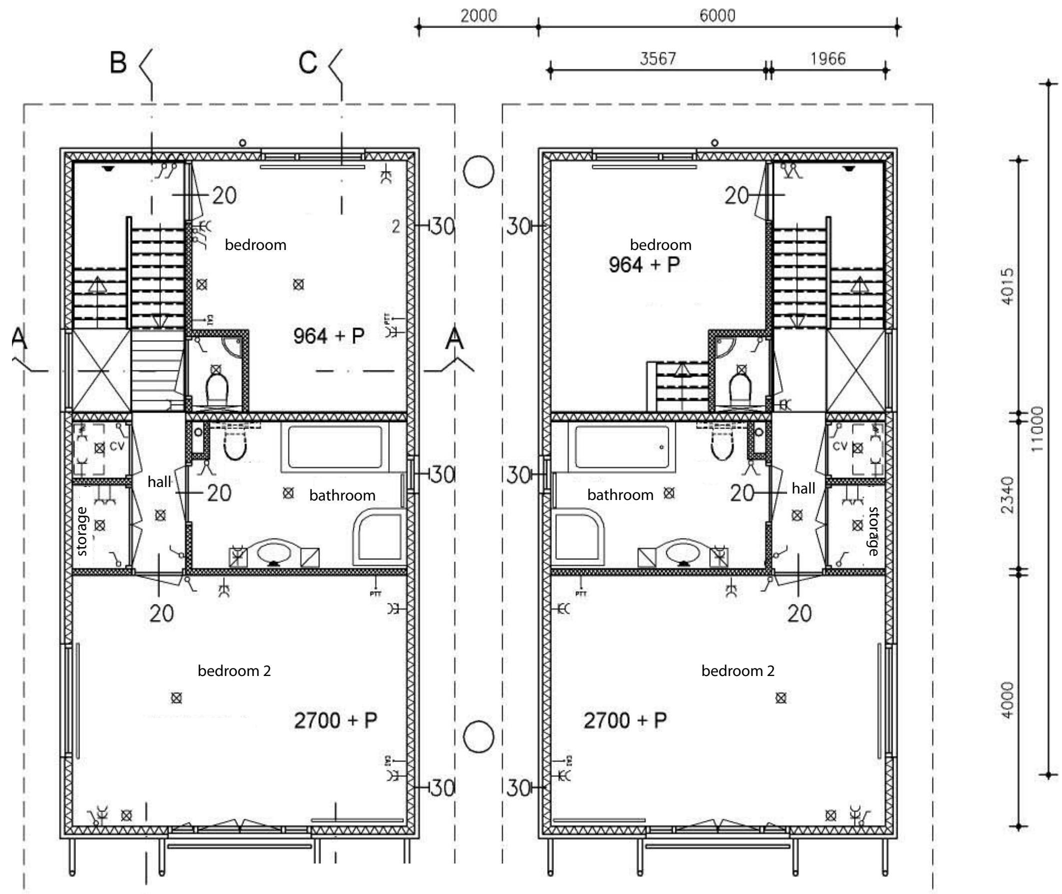
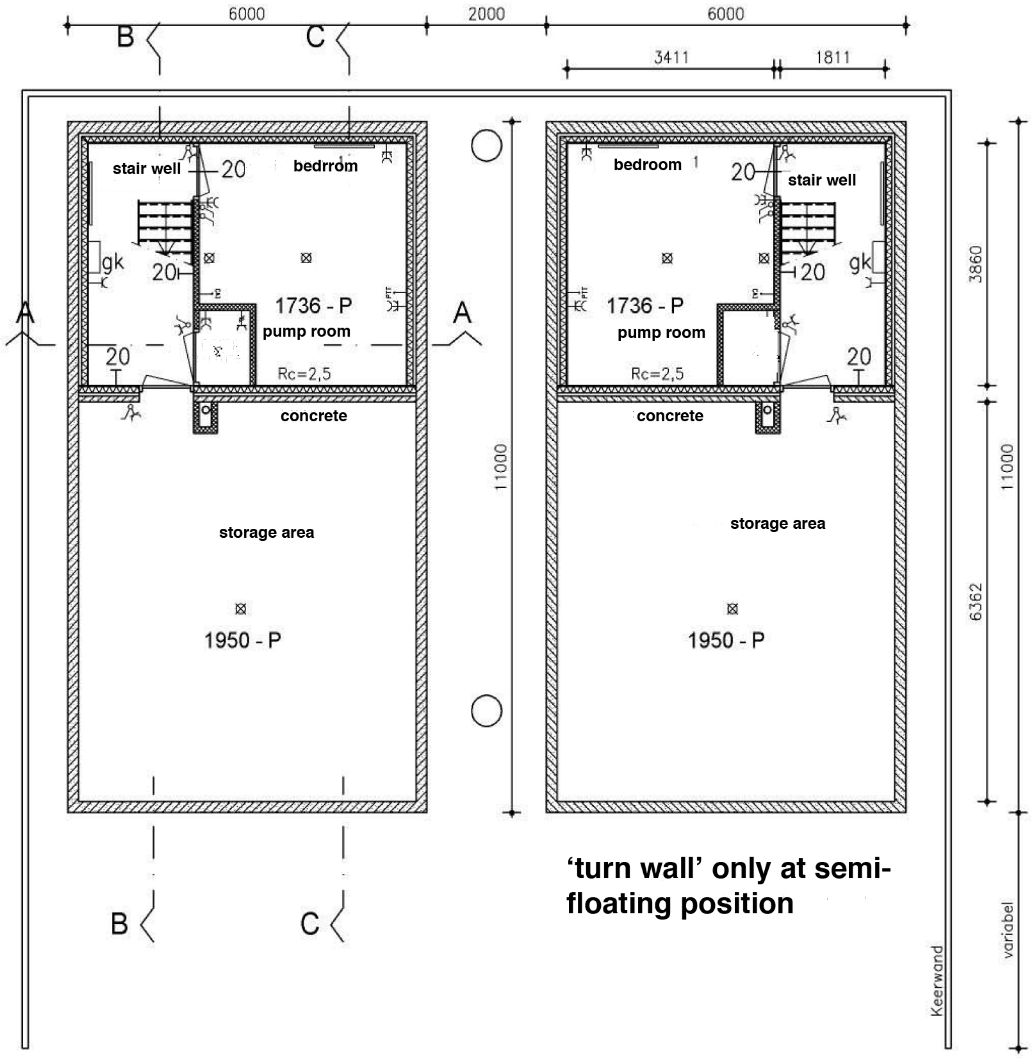


fig. 149: Ground Floor Plan



plan

fig. 150: Upper Level Plan



lower plan

fig. 151: Lower Plan

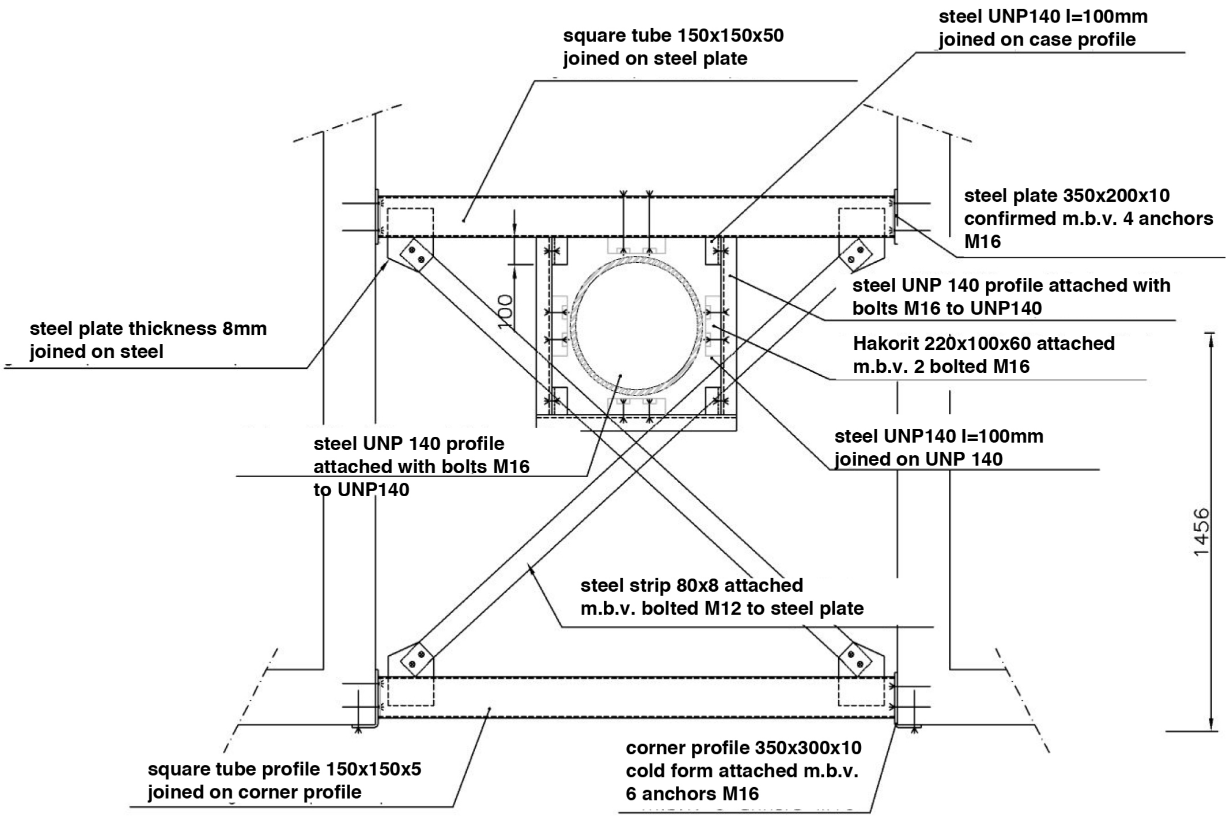


fig. 152: Foundation Detail

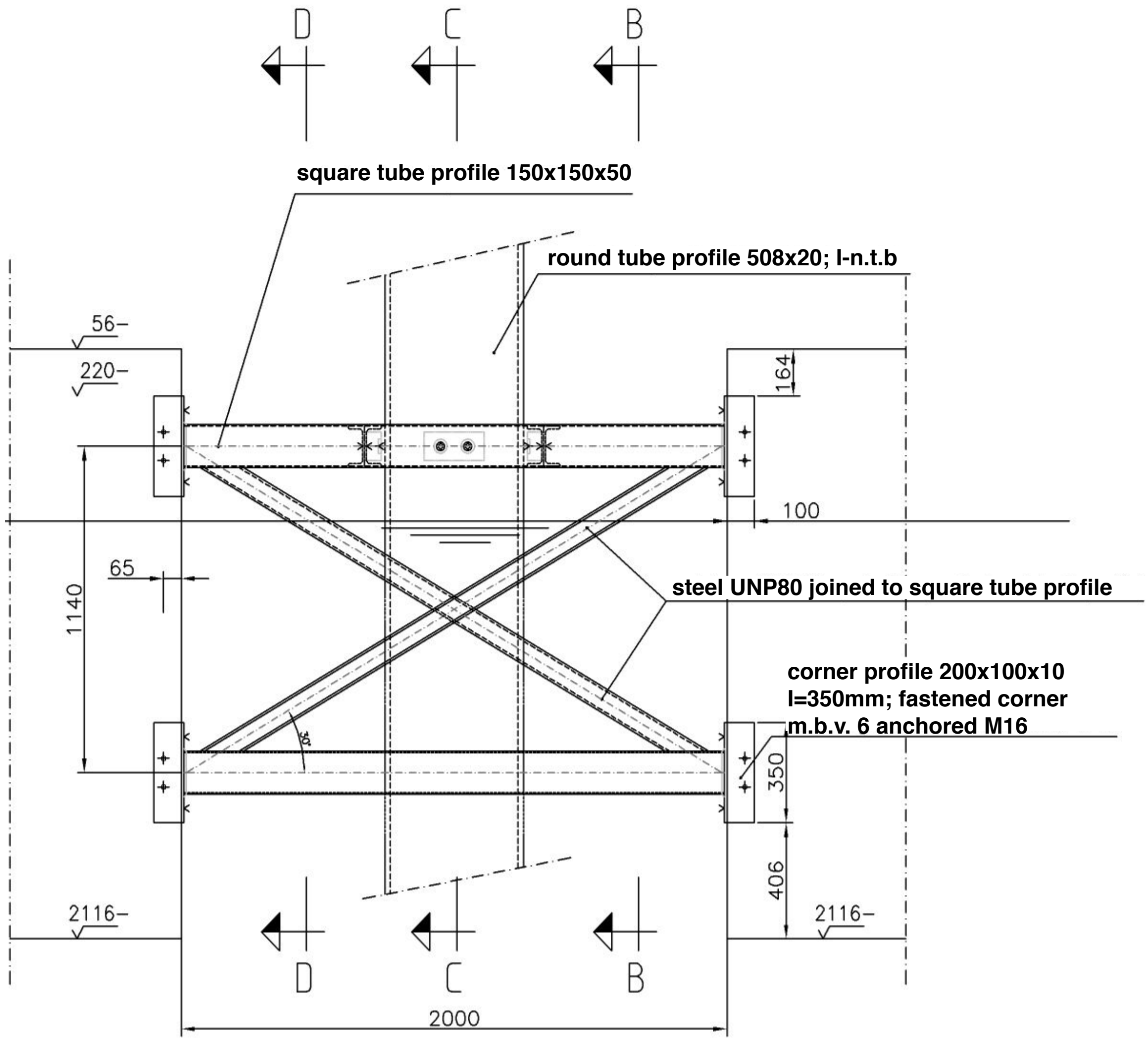
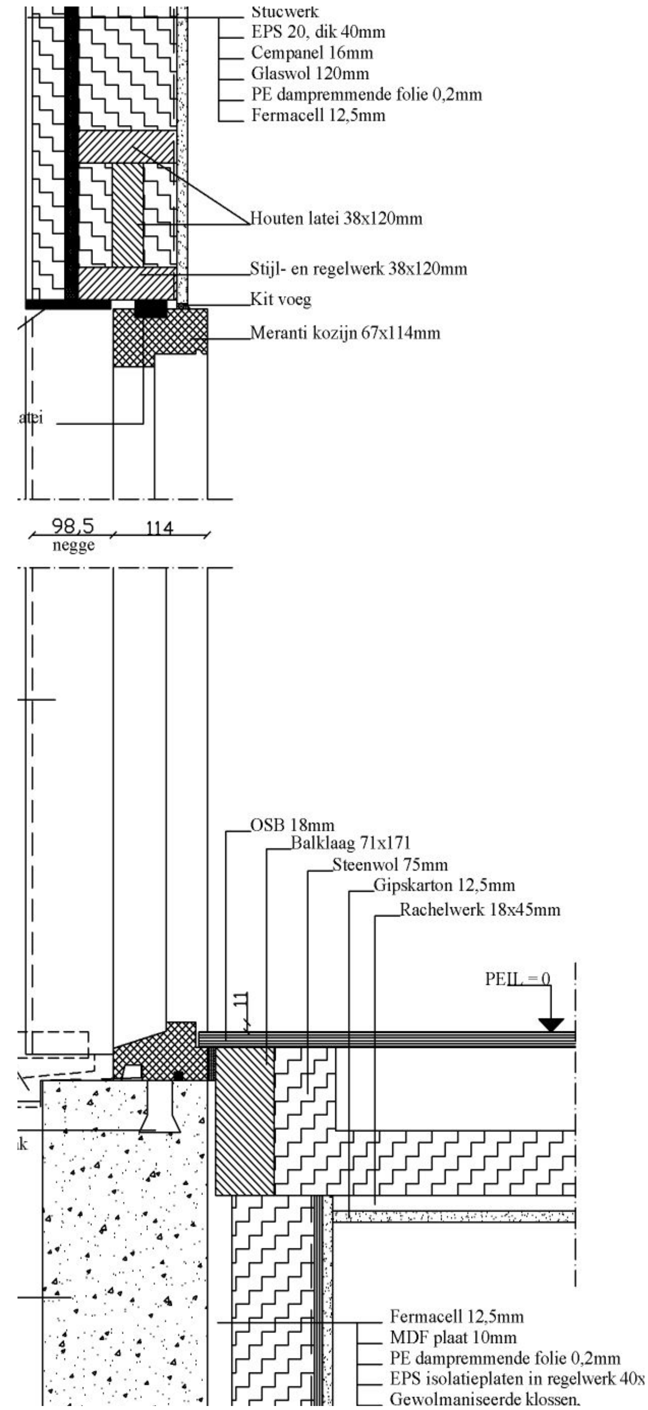
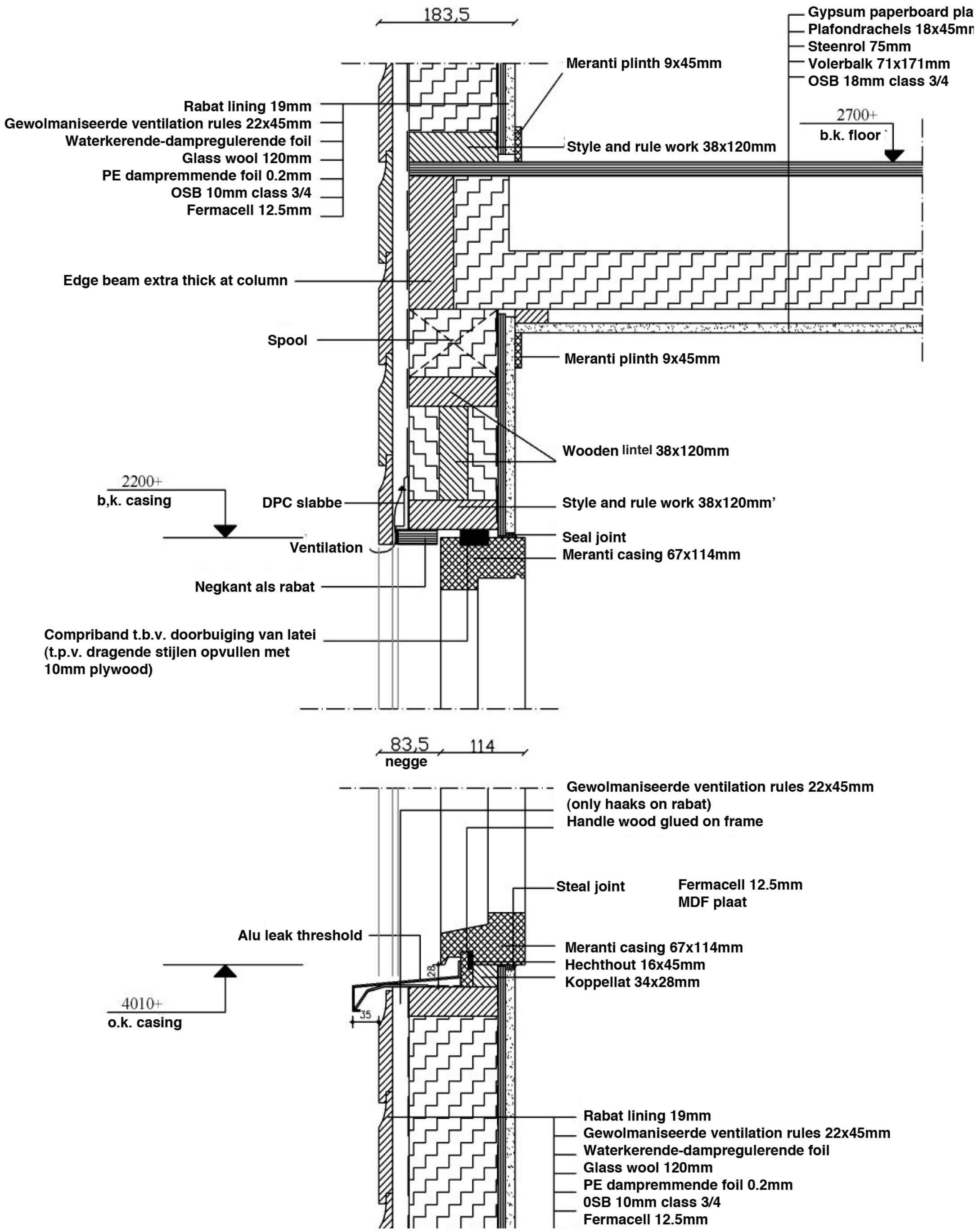


fig. 153: Connection Detail



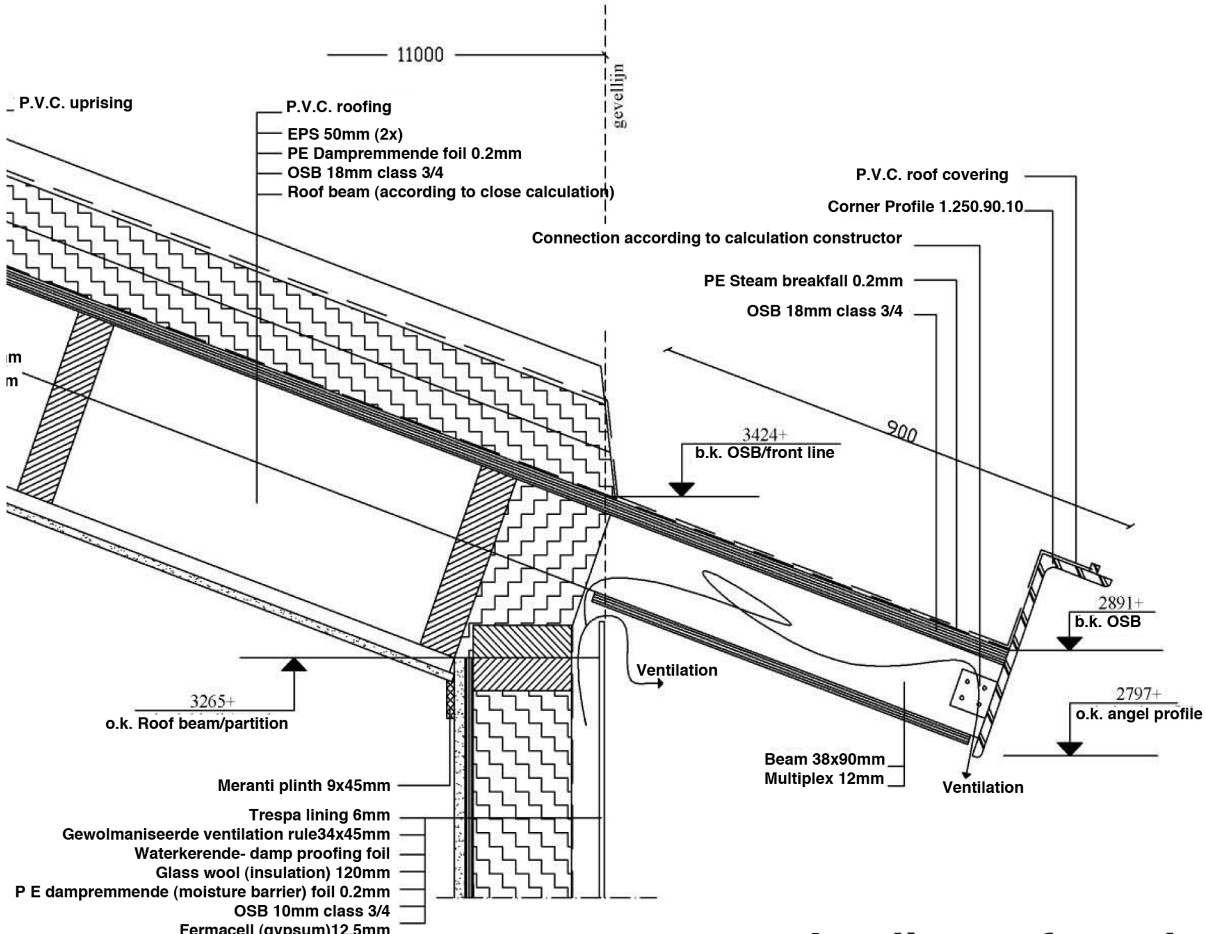
detail - wall section

fig. 154: Wall Section, Floor



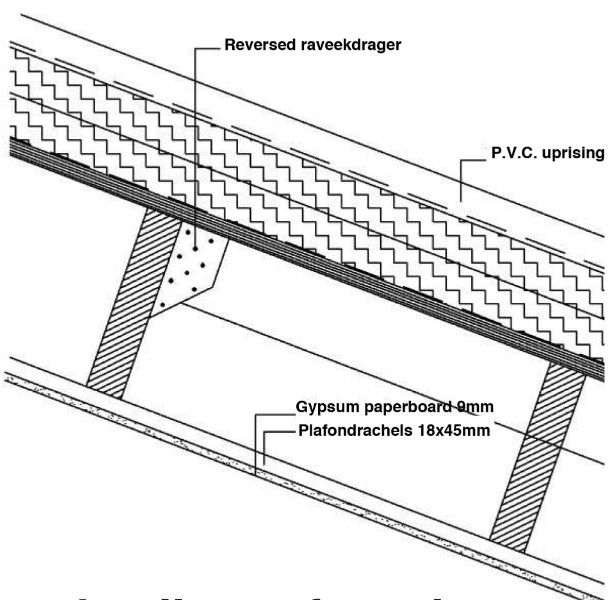
detail - wall section

fig. 155: Wall Section, Window

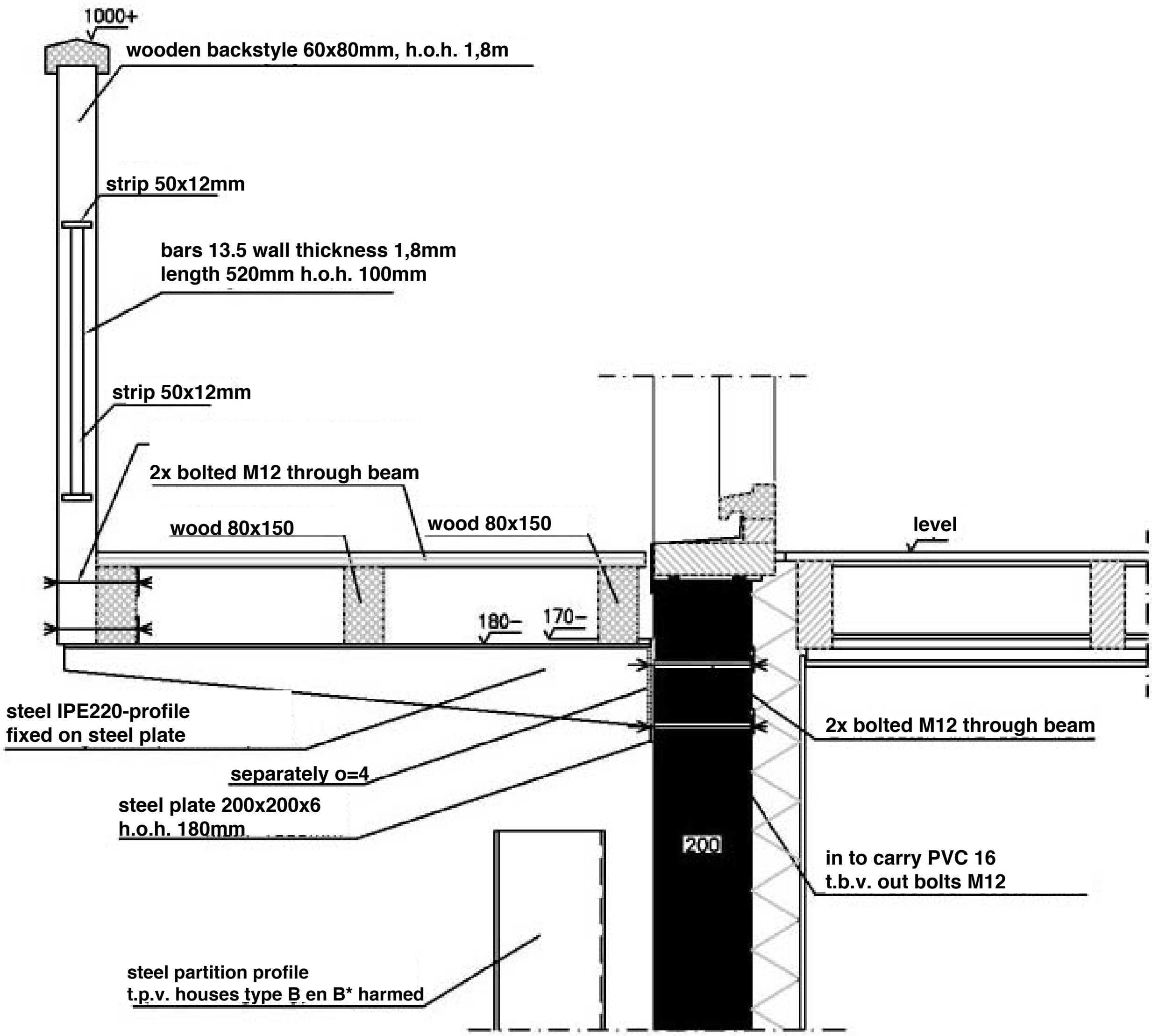


detail - roof section

fig. 156: Roof Section



detail - roof section



detail - floor section

fig. 157: Floor Section

05
iv
technical feasibility: LSU hurricane center prototype

fig. 158: Partial View of Louisiana State University Campus


louisiana
state
university

hurricane
center
prototype

CONSTRUCTION OF PROTOTYPE AT LOUISIANA STATE UNIVERSITY (LSU)

In June of 2007, the BFP conducted a successful full-scale partial prototype demonstration of buoyant foundation technology on the Louisiana State University (LSU) campus (fig. 158). Elizabeth English, Associate Professor of Research at the LSU Hurricane Center at the time, led a group of engineering students in the design, construction, and testing of the BFP prototype (fig. 159). The prototype was 13 feet (full width) by 24 feet (forty percent full length) of a typical shotgun house (fig. 160).[187]

Five LSU Mechanical Engineering students — Scott Schroth, Dustin Husser, Dustin Ewing, Matt Guidry and Ben Morvant — built a platform and installed a buoyant foundation between January and April of 2007, to test the system for flotation and stability.[188]

The platform was built in a series of steps. First, shallow holes were dug along the footprint and masonry piers were built up from each hole to a height of 3 feet. A wooden platform was built on top of the masonry piers and sill beams. Next, a metal frame was installed under the platform using channels and double angles (the double angles are hereafter referred to as T-beams). The channels were 20 feet in length and pre-drilled with a 12-inch offset and ½ inch holes. They were installed manually by sliding the channels onto the brick piers, and then attaching them to the sill beams with lag screws. Holes were drilled into the T-beams on site with a magnetic drill press in order to attach them to the channels. All bolts used for the system were ½ inch. Once the channels and T-beams were in place, vertical guidance posts and guide collars (or sleeves) (fig. 161) and the buoyancy blocks (fig. 162) were installed.[189] Figure 163 is a diagram showing the prototype's components assembled.

Testing at this stage included a vertical lift test for basic functionality of the system, an inclined lift test for seizing of the collars on the vertical guidance posts, a lift without buoyancy foam to determine the maximum angle, a lift from the lateral face to determine the seating of the structure and a trim lift to determine the longitudinal angle. Throughout the testing procedure the students discovered issues with the system, specifically with regards to implementation. The assembly process was questioned, as was the sequence in which the buoyant foundation system was put together.[190]

From May to July 2007, Stuart Broussard and Ezra Boyd, along with other students at the LSU Hurricane Center, built a frame suggesting a house on top of the previously built platform and buoyant foundation. They also built a temporary flood tank surrounding the platform in order to carry out the flotation test. The platform was lifted and moved with a boom crane in order to install the flood tank liner. A swimming pool liner was used to seal the inner surface of the tank. Holes were cut in the liner to accommodate the masonry piers and vertical guidance posts, and a thick layer of sand was used to hold down the liner. Water was pumped into the tank from the nearby Mississippi River. When the water had risen to a sufficient level, the buoyancy blocks began to float, lifting the platform and house frame off the masonry piers. To simulate the full weight of a house and its contents, water barrels and sandbags were added. A stability test was conducted using unevenly distributed sandbags to represent an imbalanced live load which tilted the floating platform (fig. 164, 165).[191] The flood test revealed that the proposed amphibious foundation system works with a flood test in an observed, calibrated, and controlled test facility.

fig. 159: The Original Team of LSU Mechanical Engineering Students

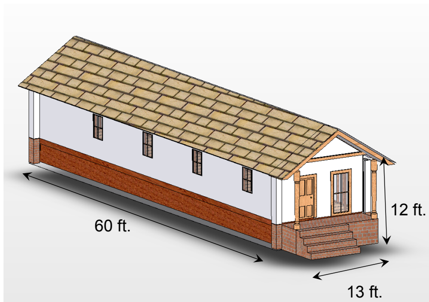


fig. 160: Diagram of a Typical Shotgun House

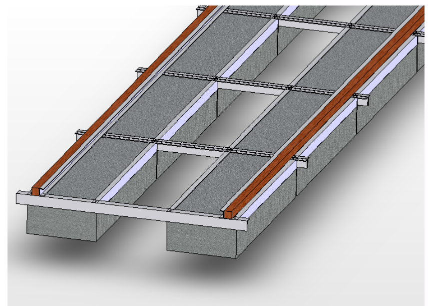


fig. 161: Diagram of Foam Buoyancy Blocks, Angles and T-Beams

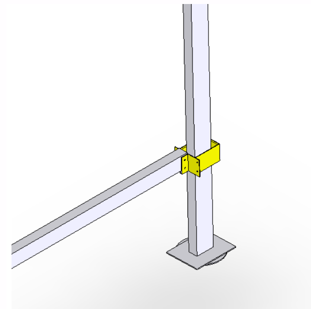


fig. 162: Diagram of Vertical Guidance Post and Sleeve

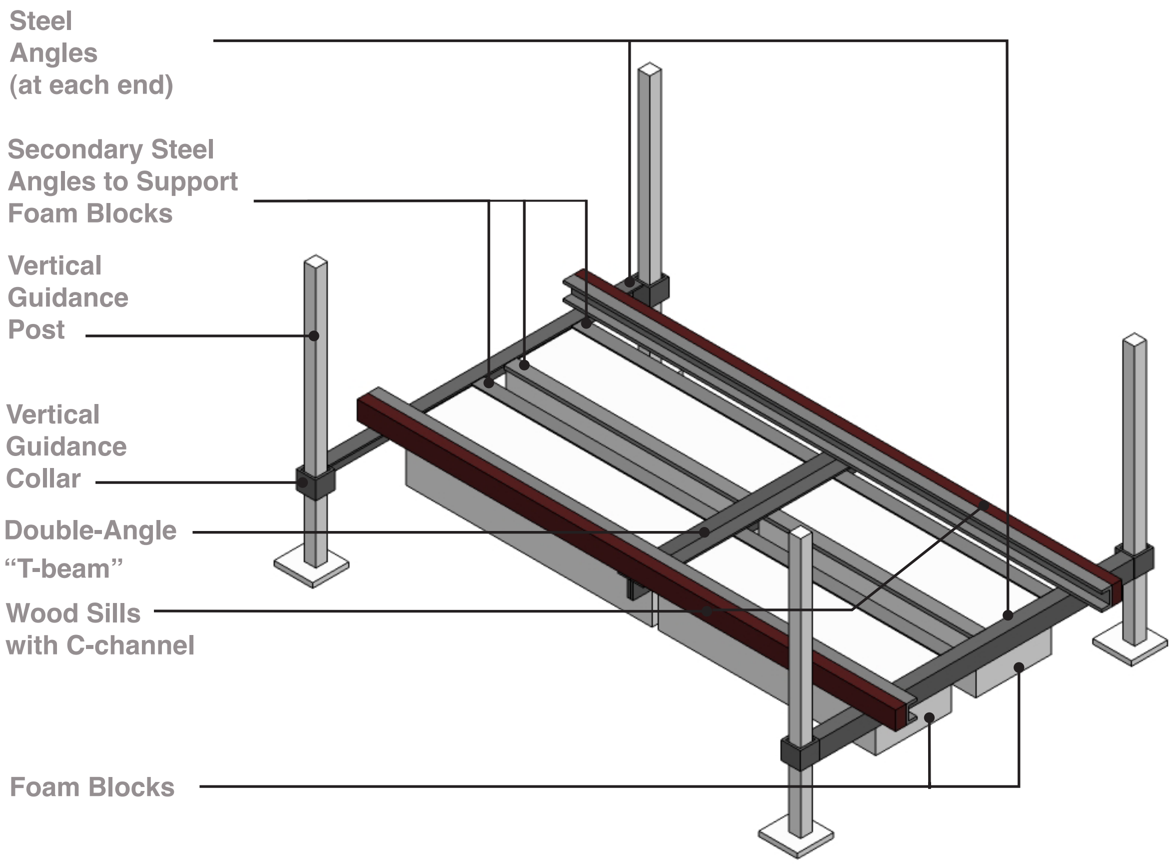


fig. 163: Diagram of LSU Prototype's Components Assembled

Part 1:

Building the platform

Setting the vertical guidance poles

Part 2:

Adding the house frame and flood tank

A layer of sand holds down the tank liner

fig. 164: First Prototype at LSU, Construction Process

Part 2:

LIFT-OFF!

Resting on the water

Part 2:

Moving the sandbags to tilt the house

Aerial view

fig. 165: First Prototype at LSU, Construction Process

05

V

technical feasibility: noah's ark project

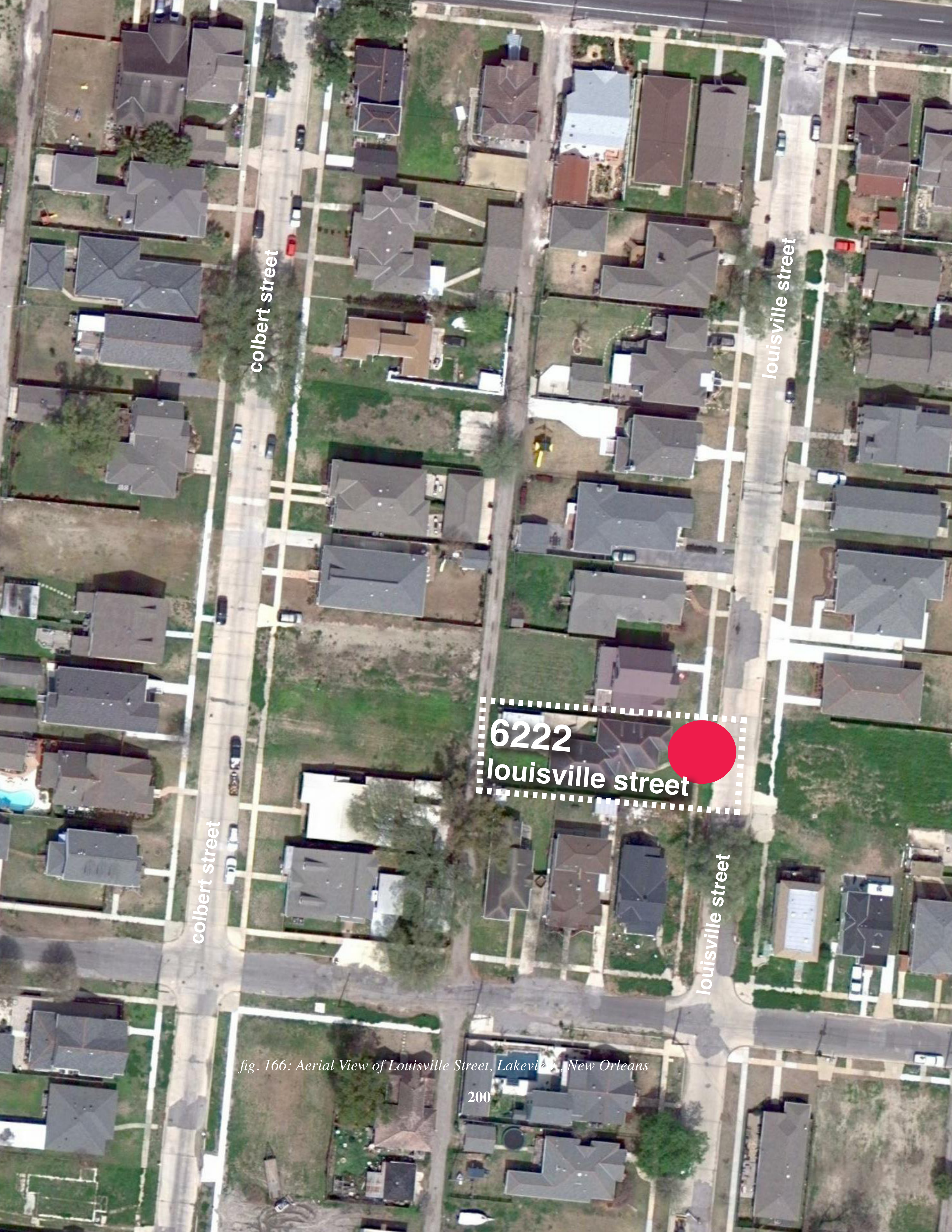


fig. 166: Aerial View of Louisville Street, Lakeview, New Orleans

noah's ark project in lakeview, new orleans

fig. 167: 6222 Louisville Street, Lakeview, New Orleans

fig. 168: Entry Stair

fig. 169: Vertical Guidance Post

NOAH'S ARK PROJECT
AMPHIBIOUS HOUSE IN LAKEVIEW,
NEW ORLEANS

This amphibious house is a local example situated in Lakeview, New Orleans, at 6222 Louisville Street (fig. 166). The "Noah's Ark Project" was designed and constructed by Spatz Development. The house was built in 2007 using prefabricated steel frame construction and is approximately 2,700 square feet (fig. 167). It can rise up to 12 feet in flooded conditions and can withstand Category 5 hurricane winds. The house is listed at $549,000 US Dollars.[192]

Clayton DeKorne reports on the Noah's Ark Project, explaining the construction method: "The shell of the home was contracted out to a modular home builder that constructs homes in a tornado-plagued Midwest. The homes are framed in steel and sheathed with OSB that is glued and screwed to the exterior walls to create a perfectly rigid shell."[193]

The house also incorporates sustainable elements such as an energy efficient roof that reduces cooling costs up to 20%. The roof is clad with metal shingles made of 98% recycled materials. The windows are clad in vinyl and are impact-resistant with shatterproof glass.[194] Figure 168 is a photograph of the entry stair. Note that it is detached from the house so that the staircase remains on the ground when the house floats.

AMPHIBIOUS FOUNDATION SYSTEM:

DeKorne discusses how the amphibious foundation system operates. He states, "[Bill Spatz] contracted with barge-builder Marine Inland Fabricators of Panama City, Fla., to craft a 3-foot-tall barge — in essence a floating crawlspace welded together from plate steel and iron trusses that could carry the weight of a steel-framed, 2,700-square-foot home. It functions as a crawlspace through which to route water and sewer lines, but it remains completely outside the thermal envelope, and all the HVAC for the house stays within the modular units above it."[195]

fig. 170: View of Vertical Guidance Post at Corner

fig. 171: Vertical Guidance Post - Detail

DeKorne comments on the construction of the foundation, "Spatz originally thought the foundation would be built on three self-contained barge units. But to keep costs within bounds, it was built as one large barge in three sections. This meant individual sections had to be tied together with steel bridging inside and seam-welded on the exterior."[196] DeKorne further reports on how the house is kept from moving laterally:

> To keep the home from floating down the street, pilings were driven some 30 feet into the ground on either side of the foundation near the house corners [fig. 169-171]. Then, a pair of steel brackets was slipped around each piling and welded to the barge. These brackets are oversized to provide ample room to slip up the pole as the waters rise. 'The toughest part of this detail,' said Spatz, 'was finding straight timber pilings, and taking care when driving them in, so the 10 feet that rose out of the ground remained perfectly plumb.'[197]

Noah's Ark Project's vertical guidance system is similar to that used for the LSU prototype in that both are composed of posts with steel sleeves, however for the LSU prototype the posts are made of steel as well.

FLEXIBLE UTILITIES:

The movable foundation created a challenge when making connections for the water, sewer, and electrical lines. The utilities must either disconnect or move with the foundation as it beings to float. Flexible piping and wiring were implemented for water and electrical connections. The local electrical company supplied a loop of wire above the service mast that can accommodate the house rising up to 10 feet. Originally a manual disconnect was specified for the sewage connection, in the form of a simple valve and gasket since it was more cost-effective. Self-sealing breakaway connections are currently in the process of being implemented.[198]

fig. 172: Noah's Ark Project, Front View

fig. 173: Noah's Ark Project, Back View

The following article by Nikki Buskey appeared in *Houma Today* on November 8, 2009. It discusses the legal issues involved with the amphibious foundation used at Lakeview (fig. 172, 173):

> Pat Gordon, planning and zoning director for Terrebonne Parish government, said he has not been approached with any plans to build a floating house locally.
>
> 'It's not something we'd promote,' he said.
>
> It may not even be legal in some of the most flood-prone areas of Terrebonne. [Mike] Hunnicutt [of FEMA] said that a stop order was issued to prevent construction of a floating house in the Lakeview area of New Orleans because that community is considered a special flood-hazard zone, which means FEMA deems it especially vulnerable to storm surges. Much of Terrebonne and Lafourche lie in such special flood-hazard zones.
>
> A floating home would not meet elevation standards, and you could not purchase flood insurance, Hunnicutt said.
>
> 'We promote elevation of homes, or in extreme cases, buyouts of repeatedly flooded properties, and moving north,' Gordon said.
>
> There are grants that the parish can help you to apply for if your home has been repeatedly flooded. Parish grants can provide up to $30,000 for elevating. The parish has helped to elevate 150 homes since Hurricane Lili in 2002.[199]

This article promotes the recommended method of flood protection by the United States federal government of permanent static elevation or in extreme cases buyouts and re-location. Spatz has offered a viable solution for residents in this flood-prone area to protect their property and remain part of their community.

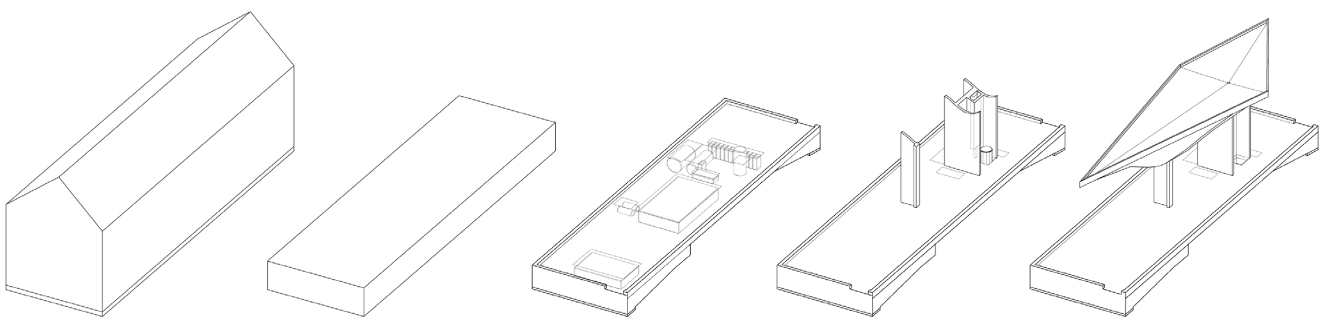
Spatz Development hopes to obtain an occupancy permit in the near future. He has been unable to acquire one due to his specification of a manual disconnect for the sewage connection. Spatz is developing a solution using self-sealing breakaway connections in order to satisfy the City of New Orleans Department of Safety and Permits.

05 vi

technical feasibility: FLOAT house

fig. 174: Aerial View of Tennessee Street, Lower Ninth Ward, New Orleans

FLOAT house by morphosis architects lower ninth ward, new orleans



HOUSE EVOLUTION

fig. 175: Design Evolution

fig. 176: Morphosis' Initial Conceptual Rendering of FLOAT House

FLOAT HOUSE - AMPHIBIOUS HOUSE IN THE LOWER NINTH WARD, NEW ORLEANS

In the wake of Hurricane Katrina, the Make It Right (MIR) foundation is building homes in part of the Lower Ninth Ward. These homes are architect-designed, durable, safe, affordable, and ecologically sustainable. Morphosis' FLOAT House was selected as one of the LEED platinum winning designs, and was completed in the fall of 2009. This 945-gross-square-foot amphibious house is a single-family residence at 1638 Tennessee Street in the Lower Ninth Ward, New Orleans (fig. 174).[200] Figure 175 is an early conceptual diagram of the FLOAT House. Figure 176 is an early conceptual rendering. The project merges prefabricated and site-constructed modular building systems, which can be seen in figure 177. Figures 178-180 display the initial design drawings of the FLOAT House.

Morphosis states, "the form and design of the house is fully integrated with the mechanical and support systems that allow the home to function largely independent of traditional city infrastructure."[201] This is an important feature in providing added resistance to flooding.

Morphosis describes their twofold concept for the design of the FLOAT House:

> [First, t]o design a foundation that enables the house to function independently of the basic infrastructure and public services that have yet to be adequately repaired in the Lower Ninth Ward and which are likely to fail again. [Second, t]o create a new house that rests upon that foundation but is wholly integrated with the natural environment, respectful of New Orleans vernacular, and enriched with sustainable technologies.[202]

The house is separated from the basic infrastructure by what Morphosis calls the "chassis." They use the analogy of a car's chassis to describe the house's functions, "the chassis hosts all of the essential mechanical and technological equipment to provide the house with power, water, and fresh air. Additionally, the foundation should protect the house from future water and weather threats. To accomplish this, the foundation was engineered out of expanded polystyrene foam, which is encased in glass fiber reinforced concrete. This composite results in a strong, resilient foundation that will float with the rising flood water."[203]

Morphosis further elaborates on the chassis and construction methods:

> The chassis of the house is the primary element around which the rest of the house is organized and assembled. Consisting of a thickened raft slab, a service core, and a large rooftop rain collector, it is designed to take maximum advantage of shop labor rates and quality control available through off-site fabrication. Constructed of polystyrene foam and glass fiber reinforced concrete, the pre-fabricated unit is shipped as a whole to the site with all required wall anchors, rough-ins, electrical and mechanical routing pre-installed. Sized for transportation on a standard flatbed trailer, all required system storage and internal infrastructure are installed in the shop. The unit is placed on site atop four stabilizing concrete pads located between a front and rear exterior deck, which act as the anchors for the house when in flood mode. The decks and their associated grade beams are constructed on site using local labor and conventional construction techniques. Finally, the modular wall framing, interior finish elements, prefabricated roofing, and remaining system components arrive on site for assembly in the field. The specific design and resultant form of the chassis allows for easy maintenance of all systems. LP and wastewater tanks are accessed from outside the house, while filters, batteries and mechanical components are accessed from within.[204]

FLOAT house was built using on and off site modular construction techniques, which allows for a greater degree of flexibility when servicing particular areas.

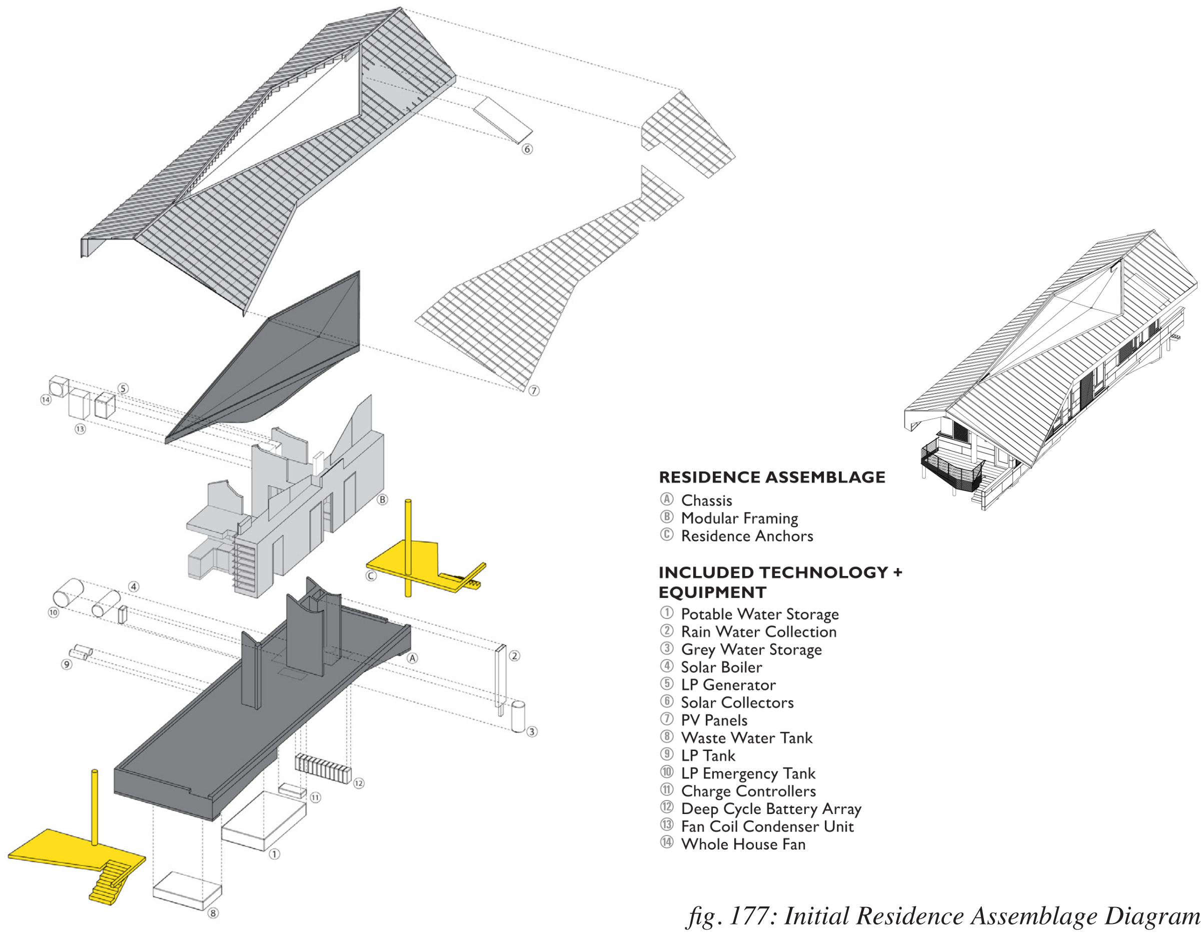


fig. 177: Initial Residence Assemblage Diagram

According to Morphosis, "FLOAT House can rise vertically on [two] guideposts, securely up to 12 feet as water levels rise. . . . [vertical guidance posts] are anchored to the ground by two concrete pile caps each with six 45-foot deep piles."[205] When water levels rise, the house floats straight upward along the guideposts and does not move laterally, away from the site. Thom Mayne, founder of Morphosis Architects claims, "indeed, at first the house was too light and needed a ballast. It had too much buoyancy, so we added a topping slab to the mass of the building, like putting a lead keel on a boat."[206] He goes on to say, "there were a number of code issues to work out with the local building officials, given its nonstandard systems and structure, but it eventually won their approval. Apparently, no insurance underwriter has weighed in on the design but I would think they'd be elated, because during a flood, the homeowner's biggest investment should stay intact. Ideally, by that time, the homeowner will have closed the carbon-fiber panels over the windows and left town."[207]

This project provides an extremely useful built precedent for the BFP. Together with the local community, MIR (a reputable, non-profit organization) and Morphosis (a world-class architecture firm), designed and constructed the first amphibious house to receive an occupancy permit in the United States. It is a helpful precedent in gaining acceptance by FEMA and the NFIP. The advantages of this system should be apparent to government regulatory agencies and the insurance industry.

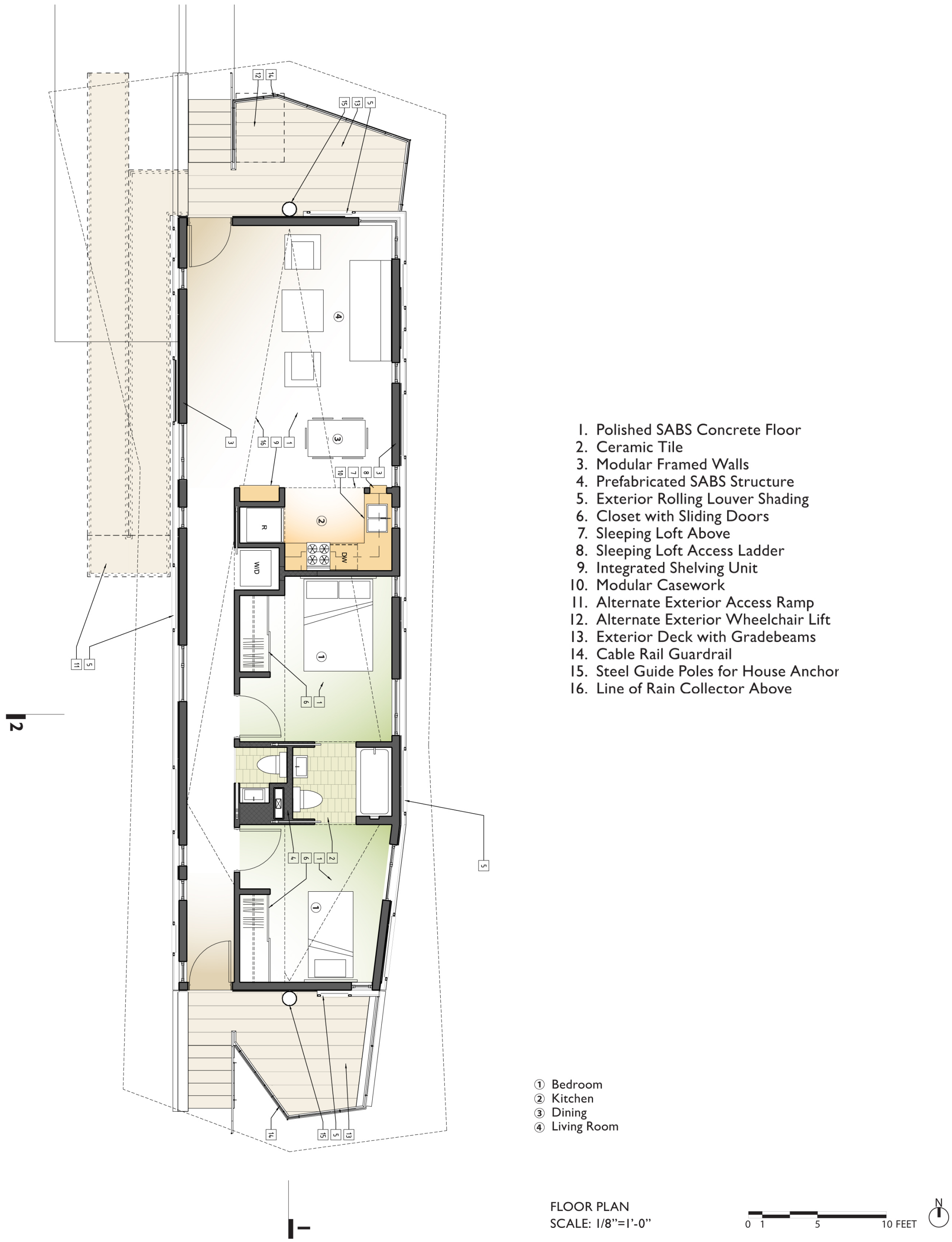


fig. 178: Initial Plan

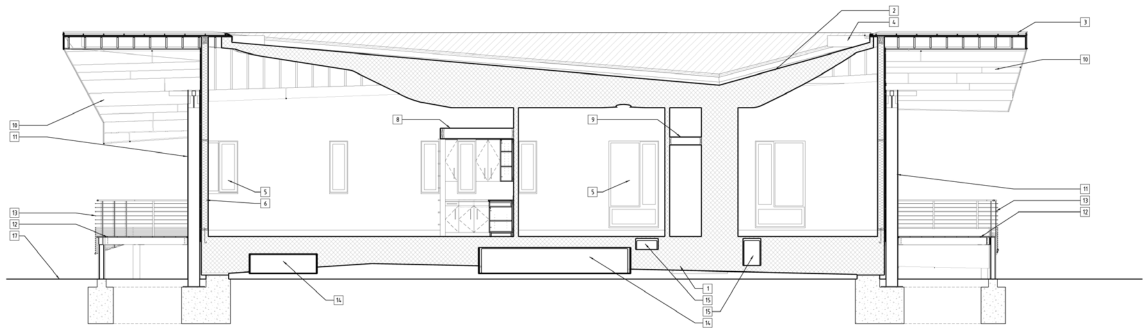


fig. 179: Initial Section

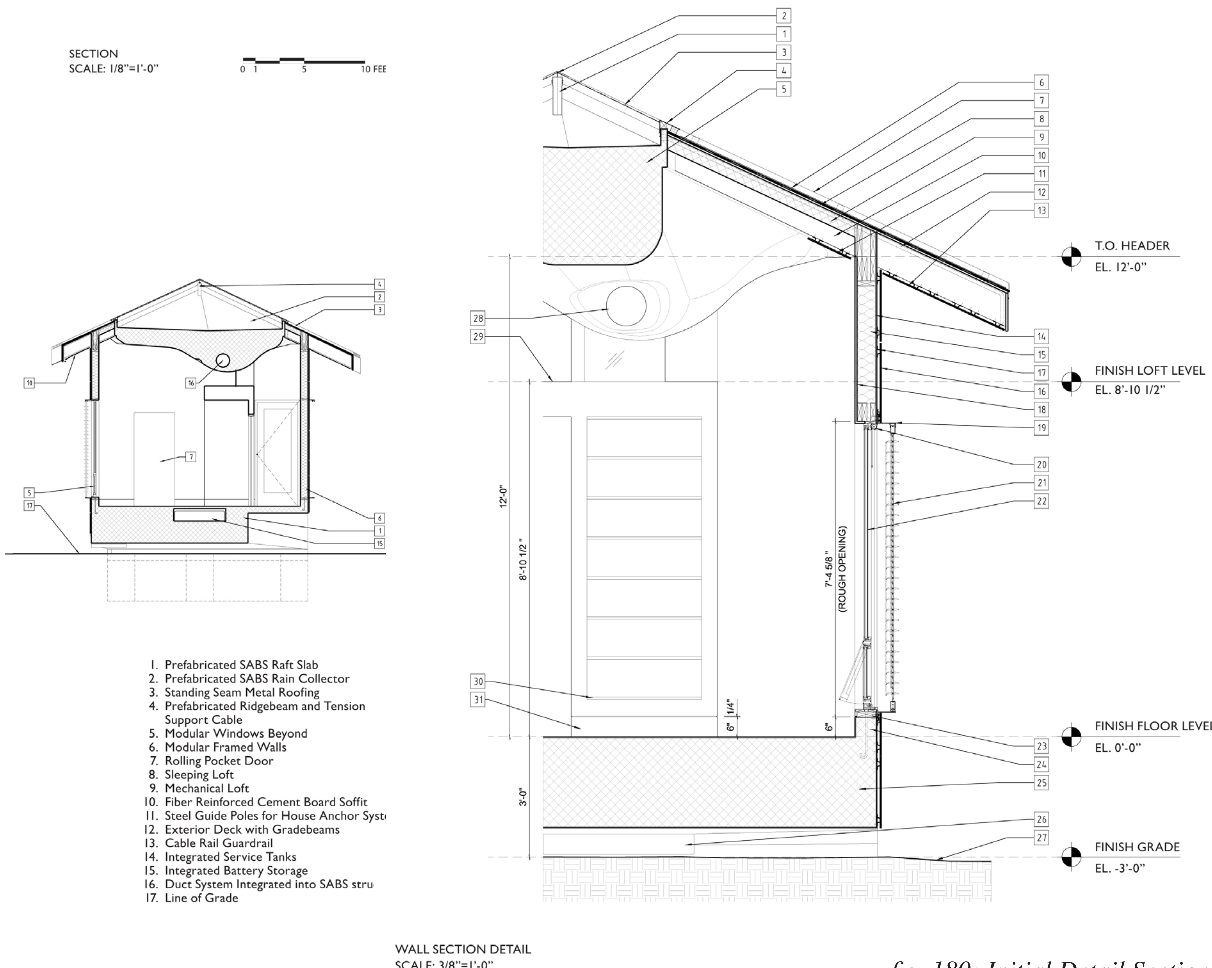


fig. 180: Initial Detail Section

POWER + USAGE

Morphosis states, "An integrated photovoltaic solar system collects and stores the power for the home, allowing it to function off the grid. Liquid propane fuel for cooking and an emergency generator supplement this system. . . . Sizing of the photovoltaic solar system considers the typical energy required for a family of four on a monthly basis, and the ability to function up to four days without sun [fig. 181-184]."[208] Sustainable design elements have been implemented to power the FLOAT House in the event of a power outage during a storm. Morphosis further comments on the rain water collection system, "The sloped concave roof collects rainwater, and funnels it into cisterns housed in the chassis, where it is filtered and stored for daily use."[209] The law in New Orleans does not permit rainwater collection for use other than irrigation. It is unknown if the rainwater collection system specified in the design of the FLOAT House is active.[210]

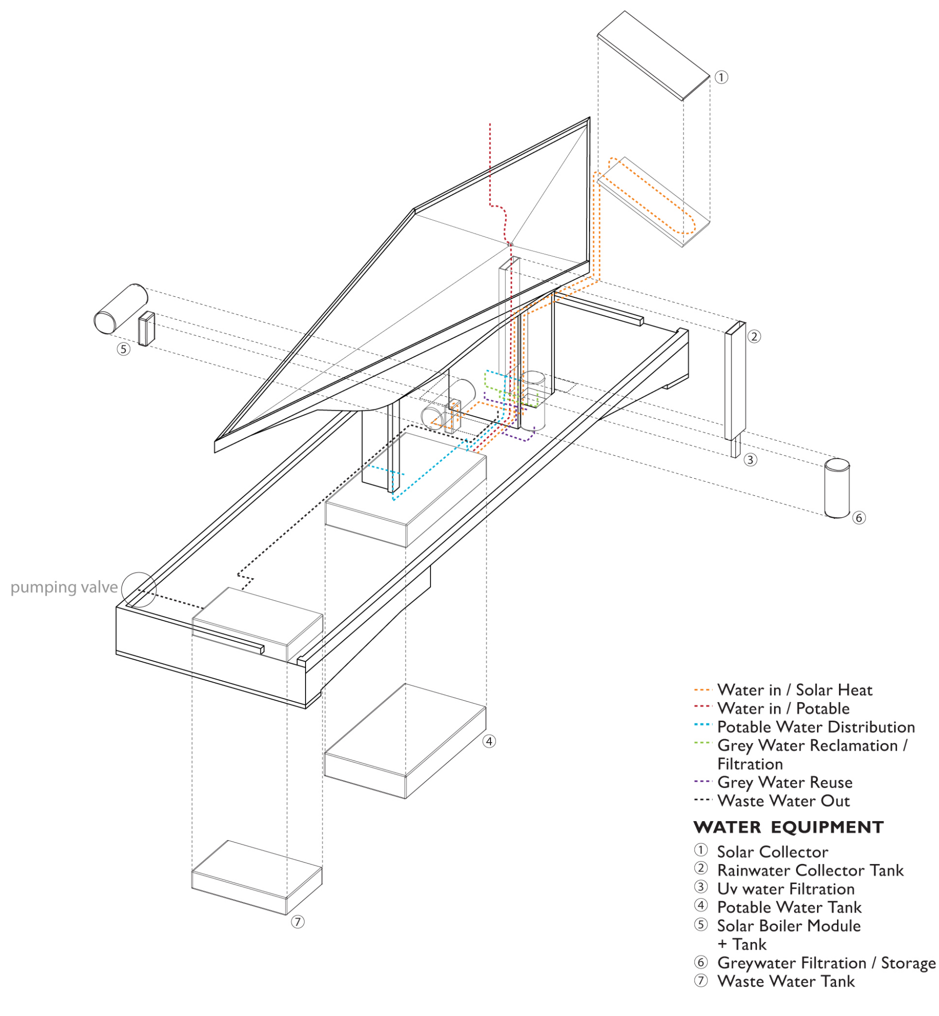


fig. 181: Initial Water Equipment Diagram

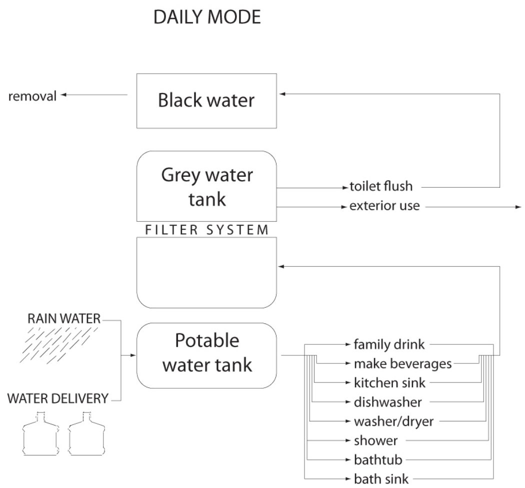


fig. 182: Initial Water Usage Flowchart

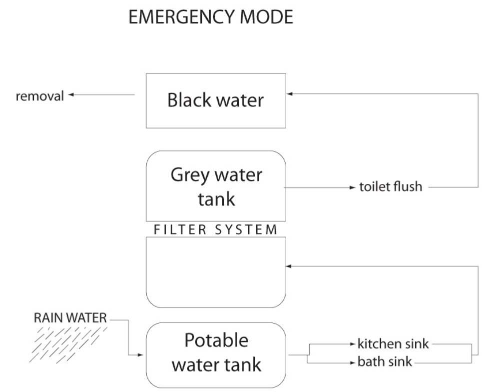


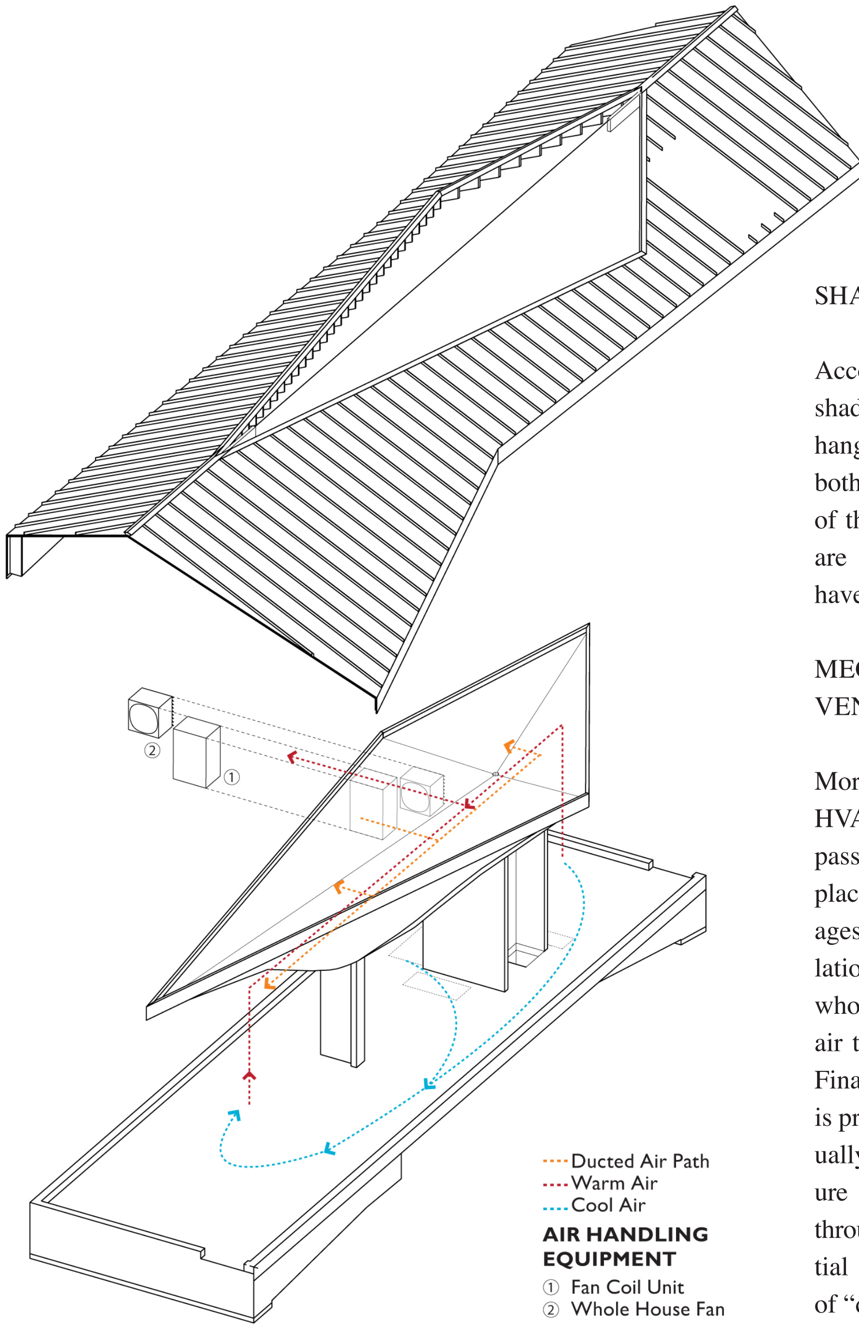
fig. 183: Initial Emergency Mode Flowchart

WATER USAGE

Water items: Included

Item	Brand	Model	H20 Used (gal/cycle)	Usage days/ month	H20 Use Family of 4 (gal/mnth)	Initial cost	Comments
*Potable water tank	American T	0255-025	0	30	0	1200	1140 gallon capacity / collapsible / 144x84x24
*Wastewater tank	American T	0416-060	0	30	0	1400	1250 gal, single compartment in ground / pumped weekly
*Wastewater tank	Monarch	500 gal	0	30	0	800	500 gal, single compartment / emergency use / 5'8"x5'1"x4'5"
*Solar water heating	Thermodyna	SB64-9PV	0	30	0	4563	2 collector system
*Solar water pump	Thermodyna	P50140 - 12VDC	0	30	0	633	pump / motor / TDL booster
*Solar water pump pv	Thermodyna	PV32	0	30	0	754	
*Hot water tank (solar)	Thermodyna	TG454	0	30	0	796	80 gallon capacity / 24x60
*Dishwasher	Bosch	see above	10.6	15	159	sa	
*Laundry	GE	see above	36.3	16	580.8	sa	
*Toilet	Caroma	double flush	4.8	240	1152	400	dual flush
*Shower head	GAIAM	ULTRAOXYGENICS 01-45	0	30	0	55	
Shower adult	GAIAM		20	90	1800	na	3 showers/day
*Sink faucet	American S	6056105	0	30	0	80	
*Bath sink	Pegasus	PGS1437	0	30	0	130	
Wash hands	American Standard		0.75	240	180	na	
Brush teeth	American Standard		1	240	240	na	2 min brush time
Shave	American Standard		1.5	24	36	na	
*Bath faucet	American S	Tropic Bath Kit	0	30	0	50	
*Bath tub	Crane	118939	0	30	0	140	60x30x15.5 tub size
Bath adult	American Standard		20	4	80	na	fill to 20 gal ea bath
Bath child	American Standard		8	30	240	na	fill to 8 gal ea bath
*Kitchen sink faucet	American S	Colony Soft 2 Handle	0.5	4	2	97	
*Kitchen sink faucet	American S	7143.803	0	0	0	115	
Wash dishes/hand	American Standard		2.5	30	75	na	5 min wash time
Plant watering			0.4	30	12	na	indoor plants/daily
Monthly total greywater					4556.8		
Drinking water			1.2	30	36	na	separate tank
Making beverages			0.6	30	18	na	separate tank
Monthly total drinking water					54		
Greywater filtration system	BRAC	W-125	-46.1	30	-1383	1345	greywater diversion
UV water filtration system	Mightypure	MP22A	0	30	0	645	POE filtration
Monthly total water reuse					-1383		
Monthly included totals					**3227.8**	**3057**	

fig. 184: Initial Water Usage Table



SHADING

According to Morphosis, “Exterior shading in the form of large roof overhangs and exterior louvers regulate both the interior and exterior climate of the house.”[211] Figures 185 and 186 are initial diagrams of the roof and have changed during construction.

MECHANICAL + NATURAL VENTILATION

Morphosis further comments on the HVAC system, “The house relies on passive ventilation through window placement and sizing that encourages cross-ventilation. Passive ventilation is supplemented by an active, whole-house fan system, which pulls air through, up and out of the home. Finally, a more traditional HVAC unit is provided to cool each room individually on an as-needed basis.”[212] Figure 185 displays the ventilation path throughout the structure. It is an initial diagram which suggests the path of “ducted” air, warm air and cool air, as it circulates through the house. It also shows where the fan coil unit and whole house fan were initially located during design development.

fig. 185: Initial Ventilation Diagram

fig. 186: Initial Materiality

MATERIALITY

Morphosis outlines the major material used throughout the FLOAT House. They state, "Areas of fiber-reinforced concrete used in the house chassis and rain collector are left exposed on ceilings and floors to store and transmit cool energy throughout the day."[213] Figure 186 displays an initial diagram showing the areas of the house that were to be made of fiber-reinforced concrete. Figure 187 is a physical model built by Morphosis, showing how the house could slide up the vertical guidance posts under flooded conditions. Figures 188-193 are images of the house under construction taken in August 2009. Figures 194-198 are photographs, renderings and drawings of the completed FLOAT House. Figure 199 is drawing of the final plan and three-dimensional axonometric view outlining the significant components of the project. Morphosis states: "The primary living spaces: living room, kitchen, bedrooms, and bathrooms are aligned end-to-end within a 16' x 58' bar."[214] The rooms are aligned in a row reminiscent of vernacular shotgun housing; however, circulation space is separated, which is not a common characteristic of shotgun housing typology.

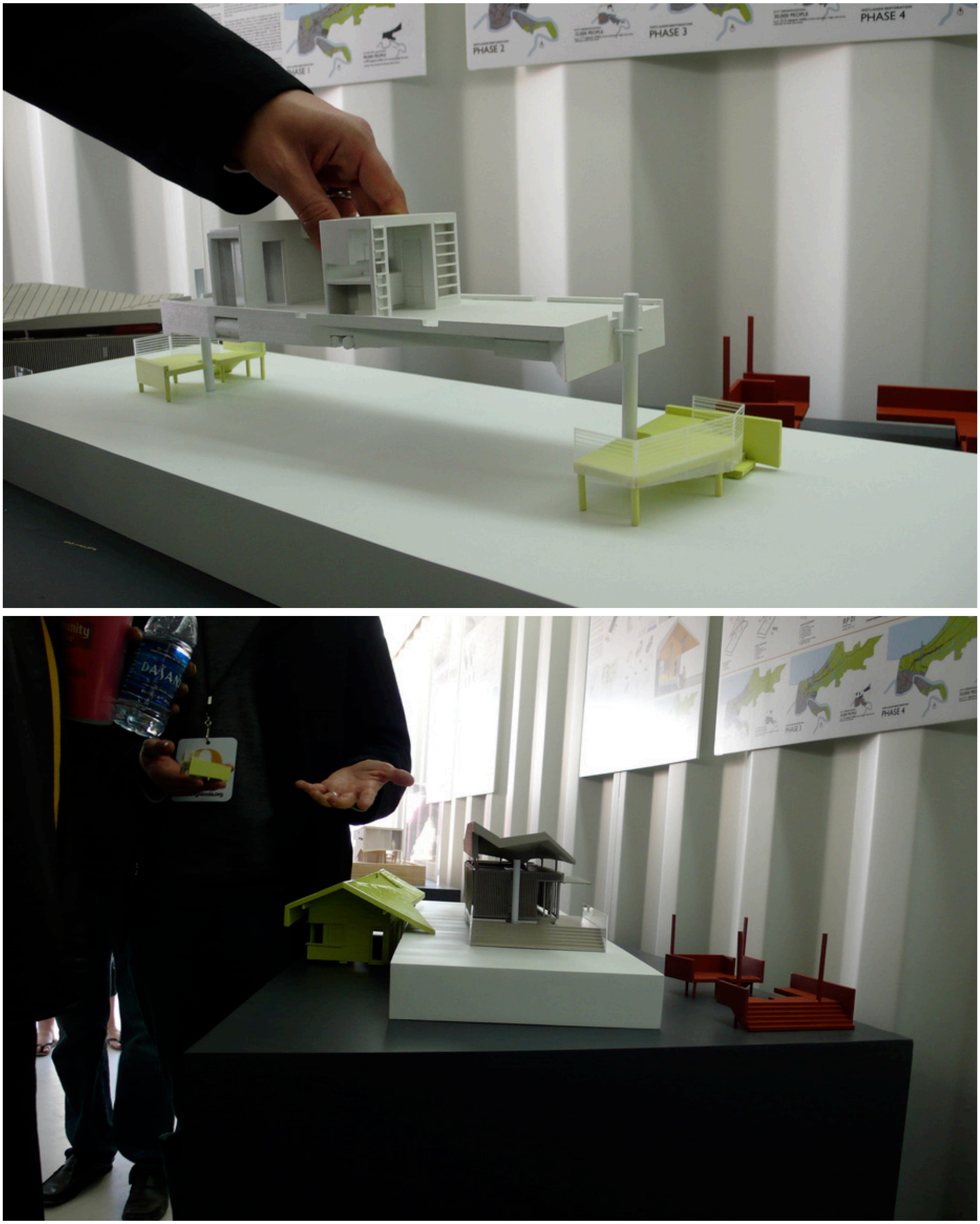


fig. 187: FLOAT House, Model

fig. 188: FLOAT House, North East Perspective, August 2009

fig. 189: FLOAT House, East View, August 2009

fig. 190: FLOAT House, Scaffolding on South West Perspective, August 2009

fig. 191: FLOAT House, North View, August 2009

fig. 192: FLOAT House, Base of Vertical Guidance Post, August 2009

fig. 193: FLOAT House, Foundation, August 2009

fig. 194: FLOAT House Completed October 6th 2009, Front View

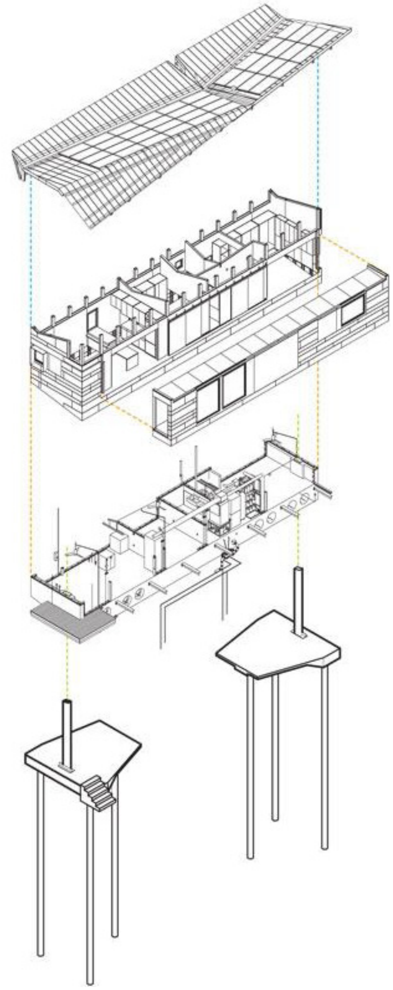


fig. 195: FLOAT House, Recent Exploded Axonometric

fig. 196: FLOAT House Completed October 6th 2009, Interior View

fig. 197: FLOAT House, Back View

fig. 198: FLOAT House Completed October 6th 2009, Corner View

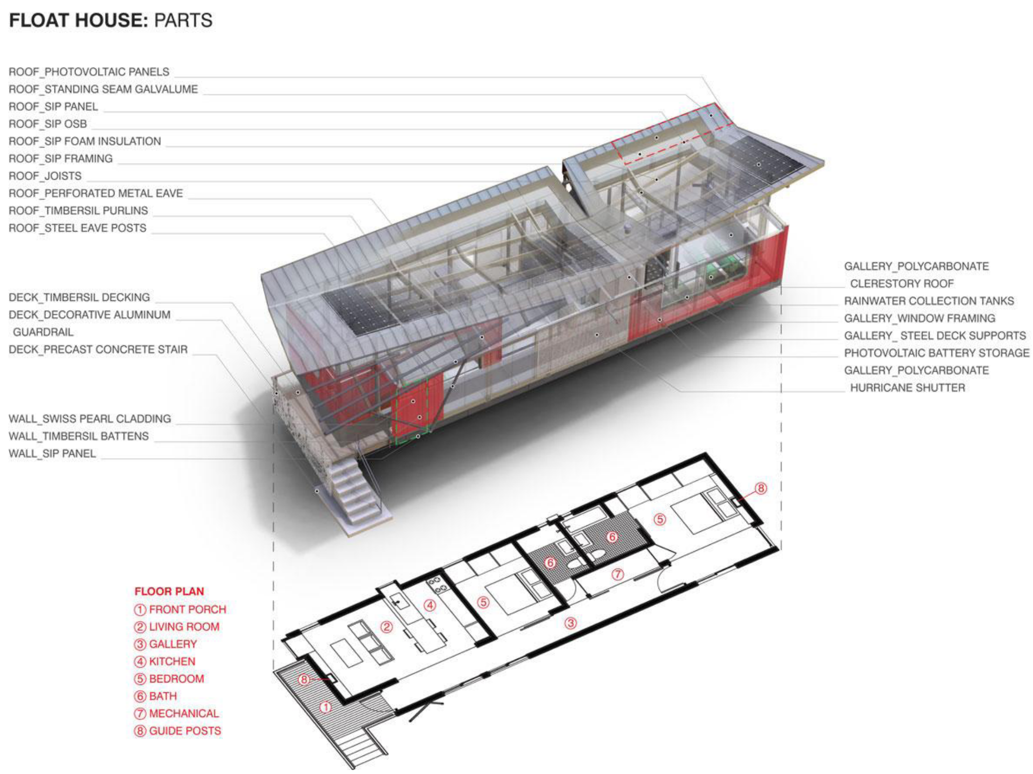


fig. 199: FLOAT House, Recent Plan and 3D Axonometic

05 vi

technical feasibility: LIFT house

LIFT House dhaka bangladesh

fig.200: Partial Aerial View of Dhaka Bangladesh


dar-us-salam road
HBRI building
dhaka-aricha highway

LIFT HOUSE -
AMPHIBIOUS HOUSING IN
DHAKA, BANGLADESH

Prithula Prosun, a graduate student in architecture at the University of Waterloo, has recently designed and built the first engineered and code compliant amphibious house in Dhaka, Bangladesh. It is also believed to be the first engineered amphibious housing project constructed outside the Netherlands and the United States. She calls the project LIFT House, which stands for Low Income Floating Technology. It was designed for implementation in impoverished communities situated in low-lying, flood-prone areas of Dhaka, and has the capability of floating in rising water. She was successful in obtaining a grant from the International Development Research Center (IDRC) to support the research, design and construction of the two-unit prototype. According to Prosun, “The project has been constructed, flotation-tested, and was inaugurated by the Agricultural Minister Matia Chowdhury at House Building Research Institute at Mirpur in Dhaka on January 26, 2010 [fig. 200].”[215]

As published in Canadian Architect, April 2010, “Prithula designed an affordable house with a projected cost per unit of $4,000 made from sustainable and recycled material such as bamboo. [The house] derives its buoyancy from recycled plastic water bottles. . . . These bottles are plentiful; in fact, they litter the city and cause drainage problems. . . . Electricity is derived from two 60 Watt solar panels to power lighting and fans. The houses are served by composting toilets, and urine is directed to the garden through an underground pipe system.”[216]

LIFT House, built by construction workers and volunteers from the local area, is a particularly useful precedent for the BFP as it may serve to inform the future implementation of sustainable materials, funding, media relations and project coordination.

The following excerpt is the abstract Prosun submitted for the IDRC, which describes details and initiatives of the project.

Rapid urbanization in Dhaka, Bangladesh has forced a large portion of the city’s population to take shelter in substandard housing in slum and squatter settlements deprived of basic services. The heavy influx of rural-urban migration, amongst other factors, has resulted in a housing market that does not cater to the urban poor. Large public housing initiatives have proven to be inadequate to solve the problem of housing Dhaka’s slum and squatter inhabitants. Frequent floods in the city have further deteriorated the lives of the urban poor, creating great economic losses and an array of health problems. Low lying portions of the city experience annual inundation due to the overflow of surrounding rivers and heavy monsoon precipitation, creating a threshold for development. The high land prices of Dhaka make these flood-prone areas especially attractive to hazardous slum and squatter settlements.

The design proposal provides a solution for housing that will become a new typology for urban slums and squatters. A prototype of a sustainable amphibious housing community will provide opportunities for home based income generation aimed at empowering women. The design consists of a service spine which is a concrete structure that contains all the service connections and houses green technologies such as composting toilets and rainwater harvesting cisterns. The structure for the amphibious houses attach to the service spine that act as the vertical guide. The chosen residents, currently squatter inhabitants, will be responsible for taking a micro-credit loan to finance and construct the finishes and roofing for the amphibious houses. This innovative prototype of flood protected housing for the urban poor will begin a process that can spread and adapt to the slum and squatter areas of Dhaka, giving each citizen a chance to exercise their right to decent housing.[217]

Notable design features include:

- *A Raised Courtyard and Vegetable Garden: Soil from excavation is used for a shared courtyard and vegetable garden.*

- *Washrooms: Toilets and showers are located on the ground level in the brick service spine and remain stationary during a flood.*

- *Brick Service Spine: Contains service lines, water cistern and composting tanks.*

- *Indigenous Materials: Exterior cladding, interior finishes and roofing are all made from indigenous materials.*

- *Bamboo Units on Amphibious Foundations: Connected to the brick service spine, that acts as a vertical guide during flotation.*

- *Elevated Walkways: The top of the brick service spine becomes an elevated brick pathway and exterior space for residents.*[218]

Prosun's original design began as an 8-unit residence, but the experimental prototype constructed has 2 units. The following descriptions reflect the initial 8-unit concept.

Figure 201 is the initial rendered plan of the ground level displaying the showers, composting toilets, service stairs and a vegetable garden. Dual access is provided, allowing compartmentalization of living spaces. The amphibious housing units made of bamboo are attached with steel connectors to the brick service spine. Figures 202 and 203 are the initial rendered sectional comparisons of the units in dry conditions and flooded conditions. Figure 204 highlights the initial notable design elements. Figures 205-207 are initial conceptual perspective renderings. Figures 208 and 209 are renderings of the 2-unit prototype.

HOW IT WORKS

Each of the two-unit dwellings is primarily made of bamboo and provides living and sleeping quarters for a single family. The central brick spine houses the plumbing, utilities and rainwater storage cisterns. The vertical guidance system is comprised of a steel pipe that is cast into the masonry service core with a slit cut along the front, facing the bamboo house. Inside the pipe, a smaller steel pipe (approximately 1 foot in length) is inserted that slides up and down inside the main pipe. The smaller pipe is attached to the bamboo dwelling with metal plates that pass through the slot in the larger pipe. Buoyancy of the bamboo dwelling units is achieved using two different systems: one of the dwellings has a hollow ferrocement foundation, the other is a bamboo frame foundation filled with recapped empty water bottles. The steel vertical guidance system attaches the bamboo dwellings to the brick and concrete service spine and the dwellings slide up and down vertically.[119]

CONSTRUCTION TIMELINE

Figures 210-221 are site photographs of the project under construction. At the beginning of November 2009, soil tests were initiated on the site of LIFT House. Excavation began on November 12, 2009, and lasted for four days. On the fifth day, November 17, 2009, reinforcement for the concrete slab was set in place and two days later, concrete was poured for the foundation. On November 22, 2009, the team began constructing the brick walls for the central service spine to house the composting latrines and rainwater storage cisterns, which took 12 days to complete. While the masonry service spine was being constructed, bamboo was also obtained to construct the amphibious housing units and was later chemically treated. The first buoyancy element was then created for testing, using empty recapped plastic water bottles encased in a bamboo frame. On November 23, 2009, the bamboo encased-water bottle buoyancy element was tested with live load; four team members stood on top of the buoyancy element to test its capacity. On December 14, 2009, a ferrocement frame was prepared in order to create one of the buoyant foundations. On December 31, 2009, the empty recapped plastic water bottles were prepared and grouped into plastic bags. By January 5th, 2010, the bamboo frames for both units were completely erected and ready to be clad. On January 11, 2010, woven bamboo cladding was attached to the bamboo structural frames of each unit to create the walls and windows. On January 26, 2010, the LIFT House was fully completed and the opening ceremony was held on site in Dhaka, Bangladesh. Figures 222 and 223 are photographs of the completed project in January 2010.[220]

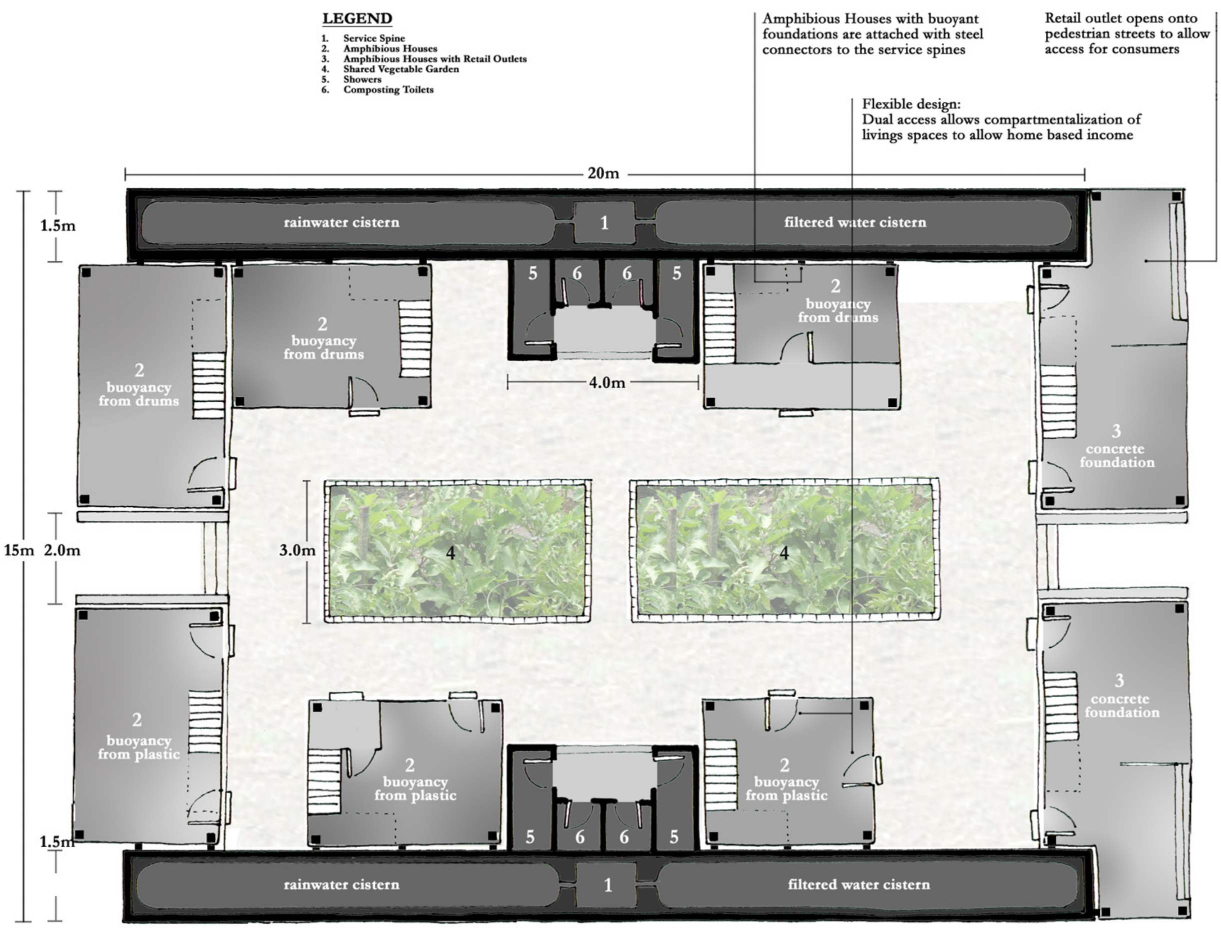


fig. 201: LIFT House, Rendered Plan

fig. 202: LIFT House, Rendered Section In Dry Conditions

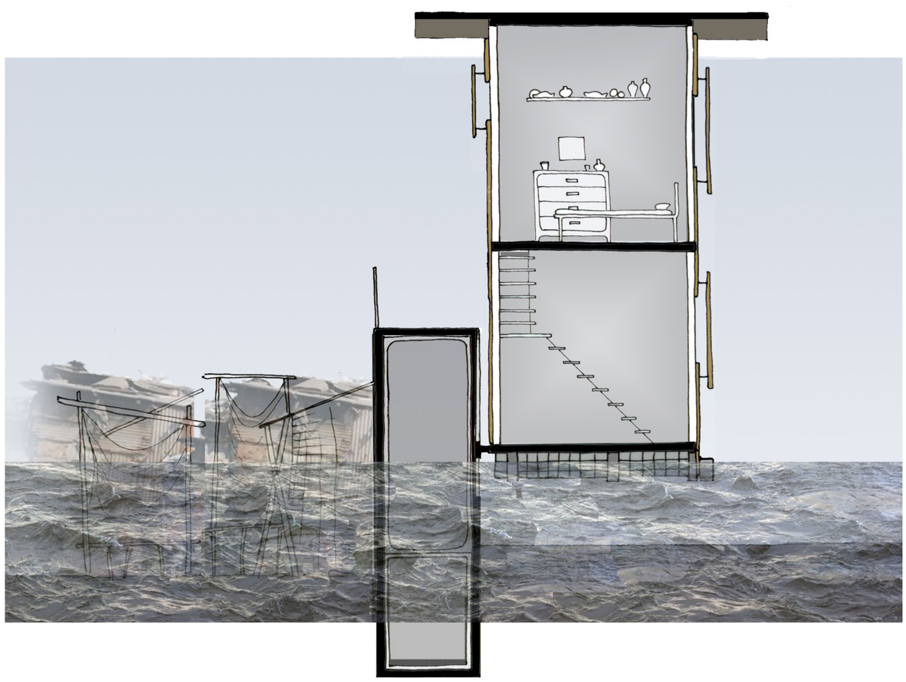


fig. 203: LIFT House, Rendered Section During a Flood

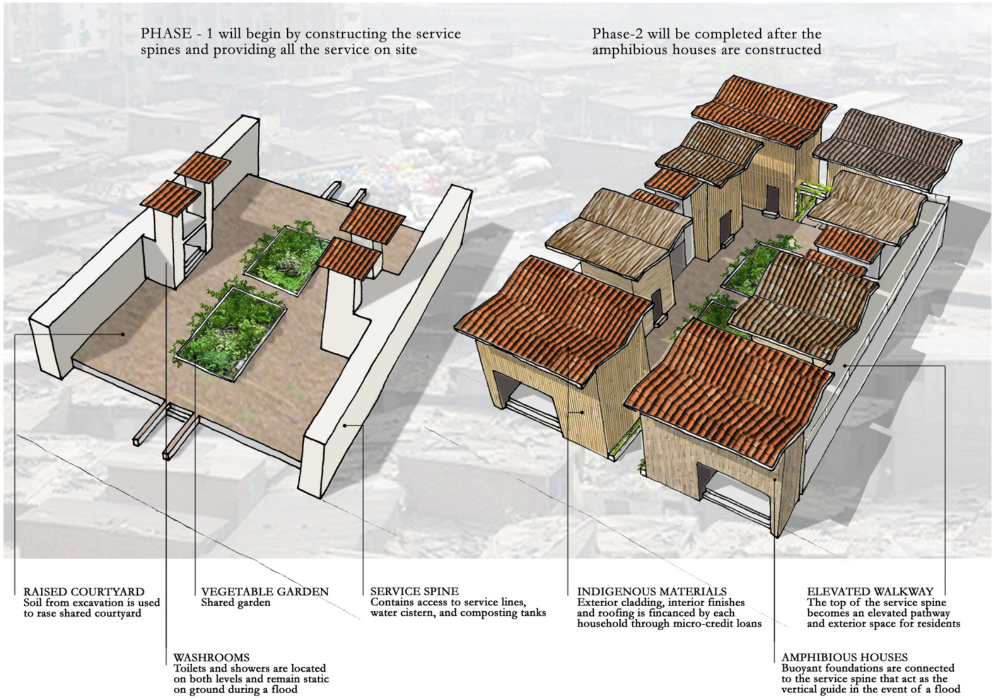


fig. 204: LIFT House, Design Elements

fig. 205: LIFT House, Perspective During a Flood

fig. 206: LIFT House, Rendered Perspective of Courtyard

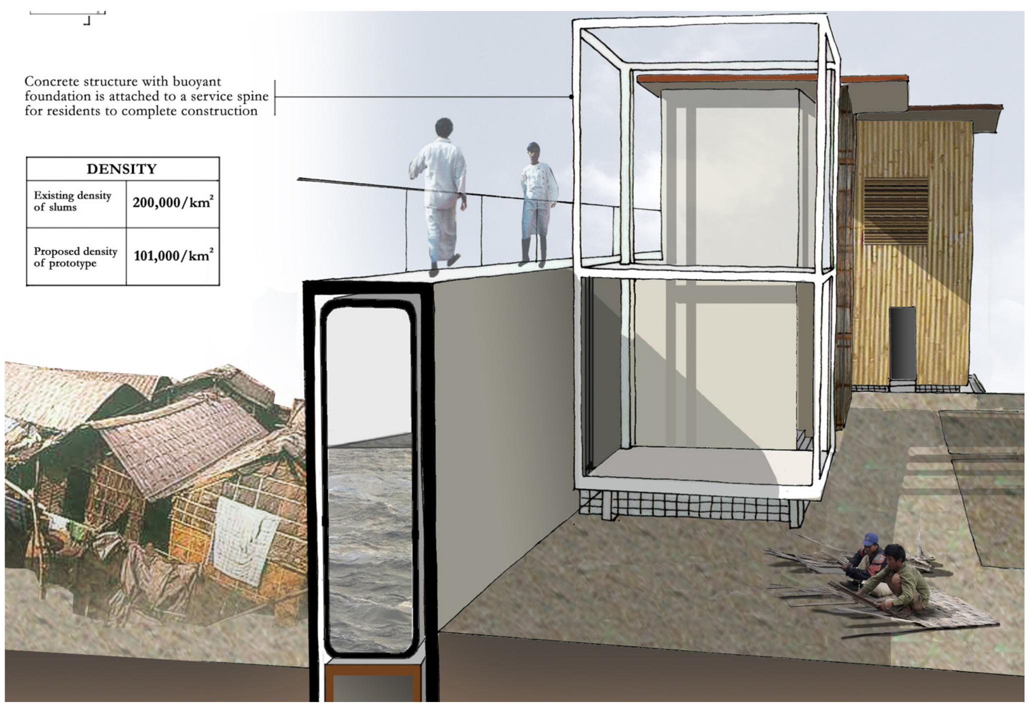


fig. 207: LIFT House, Rendered Sectional Perspective of Amphibious Structure

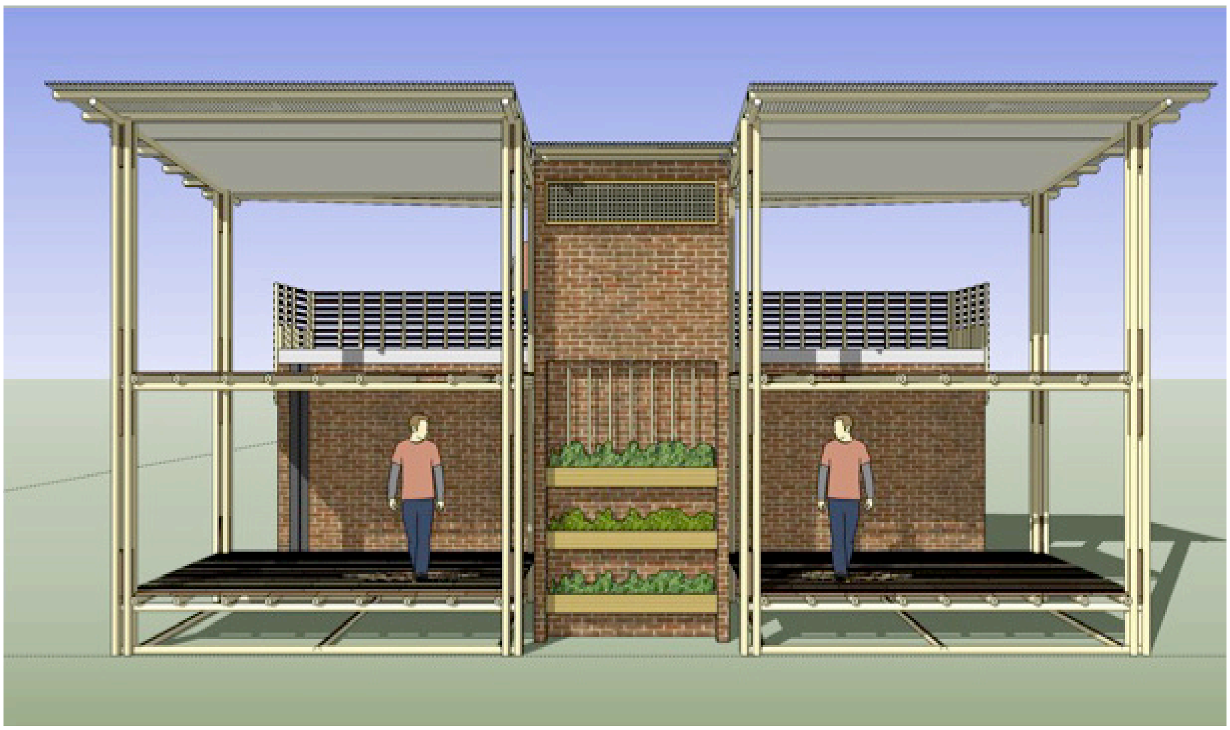


fig. 208: LIFT House, Double Unit Rendering, Front Perspective

fig. 209: LIFT House, Double Unit Rendering, Side Perspective

fig. 210: Digging Bore Hole for Soil Test

fig. 211: Prithula Overseeing Excavation

fig. 212: Excavation

fig. 213: Preparing Foundation

fig. 214: Preparing Foundation 2

fig. 215: Capped Water Bottle Buoyancy System

fig. 216: Prithula Overseeing Wall Construction

fig. 217: Wall Construction,

fig. 218: Construction Team Assembling Masonry Wall

fig. 219: Bamboo Structure in Place

fig. 220: Bamboo Structure in Place beside Concrete Spine

fig. 221: Bamboo Structure in Place beside Concrete Spine, Perspectival View

fig. 222: LIFT House, Completed January 2010, Front View

fig. 223: LIFT House, Completed January 2010, Three-Quarter View

05 vii

technical feasibility: analysis

fig. 224: Amphibious Fishing Camps, Raccourci Old River, Louisiana

fig. 225: Amphibious Housing, Maasbommel, Netherlands

fig. 226: LSU Prototype, Baton Rouge, Louisiana

fig. 227: Noah's Ark Project, New Orleans, Louisiana

fig. 228: FLOAT House, New Orleans, Louisiana

fig. 229: LIFT House, Dhaka, Bangladesh

TECHNICAL FEASIBILITY SUMMARY

The following summary highlights relevant components of each example in relation to the Buoyant Foundation Project (BFP).

POINTE COUPEE PARISH (mid 1970s to present)

The first amphibious fishing camps at Raccourci Old River in Pointe Coupee Parish, Louisiana, were constructed around the mid-1970s (fig. 224). They display an amphibious foundation system installed on mobile housing, and prove its reliability, functionality, and affordability. They have been designed and installed by homeowners, providing an example of a retrofit system that has worked for over 30 years. The amphibious fishing camps utilize a basic system configuration that can be engineered, made code compliant, and aesthetically appropriate for urban applications. The amphibious system is usually comprised of expanded polystyrene (EPS) foam blocks fastened under the steel frame, with steel sleeves that slide up and down on steel vertical guidance posts. It is a reliable system that is cost-effective and uses retrofit construction to encourage the preservation of existing structures, which also makes it sustainable.[221]

MAASBOMMEL (2006)

The amphibious housing at Maasbommel (fig. 225) exemplifies a modern, engineered solution that can be easily reproduced. It is a widely publicized built example of amphibious architecture in the Netherlands, classifying it as a type and announcing its technical feasibility for new construction. It is an internationally known example of the concept's feasibility, functionality and appropriateness as a flood mitigation strategy in flood-prone applications.

Maasbommel's amphibious housing is new construction that allows for a greater degree of design flexibility in the search for appropriate innovative solutions that achieve stability. Each platform supports two houses and the vertical guidance posts are located in an unobtrusive position between the houses. In contrast, the BFP is a retrofit, where stabilization and concealing vertical guidance posts is more challenging.[222]

LSU HURRICANE CENTER PROTOTYPE (2007)

This prototype (fig. 226) is a simple demonstration that the amphibious foundation system proposed by the BFP works when flood tested in an observed, calibrated, and controlled test facility. The amphibious fishing camps at Pointe Coupee Parish provide an example of the basic system configuration for the prototype. The main components of the amphibious system are expanded polystyrene (EPS) blocks fastened to a steel substructure with sleeves sliding on four fixed vertical guidance posts.[223]

NOAH'S ARK PROJECT (2007)

This example in the Lakeview neighbourhood of New Orleans is believed to be the first fully engineered and legally permitted amphibious house constructed in the United States (fig. 227). The house is prefabricated, steel-frame construction that is technically feasible and aesthetically appropriate for New Orleans. The house sits on a 3-foot-high hollow box that is constructed from welded plate steel and iron trusses. Heavy timber vertical guidance posts are sunk into the ground at the four corners of the house. Metal sleeves that can slide up and down on the posts are welded to the metal box base.[224]

FLOAT HOUSE (2009)

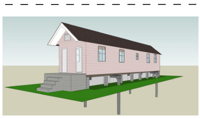
The FLOAT House (fig. 228) demonstrates the technical feasibility and appropriateness of amphibious construction for the culture of a local neighbourhood in New Orleans. It is situated in close proximity to the potential site of the BFP in the Lower Ninth Ward and is the first amphibious house to receive an occupancy permit in the United States.[225]

The base of the house, what Morphosis refers to as the "chassis," provides buoyancy. It allows the house to slide vertically on two steel guidance posts as water levels rise and float up to a height of twelve feet. The "chassis" was prefabricated and modular, made of a single unit of expanded polystyrene foam coated in glass fiber reinforced concrete. It houses all the required anchors, electrical, mechanical, and plumbing systems pre-installed. Two vertical guidance posts, exposed on the interior but not visible from the exterior, are encased in concrete reinforced sleeves one at each end of the house. Two concrete piles caps, each with six 45-foot deep piles, anchor the vertical guidance posts to the ground. The house rests on a raised 4-foot base under normal conditions, which facilitates accessibility while fostering the porch culture of the Lower Ninth Ward neighbourhood. FLOAT House not only serves as a design precedent, but also as a political precedent in obtaining local building permits. MIR has contributed to the exposure of amphibious solutions, raising public awareness and stimulating the demand for amphibious housing in the Lower Ninth Ward, New Orleans and elsewhere.[226]

LIFT HOUSE (2010)

Prithula Prosun, a graduate student at the University of Waterloo School of Architecture, created the LIFT House. This recently completed project targets the low-income population in flood-prone Dhaka, Bangladesh (fig. 229). It is an international example of technical and economic feasibility and appropriateness, employing the use of sustainable materials. Buoyancy is achieved through two methods: a hollow ferrocement foundation for one unit and a bamboo frame foundation filled with recapped empty water bottles for the other. A central, masonry service spine provides vertical guidance for the two bamboo dwellings. These innovative techniques may provide insight to the BFP during future development.[227]

Figure 230 compares significant parameters of each example, visually outlining feasibility aspects in relation to the BFP.

amphibious project name + location	completion	architect/ builder	challenges	max height during flooded conditions + total living area
 fishing camps raccourci old river, louisiana	mid 1970's to present	individual homeowners	annual spring flooding of mississippi river lakefront area in rural louisiana	15-25 feet size varies - 540-960 sq ft (typical size of a single-wide)
 maasbommel mass river, netherlands	2006	ger kengen factor architecten chris zevenbergen dura vermeer construction	60% of netherlands below sea level creates a vulnerable topographic condition supplement to infrastructural flood mitigation strategies, constructed on a recreational site outside the dike system	18 feet 1600 sq ft (approx.) for each 2-storey housing unit
 LSU hurricane center prototype baton rouge, louisiana	2007	dr. elizabeth english working with LSU mechanical engineering and hurricane center students	full scale prototype conducted on LSU campus demonstrating the efficacy of the buoyant foundation system	5 feet 312 sq ft (13' x 24')
 noah's ark project new orleans, louisiana	2007	spatz developments and noah's ark project	situated in a low-lying, flood-prone neighbourhood - lakeview, new orleans noah's ark project provides flood protection for a 2-storey, new construction house, alleviates the inconvenience of a permanently elevated house by allowing the house to remain close to street level	12 feet 2,700 sq ft (approx)
 FLOAT house new orleans, louisiana	2009	tom mayne morphosis architects brad pitt make it right foundation	amphibious housing solution subsidized by MIR innovative sustainable structure to protect a single-storey new construction house from flooding, alleviates the inconvenience of a permanently elevated home, facilitates the local porch culture by allowing the house to remain close to street level	12 feet 1000 sq ft (approx)
 LIFT house dhaka, bangledesh	2010	prithula prosun uw m.arch candidate	rapid urbanization - large portion of the city's population in slum and squatter settlements low-lying portions of the city experience annual flooding due to the overflow of surrounding rivers and heavy monsoon precipitation.	5 feet 400 sq ft for each 2-storey housing unit
 BFP projected for new orleans, louisiana	projected 2011/2012	dr. elizabeth english the buoyant foundation project	the BFP provides an alternative form of flood protection to alleviate the inconvenience of permanently elevated homes - allowing homes to sit close to street level under normal conditions and float when it floods - greater degree of protection from extreme flooding than permanently elevated homes	25 feet 700-1100 sq ft

buoyancy + vertical guidance systems	major building materials	cost	technical feasibility application to the BFP	
expanded polystyrene (EPS) blocks fastened under the frame with sleeves that slide up on fixed vertical guidance posts	steel / timber, EPS foam for buoyancy	$ 5,000 (or less)	amphibious fishing camps in pointe coupee parish provide the basic system configuration that needs to be engineered, made code compliant and aesthetically appropriate for urban applications	1
70-tonne concrete box provides buoyancy and forms the basement on which the wooden superstructure is built boxes come in semi-detached pairs, connected by a deck - each pair is set into a niche in the river bank and held there by 2 large steel posts	timber, concrete, steel	$ 310,000 (starting price)	massbommel was the first modern built amphibious architecture project, classifying it as a type, demonstrating its feasibility and functionality for flood mitigation in below sea-level applications.	2
expanded polystyrene (EPS) blocks fastened to a steel substructure with sleeves sliding on four fixed vertical guidance posts	steel / timber, EPS foam for buoyancy	$ 6,500 (including temporary flood tank)	a simple demonstration that the proposed BFP system works in an observed, measured calibrated flood test in a controlled test facility demonstrating the technical feasibility.	3
a hollow 3-foot high barge welded together from plate steel and iron trusses that carry the weight of this steel-framed home wooden vertical guidance posts at the four corners of the house	steel for frame timber for vertical guidance posts prefabricated construction	$ 525,000 (asking price)	demonstrates the technical feasibility and appropriateness for new orleans using pre-fabricated new construction	4
the base of the house is reconceived as a chassis – acts as a raft, allowing the house to rise vertically on two steel guidance posts, floating up to twelve feet as water levels rise -the 'chassis' made from polystyrene foam coated in glass fiber reinforced concrete	steel, concrete, EPS foam coated in glass-fiber reinforced concrete, house is wood-frame construction	$ 150,000* (list price subsidized by MIR - actual cost of construction is undisclosed)	demonstrates the technical feasibility and appropriateness for the local culture of new orleans, particularly the lower ninth ward	5
buoyancy is achieved from two different systems: one of the dwellings has a hollow ferrocement foundation, the other is a bamboo frame foundation filled with recapped empty water bottles - the steel vertical guidance system attaches the bamboo dwellings to the brick and concrete service spine - dwellings slide up and down vertically	bamboo, masonry, ferrocement, plastic water bottles for buoyancy, slotted steel tubes cast into masonry base for vertical guidance	$ 4,000 per unit	demonstrates the technical and economic feasibility and appropriateness for a low-income population and use of sustainable materials	6
coated EPS foam for buoyancy fastened to the steel substructure - telescoping vertical guidance posts that pull out of the ground as the house rises are being developed	steel, coated EPS foam for buoyancy (possible use of thermoplastic timber in place of steel)	$ 20,000 + (cost to restore upper portion of house if necessary)	combines all design parameters listed above as well as potentially implementing thermoplastic timber	

fig 230: Technical Feasibility Comparison Chart

ANALYSIS

The previous chart outlines the parameters and components common to each example of amphibious architecture. The following analysis will elaborate on the information noted in the chart, compare the key elements of each amphibious system, and assess the place of the BFP in the discussion of amphibious architecture.

The projects presented are international examples of amphibious flood-protection strategies for urban and rural housing types. They were all built in the last 5 years, with the exception of the amphibious fishing camps in Pointe Coupee Parish, which first appeared in the 1970s.[228]

The examples of amphibious architecture discussed provide effective and reliable solutions to the overarching problem of flood mitigation for housing in low-lying, flood-prone areas. Each location faces the challenge of global warming. In addition, the following, specific challenges apply to individual projects: seasonal flooding, subsidence, vulnerability to storm surge, severe weather conditions, and unreliable large-scale infrastructure.

The following fundamental characteristics are present in each example of amphibious architecture: the ability to operate passively and move vertically, while possessing buoyancy elements, a vertical guidance system and the flexibility to reside on land and, when required, float on water. The design constraints are generally dictated by the context, the type of construction and budget.

The ranges of techniques implemented are primarily based on whether the project is new construction or a retrofit. New construction allows for a higher degree of flexibility and aesthetic refinement when incorporating the amphibious elements. For example, the FLOAT House is designed with the vertical guidance system on the interior of the structure and a “chassis” to provide buoyancy, situated beneath the residential portion of the structure.[229]

In addition, lateral stability can be achieved more easily with new construction, as observed with Maasbommel and the LIFT House. In each of these examples, housing units are joined by sharing a common element that provides lateral resistance. For the amphibious houses in Maabommel, two houses share a platform that provides lateral stability. For the LIFT House, a central, fixed, masonry spine provides both stability and vertical guidance.[230]

Although retrofits do not allow for a great deal of design flexibility, as exhibited by the amphibious fishing camps at Point Coupee Parish, they are a catalyst for rehabilitation of damaged structures and are a more sustainable choice than demolition and new construction.

The LIFT House exhibits some unique and distinctive features. The buoyancy elements are compartmentalized to provide a greater degree of reliability and serviceability. For one of the two LIFT houses, recapped empty plastic water bottles are used for buoyancy. They are grouped in bundles wrapped in plastic bags, and then encased in a bamboo frame. In the event that one bundle gets damaged, it can be easily replaced without affecting the others. In addition, the vertical guidance system possesses unique connection details. It is comprised of a steel pipe that is cast into the masonry service core with a slit cut along the front, facing the bamboo house. Inside the pipe is inserted a smaller steel pipe, approximately 1 foot in length, which slides up and down inside the main pipe. The smaller pipe is fastened to the bamboo dwelling with metal plates that pass through the slot in the larger pipe.[231]

The size of each project falls within a range of 300 to 2,700 square feet. The major variance in size is between a double or single unit, and one or two-storeys.[232]

Although the budget for each project created design constraints, it simultaneously offered an opportunity for innovation.

The unique typology of amphibious architecture fosters inventive solutions that allow land-based structures to adapt to water. The price range for each project varies from the more modest schemes of $5000 for the retrofit of fishing camps in Pointe Coupee Parish, to $525,000 for a newly constructed amphibious home, Noah's Ark Project. The amphibious fishing camps in Pointe Coupee Parish, LIFT House, and the BFP prototype are all low-cost examples, ranging from $4000 to $5000 compared to Maasbommel, Noah's Ark Project and FLOAT House which are between $400,000 to $500,000. [233]

Material selection was essentially based on budget, availability, functional requirements, and the type of construction. Many of the new construction examples utilize prefabricated elements.

The key component of the FLOAT House is a prefabricated "chassis," made from polystyrene foam coated in glass fiber-reinforced concrete. Maasbommel employed the use of prefabricated elements for the roof and cladding. Noah's Ark Project also used pre-fabricated construction for the upper portion of the house. The amphibious fishing camps in Point Coupee Parish in some cases retrofit existing prefabricated mobile homes. Each vertical guidance system is made from steel components, except for the Noah's Ark Project, where the posts are solid timber. The buoyancy elements varied for each project. Maasbommel and Noah's Ark Project both used hollow boxes (Maasbommel made of concrete and Noah's Ark made of steel) as the flotation device. Pointe Coupee Parish and the LSU prototype used expanded polystyrene (EPS) foam blocks. As mentioned previously, the LIFT House used recapped water bottles in a bamboo frame for one unit. The second unit uses a hollow ferrocement foundation, similar to Maasbommel. The cladding for the LIFT House dwelling units is natural hand-woven plant material.[234]

In some cases, for Point Coupee Parish, flexible utility connections are utilized. Manual disconnect is usually used for water and sewer and umbilical connections are used for electrical.[235]

Along with the functional constraints that exist for new or retrofit amphibious housing, the majority of cases must comply with legal policies that dictated a portion of the design. For example, Noah's Ark Project originally specified a manual disconnect for sewage. However, the City of New Orleans has apparently objected to this type of connection; therefore a self-sealing breakaway connection will be used instead.[236]

COMPARATIVE ANALYSIS

It is a challenge to compare these projects to each other as there are unique factors employed in each project. Projects may be comparatively analyzed with two or more common elements such as their location and construction types. It is more effective to deconstruct each example.

APPLICATION + IMPROVEMENTS FOR THE BFP

As observed with the fishing camps in Pointe Coupee Parish, the most cost-effective mode to construct an amphibious foundation is through retrofit. This precedent was highly influential in the development of the LSU prototype as it employs similar approaches to buoyancy and vertical guidance.[237]

Since FLOAT House and the BFP share a similar location and a close proximity, design considerations for the FLOAT House are more applicable than perhaps any other example. The scale of the project is also the closest to the BFP and they are both single units. The completion of the FLOAT House in the Lower Ninth Ward demonstrates how appropriate that neighbourhood is for amphibious solutions. It also displays FEMA's shifting attitude towards amphibious housing, which may open the door to future amphibious projects in North America.

Telescoping vertical guidance posts are currently being developed. This is an unprecedented method of achieving lateral stiffness and stability, specific to the BFP. It will allow for a greater height variance, up to 25 feet, concealing the post below grade during normal conditions.

The telescoping posts will be attached to the steel frame and will "telescope," as the name suggests, out of the ground during a flood. A unique connection between the telescoping guidance posts and steel frame will also need to be designed. Engineering, testing and cost-analysis are required before this component can be implemented.[238]

Thermoplastic timber is being considered to replace the steel substructure and vertical guidance posts. The switch to this material in place of steel will address the challenge of achieving lateral stability. Among the more apparent benefits of thermoplastic timber and its resilience to moisture, it is advantageous because it eliminates the need for a frictionless connection for the telescoping vertical guidance posts. However, it is not a cost-effective solution when building a small number of buoyant foundations. Should the use of thermoplastic timber not be feasible, all steel components will need to be protected against corrosion. A water resistant coating for the substructure and vertical guidance system is required. An epoxy coating for the steel components may provide sufficient protection against corrosion and would cost significantly less than using thermoplastic timber. The disadvantage of implementing a polymer-based coating for the vertical guidance posts would be that it creates too much friction as the house is sliding up and down. A galvanized steel coating is another option which would be cost-effective and create less friction.[239]

Compartmentalizing buoyancy elements as employed by the LIFT House could provide a greater degree of reliability and serviceability. However, a frame or lightweight structure would need to be designed to encase these elements. Expanded polystyrene (EPS) foam is vulnerable to solvents and gasoline, which may be excreted into floodwaters. Coating the buoyancy elements with a fiber-reinforced concrete as utilized for the FLOAT House would add extra protection and reliability to the EPS foam blocks. The major setback to this recommendation is the high cost involved to coat multiple small blocks. Perhaps other types of coating such as an acrylic epoxy/polymer-based paint used for marine application may be more cost-effective initially. However, it will require regular maintenance, increasing the overall cost. Polyethylene is another suitable coating material for the EPS foam blocks. Of course another option would be to use a different material for buoyancy altogether.

The LIFT House suggests two other buoyancy options that are cost-effective and technically feasible –a hollow ferrocement concrete box for one unit and recapped plastic water bottles encased in a bamboo frame for the other. Maasbommel also employs a hollow concrete foundation to provide buoyancy for its amphibious homes. Another option is a hollow steel box, as displayed in Noah's Ark Project. However it would be the least cost-effective solution, and needs to be coated to protect against corrosion. A method of stabilization against such lateral loads as wind and flowing water is necessary. As mentioned earlier, Maasbommel and LIFT House join two housing units, centrally, by sharing a common element that counteracts lateral loads.[240]

Such a method of lateral stabilization could be explored for the BFP. Given the nature of tight-knit communities in New Orleans, another option, provided the city is in agreement, is that two neighbours who desire to implement buoyant foundations could connect their houses using on a common platform (eg: Maasbommel's amphibious houses). If this option were to become permissible, vertical guidance posts could be located between the houses as well.

The Noah's Ark Project and FLOAT House have had to specify the correct type of utility connections required by the City of New Orleans to gain a building and occupancy permit. A combination of umbilical and self-sealing breakaway connections is required, as currently called for in the BFP's design, so that the system may operate passively.[241]

For architects, when designing amphibious housing, a multi-disciplinary approach is essential to arrive at the appropriate solution for a specific location. Amphibious architecture is a new typology that is in the process of being defined. It requires collaboration from a variety of disciplines to arrive at innovative strategies, as highlighted in this chapter. The main elements common to all projects are buoyancy and vertical guidance, which may need to include lateral stabilization. Specific policies for each location provide an added design constraint, in addition to the usual constraints necessary for obtaining building and occupancy permits.

05 viii summary

Chapter five discussed local and international examples of amphibious housing that are technically feasible, in relation to the Buoyant Foundation Project (BFP).

The six pertinent and completed projects discussed are as follows: Amphibious Fishing Camps in Point Coupee Parish, Louisiana; Amphibious Housing in Maasbommel, Netherlands; LSU Prototype in Baton Rouge, Louisiana; Noah's Ark Project in Lakeview, New Orleans; FLOAT House in the Lower Ninth Ward, New Orleans; and LIFT House in Dhaka, Bangladesh. Each provided an example of a retrofit, prototype, and/or new construction employing an amphibious foundation for housing. Full documentation was provided for each of the six projects, appearing chronologically based on the date of construction.

To conclude the chapter, a summary was provided. It outlined each project's key features and its significant contributions to, or possible future influence on, the BFP. A chart follows to accompany this summary, highlighting the pertinent factors of each project's technical feasibility. Factors such as date of completion, architect, challenges, maximum height during flooding, size of unit, buoyancy system, major building materials and cost were visually displayed to allow for comparison and cross referencing among the six examples and the BFP.

An analysis was then provided, that discussed the common characteristics and distinctive features of each project. Common to each project is a buoyancy element and vertical guidance system. Some distinctive features are the use of recapped recycled water bottles encased in a bamboo frame used for buoyancy in one unit of the LIFT House and the unique "chassis" system employed by the FLOAT House. A brief comparison was drawn between projects with two or more similar parameters; however this proved to be a challenge, due to the distinct locations, budgets and sizes of each project. Application and areas for improvement were discussed, suggesting alternative strategies to improve the BFP's design, to make it more cost-effective and efficient. Such strategies included protective coatings for the EPS foam buoyancy blocks, compartmentalizing buoyancy elements and exploring the possibility of joining neighbouring properties to create lateral stability, among other suggestions.

05

ix

endnotes

173. Owen J. Bello, “Pointe Coupee Parish, Louisiana,” http://www.pcpolicejury.org (accessed September 1, 2009).

174. Louisiana Sportsman Magazine, “Old River, Pointe Coupee,” http://www.fishinglouisiana.com/area2/#Old%20River (accessed September 1, 2009).

175. Elizabeth English, “Amphibious Foundations and the Buoyant Foundation Project: Innovative Strategies for Flood-Resilient Housing,” (paper presented at the International Conference on Urban Flood Management, Paris, France, November 25-27, 2009), 4 (appendices, 412).

176. ibid.

177. James Lee Witt Associates, “Pointe Coupee Parish Hazard Mitigation Plan Update and Project Scoping,” July 01, 2009, 52-58, http://www.pcpjury.org/Pointe%Coupee%Parish%complete%document%07%01%09.pdf.

178. Amy Wold, “Float this House: Professor Hopes to Save Ambiance of N.O. Homes,” *The Advocate, Baton Rouge,* June 2, 2007, 1 (appendices, 340).

179. Waterland: Water Information Network, “History of Dutch Water Management,” http://www.waterland.net/index.cfm/site/Water%20in%20the%20Netherlands/pageid/CDA0E5A3-D1F5-1767-58EECA08BC8288ED/index.cfm/water%20history (accessed September 30, 2009).

180. Wikipedia, “Maasbommel,” http://en.wikipedia.org/wiki/Maasbommel (accessed September 1, 2009); and Dura Vermeer, “Amphibious and Floating Homes in Maasbommel,” http://www.duravermeerbusinessdevelopment.nl/uk/project_info.asp?id=579 (accessed September 1, 2009).

181. Dura Vermeer, “Amphibious and Floating Homes in Maasbommel,” http://www.duravermeerbusinessdevelopment.nl/uk/project_info.asp?id=579 (accessed September 1, 2009); and Jonathan Glancey, “Sink or Swim: In Times of Flood, These Houses Rise To The Occasion,” http://www.guardian.co.uk/artanddesign/2004/may/24/architecture (accessed September 30, 2009).

182. Andrew Eames, “Floods without Tears,” http://www.telegraph.co.uk/property/3350061/Floods-without-tears.html (assessed September 1, 2009).

183. Dura Vermeer, “Amphibious and Floating Homes in Maasbommel,” http://www.duravermeerbusinessdevelopment.nl/uk/project_info.asp?id=579 (accessed September 1, 2009).

184. Glancey. 2004.

185. ibid.

186. ibid.

187. English 2009, 7 (appendices, 412).

188. Dustin Husser, Matt Guidry, Scott Schroth, Ben Morvant, Dustin Ewing, “ME 4243 Spring 2007: Buoyant Foundation,” Powerpoint presenation for Mechanical Engineering, Louisiana State University.

189. ibid.

190. ibid.

191. ibid.

192. Spatz Development, “Parade of Homes Around Lakeview.” www.associationevent.com/PATL/BUILDER/spatz.pdf (accessed November 1, 2009).

193. Clayton DeKorne, “Floating Out the Storm: A Concept Home Designed to Resist Flood and Wind Rises Out of the Wreckage of New Orleans,” *Coastal Contractor* (2008): 1, http://www.coastalcontractor.net/cgi-bin/article.pl?id=189 (accessed September 1, 2009).

194. Bayou Buzz Staff, “Hurricane Homes,” http://www.bayoubuzz.com/News/Louisiana/Business/Louisiana_Business_Shorts__Michael_Bloomberg_Jindal_and_Economic_Development_Hurricane_Homes_Tidewater___5170.asp (accessed November 1, 2009).

195. DeKorne. 2008, 2.

196. ibid., 3.

197. ibid.

198. ibid.

199. Nikki Buskey, “Could floating homes be on the way?” *Houma Today*, Sunday, November 8, 2009, http://www.houmatoday.com/article/20091108/ARTICLES/911089976 (accessed November 30, 2009) (appendices, 340).

200. Morphosis, ”FLOAT House,” June 7, 2010, http://morphopedia.com/projects/float-house (accessed November 1, 2009).

201. Morphosis, “Morphosis MIR HOUSE.pdf,” 13 http://morphopedia.com/projects/float-house (accessed September 1, 2009).

202. ibid., 13.

203. ibid., 13.

204. ibid., 15.

205. Archinnovations, “Morphosis FLOAT House: How It Works,” December 2009, http://www.archinnovations.com/featured-projects/housing/morphosis-float-house-how-it-works/ (accessed September 1, 2010).

206. Bradford McKee, "Float House," October 6, 2009, http://observatory.designobserver.com/entry.html?entry=11247 (accessed September 1, 2009).

207. ibid.

208. Morphosis. 2009, 16.

209. Archinnovations, 2009.

210. Personal Communication with Linda Stone, Policy Associate for Global Green, December 2010.

211. Morphosis. 2009, 18.

212. ibid.

213. ibid.

214. Archinnovations, 2009.

215. Prithula Prosun, *The LIFT House: An Amphibious Strategy for Sustainable and Affordable Housing for the Urban Poor in Flood-prone Bangladesh,* Masters Thesis, (Waterloo: University of Waterloo, 2010), iii. Prithula is defending her thesis on December 8, 2010, and expects to graduate shortly thereafter. Her thesis will be made electronically available and can be accessed through the following site: http://uwspace.uwaterloo.ca/handle/10012/6.

216. Alexandra Shimo, "Uplifting: A University of Waterloo Architecture Student Designs Flood-Proof Buoyant Houses for her Native Bangladesh," *Canadian Architect 55* (2010):46

217. Prithula Prosun, "Innovative Flood Mitigation: Sustainable Amphibious Housing for the Urban Poor in Dhaka, Bangladesh." paper for ECOPOLIS Design Award Proposal (May 2009) in Prosun. 2010, 158.

218. ibid.

219. Prosun. 2010, 70-72.

220. ibid. 89-147.

221. English. 2009, 4 (appendices, 412).

222. Personal Communication with Elizabeth English, March 2010.

223. Dustin Husser, Matt Guidry, Scott Schroth, Ben Morvant, Dustin Ewing, "ME 4243 Spring 2007: Buoyant Foundation," Powerpoint presenation for Mechanical Engineering, Louisiana State University.

224. DeKorne. 2008. 1-3.

225. ibid.

226. E-Architect, "Morphosis FLOAT House Completed for Make It Right Foundation," October 6, 2009, http://www.e-architect.co.uk/america/make_it_right_float_house.htm (accessed September 1, 2010); and Morphosis. 2009, 13; and Archinnovations, 2009.

227. Prosun. 2010, 70-72.

228. Owen J. Bello, "Pointe Coupee Parish, Louisiana," http://www.pcpolicejury.org (accessed September 1, 2009).

229. Archinnovations, 2009.

230. Dura Vermeer, 2009; and Personal Communication with Prithula Prosun, September 2010.

231. Prosun, 2010, 70-72.

232. English. 2009, 7 (appendices, 412); and Glancey. 2004; and DeKorne. 2008; and McKee. 2009; and Prosun. 2010, 77-88.

233. ibid.

234. Archinnovations. 2009; and Dura Vermeer. 2010; and DeKorne. 2008, 3; and Prosun. 2010, 70-72.

235. Elizabeth English, Interviewed by Charlotte Garson, *French Public Radio Station in Breaux Bridge*, LA, August 2008 (appendices, 384).

236. DeKorne. 2008, 3.

237. Dustin Husser, Matt Guidry, Scott Schroth, Ben Morvant, Dustin Ewing, “ME 4243 Spring 2007: Buoyant Foundation,” Powerpoint presenation for Mechanical Engineering, Louisiana State University.

238. English and Garson. 2008 (appendices, 384).

239. English. 2009, 8 (appendices, 412).

240. Prosun. 2010, 70-72; and Dura Vermeer. 2010; and DeKorne. 2008, 2.

241. Personal Communication between Bryan Spatz and Rebecca Lai, May 2010.

06

the buoyant foundation project: efficiency

efficiency:

i. introduction

ii. economy
FEMA recommended flood-proofing strategies for homes in louisiana

iii. sustainability
energy conservation
waste reduction
economic growth
sustainable materials

iv. resilience
cascading levees
building resilience workshop

v. summary

vi. endnotes

06

i

efficiency

Three major aspects have been identified which contribute to the efficiency of the Buoyant Foundation Project (BFP). Chapter six will discuss how the BFP is an economical, sustainable, and resilient form of flood protection.

The BFP proves to be a more economical form of flood mitigation through a cost comparison between the current government recommended strategy of permanent static elevation and the proposed amphibious foundation system. The following argument will discuss aspects that contribute to the BFP's sustainability as it serves a catalytic role for the restoration of damaged homes in post-Katrina New Orleans. Restoration promotes energy conservation, waste reduction, and economic growth. The potential implementation of sustainable materials will also be discussed. The concluding section on resilience will address how the BFP can contribute to a resilient strategy for flood mitigation in New Orleans by providing an integral layer in flood protection in combination with other large scale, infrastructural strategies.

The chapter concludes with a brief discussion of the Building Resilience Workshop to further reinforce the concept of resilient flood protection strategies and discuss new techniques currently being used. Multidisciplinary professionals from architecture, engineering, planning, academia and politics along with community stake holders gathered in New Orleans in February 2010, to discuss international urban flood protection strategies. Innovative, resilient, urban flood mitigation systems were presented, such as cascading levees and amphibious housing, that are currently being implemented in Germany and the Netherlands.

06
ii
efficiency: economy

permanent static elevation
= $40,000 - $60,000

fig. 231: Permanently Raised House

buoyant foundation retrofit
= $10,000 - $25,000

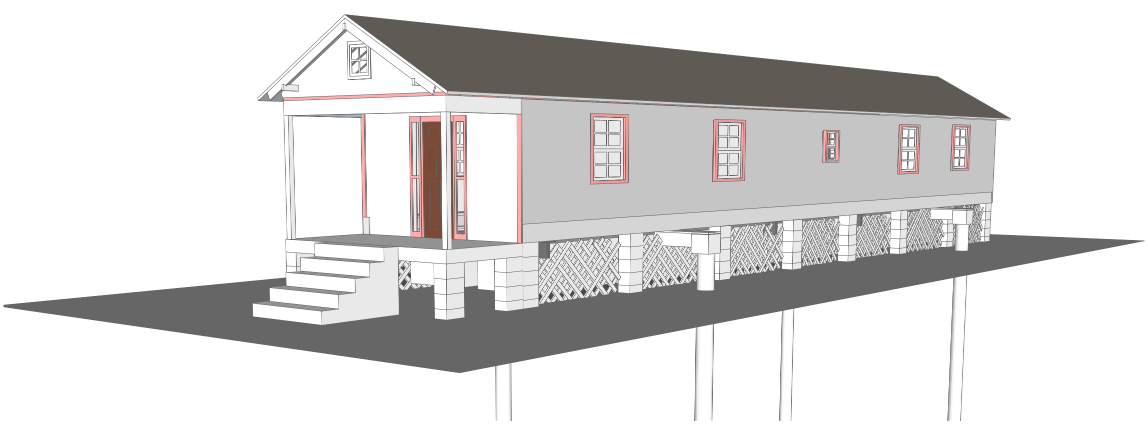


fig. 232: House on a Buoyant Foundation

ECONOMY

It is more cost effective to use buoyant foundations than permanent static elevation (fig. 231, 232). As mentioned earlier, permanent static elevation is currently a method approved and recommended by the United States federal government as a means of flood protection for residents in Louisiana. FEMA, and all FEMA-supported organizations such as Louisiana State University (LSU), University of New Orleans (UNO) and The State of Louisiana Road Home Program are advocating permanent static elevation as a 'safe' method to protect property in the event of a flood.[242]

Nikki Buskey, writer for *Houma Today*, reports on local resident Mark Callahan, of Terrebonne Parish in Louisiana. He states that he would have been interested in installing a buoyant foundation had he been given the option before he permanently elevated his home. Buskey reports, "In bayou communities, where many have been forced to elevate their homes due to repeated flooding, that could be appealing. [Callahan] said he was reluctant to elevate his home at first. He eventually paid $45,000 to boost his house 11 feet. Had he been given the choice of keeping it on the ground with new technology, he might have taken it."[243]

Permanent static elevation is currently one of the options recommended to residents by the United States federal government among five others outlined in figure 233. These options are expensive and unreliable forms of flood protection because none of them can guarantee that the property will be safe from flood waters that exceed the intervention's height, and the options of relocation and demolition ignore the problem completely. The unanticipated levee failures that accompanied Hurricane Katrina proved that a 'flood level' cannot be predicted reliably, therefore any static option will be an insufficient method of protection. In addition, only three of the six FEMA recommended flood-proofing strategies — elevation, relocation and demolition — meet the minimum requirements of the NFIP.[244] Implementing a buoyant foundation system will allow one's house to rise up to the required height (with a maximum height of 25 feet in the event of a category 5 storm surge).[245]

Figure 234 is a table which provides a detailed cost estimate to elevate a 36' x 36' (1296 sq ft) one-story home 10 feet above grade. The cost estimated by the USACE is almost $ 40,000. This price increases for homes in New Orleans, due to poor soil quality and the costs involved for stabilizing the foundation.[246]

Elizabeth English remarks, "Permanently elevated homes are vulnerable to wind damage, and elevations are expensive. Retrofitting an existing house with a floating foundation costs up to $25,000 compared with the $40,000 to $60,000 it can cost homeowners to elevate. Adding an elevator for elderly or disabled residents makes it even more expensive."[247]

English estimates that $40,000 to $60,000 is a typical range for the implementation of permanent static elevation. This is significantly greater than the cost to retrofit a house with a buoyant foundation, which is in the range of $10,000 to $25,000.[248]

It is more economical and reliable to retrofit a shotgun style home with a buoyant foundation compared to permanent static elevation as a flood mitigation strategy.

FEMA recommended flood-proofing strategies for homes in Louisiana

ELEVATION – Raising your home so that the lowest floor is above the flood level. You can accomplish this in several ways.

WET FLOODPROOFING – Making uninhabited portions of your home resistant to flood damage and allowing water to enter during flooding.

RELOCATION – Moving your home out of the floodplain to higher ground where it will not be exposed to flooding.

DRY FLOODPROOFING – Sealing your home to prevent floodwaters from entering.

LEVEES AND FLOODWALLS – Building a floodwall or levee around your home to hold back floodwaters.

DEMOLITION – Tearing down your damaged home and either rebuilding on the same property or buying or building a home elsewhere.

fig. 233: Six Ways FEMA Recommends to Protect a Home From Flooding

ELEVATION OF A 36X36 (1296 SF) ONE-STORY HOME 10 FEET ABOVE GRADE				
ITEM	**QUANTITY**	**UNIT**	**PRICE**	**COST**
Elevation of Home	1,296	SF	12	15,552
New Concrete Pier Foundation				
(see note)	25	EA	190	4,750
Pier-Slab Connection	25	EA	21.2	530
Hurricane Clips	50	EA	1.5	75
Raise Water, Sewer & Gas	10	LF	28.14	281
Elevate Air Conditioner				
Wooden Deck 5x5, treated	25	SF	7.54	188
Extended Down spouts	1	LS	150	150
Architectural Modifications				
New Front Porch (see note)	36	SF	7.54	271
Wood Front Stair & Rails	10	LF	239	2,390
Concrete Stair Pad	1	EA	50	50
New Back Porch (see note)	100	SF	7.54	754
Wood Back Stair & Rails	10	LF	239	2,390
Concrete Stair Pad	1	EA	50	50
Wooden Lattice	1,440	SF	1	1,440
Painting, Decks & Stairs	150	SF	0.39	58
Painting Lattice, Spray	1,440	SF	0.14	202
New Sidewalks	30	LF	5.52	166
Subtotal				**29,298**
Contingencies	25%			7,325
Subtotal Construction Cost				36,623
Engineering & Design	5%			1,831
Supervision & Administration	3%			1,099
Total Construction Cost				**$39,552**
Const. Cost Per Sq. Foot of Slab	**$31**			
NOTE: Concrete Piers, 9' c.c., 14' x 14' x 13'-10" pier in place. Includes 2' x 2' x 8" footing in place, 4 #4 bars each way. New Front Porch: Wood Deck, 6' x 6', treated 2x6 New Back Porch: Wood Deck, 10' x 10', treated 2x6				

fig. 234: Detailed Cost Estimate to Permanently Elevate a Home

06

iii

efficiency: sustainability

SUSTAINABILITY

The Buoyant Foundation Project (BFP) provides a sustainable solution to flood mitigation through promoting the rehabilitation of damaged homes and potentially incorporating sustainable materials into its system. It is more environmentally responsible to restore and preserve existing buildings than to demolish and rebuild them. The BFP serves as a catalyst for the restoration of damaged homes in post-Katrina New Orleans. The BFP retrofits traditional wooden shotgun-style housing, which plays a vital role in the preservation of a neighbourhood that contributes greatly to the culture of New Orleans. The BFP is also preserving a housing type built from a scarce indigenous wood, the Louisiana cypress, which is no longer available for construction; thus, these houses are irreplaceable. This type of wood is rot, termite and mould-resistant, which is particularly suitable to Louisiana's climate.[249] In addition, the BFP is considering the use of sustainable materials such as thermoplastic timber and recycled, recapped plastic water bottles.

Rehabilitating damaged buildings promotes environmentally and economically sustainable development. According to Patrice Frye of the National Trust for Historic Preservation, "The National Trust for Historic Preservation is . . . leading a national effort to develop both the research and the policies required to support the integration of historic preservation principles into the larger discourse of sustainability." [250]

Restoration promotes energy conservation, the avoidance of additional environmental impacts, waste reduction and the ability to curb sprawl. The concept of economic sustainability refers to the general economic impacts of preservation, including the ability to generate more jobs, as well as increased economic growth through the conservation of natural resources.[251]

ENERGY CONSERVATION

Embodied energy can be defined as, "The amount of energy associated with extracting, processing, manufacturing, transporting and assembling building materials."[252]

According to Calvin W. Carter, in a study assessing energy conservation:

> Conserving buildings preserves embodied energy, and reduces the need for new materials. In the 1970s, the National Trust and the Advisory Council on Historic Preservation developed calculations for measuring the embodied energy in buildings based on square footage and building types. . . [A case study on] Grand Central Arcade in Seattle's Pioneer Square concluded that the Arcade embodied 17 billion BTUs (British Thermal Units of energy), and that a new building of equivalent size would require 109 billion BTUs to construct. Preserving the Arcade would result in an energy savings of 92 billion BTUs, or 730,000 gallons of gasoline — 'enough to power 250 automobiles for 60,000 miles.'[253]

This case study is one example that illustrates how preservation conserves energy. Through the reduced use of vital renewable and non-renewable resources, energy is conserved, creating a sustainably responsible solution to post-Katrina rebuilding.

WASTE REDUCTION

Franklin and Associates, a major consulting firm dedicated to providing consulting services in life cycle analysis and solid waste management, says "preserving buildings reduces waste in landfills. Demolition of housing produces an average of 115 lbs of waste per square foot, while demolition of commercial buildings generates approximately 155 lbs of waste per square foot."[254]

They further elaborate by providing examples of building-related waste generated in the United States. According to estimates provided by the Environmental Protection Agency (EPA), "tremendous waste is generated as a result of building demolition. The EPA estimates that 136 million tons of building-related construction and demolition (C & D) debris was generated in the United States in 1996. By 2003, C & D waste was estimated to be 325 million tons – almost a 250% increase in just seven years. Annual construction and demolition debris accounts for roughly 24% of the municipal solid waste stream."[255]

Waste management is imperative to reducing harmful effects on the environment. As landfills are overwhelmed with waste, the mode in which waste is created must be re-examined to ensure the reduction of greenhouse gas emissions.

ECONOMIC GROWTH

Dr. David Listokin, a professor at the Center for Urban Policy Research at Rutgers University, asserts that historic preservation is interconnected to many other industries. "Preservation does not operate within its own isolated sphere, but touches many areas of the local economy, and affects different sectors of community life," according to Listokin. "It touches finance, real estate and government. It affects retailing, employment and tourism. It impacts the mayor, the merchant and the homeowner."[256]

Listokin argues that historic preservation can spur economic development. He states, "Historic preservation spurs economic development, [whereby] preservation serves as a catalyst for additional investment in communities. . . . Preservation creates more jobs than new construction [demonstrated] by several studies and an economic input-output model developed by Carnegie Mellon University. . . . 1998 research found that $1 million in historic preservation activity creates about 38 jobs, while $1 million in new construction of non-residential structures creates 36 jobs. The same investment yields $1.7 million in GDP for preservation, and $1.6 million for new construction."[257]

Listokin also comments on preservation as being a "powerful generator of affordable housing."[258] According to him, "equity is a core tenet of sustainable development, and affordable housing is key to achieving equity. Historic buildings have often served as a valuable source of affordable housing. Between the late 1970s and the late 1990s, 40,000 units of affordable housing were created using Historic Tax Credits."[259]

Preservation of historic buildings serves as a catalyst for additional investment in communities and plays a significant role in job creation resulting in economic growth.

fig. 235: Bridge made of Thermoplastic Timber

fig. 236: Thermoplastic Timber Beam

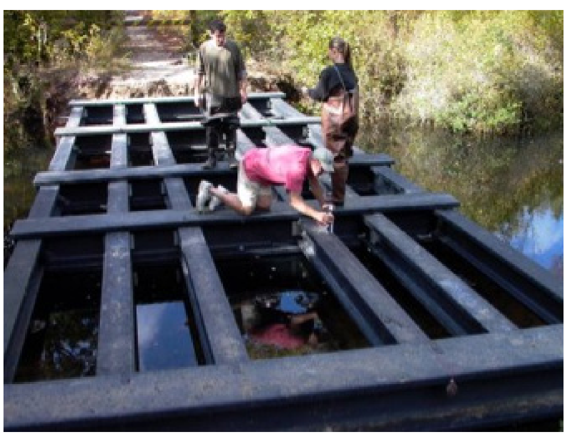


fig. 237: Thermoplastic Dock

SUSTAINABLE MATERIALS

The BFP is considering the use of sustainable materials for its major design components: structural grade Thermoplastic timber for the foundation's substructure and vertical guidance system, along with recycled plastic water bottles in place of EPS buoyancy blocks. Thermoplastic timber is a composite material made almost entirely from recycled post-consumer and industrial plastics, also known as High Density Polymer Elastics (HDPE), resin and fiberglass (fig. 235, 236).[260]

Thermoplastic timber is a fiber-glass reinforced plastic material that is structural-grade and can be used for load-bearing construction. Plastic lumber first emerged on the United States marketplace in the early 1990s.[261] Lisa Miles Jackson of Innovative Green Solutions and Thomas J. Nosker have described the origins and benefits of thermoplastic timber. According to the authors, "the patented technologies provide products that are extremely strong and durable, flexible in design, and virtually maintenance-free. Successful demonstrations have shown that Thermoplastic timber is a viable alternative to more traditional building materials including wood, steel, and concrete."[262]

Jackson and Nosker further elaborate on the nature of thermoplastic timber:

> This innovative material is made entirely from post-consumer and post-industrial recycled #2 plastic and automotive scrap. It is completely inert and will not leach harmful chemicals into the soil or water. The use of this innovative technology keeps recycled plastic out of the waste stream, effectively doubling the quantity of waste this plan will divert from landfills. . . . The Rutgers experts have developed processing that uses a minimum amount of recycled fiberglass to achieve structural stiffness, strength, and creep resistance. The fiberglass blends thoroughly with the HDPE solution created a load-bearing product.[263]

fig. 238: Thermoplastic Timber Pilings

fig. 239: Plastic Water Bottles Used for Flotation

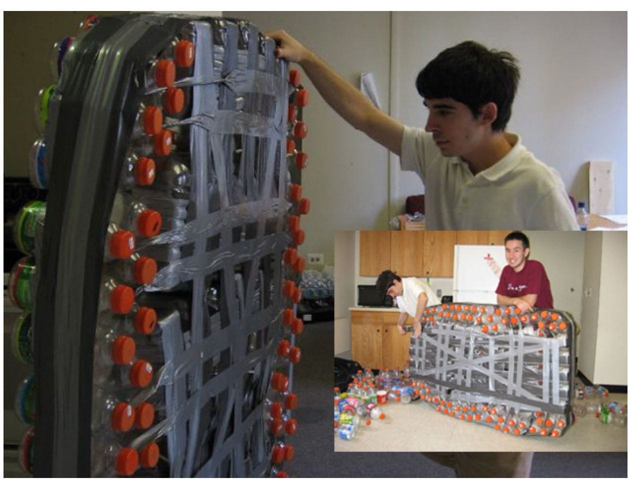


fig. 240: Plastic Water Bottle Raft

Thermoplastic timber is resistant to moisture, rot, rust or corrosion and crumbling. It is also resistant to insects and does not degrade like natural wood (chemically treated or not) when exposed to the exterior elements (fig. 237, 238).[264] Through maintaining a longer lifespan and requiring less maintenance, the amount of waste and labor costs are reduced. Compared to the use of wood, thermoplastic timber is more cost-effective and can be implemented more efficiently.[265] Thermoplastic timber can withstand extreme shifts in temperature and does not biodegrade or oxidize. In terms of durability, "accelerated weather testing was stopped at 50 years, demonstrating that Thermoplastic timber can last more than 50 years with minimal maintenance."[266]

The longevity of this product allows for minimal replacement, ultimately producing less waste. In addition to the use of Thermoplastic timber for the BFP's foundation substructure and vertical guidance system, the use of recycled plastic water bottles in place of EPS (expanded polystyrene) buoyancy blocks is being considered. According to the Container Recycling Institute, "eighty percent of plastic water bottles used in the United States become garbage or end up in landfills."[267] Reusing plastic water bottles will divert waste from landfills and provides an environmentally responsible solution for buoyancy (fig. 239, 240).

06
iv
efficiency: resilience

RESILIENCE

The Buoyant Foundation Project (BFP) is a resilient form of flood protection for New Orleans. The tragic flooding in the aftermath of Hurricane Katrina provided evidence that the larger issue of flood mitigation needs to be addressed on a local scale. Impending climate change issues affecting coastal cities internationally point to the need for a re-evaluation of humankind's relationship with water. The ability to coexist with water has become imperative and requires a combination of innovative flood mitigation strategies on a variety of scales.

As noted by Craig E. Colten, in *An Unnatural Metropolis: Wresting New Orleans From Nature*, "the human effort to manage the environment has been a vitally important dimension in shaping New Orleans' landscape, and the landscape is the visible record of human transactions with the environment."[268]

With every natural and man-made disaster to affect New Orleans, flood mitigation strategies are re-examined and new strategies are implemented. It has become apparent that a resilient strategy is necessary to mitigate future flooding in New Orleans and southern Louisiana effectively.

The Resilience Alliance is a research organization including professionals from a variety of disciplines which "explores the dynamics of complex adaptive systems." They define resilience as:

> 'to jump or leap back,' the ability to recover from or adjust easily to misfortune or change. . . . The ability to absorb disturbances, to be changed and then to reorganize and still have the same identity (retain the same basic structure and ways of functioning). It includes the ability to learn from the disturbance. A resilient system is forgiving of external shocks. As resilience declines the magnitude of a shock from which it cannot recover gets smaller and smaller. Resilience shifts attention from purely growth and efficiency to needed recovery and flexibility. Growth and efficiency alone can often lead ecological systems, businesses and societies into fragile rigidities, exposing them to turbulent transformation. Learning, recovery and flexibility open eyes to novelty and new worlds of opportunity.[269]

Perhaps this ability to "absorb disturbance," "reorganize," and adapt to change, while preserving identity can be best observed in New Orleans. This city has retained its unique character despite devastating flooding and damages throughout many hurricanes. As stated by Kevin Lynch, world renowned urban planner and author, in Vale and Campanella's book, *The Resilient City: How Modern Cities Recover from Disaster*, "a city is hard to kill, in part because of its strategic geographical location, its concentrated, persisting stock of physical capital, and even more because of the memories, motives and skills of its inhabitants."[270]

New Orleans is a resilient city, and has recovered from several damaging hurricanes throughout history. In addition to Hurricanes Katrina and Rita, it recovered from the destruction of Hurricanes Camille in 1969 and Betsy in 1965 through the hard work and stewardship of its residents (fig. 241).[271]

Flood protection is more effective in a resilient system where failures are smaller and more localized than in an overwhelming and catastrophic event. John Lopez, Director-Coastal Sustainability Program Lake Pontchartrain Basin Foundation, suggests "the multiple lines of defence strategy." He states:

> The multiple lines of defense strategy proposes that two essential elements of the Louisiana coast be managed and perpetuated that together will sustain the coast economically. . . . The two planning elements are (1) Using natural and manmade features that directly impede storm surge or reduce storm damage (lines of defense), (2) Establishing and sustaining the coastal habitat distribution (habitat goals). The ''lines of defense'' include the Gulf of Mexico shelf, the barrier islands, the sounds, marsh land bridges, natural ridges, manmade ridges, flood gates, flood levees, pump stations, home and building elevations, and evacuation routes.[272]

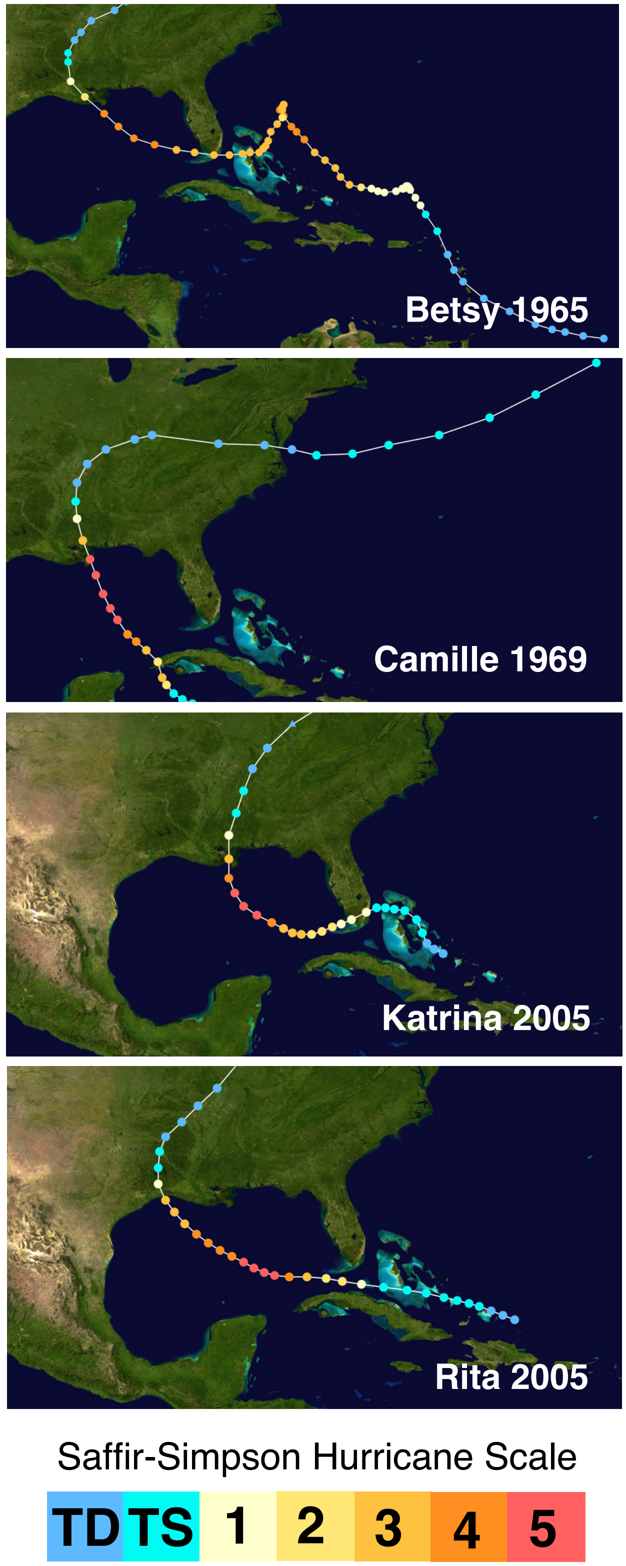


fig. 241: Paths of Significant Hurricanes which affected New Orleans

Erik Pasche *et al.*, Professor of Hydraulic Engineering at the Hamburg-University of Technology, reinforces this concept and suggests that resilient flood mitigation should be conceived in multiple layers, cascading levees, compartmentalization and multiple overlaid flood mitigation strategies. Diffusion and dispersion of risk will minimize the direct impact.[273]

The BFP could serve a catalytic role in the recovery and creation of a flood-resilient New Orleans. The BFP provides a flexible system that allows a house to adapt to changing conditions in the event of a flood. The BFP is a small-scale flood mitigation strategy that could provide one of the many layers of flood protection New Orleans will require.

CASCADING LEVEES

Elizabeth English suggests the possibility of the BFP supplementing a cascading levee system for New Orleans. In 2007, she spent time in the Netherlands at the UNESCO Living With Water Workshop, where she learned about the work of German professor Erik Pasche, who is currently developing cascading levee systems in Hamburg.

She explains in an interview with Charlotte Garson for French public radio:

> Rather than having one big huge levee, which is only as strong as its weakest part, you have a series of levees. So, we could leave the existing levees in New Orleans, not make them any bigger, just get them all to the point where they are really category 3 resistant. Then behind the levees have other smaller levees, for example there could be a secondary levee, behind the primary levee along Lake Ponchartrain, that went around City Park in New Orleans so that if it went to the south of City Park — if the new secondary levee was parallel to the primary levee but included an area that wouldn't be disastrous, absolutely disastrous if it flooded, then you can let the primary levee overtop and the park would fill up with water but the land behind the secondary levee wouldn't fill until that very large reservoir was full. And when that reservoir filled up, then that levee could overtop and there could be a tertiary levee system. It would be so easy to make cascading levees of this sort in New Orleans because we already have the boulevards with what in New Orleans is called the 'neutral ground,' which is the strip of grass between the streets going in opposite directions on either side, a boulevard. But the neutral ground is always raised, it's always mounded and in fact there is a great tradition in New Orleans of whenever there is a relatively small flood people drive their cars up onto the neutral ground so that the cars are safe and don't get flooded in the streets. Well the neutral grounds, by putting a mound where the streets are as well as where the grass is, those could be turned into a secondary or tertiary levee system.[274]

English remarks that implementing cascading levees alleviates the need for every house to be on buoyant foundations; only houses in vulnerable locations, between the primary and secondary levees, would need buoyant foundations. If that area flooded, those houses would float and the house's contents would be protected.

BUILDING RESILIENCE WORKSHOP

Cascading levees and amphibious architecture were two of many urban flood resilience strategies discussed at the workshop entitled, "Building Resilience: Implementing Innovative, Sustainable Flood Mitigation Solutions for the Gulf Coast," held at the Old US Mint in New Orleans from February 25 to 27, 2010. The conference brought together an international mix of architects, engineers, planners, policy makers, community organizers and academic researchers specializing in sustainable flood protection to discuss the challenges of living with water within cities and communities, and institutional/government's resistance to change for the Gulf Coast.[275]

English elaborates on the Building Resilience Workshop:

> Speakers from Germany, the Netherlands and across North America came together with local leaders to discuss how non-structural flood mitigation strategies such as wetlands restoration, cascading levee systems, temporary floodwalls, amphibious housing and regenerative landscaping could be implemented in the Gulf Coast region in general and in New Orleans in particular. It was a primary goal of the workshop to create greater awareness in the Gulf Coast region of approaches that are being implemented successfully in other parts of the world but may not yet be embraced in the United States. The workshop encouraged an attitude of accommodating, rather than fighting, water, recognizing that we must learn to live in safety WITH water.[276]

The innovative strategies presented at the Building Resilience Workshop were to raise local awareness. The following key questions were addressed as a basis for discussion:

- *How have international communities, faced with repeated, catastrophic storm and flood events, maintained physical and social infrastructures?*

- *What innovations have occurred in response to catastrophic events?*

- *How can mitigation strategies that diffuse risk, as opposed to concentrating risk, reduce a community's overall vulnerability and increase its resilience?*

- *How might cultures share "best practices" and incorporate innovative, sustainable technologies more quickly?*

- *What are the successful approaches that have been used elsewhere to overcome institutional resistance to change that inhibits the implementation of new strategies?*

- *How can technical solutions be more responsive to social and cultural needs and traditional ways of life?*

- *What are both the physical and cultural implications of redesigning cities for increased resilience?*

- *What planning decisions can we make now that will help us build resilience and adaptability into our cities for the future?*[277]

The five keynote speakers were: Lt. General Russel Honoré, (Ret.), Visonary leader of the New Normal and Commander of Joint Task Force Katrina; Larry S. Buss, retired Chief of Hydrologic Engineering for the US Army Corps of Engineers (USACE), P. E., CFM and long time Chair of the USACE National Nonstructural/ Flood Proofing Committee; Professor Erik Pasche, Professor for Hydraulic Engineering at the Hamburg University of Technology; Chris Zevenbergen, Professor at the Water Engineering Department of UNESCO-IHE; and Dr. Jack Martin, a Professor in the Department of Technology at Appalachian State University.[278] Each of their presentations discussed local and international culturally respectful strategies, which can fortify communities to become more flood resilient. Broader issues such as the "physical and cultural implications of redesigning cities for resilience" in the face of global climate change were also explored.[279]

The BFP is a resilient flood mitigation strategy and, when combined with other large-scale infrastructural systems such as cascading levee systems, would provide significantly stronger, more reliable flood protection.

06 V summary

The Buoyant Foundation Project (BFP) is a resilient flood mitigation strategy and, when combined with other large-scale infrastructural systems such as cascading levees, would provide significantly stronger, more reliable flood protection.

This chapter has outlined how the BFP is an efficient solution to flood mitigation through providing an economical, sustainable and resilient strategy for homeowners in New Orleans.

Cost efficiency is proven through a comparison of the government recommended strategy of permanent static elevation and the proposed buoyant foundation system. The BFP is a more-cost effective solution than permanent static elevation and is effective in providing adequate flood protection for shotgun-style housing.

The BFP attempts to provide a sustainable flood mitigation solution through implementing sustainable materials and encouraging the rehabilitation of damaged homes. The aforementioned environmental and economic benefits of building preservation provide sufficient evidence why it is sustainably more responsible than demolition and rebuilding. Energy conservation, waste reduction, job creation, affordable housing and the use of sustainable materials are all aspects that make the BFP a sustainable flood protection strategy.

Lastly, the BFP can contribute to the creation of a more resilient flood-mitigation system for New Orleans, through its ability to adapt passively to changing conditions. The BFP is not the only strategy required to protect against flooding, rather it is intended to be part of a network of flood protection strategies on various scales. The BFP provides a small-scale solution, which, when combined with larger infrastructural methods, can create a multi-layered system. In the event of flooding, failures will become smaller and more localized rather than a single catastrophic event, as was the case with Hurricane Katrina.

242. Federal Emergency Management Agency, "Homeowner's Guide to Retrofitting, Second Edition." http://www.fema.gov/library/viewRecord.do?id=1420 (accessed July 30, 2010).

243. Nikki Buskey, "Could floating homes be on the way?" *Houma Today*, Sunday, November 8, 2009, http://www.dailycomet.com/article/20091108/ARTICLES/911089976?Title=Could-floating-homes-be-on-the-way- (accessed November 30, 2009) (appendices, 340).

244. Federal Emergency Management Agency, "Homeowner's Guide to Retrofitting, Second Edition." http://www.fema.gov/library/viewRecord.do?id=1420 (accessed July 30, 2010).

245. Personal Communication with Elizabeth English on August 6, 2010.

246. USACE and the National Flood Proof Committee, "Raising and Moving a Slab-on-Grade House with Slab Attached," 1990, http://www.nwo.usace.army.mil/nfpc/fpslab/ace2_10.htm#TopOfPage, (accessed May 1, 2010).

247. Buskey. 2009. 1 (appendices, 340); and Elizabeth English, "Amphibious Foundations and the Buoyant Foundation Project: Innovative Strategies for Flood-Resilient Housing," (paper presented at the International Conference on Urban Flood Management, Paris, France, November 25-27, 2009), 7 (appendices, 412).

248. Amy Wold, "Float this House: Professor Hopes to Save Ambiance of N.O. Homes," *The Advocate, Baton Rouge,* June 2, 2007, 1 (appendices, 340).

249. Elizabeth English, Interviewed by Charlotte Garson, *French Public Radio Station in Breaux Bridge*, LA, August 2008 (appendices, 384).

250. Patrice Frey, "Making the Case: Historical Preservation as Sustainable Development," October 15, 2007, www.preservationnation.org/issues/sustainabilit/additional-resources/Discussion-Draft_10_15.pdf (accessed September 30, 2009).

251. ibid.

252. Calvin W. Carter, “Assessing Energy Conservation Benefits: A Study,” *New Energy from Old Buildings*, (Washington: National Trust for Historic Preservation, 1981), 103-104, as quoted in Patrice Frey, “Making the Case: Historical Preservation as Sustainable Development,” October 15, 2007. www.preservationnation.org/issues/sustainabilit/additional-resources/DiscussionDraft_10_15.pdf (accessed September 30, 2009).

253. Booz Allen Hamilton, “Advisory Council on Historic Preservation, Assessing the Energy Conservation Benefits of Historic Preservation: Methods and Examples,” (Washington, DC: 1979), 106, as quoted in Frey, “Making the Case: Historical Preservation as Sustainable Development,” October 15, 2007. www.preservationnation.org/issues/sustainabilit/additional-resources/DiscussionDraft_10_15.pdf (accessed September 30, 2009).

254. Franklin Associates, “Characterization of Building-Related Construction and Demolition Debris in the United States,” (Washington: U.S. Environmental Protection Agency, 1998) 2-4, as quoted in Patrice Frey, “Making the Case: Historical Preservation as Sustainable Development,” October 15, 2007. www.preservationnation.org/issues/sustainabilit/additional-resources/DiscussionDraft_10_15.pdf (accessed September 30, 2009).

255. ibid.

256. Donovan Rypkema, *The Economics of Historic Preservation: A Community Leader’s Guide* (Washington, D.C.: National Trust for Historic Preservation, 2005), 23 as quoted in Patrice Frey, “Making the Case: Historical Preservation as Sustainable Development,” October 15, 2007. www.preservationnation.org/issues/sustainabilit/additional-resources/DiscussionDraft_10_15.pdf (accessed September 30, 2009).

257. David Listokin, Barbara Listokin and Michael Lahr, “The Contributions of Historic Preservation to Housing and Economic Development,” *Housing Policy Debate 9* (1998): 456, as quoted in Patrice Frey, “Making the Case: Historical Preservation as Sustainable Development,” October 15, 2007. www.preservationnation.org/issues/sustainabilit/additional-resources/DiscussionDraft_10_15.pdf (accessed September 30, 2009).

258. ibid.

259. ibid., 449

260. Lisa Miles Jackson and Thomas J. Nosker, “Technology, Applicability, and Future of Thermoplastic Timber,” http://igsfederal.com (accessed September 1, 2009).

261. ibid.

262. ibid.

263. ibid.

264. ibid.

265. ibid.

266. ibid.

267. Nalgene Community Sustainability Program, http://www.refillnotlandfill.org/ncsp/index.html (accessed September 30, 2009).

268. Craig E. Colten, *An Unnatural Metropolis: Wresting New Orleans From Nature* (Louisiana: Louisiana State University Press, 2005), 11.

269. Resilience Alliance, “Key Concepts,”http://www.resalliance.org/564.php (accessed November 23, 2009).

270. Kevin Lynch, *Wasting Away - An Exploration of Waste: What It Is, How It Happens, Why We Fear It, How To Do It Well*. New York: Random House Inc., 1991. in Vale, Lawrence and Campanella, Thomas, *The Resilient City: How Modern Cities Recover From Disaster* (Oxford Press: New York, 2005), 347.

271. NOAA Coastal Services Center, http://csc-s-maps-q.csc.noaa.gov/hurricanes/viewer.html (accessed February 1, 2010).

272. John A. Lopez, "Multiple Lines of Defense," *Journal of Coastal Research, Special Issue No. 54* (2009): 189-190.

273. Erik Pasche *et al*., "Flood Mitigation Using Cascading Dike System," paper for Forum DK-KV/CEDIM: Disaster Reduction in Climate Change 15, Hamburg, Germany, October 16, 2007, 1.

274. Elizabeth English, Interviewed by Charlotte Garson, *French Public Radio Station in Breaux Bridge, LA,* August 2008, (appendices, 384).

275. Elizabeth English, "Building Resilience: Implementing Innovative, Sustainable Flood Mitigation Solutions for the Gulf Coast 2010," http://resilienceworkshop.org/ (accessed February 1, 2010).

276. ibid.

277. ibid.

278. ibid.

279. ibid.

07

the buoyant foundation project: future

the future:

i. introduction

ii. future of the BFP
100 block concept
future considerations:
use of sustainable materials

iii. timelines
BFP timeline
amphibious architecture timeline

iv. summary

v. endnotes

07 i the future

Chapter seven will discuss future objectives and requirements to bring the Buoyant Foundation Project (BFP) closer to completion.

A 100-block concept is discussed, analyzing the hypothetical situation if 300 houses had implemented buoyant foundations prior to Hurricane Katrina. This concept provides insight as to how the BFP may have aided in a quicker recovery of the Lower Ninth Ward in New Orleans.

The BFP is considering the use of a new thermoplastic composite structural grade material in place of the steel frame substructure and telescoping steel vertical guidance posts. There is also research being conducted on incorporating containers filled with recapped, recycled plastic water bottles to replace the EPS buoyancy blocks.

To conclude the chapter, a comparison of amphibious architecture and the Buoyant Foundation Project is provided by displaying timelines of the major milestones in the history of amphibious architecture with the progress of the Buoyant Foundation Project.

07

ii

future: the BFP

100-BLOCK CONCEPT

What if 300 residences in the Lower Ninth Ward had installed buoyant foundations on shotgun houses prior to Hurricane Katrina? In figure 242, the shaded area, south of North Claiborne Avenue and north of St. Claude Avenue is the zone that the BFP has targeted for the implementation of buoyant foundations on single shotgun residences. Figure 243 outlines 100 blocks that have been identified within this zone of the Lower Ninth Ward. Residential blocks are marked in red and commercial or vacant blocks are marked in blue. Only blocks marked in red possess residences that are potentially suitable for retrofit with the buoyant foundation system. Given an average house hold size of 4 persons per shotgun house, if 3 houses per block had retrofitted their homes with buoyant foundations, 1200 residents could have immediately returned to their homes with possessions intact after the storm. If these 1200 residents had returned immediately after Katrina, this would have expedited the return of utilities, encouraging other former residents to return much sooner. Figure 244 displays the recovery of housing units per block between North Claiborne Avenue and St. Claude Avenue in 2010. Figure 245 is a table comparing active households receiving mail in the Lower Ninth Ward before and after Hurricane Katrina. Three years after Katrina, only 11% of households were receiving mail.[280] Presently, only 24% of Lower Ninth Ward residents are receiving mail, which one of the lowest percentages for neighbourhoods in New Orleans.[281] This slow recovery could have been prevented by having amphibious housing in this area. Figure 246 is an aerial view of a portion of the Lower Ninth Ward, south of North Claiborne Avenue and north of St. Claude Avenue, displaying the current state of housing in 2010.

fig. 242: Focus of the BFP, Lower Ninth Ward, New Orleans

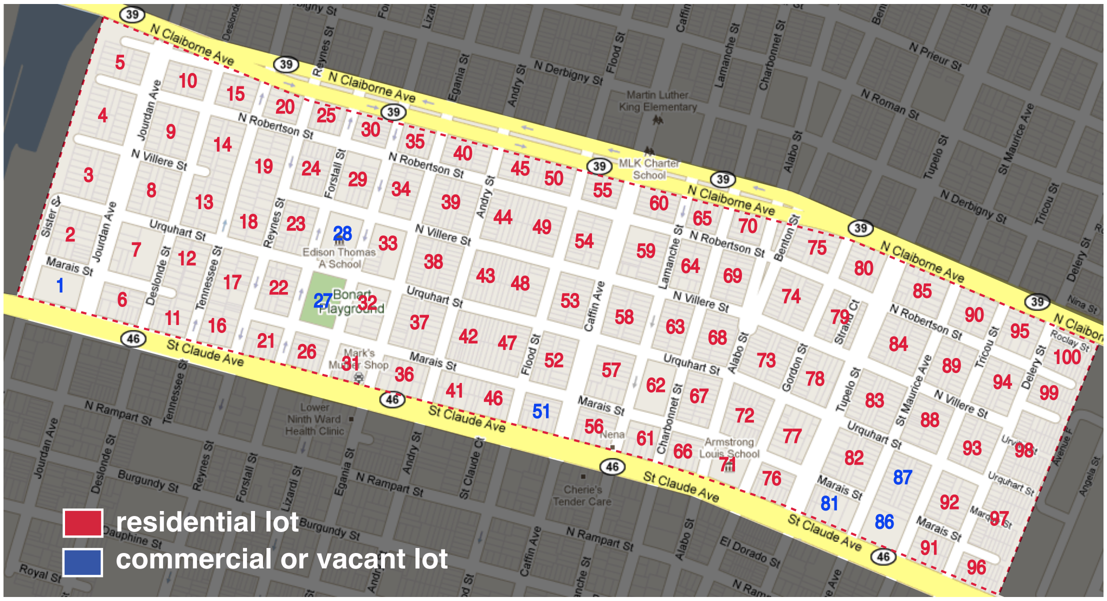


fig. 243: The Future of the BFP, 100-Block Concept

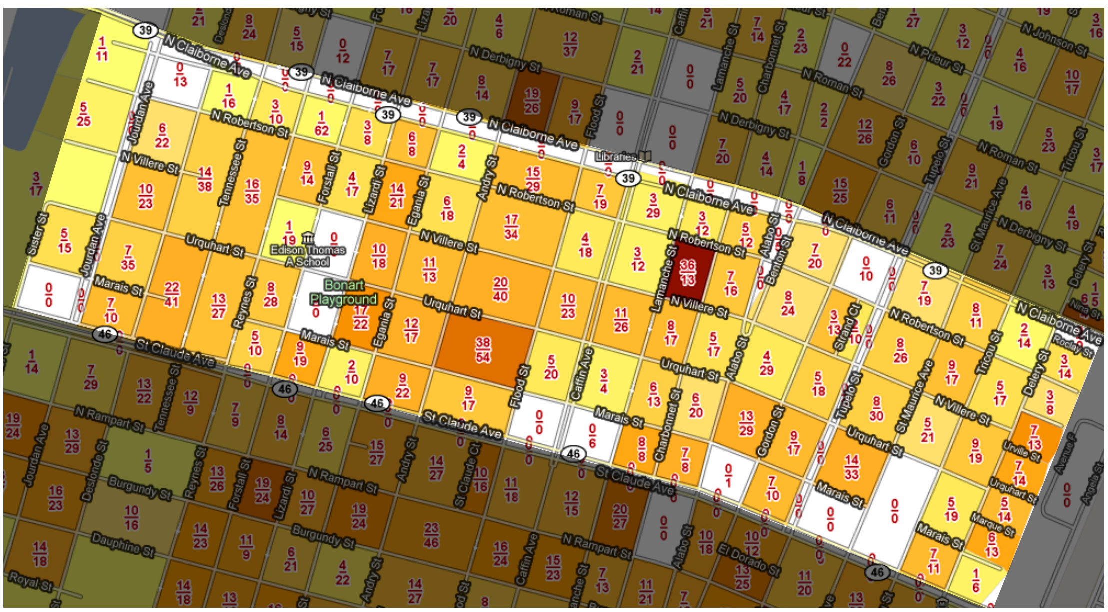
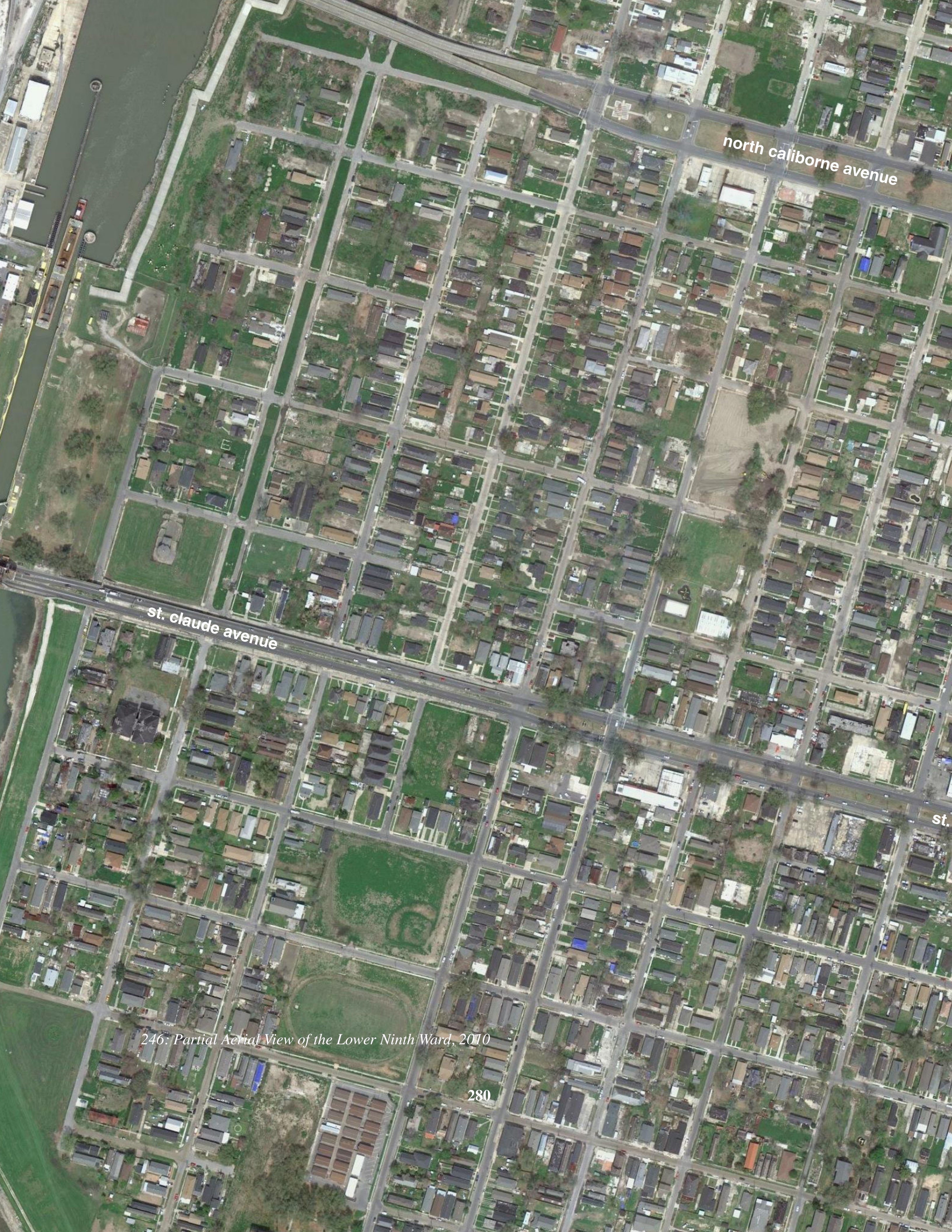


fig. 244: Housing Recovery By Block, 2010

Neighborhood	June 2005	June 2008	June 2009	June 2010	% Recovery June 2010
Lakeview Neighborhood	4,711	1,912	2,358	2,774	59%
Lakewood	786	590	593	624	79%
Leonidas	3,726	3,521	3,485	3,288	88%
Little Woods	16,504	8,907	11,385	12,751	77%
Lower Garden District	4,406	4,073	4,295	4,542	103%
Lower Ninth Ward Neighborhood	5,363	601	1,017	1,271	24%
Marigny	2,133	2,079	2,119	2,128	100%
Marlyville/Fountainebleau	3,010	2,706	2,752	2,792	93%
McDonogh	1,270	1,323	1,281	1,279	101%

fig. 245: Households Actively Receiving Mail in New Orleans, 2010



246: Partial Aerial View of the Lower Ninth Ward, 2010

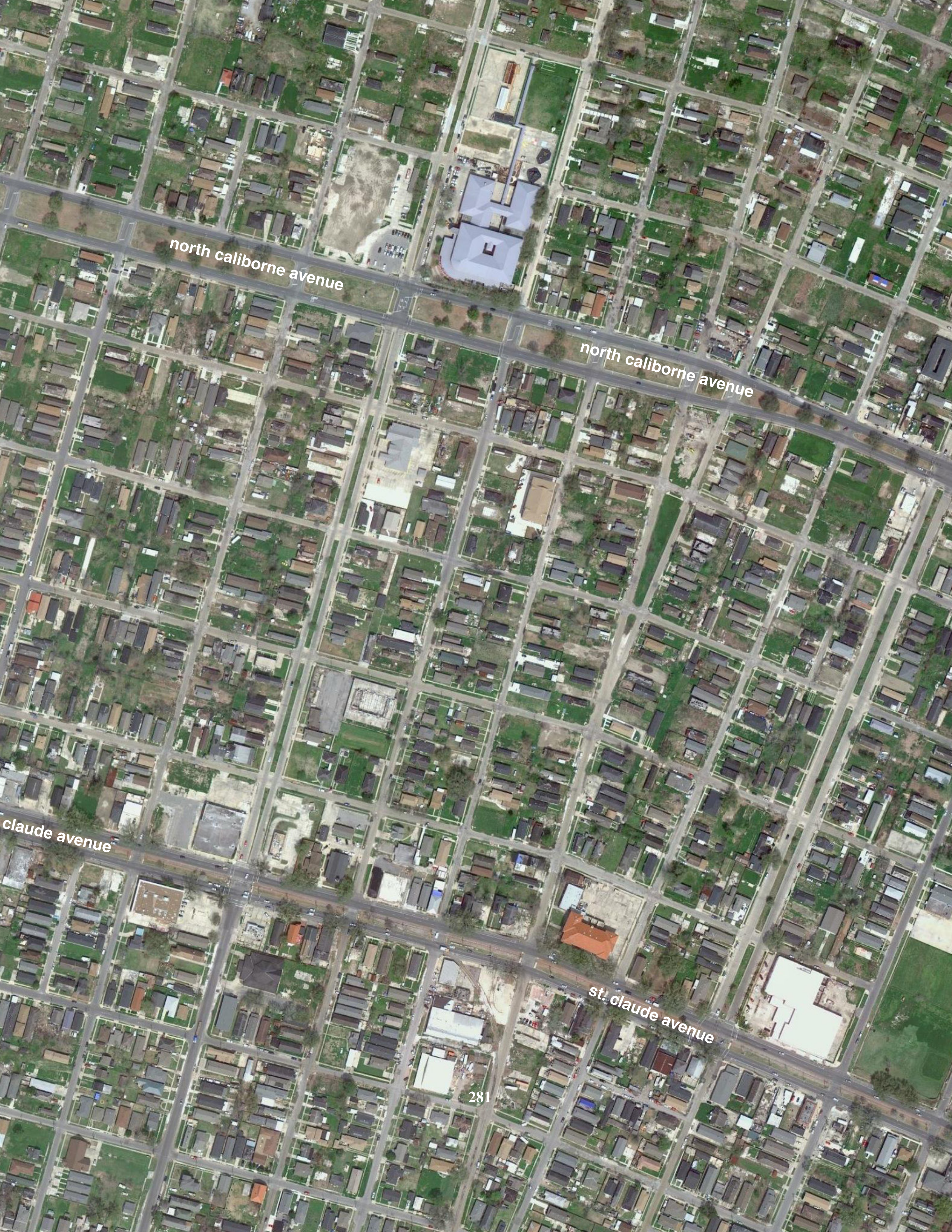

north caliborne avenue
north caliborne avenue
claude avenue
st. claude avenue

fig. 247: Thermoplastic Timber Piling Installation

fig. 248: Elevated Rail in Chicago Using Thermoplastic Ties

fig. 249: Water Bottle "Junkraft"

FUTURE CONSIDERATIONS:
USE OF SUSTAINABLE MATERIALS

As discussed in previous chapters, the use of thermoplastic timber (fig. 247, 248) in place of the steel frame substructure and telescoping steel vertical guidance posts is currently being investigated. Thermoplastic timber does not corrode and is a more suitable material than steel for structures partially submerged in water.

Recapped, recycled empty water bottles in place of EPS flotation blocks are also being considered. Bundles of air-filled, sealed plastic bottles can provide both buoyancy and redundancy (fig. 249, 250).

Either a cavity or frame would need to be created to hold the water bottles in place, much like the N55 flotation system (fig. 251) that uses plastic modules attached to a frame to form a cohesive buoyancy element. This "Floating Platform" is part of N55's "Spaceframe" project, completed in 2002. N55 is a multi-disciplinary design firm based in Denmark.

Maria Alexandrescu, a student at the University of Waterloo School of Architecture, has provided the following research as part of her submission for "ARCH 684-016 Amphibious Architectures: The Buoyant Foundation Project and Alternative Flood Mitigation Strategies in Post-Katrina New Orleans." This was an elective course held at the school in spring 2009.

According to N55:

> The Floating Platform is a modular construction, which is intended to function as a buoyant foundation for N55 Spaceframe (see manual for N55 Spaceframe), or for other lightweight constructions. . . . The Floating Platform is a space lattice, comprised of small modules made from stainless steel with built-in buoyant tanks. The small modules in the platform can all be assembled by hand. . . .

fig. 250: Capped Water Bottle Raft

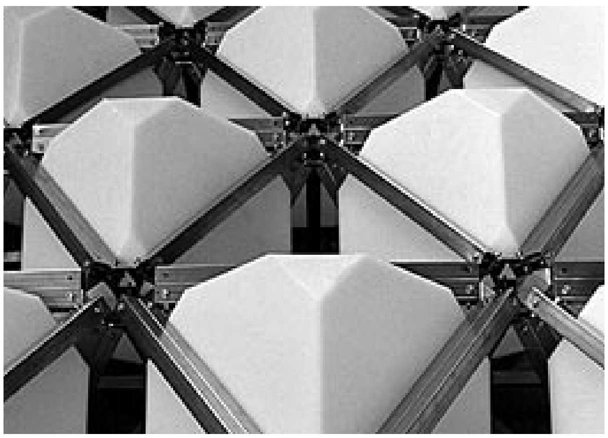


fig. 251: Flotation Platform by N55

fig. 252: Plastic Water Bottles Used for Testing Prior to Construction of the LIFT House

> The modular system facilitates gradual extensions and makes the platform less vulnerable to damage; for example, leaks only have local impact and can be repaired locally. . . . The platform draws approximately 1.2 meters when loaded. . . is constructed as an "octet truss" space lattice (see Manual for N55 Spaceframe) and is shaped as an equilateral triangle. 189 polyethylene tanks make the platform buoyant. They are concentrated in the three pontoons situated in each corner of the platform. The pontoons are constructed from 3 layers of tanks and are shaped as tetrahedra with one vertex pointing downwards and a plane facing upwards.[282]

The Floating Platform provides an example of a modular buoyancy system using the geometry of an "octet truss" to provide a light-weight, rigid frame. The plastic compartments can be easily serviced and maintained without causing a major failure to the entire system. (See pages 327-329 in the appendices for further information on the N55 Floating Platform).

This design principle was implemented by Prithula Prosun for the buoyancy elements of the LIFT House. Figure 252 is a photograph taken on the site of Prithula Prosun's LIFT House. She utilized bundles of recapped plastic water bottles in plastic bags for buoyancy blocks for one of the full-scale built prototypes of her amphibious housing. Like the plastic compartments of the Floating Platform, these bundles act as modules that can be serviced individually without disrupting the whole system.

On the following pages, figures 253 and 254 display timeliness of the major milestones of amphibious architecture and the BFP.

07

iii

future: timelines

BFP timeline

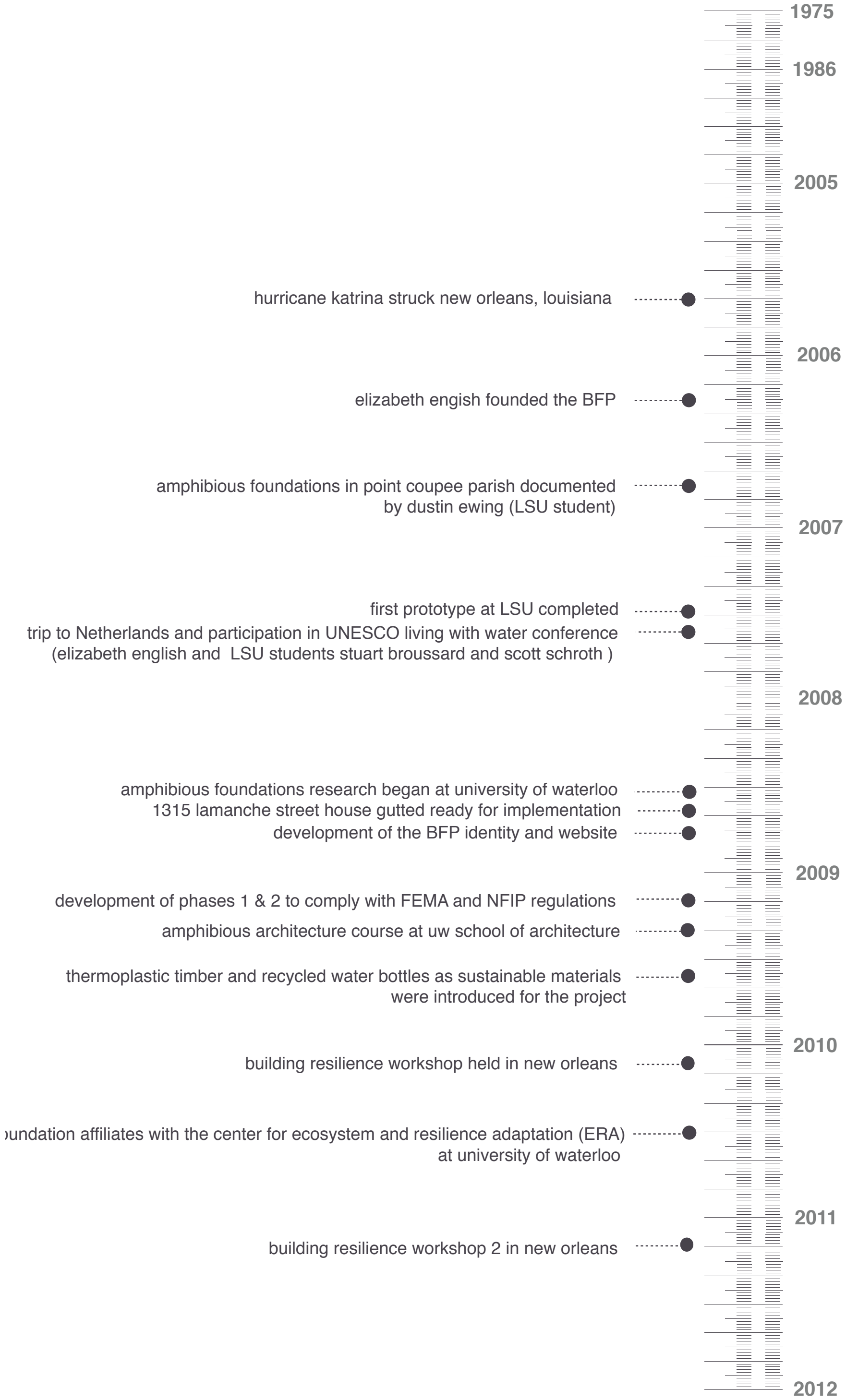


fig. 253: BFP Timeline

amphibious architecture timeline

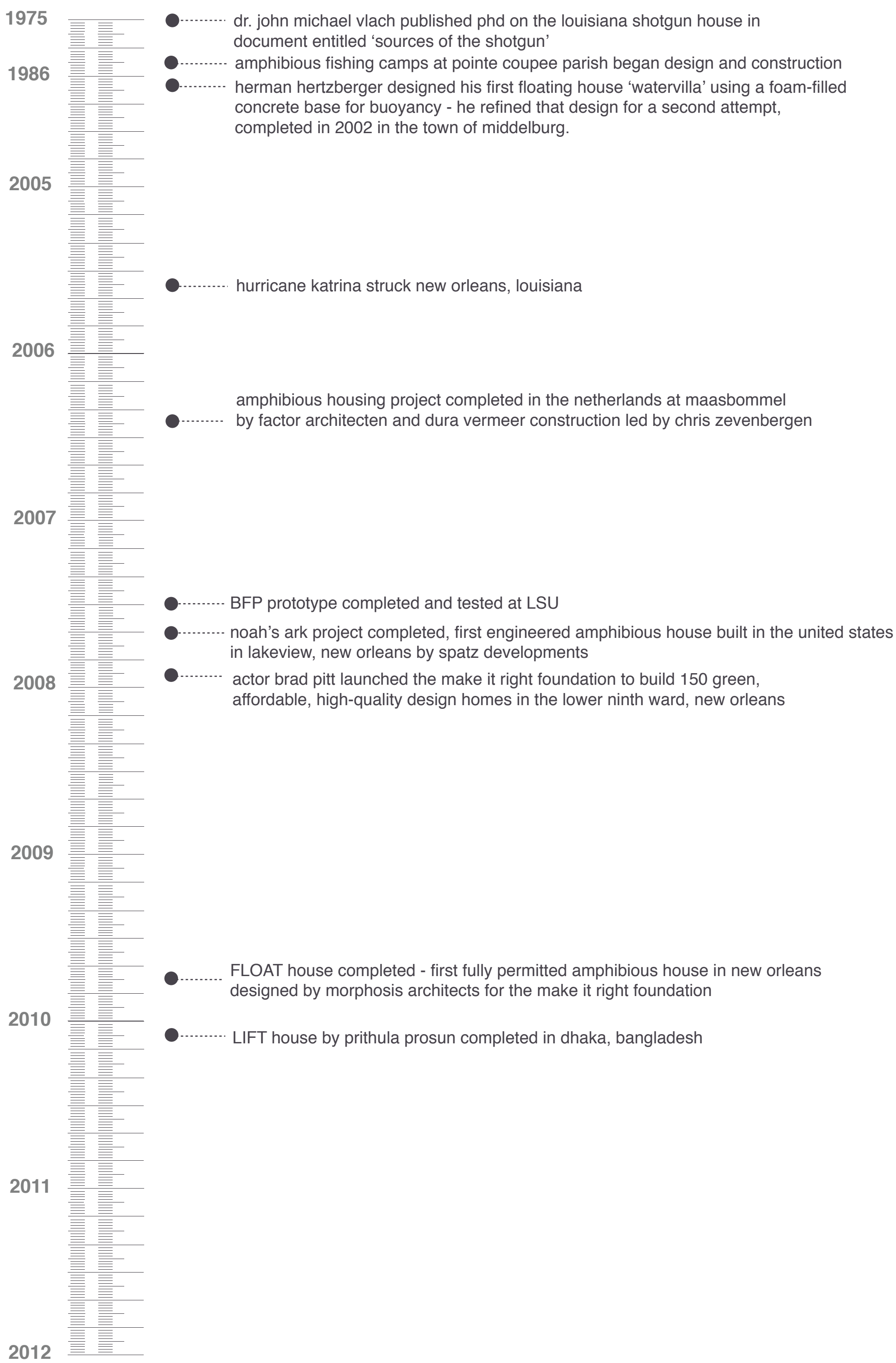


fig. 254: Amphibious Architecture Timeline

07

iv

summary

This chapter has outlined significant future considerations that will carry the project into the next phase of investigation.

The 100-block concept provides insight as to how neighbourhoods may recover more quickly after catastrophic flooding. If buoyant foundations had been implemented on just 300 homes, at least 1200 residents may have returned to their former homes immediately after the storm and could have expedited the return of utilities and services, enabling the return of more residents.

The implementation of materials such as Thermoplastic timber and recapped recycled water bottles could improve the overall sustainability of the project, however further investigation is required.

Lastly, the BFP has been progressing simultaneously with many significant amphibious architectural projects as illustrated in the adjacent timelines. Since the BFP was founded in 2006, the amphibious homes in Maasbommel, Netherlands, the amphibious house in Lakeview, New Orleans, the FLOAT House in the Lower Ninth Ward, New Orleans, and the LIFT house in Dhaka, Bangladesh, have been completed and are providing effective flood mitigation both locally and internationally.

07

V

endnotes

280. Allison Plyer, "Neighborhood Recovery Rate Resiliency of New Orleanians Shown in Neighborhood Repopulation Numbers," http://www.gnocdc.org/RecoveryByNeighborhood/index.html (accessed July 1, 2010).

281. ibid.

282. N55, "Manual for Floating Platform," http://www.n55.dk/MANUALS/FLOAT_PLAT/FLOAT_PLAT.html (accessed September 1, 2009).

08

the buoyant foundation project: conclusions

CONCLUSIONS

Climate change is an urgent matter and it has become critical to reevaluate humankind's relationship with water. Flood mitigation strategies for coastal cities world-wide must be reconceived to accommodate the flux in climate. Flexible, multi-layered systems that can adapt to changes in sea level are imperative. Passive systems, which operate both statically and dynamically when required, are needed to accommodate the dynamic relationship between land and water.

Classic methods implemented to "control" water have caused further damage to New Orleans. Infrastructure used to prevent flooding has disrupted the city's natural defense system by inhibiting silt deposition and replenishment of the natural levee system. Groundwater pumping has increased the rate of subsidence. Hurricane Katrina revealed the inadequacy of USACE designed flood protection systems, where artificial systems used to manage water ultimately failed.

The importance and necessity of an alternative flood protection system is apparent. The tragic aftermath of Hurricane Katrina demonstrated the inadequacy of the United States federal government's hurricane protection system. Multiple levee failures, a lack of preparedness, insufficient aid and the slow return of utilities delayed the recovery of New Orleans, particularly the Lower Ninth Ward. This neighbourhood was one of the most severely damaged yet recoverable areas of New Orleans. Many homes were salvageable and could be suitable for retrofit with buoyant foundations. Residents surveyed from the Lower Ninth Ward have expressed a strong desire to return home despite the tragic events of Katrina. It is hoped that implementation of the BFP will convince residents that they can return to their former neighbourhoods in safety.

The BFP's goal is to provide an affordable solution for homeowners to protect their possessions and enable the return of residents after a flood. The current solution promoted by the United States federal government recommends or requires permanent static elevation for homeowners in flood-prone areas. It is not a viable or practical response. Permanently elevating a home is costly, inconvenient, and heightens the risk of wind damage during future hurricanes. It also destroys neighbourhood character by disrupting the relationship of house to street and does not foster a culture of social interaction. The BFP recognizes the importance of a street-level front porch and its role in maintaining New Orleans' tight-knit community culture.

The BFP provides a culturally sensitive, technically feasible, economical, sustainable and resilient form of flood protection for residents of the Lower Ninth Ward in post-Katrina New Orleans. This low-impact flood mitigation strategy promotes the restoration of existing shotgun homes through their retrofit with buoyant foundations using cost-effective and sustainable materials. It enables them to float during a flood. The BFP is currently the only strategy that addresses the technical, safety-related, environmental and socio-cultural aspects of flood protection simultaneously.

The BFP supports the local culture and restoration of the physical habitat. The shotgun house plays an integral part in shaping the distinctive cultures in New Orleans by contributing to the strengthening of tight-knit communities and reinforcing the sense of place. The lack of interior privacy created by the absence of separated circulation space, coupled with the utilization of the front porch as a social realm, has fostered a culture of social interaction in the Lower Ninth Ward and other similar New Orleans neighbourhoods.

Local and international precedents prove the technical feasibility of amphibious foundations. On a local scale at Pointe Coupee Parish, Lakeview and the Lower Ninth Ward, and on global scale in the Netherlands and Bangladesh, different variations of amphibious foundation systems have been constructed in vulnerable flood-prone locations.

The retrofitted, pre-manufactured mobile homes that comprise the amphibious fishing camps on Raccourci Old River in Pointe Coupee Parish (some of them in existence for more than 30 years) inspired the basic system configuration and materiality of the BFP. Engineered design, aesthetic modification and code compliance are necessary for implementation in an urban setting.

The amphibious housing at Maasbommel is a modern engineered solution. It was the first known and widely publicized example of modern amphibious housing, gaining exposure as a type. It demonstrates feasibility of concept and the appropriateness of amphibious architecture for a low-lying flood-prone region.

The LSU Hurricane Center prototype was a full-scale partial prototype of the BFP system that demonstrated its functionality. Mechanical Engineering students built a platform on a buoyant foundation to test for stability, and LSU Hurricane Center students completed the prototype by building a house frame and a flood tank around the platform to carry out flood tests. The prototype proved that the BFP system works with an observed flood test in a controlled testing facility. This example revealed areas for improvement directly relating to the BFP.

Noah's Ark Project in Lakeview, New Orleans, was the first legally permitted, modern engineered home constructed in North America with an amphibious foundation. It demonstrates the feasibility and appropriateness of this concept for New Orleans. Although it is neither a shotgun house nor a retrofit, it demonstrates similar technical aspects to the design of a buoyant foundation. It uses vertical guideposts and sleeves similar to the LSU Hurricane Center prototype and has had to tackle zoning and permitting issues.

The recent completion of Morphosis' FLOAT House made ground breaking progress as the first home to implement an amphibious foundation in New Orleans and receive an occupancy permit. The FLOAT House paves the way politically, opening the door for local opportunities, and has played a significant role in addressing FEMA and NFIP objections to implementing the BFP.

The LIFT House is another international example of the technical and economic feasibility and appropriateness for a low-income population in Dhaka, Bangladesh. Prithula Prosun, a masters student at the University of Waterloo School of Architecture, designed and built an amphibious house, which may serve to inform the BFP on the implementation of sustainable materials and the acceptance of the concept and feasibility.

The BFP is a more economical form of flood protection than permanent static elevation, as it is more cost-effective to implement. It also provides a higher level of flood protection than permanent static elevation because as it is able to adapt to changing flood levels. Through the retrofit of existing structures with buoyant foundations, less waste and energy are consumed in comparison to new construction. The BFP contributes to the creation of flood-resilient neighbourhoods in New Orleans by providing a flexible system that allows a house to adapt to changing conditions when flooding occurs. It serves as a small-scale intervention, one of the many layers of flood protection necessary to provide New Orleans with greater resilience to flooding.

To achieve the BFP's commitment to providing cost-effective, alternative flood protection will require innovative methods of funding to enable the project's completion and implementation. Students, volunteers, sponsors, partners, and affiliates have all collaborated both locally and nationally in bringing the project to its current state.

Much effort is still required to achieve the completion of a full-scale buoyant foundation in the Lower Ninth Ward. However, as public awareness continues to grow, and with an increasing number of international amphibious projects, the BFP team is confident that successful implementation of the Buoyant Foundation Project is likely in the near future.

the buoyant foundation project:

bibliography

ACORN, Cornell University, University of Illinois, Columbia University and NSF. "The People's Plan for Overcoming the Hurricane Katrina Blues: A Comprehensive Strategy for Building a more Vibrant, Sustainable and Equitable 9th Ward." http://www.rebuildingtheninth.org/resources/ (January 15, 2010). In Reardon, Ken and John Forester (eds.), *Rebuilding Community After Katrina: Transformation Education in The New Orleans Planning Initiative* (under review for publication 2010).

AHUP (ACORN Housing/University Partnership). "Planning District 7 and 8 Assessment and Needs Analysis." in Rebekah Green, Lisa K. Bates and Andrew Smyth. "Impediments to recovery in New Orleans' Upper and Lower Ninth Ward: One year after Hurricane Katrina." Disasters 31 (2007):311-335.

A1 Tarps. "Tarp Company Expands Business by Participating in Disaster Relief Efforts." www.a1tarps.com/assets/File/pressreleases2007.pdf. (June 1, 2010).

Associated Press. "New Orleans' Katrina-Ravaged 9th Ward Can Be Rebuilt, Planners Say." http://www.foxnews.com/story/0,2933,242316,00.html. (October 23, 2009).

Abrahams, Roger D., *et al*. *Blues for New Orleans: Mardi Gras and America's Creole Soul*. Philadelphia: University of Pennsylvania Press, 2006.

Andersen, Christine F., *et al*. *New Orleans Hurricane Protection System : What Went Wrong and Why, A Report*. Reston: ASCE, 2007.

Anderson, R. Bentley. *Black, White, and Catholic: New Orleans Interracialism 1947 to 1956*. Nashville: Vanderbilt University Press, 2005.

Archinnovations. "Morphosis FLOAT House: How It Works." December 2009. http://www.archinnovations.com/featured-projects/housing/morphosis-float-house-how-it-works/. September 1, 2010.

Basso, Keith H. *Wisdom Sits in Places: Landscape and Language Among the Western Apache*. New Mexico: University of New Mexico Press, 1996.

Baum, Dan. "Letter From New Orleans, The Lost Year: Behind the Failure to Rebuild." *The New Yorker*, August 21, 2006. http://www.newyorker.com/archive/2006/08/21/060821fa_fact2. (October 23, 2009).

Bayou Buzz Staff. "Hurricane Homes." http://www.bayoubuzz.com/News/Louisiana/Business/Louisiana_Business_Shorts__Michael_Bloomberg_Jindal_and_Economic_Development_Hurricane_Homes_Tidewater___5170.asp. (November 1, 2009).

Bello, Owen J. "Pointe Coupee Parish, Louisiana." http://www.pcpolicejury.org. (September 1, 2009).

Bergal, Jenni. *City Adrift : New Orleans Before and After Katrina*. Baton Rouge: Louisiana State University Press, 2007.

Bernstein, Mark. *Rebuilding Housing Along the Mississippi Coast : Ideas for Ensuring an Adequate Supply of Affordable Housing*. Santa Monica: RAND Corporation, 2006.

Birch, Eugenie Ladner and Susan M. Wachter (eds). *Rebuilding Urban Places after Disaster : Lessons from Hurricane Katrina*. Philadelphia : University of Pennsylvania Press, 2006.

Booz Allen Hamilton Inc. "Assessing the Energy Conservation Benefits of Historic Preservation: Methods and Examples." Washington, DC: Advisory Council on Historic Preservation, 1979.

Boyd, Ezra. "Preliminary Summary Report of Hurricane Katrina Deceased Victim Recovery Locations in Louisiana." presented at the ESRI Gis and Public Health Conference in November 2006. http://proceedings.esri.com/library/userconf/health06/index.html, (August 1, 2010).

Boyd, Ezra, Brian Wolshon and Ivor Van Heerden. "Risk Communication and Public Response during Evacuations: The New Orleans Experience of Hurricane Katrina." *Public Performance and Management Review 32,* no.3 (March 2008):454.

Brinkley, Douglas. *The Great Deluge : Hurricane Katrina, New Orleans, and the Mississippi Gulf Coast*. 1st ed. New York: Morrow, 2006.

Brookings Institution Metropolitan Policy Program. "New Orleans After the Storm: Lessons from the Past, A Plan for the Future." Washington, DC: Author, 2005. http://www.brookings.edu/reports/2005/10metropolitanpolicy.aspx. (September 1, 2009).

---. "The New Orleans Index: Tracking the Recovery of New Orleans and The Metro Area." Metropolitan Policy Program, 2009. https://gnocdc.s3.amazonaws.com/NOLAIndex/NOLAIndex.pdf. (September 1, 2009).

Brown, Barbara B., and Douglas D. Perkins. "Disruptions in Place Attachment." In I. Altman and S. M. Low (eds.), *Place Attachment*. New York: Plenum Press, 1992.

Bureau Hans Venhuizen. "Amphibious Living." http://www.amfibischwonen.nl/index2-e.html, (accessed July 1, 2010).

Buskey, Nikki. "Could Floating Homes Be on the Way?" *Houma Today.* Sunday, November 8, 2009. http://www.dailycomet.com/article/20091108/ARTICLES/911089976. (November 30, 2009). *(appendix viii)*.

Busques, Joan and Felipe Correa. *New Orleans: Strategies for a City in Soft Land*. Boston: Harvard University Graduate School of Design, 2005.

Campanella, Richard. *Geographies of New Orleans*. Lafayette: University of Louisiana at Lafayette, Center for Louisiana Studies, 2008.

---. "Building Resilience Workshop: Implementing Innovative, Sustainable Flood Mitigation Solutions for the Gulf Coast 2010." http://resilienceworkshop.org/. (February 1, 2010). *(appendix viii)*.

Campanella, Richard and Marina Campanella. *New Orleans Then and Now.* New Orleans: Pelican Publishing Company, 1999.

Carter, Calvin W. “Assessing Energy Conservation Benefits: A Study.” *New Energy from Old Buildings*. Washington, D.C.: National Trust for Historic Preservation, 1981.

Colten, Craig E. *Perilous Place, Powerful Storms : Hurricane Protection in Coastal Louisiana*. Jackson: University Press of Mississippi, 2009.

---. *An Unnatural Metropolis: Wresting New Orleans From Nature*. Louisiana: Louisiana State University Press, 2005.

Cochrane, Timothy. “Place, People and Folklore: An Isle Royale Case Study.” *Western Folklore 46* (1987):1-12.

Correa, Felipe. “City in Suspension: New Orleans and the Construction of Ground.” *AD Magazine 77* (2007): 98-105.

Curtis, Stephen A. *Hurricane Katrina Damage Assessment : Louisiana, Alabama, and Mississippi Ports and Coasts*. Reston: American Society of Civil Engineers, 2007.

Dapples, E.C. and M.E. Hopkins. “Environments of Coal Deposition.” *Boulder Colorado Geological Society of America Special Paper 114* (1969): 63-68.

Darden, Thomas. “Rebuilding a Sustainable Lower Ninth Ward.” *MIR Annual Report 2007*. http://www.makeitrightnola.org/index.php/about/detail/financials/ (September 1, 2009).

DeKorne, Clayton. “Floating Out the Storm : A Concept Home Designed to Resist Flood and Wind Rises Out of The Wreckage of New Orleans.” http://www.coastalcontractor.net/abstract/189.html. (September 1, 2009).

DeMond, Shondell Miller and Jason David Rivera. *Hurricane Katrina and the Redefinition of Landscape*. Lanham: Lexington Books, 2008

Dilip da Cunha and Mathur Anuradha, “Negotiating Fluid Terrain.” In Eugenie Ladner Birch and Susan M. Wachter (eds). *Rebuilding Urban Places after Disaster : Lessons from Hurricane Katrina*. Philadelphia : University of Pennsylvania Press, 2006.

Dugan, Bridget. “Loss of Identity in Disaster: How to Say Goodbye to Home?” *Perspectives in Psychiatric Care 43* (2007): 41-46

Dura Vermeer. “Amphibious and Floating Homes in Maasbommel.” http://www.duravermeerbusinessdevelopment.nl/uk/project_info.asp?id=579. (September 1, 2009).

Dyson, Michael Eric. *Come Hell or High Water : Hurricane Katrina and the Color of Disaster*. New York: Basic Civitas, 2006.

Eames, Andrew. “Floods without Tears.” http://www.telegraph.co.uk/property/3350061/Floods-without-tears.html (September 1, 2009).

Edwards, Jay D. “New Orleans Shotgun: An Historical Cultural Geography, Cultures of Rebuilding Conference.” Powerpoint Presentation presented at the Cultures of Rebuilding in Post-Katrina New Orleans: An Interdisciplinary Conference, University of New Orleans and the Louisiana State Museum, Louisiana, November 6-8, 2008.

---. “Shotgun: The Most Contested House in America.” *Buildings and Landscapes: Journal of the Vernacular Architecture Forum 16* (2009):62-96

---. “The Origins of Creole Architecture.” *Winterthur Portfolio 29* (1994):155-189.

---. “Cultural Syncretism in the Louisiana Creole Cottage.” *Louisiana Folklore Miscellany 4* (1978-80):9-40.

English, Elizabeth. “Amphibious Foundations and the Buoyant Foundation Project: Innovative Strategies for Flood-Resilient Housing.” Paper presented at the International Conference on Urban Flood Management, Paris, France. November 25-27, 2009. *(appendix viii)*.

---. “Amphibious Housing and the Buoyant Foundation Project: An Innovative, Sustainable Strategy for a More Flood-Resilient New Orleans.” Powerpoint Presentation for the National Association of Environmental Law Societies Annual Conference New Orleans, March 6 2010, http://www.buoyantfoundation.org (accessed September 1, 2009).

---.“Building Flood Resilience with Amphibious Architecture, ChaRisMa: 1st Waterloo Conference on the Characteristics, Risk and Management of Natural Hazards, December 2, 2010, http://www.buoyantfoundation.org (accessed December 3, 2010) *(appendix vii)*.

---. “Building Resilience: Implementing Innovative, Sustainable Flood Mitigation Solutions for the Gulf Coast 2010.” http://resilienceworkshop.org/. (February 1, 2010).

---. “The Buoyant Foundation Project.” http://www.buoyantfoundation.org. (September 1, 2010).

---. Interviewed by Charlotte Garson. *Interview for French Public Radio Station,* Breaux Bridge, LA, August 2008. *(appendix vi)*.

Eyles, John D. “The Geography of Everyday Life.” In D. Gregory and R. Walford (eds). *Horizons in Human Geography*. New Jersey: Barnes and Noble, 1989.

Federal Emergency Management Agency. “50,000 New Orleans’ Homes Still Eligible For Blue Roofs.” http://www.fema.gov/news/newsrelease.fema?id=21820. (January 1, 2010).

---. “Advisory Flood Elevations and Disaster Assistance.”ABFE_FAQ.pdf. http://www.fema.gov/news/newsrelease.fema?id=23283. (September 30, 2009).

---. “Answers to Questions about the NFIP: Flood Hazard Assessments and Mapping Requirements.” http://www.fema.gov/business/nfip/fhamr.shtm#79. (October 23, 2009).

---. “Base Flood.” http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/base_flood.shtm. (September 30, 2009).

---. “Base Flood Elevation.” http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/base_flood_elevation.shtm. (September 30, 2009).

---. “Definitions of FEMA Flood Zone Designations.” http://www.msc.fema.gov/webapp/wcs/stores/servlet/info?storeId=10001&catalogId=10001&langId=-1&content=floodZones&title=FEMA%20Flood%20Zone%20Designations. (October 23, 2009).

---. “Designing for Flood Levels Above the BFE.” www.fema.gov/library/file?type=publishedFile&file=fema549_apndx_e_ra8.pdf&fileid=143da3a0-0316-11dc-a1f1-000bdba87d5b fema549_apndx_e_ra8.pdf. (September 30, 2009).

---. “Flood Zones: NFIP Policy Index.” http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/flood_zones.shtm. (October 23, 2009).

---. “Flood Recovery Guidance: Frequently Asked Questions.” FRG_Addendum_FAQ’s_092107.pdf. http://www.docstoc.com/docs/9245904/INTRODUCTION-ADVISORY-BASE-FLOOD-ELEVATIONS-%28ABFEs%29. (September 30, 2009).

---. “FEMA Recovery Guidance: Questions and Answers about the Advisory Flood Elevations.” http://www.fema.gov/hazard/flood/recoverydata/katrina/katrina_la_qa_afe.shtm. (September 30, 2009).

---. “Highest Adjacent Grade.” http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/highest_adj_grade.shtm. (October 23, 2009).

---. “Homeowner’s Guide to Retrofitting, Second Edition.” http://www.fema.gov/library/viewRecord.do?id=1420. (July 30, 2010).

---. “Hurricane Katrina Flood Recovery Maps.” http://www.fema.gov/hazard/flood/recoverydata/katrina/katrina_la_gis.shtm (September 30, 2009).

---. “Zone A: NFIP Policy Index.” http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/zone_a.shtm and Federal Emergency Management Agency. (October 23, 2009).

---.“Zone Z: NFIP Policy Index.” http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/zone_v.shtm. (October 23, 2009).

E-Architect. “Morphosis FLOAT House Completed for Make It Right Foundation.” October 6, 2009. http://www.e-architect.co.uk/america/make_it_right_float_house.htm (September 1, 2010).

Entergy. “Entergy Facts.” http://www.entergy.com/about_entergy/entergy_facts.aspx (Spetember 1, 2010).

Franklin Associates. “Characterization of Building-Related Construction and Demolition Debris in the United States.” Washington, D.C.: United States Environmental Protection Agency, 1998.

Frazier, D.E and A. Osanik. “Recent Peat Deposits-Louisiana Costal Plain.” In E.C. Dapples and M.E. Hopkins, (eds). “Environments of Coal Deposition,” *Boulder Colorado Geological Society of America Special Paper 114* (1969), 63-68.

Frey, Patrice. “Making the Case: Historical Preservation as Sustainable Development,” October 15, 2007. www.preservationnation.org/issues/sustainabilit/additional-resources/DiscussionDraft_10_15.pdf (accessed September 30, 2009).

Gautreau, Chris. “N.O. Ideal for Buoyant Houses.” *The Advocate*. October 18, 2006. http:/www.2theadvocate.com (September 30, 2009) *(appendix v)*.

Hayden, Thomas. “Storm Experts Feared the Worst: Diary of a Mad Hurricane.” http://www.stormsurge.lsu.edu/paperarticles/USNEWS_Sep17.pdf. (June 1, 2010).

“Help Holy Cross,” http://www.helpholycross.org/ (September 1, 2009).

Holl, Steven. *Pamphlet Architecture 1-10: Number 9 - Rural and Urban House Types in North America*. New Jersey: Princeton Architectural Press, 1998.

Horne, Jed. *Breach of Faith : Hurricane Katrina and the Near Death of a Great American City*. 1st ed. New York: Random House Inc., 2006.

Husser, Dustin, Matt Guidry, Scott Schroth, Ben Morvant and Dustin Ewing. “ME 4243 Spring 2007: Buoyant Foundation,” Powerpoint presenation for Mechanical Engineering, Louisiana State University.

Giegengack, Robert and Kenneth R. Foster. “Physical Constrains on Reconstructing New Orleans.” In Eugenie L. Birch and Susan M. Wachter (eds). Rebuilding Urban Places after Disaster: Lessons from Hurricane Katrina.

Glancey, Jonathan. “Sink or Swim: In Times of Flood, These Houses Rise To The Occasion.” http://www.guardian.co.uk/artanddesign/2004/may/24/architecture (September 30, 2009).

Green, Rebekah, Lisa K. Bates and Andrew Smyth. “Impediments to Recovery in New Orleans’ Upper and Lower Ninth Ward: One year after Hurricane Katrina.” *Disasters 31* (2007): 311-335

Gregory, D. and R. Walford (eds). *Horizons in Human Geography*. New Jersey: Barns and Noble, 1989.

Greater New Orleans Community Data Center. “Days Wet By Block.” http://www.grcamerada.com/ (accessed August 6, 2009)

Innovative Green Solutions. “Thermoplastic Timber.” http://www.igsfederal.com/thermoplastic-timber-durability.html. (September 1, 2009).

Interface Sustainability. “Social Sustainability.” http://www.interfacesustainability.com/social.html (September 1, 2009).

Jackson, Lisa Miles and Thomas J. Nosker. “Technology, Applicability, and Future of Thermoplastic Timber.” http://igsfederal.com. (September 1, 2009).

James Lee Witt Associates. “Pointe Coupee Parish Hazard Mitigation Plan Update and Project Scoping.” July 01, 2009. http://www.pcpjury.org/Pointe%Coupee%Parish%complete%document%07%01%09.pdf. (Septem ber 1, 2009).

Jordan, Chris, Bill McKibben, and Susan Zakin. *In Katrina’s Wake : Portraits of Loss from an Unnatural Disaster.* New York: Princeton Architectural Press, 2006.

Kelman, Ari. *A River and Its City: The Nature of Landscape in New Orleans*. California: University of California Press, 2006

Kengen, Ger A.L. “Amphibious Houses, A Sustainable Alternative?” *Power Point Presentation*. 2007. www.bwtinfo.nl/ufc/file/bwti_sites/028e4669606d529492fc11fc2a11ae1f/pu/W1_8_maasbom mel_floating_houses_22november2007.pdf. (August 3, 2009).

Knabb, Richard D, Jamie R. Rhome and Daniel P Brown. “Tropical Cyclone Report: Hurricane Katrina: 23-30 August 2005.” *National Hurricane Center.* December 20, 2005; updated August 10, 2006. http://www.nhc.noaa.gov/pdf/TCR-AL122005_Katrina.pdf. (September 1, 2009).

Kingsley, Karen. *Buildings of Louisiana*. New York: Oxford University Press, 2003.

Krenz, Bonnie. “Downsizing by District, Mission 2010: New Orleans.” http://web.mit.edu/12.000/www/m2010/finalwebsite/solutions/vision.html. (January 15, 2010).

Lampo, Richard G, *et al*. “Thermoplastic Composites as Degradation-Resistant Material Systems for Timber Bridge Design.” www.trilogy-capital.com/content/axih/docs/axih_dod092909.pdf. (September 1, 2009).

Listokin, David, Barbara Listokin and Michael Lahr. “The Contributions of Historic Preservation to Housing and Economic Development.” *Housing Policy Debate 9* (1998): 431-478

Lopez, John A. “Multiple Lines of Defense.” *Journal of Coastal Research, Special Issue No. 54* (2009): 189-190.

Louisiana Geographic Information Center. “Louisiana Hurricane Impact Atlas, Volume 1.” 2005. http://lagic.lsu.edu/hurricanes.htm. (October 4 2009).

Louisiana Sportsman Magazine. “Old River, Pointe Coupee.” http://www.fishinglouisiana.com/area2/#Old%20 River (September 1, 2009).

Louisiana State University’s Water Resources Research Institute and Army Corps of Engineers. “Going Under.” http://www.nola.com/hurricane/content.ssf?/washingaway/goingunder.html. (June 1, 2010).

Lynch, Kevin. *Wasting Away - An Exploration of Waste: What It Is, How It Happens, Why We Fear It, How To Do It Well*. New York: Random House Inc., 1991.

Make It Right. “Work In Progress Lower Ninth Ward Timeline.” http://www.makeitrightnola.org/index.php/work_progress/timeline_katrina/. (September 1, 2009).

--- “About Make It Right: Our History,” http://www.makeitrightnola.org/index.php/about/detail/our_history/ (September 1, 2009).

Massachusetts Institute of Technology. “Mission 2010.” http://web.mit.edu/12.000/www/m2010/finalwebsite/solutions/vision.html. (September 30, 2009).

McAlester, Virginia *et al*. *A Field Guide to American Houses*. New York: Knopf, 1997.

MacCash, Doug. “Search for New Orleans’ Population Centers.” *The Times-Picayune*. February 24, 2010. http://www.nola.com/arts/index.ssf/2010/02/search_for_new_orleans_histori.html (accessed March 1, 2010).

McCulloh, Richard P., Paul V. Heinrich, and Bill Good. “Geology and Hurricane-Protection Strategies in the Greater New Orleans Area.” Louisiana: The Louisiana Geological Survey, 2006. www.lgs.lsu.edu/deploy/uploads/11strategies.pdf. (June 1, 2010).

McKee, Bradford. “Float House.” http://observatory.designobserver.com/entry.html?entry=11247 (September 1, 2009).

McQuaid, John, and Mark Schleifstein. *Path of Destruction : The Devastation of New Orleans and the Coming Age of Superstorms*. 1st ed. New York: Little, 2006.

---. “Washing Away: New Orleans, The Times-Picayune, Special Report, five-part series published June 23-27, 2002.” http://www.nola.com/hurricane/?/washingaway/. (October 23, 2009).

Miller, DeMond Shondell, and Jason David Rivera. *Hurricane Katrina and the Redefinition of Landscape*. Lanham: Lexington Books, 2008.

Montoya, Maria C. “Katrina Adds Poignancy to a Picture of a Shotgun House Hanging in the White House.” http://www.nola.com/living/index.ssf/2009/08/katrina_adds_poignancy_to_a_pi.html (September 1, 2009).

Morphosis. “Morphosis MIR HOUSE.” http://morphopedia.com/projects/float-house (September 1, 2009).

---. “FLOAT House,” http://morphopedia.com/projects/float-house (accessed November 1, 2009).

“Morphosis FLOAT House: How It Works.” http://www.archinnovations.com/featured-projects/housing/morphosis-float-house-how-it-works/ (September 1, 2010).

N55. “Manual for Floating Platform.” http://www.n55.dk/MANUALS/FLOAT_PLAT/FLOAT_PLAT.html. (September 30, 2009).

"Nalgene Community Sustainability Program." http://www.refillnotlandfill.org/ncsp/index.html. (September 30, 2009).

"New Orleans Home : Architecture Information- Make it Right (MIR) Home : Louisiana Housing Development." http://www.e-architect.co.uk/america/make_it_right_float_house.htm (September 1, 2010).

National Oceanic and Atmospheric Administration and National Geodetic Survey."NOLA 17th Street Breach, Aug 31 2005." http://en.wikipedia.org/wiki/File:NOAA_Katrina_NOLA_17th_Street_breach_Aug_31_2005.jpg (accessed September 1, 2009).

National Oceanic and Atmospheric Administration Coastal Services Center. http://csc-s-maps-q.csc.noaa.gov/hurricanes/viewer.html. (February 1, 2010).

Pasche, Erik *et al*. "Flood Mitigation Using Cascading Dike System." Paper for Forum DKKV/CEDIM: Disaster Reduction in Climate Change 15, Hamburg, Germany. October 16, 2007.

Plyer, Allison. "News Release: Facts for Features Hurricane Katrina Impact." http://www.gnocdc.org/Factsforfeatures/HurricaneKatrinaImpact/index.html. (April 1, 2010).

Polidori, Robert. *After the Flood*. 1st ed. London: Steidl, 2006.

Preservation Alliance of Louisville and Jefferson Co. "The Shotgun House: Urban Housing Opportunities." In "Shotgun House," http://en.wikipedia.org/wiki/Shotgun_house. (September 1, 2009).

President's Council on Integrity and Efficiency. "Oversight of Gulf Coast Hurricane Recovery, a Semiannual Report to Congress." April 30, 2006. http:// www.ignet.gov/pande/hsr/hksemi0406.pdf (accessed September 1, 2009).

Prosun, Prithula. *The LIFT House: An Amphibious Strategy for Sustainable and Affordable Housing for the Urban Poor in Flood-prone Bangladesh,* Masters Thesis, (Waterloo: University of Waterloo, 2010).

---. "Innovative Flood Mitigation: Sustainable Amphibious Housing for the Urban Poor in Dhaka, Bangladesh." *ECOPOLIS Design Award Proposal*, May 2009.

Resilience Alliance. "Key Concepts." http://www.resalliance.org/564.php. (November 23, 2009).

Roettger, Betsy. *Building After Katrina : Visions for the Gulf Coast. Urgent Matters*. 1st ed. Charlottesville: University of Virginia School of Architecture, 2007.

Rypkema, Donovan. *The Economics of Historic Preservation: A Community Leader's Guide*. Washington, D.C.: National Trust for Historic Preservation, 2005.

Saucier, Roger T. "Geomorphology and Quaternary Geologic History of the Lower Mississippi Valley." *U.S. Army Corps of Engineers Waterways Experiment Station, Volume 1*, (1994): 346.

Sargent, William. *Just Seconds from the Ocean: Coastal Living in the Wake of Katrina*. Hanover: University Press of New England, 2007.

Schleifstein, Mark. “Last Line of Defence: Hoping the Levees Hold.” *The Times-Picayune*. June 23-27, 2002. http://www.nola.com/speced/lastchance/t-p/index.ssf?/hurricane/content.ssf?/washingaway/nolalevees.html. (June 1, 2010).

---. “Coastal Resuscitation.” *The Times-Picayune*. June 23-27, 2002. http://www.nola.com/speced/lastchance/t-p/index.ssf?/hurricane/content.ssf?/washingaway/futureofcoast_1.html. (June 1, 2010).

Sewage and Water Board of New Orleans. “History and Facts: Drainage Overview.” http://www.swbno.org/history_drainage_overview.asp (accessed March 1, 2010).

Shimo, Alexandra. “Uplifting: A University of Waterloo Architecture Student Designs Flood-Proof Buoyant Houses for her Native Bangladesh.” *Canadian Architect 55* (2010):1-46

Spatz Development. “Parade of Homes Around Lakeview.” www.associationevent.com/PATL/BUILDER/spatz.pdf. (November 1, 2009).

Steinberg, Philip E. and Rob Shields. *What is a City?: Rethinking the Urban after Hurricane Katrina*. Athens, G.A.: University of Georgia Press, 2008.

Swenson, Dan D. and Bob Marshall. “Flash Flood: Hurricane Katrina’s Inundation of New Orleans, August 29, 2005.” http://www.nola.com/katrina/graphics/credits.swf. (August 1, 2009).

The New Orleans Mayor’s Office. “Situation Report for New Orleans,” Press Release 17. June 2006. In Green, Rebekah, Lisa K. Bates and Andrew Smyth. “Impediments to Recovery in New Orleans’ Upper and Lower Ninth Ward: One year after Hurricane Katrina.” *Disasters 31* (2007):311-335.

Throsby, David. “Sustainability in the Conservation of the Built Environment: An Economists’ Perspective.” *The Getty Conservation Institute*, 2003.

Tucker, Sheryl G. “Reinnovating the African-American Shotgun House.” *Places 1* (1995):64-71

Townsend, Frances. “The Federal Response to Hurricane Katrina: Lessons Learned.” http://www.whitehouse.gov/reports/katrina-lessons-learned.pdf. (September 1, 2009).

United States Army Coprs of Engineers and the National Flood Proof Committee. “Raising and Moving a Slab-on-Grade House with Slab Attached.” 1990. http://www.nwo.usace.army.mil/nfpc/fpslab/ace2_10.htm#TopOfPage. May 1, 2010.

United States Census Bureau, Population Division. “County Total Population and Estimated Components of Population Change: April 1, 2000 to July 1, 2009.” From a compilation by the GNO Community Data Center. http://www.gnocdc.org. (June 1, 2010).

United States Department of Commerce, NOAA/NESDIS. "Hurricane Katrina: A Climatological Perspective." http://www.nhc.noaa.gov/2005atlan.shtml. (September 1, 2009).

United States Department of Homeland Security. "The 18-Month Anniversary of Hurricane Katrina -Progress Made and Lessons Learned." http://www.access.gpo.gov/congress/house/house07ch109.html (September 1,2009).

United States Department of Housing and Urban Development's Office of Policy Development and Research. "Current Housing Unit Damage Estimates, Hurricanes Katrina, Rita and Wilma." http://www.huduser.org/publications/destech/GulfCoast_HsngDmgEst.html. (September 1, 2009).

United States House of Representatives Committee on Government Reform."Sifting through Katrina's Legal Debris: Contracting in the Eye of the Storm." http://www.access.gpo.gov/congress/house/house07ch109.html. (September 1, 2009).

United States Department of Housing and Urban Development's Office of Policy Development and Research. "Current Housing Unit Damage Estimates, Hurricanes Katrina, Rita and Wilma." http://www.huduser.org/publications/destech/GulfCoast_HsngDmgEst.html. (September 30, 2009).

Upton, Dell and John Michael Vlach (eds). *Common Places: Readings in American Vernacular Architecture*. Athens: The University of Georgia Press, 1986.

Upton, Dell. "Understanding New Orleans' Arhitectural Ecology." In Eugenie Ladner Birch and Susan M. Wachter (eds). *Rebuilding Urban Places after Disaster : Lessons from Hurricane Katrina*. Philadelphia : University of Pennsylvania Press, 2006.

Vale, Lawrence and Thomas Campanella. *The Resilient City: How Modern Cities Recover from Disaster*. New York: Oxford University Press, 2005.

Vlach, John Michael. *By the Work of Their Hands: Studies in Afro-American Folklife*. Charlottesville: University of Virginia Press, 1991.

---. "Sources of the Shotgun: African and Caribbean Antecedents for Afro-American Architecture." (Volumes I and II) PhD. Diss., Bloomington: Indiana University, 1975.

---. "Shotgun Houses." *Natural History 86* (1977):51–57.

---. "The Shotgun Houses: An African Architectural Legacy." In Dell Upton and John Michael Vlach (eds). *Common Places: Readings in American Vernacular Architecture*. Athens: The University of Georgia Press, 1986.

Waterland: Water Information Network. "History of Dutch Water Management." http://www.waterland.net/index.cfm/site/Water%20in%20the%20Netherlands/pageid/CDA0E5A3-D1F5-1767-58EECA08BC8288ED/index.cfm/water%20history. (September 30, 2009).

Wikipedia. "Maasbommel." http://en.wikipedia.org/wiki/Maasbommel. (September 1, 2009).

Wold, Amy. “Float this House: Professor Hopes to Save Ambiance of N.O. Homes.” *The Advocate, Baton Rouge*. June 2, 2007 *(appendix v)*.

Websites

A1 Tarps, www.a1tarps.com/assets/File/pressreleases2007.pdf
Bureau HansVenitiuizen, “Amphibious Living”. http://www.amfibischwonen.nl/index2-e.html
Dismal World Blog, http://www.dismalworld.com/disasters/hurricane_katrina.php
Flikr, http://www.flikr.com
Federal Emergency Management Agency, www.FEMA.gov
Geophysical Research Company, http://www.grcamerada.com/
Google Earth, http://earth.google.com
Greater New Orleans Community Data Center, http://www.gnocdc.org/
Innovative Green Solutions, http://www.igsfederal.com/thermoplastic-timber-durability.html
Louisiana Geographic Information Center, http://lagic.lsu.edu/hurricanes.htm
Manual for Floating Platform, http://www.n55.dk/MANUALS/FLOAT_PLAT/FLOAT_PLAT.html
Nalgene Community Sustainability Program, http://www.refillnotlandfill.org/ncsp/index.html
National Oceanic Atmospheric Administration, US Department of Commerce NOAA/NESDIS,
http://www.ncdc.noaa.gov/oa/climate/research/2005/katrina.html
Panoramio, http://www.panoramio.com
Resilience Alliance, http://www.resalliance.org/564.php
Shotgun House, http://bywater.org/about-bywater/architecture/shotgun-house/
Shotgun House, http://en.wikipedia.org/wiki/Shotgun_house
The Buoyant Foundation Project, Dr. Elizabeth English. http://www.buoyantfoundation.org
United States Army Corps of Engineers, http://www.tec.army.mil/echarts
United States Coast Guard: U.S. Department of Homeland Security, http://www.uscg.mil/lantarea/
United States Coast Guard: Atlantic Area, http://www.uscg.mil/lantarea/HurricaneInfo/Default.htm
United States Department of Commerce NOAA/NESDIS,
http://www.ncdc.noaa.gov/oa/climate/research/2005/katrina.html
United States Environmental Protection Agency,
http://www.epa.gov/climatechange/wycd/waste/calculators/ReCon_Online.html
United States Geological Survey, http://www.usgs.gov/
Waterland: Water Information Network, http://www.waterland.net/index.cfm/site/Water%20in%20the%20
Netherlands/pageid/CDA0E5A3-D1F5-1767-58EECA08BC8288ED/index.cfm/water%20history
World Alliance for Citizen Participation, http://www.civicus.org
Wikipedia, http://en.wikipedia.org/wiki/Shotgun_house

Precedent References:

Pointe Coupee Parish:

Old River, Pointe Coupee. 1999-2009, http://www.fishinglouisiana.com/area2/#Oldpercent20River
Pointe Coupee Parish, Louisiana, http://www.pcpolicejury.org

Maasbommel:

Factor Architecten, http://www.factorarchitecten.nl/
Gouden Kust, http://www.goudenkust.nl/
Dura Vermeer, http://www.duravermeer.nl/

Morphosis MIR House:

DeZeen, Design Magazine, http://www.dezeen.com/2008/01/23/housing-for-new-orleans-by-david-adjaye-morphosis-mvrdv-shigeru-ban-and-others/
E-Architect, http://www.e-architect.co.uk/america/make_it_right_float_house.htm
Morphopedia, http://morphopedia.com/projects/float-house
Dwell, http://www.dwell.com/articles/morphosis-float-house-for-nola.html

Amphibious House in Lakeview:

Bayou Buzz, http://www.bayoubuzz.com/News/Louisiana/Business/Louisiana_Business_Shorts__Michael_Bloomberg_Jindal_and_Economic_Development_Hurricane_Homes_Tidewater___5170.asp

Lower Ninth Ward References:

Greater New Orleans Community Data Center, www.gnocdc.org
Lower Ninth Ward Blog, http://kathyprice.typepad.com/dispatch_from_new_orleans/lower_ninth_ward/
Make It Right, http://www.makeitrightnola.org/
NOLA Masterplan, http://www.nolamasterplan.org/
Rebuilding the Ninth, http://www.rebuildingtheninth.org/resources/
The Brookings Institute, http://www.brookings.edu/reports/2007/08neworleansindex.aspx

Appendix Bibliography

Beitiks, Moe. “Eco Art: Swoon’s ‘Junk Rafts’.” http://www.inhabitat.com/2009/04/04/eco-art-swoon-swimming-cities/

Flesche, Felix, and Christian Burchard. *Water House*. New York: Prestel, 2005.

International Marine Floatation Systems Inc. “International Marine Floating Structures.” http://www.floatingstructures.com/menu.php?id=1

Floating Neutrinos. “Floating Neutrinos.” http://www.floatingneutrinos.com/

Asia Forest Network. “Flood Forests, Fish, and Fishing Villages - Tonle Sap, Cambodia.” http://www.asiaforestnetwork.org/pub/pub49.pdf

Frye, Northrop. *Bush Garden : Essays on the Canadian Imagination*. Toronto: Anansi, 1971.

Algalita Marine Research Foundation. “Junk Raft.” Junk Blog. http://junkraft.blogspot.com/

O’Reilly Media, Inc. “Junkboat Fleet : The Miss Rockaway Armada,” Make: Technology on Your Time Blog.” http://blog.makezine.com/archive/2006/07/junkboat_fleet_the_miss_r.html

Ochsenschlager, Edward. “Life on the Edge of the Marshes.” http://www.laputanlogic.com/articles/2004/04/14-0001.html

Mellin, Robert. T*ilting: House Launching, Slide Hauling, Potato Trenching, and Other Tales from a Newfoundland Fishing Village*. New Jersey: Princeton Architectural Press, 2003.

N55. “Manual of Floating Platform.” http://www.n55.dk/N55_BOOK_PDF/N55BOOK.pdf

Asian Development Bank.“Preparing the Chong Kneas Environmental Improvement Project.” http://www.adb.org/Documents/TACRs/CAM/36176-CAM-TACR.pdf

Saieh, Nico. “Floating House/MOS Architects.” http://www.archdaily.com/10842/floating-house-mos/

SWOON. “Swimming Cities of Switchback Sea.” http://www.switchbacksea.org

---. “Swimming Cities of Serenissima.” http://www.swimmingcities.org

Winston International. “The Winston Land-Locked Floating House.” http://www.floodproofhousing.com/home.html,

45 Amazing and Incredible Artificial Islands. “Uros Islands.” http://www.lifeinthefastlane.ca/45-amazing-and-incredible-artificial-islands/weird-science

the buoyant foundation project: appendices

appendix i

primitive amphibious architecture

This section was provided by Prithula Prosun as her submission to "ARCH 684-016 Amphibious Architectures: The Buoyant Foundation Project and Alternative Flood Mitigation Strategies in Post-Katrina New Orleans," an elective course held at the University in spring 2009.

HALONG BAY, VIETNAM

Located North East of Vietnam in Quang Ninh province, Halong Bay is a group of offshore islands that is the best example of marine invaded tower karst in the world. The bay is a UNESCO World Heritage site. Floating villages surround many of the islands. These villages are small communities of local residents, many of who never lived on solid ground. Most of Halong bay's local inhabitants make their living by fishing. There are currently four fishing villages within the World Heritage protected area, with around 1600 inhabitants who live on floating houses and boats. Each village is made up of approximately 7-10 floating homes constructed out of bamboo and various woods. The houses remain permanently buoyant and are inhabited throughout the whole year. The house floats on empty air drums attached to the underside of a wood frame that creates the foundation. The floating structures are not just for residential use. There are also floating electric generators and disco centers within the village (fig. 255-258).[1]

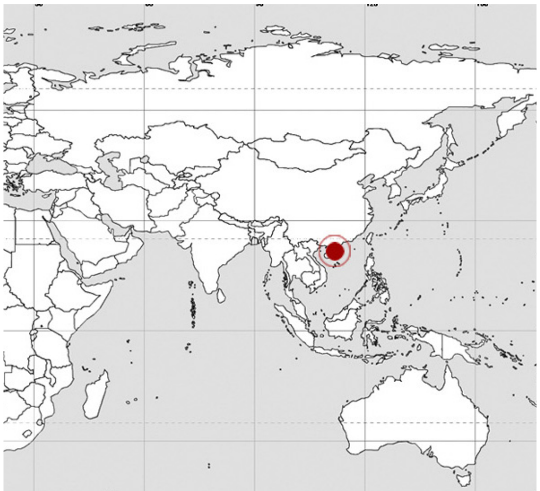


fig. 255: Location Vietnam

fig. 256: Halong Bay, Vietnam

fig. 257: Floating House, Halong Bay, Vietnam

fig. 258: Floating House, Halong Bay, Vietnam 2

AGUSAN MARSH, PHILIPPINES

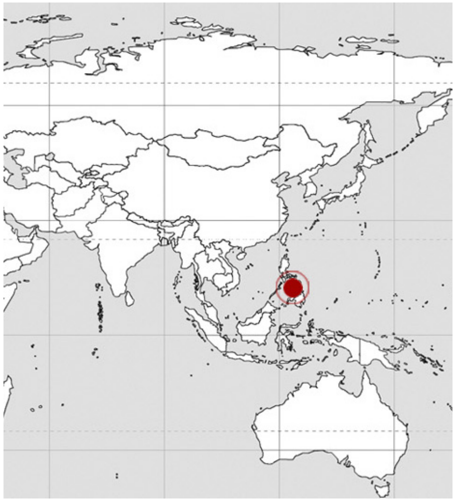


fig. 259: Location Philippines

Agusan Marsh is a vast complex of freshwater marshes and watercourses with numerous lakes and ponds in the upper basin of the Agusan River. Some parts of the marsh are used for traditional fish ponds and rice paddies. The site acts as storage for rain water and reduces the immediate downstream flow of flood water into Butuan City. This marsh is also a UNESCO world heritage site. Agusan Marsh is a primitive fishing village without access to electricity. The floating village of Agusan marsh is a grass roots solution to problems caused by excessively fluctuating tidewaters and frequent earthquakes. Houses on the shore are at risk of destruction, while the floating village can respond to the risks of the environment. The tiny community of mostly ethnic Manobos has made their permanent homes deep within the marsh, living on floating homes. The small houses made of bamboo and nipa lashed to hard wood logs, freely rise or fall with the level of the marsh itself. The marsh provides virtually everything the Manobos need (fig. 259-263).[2]

fig. 260: Floating House, Agusan Marsh

fig. 261: Floating House, Agusan Marsh 2

fig. 262: Floating House, Agusan Marsh 3

fig. 263: Floating House, Agusan Marsh 4

CHONG KNEAS, CAMBODIA

Chong Kneas is the major boat-landing site connecting Siem Reap with the Tonle Sap Lake. It is a popular transit route. When the lake is at its highest level, all transshipment activities and most of the Chong Kneas population are concentrated around Phnom Kraom, an isolated rocky outcrop rising about 140 m above the otherwise flat terrain.[3]

Chong Kneas consists of 7 fishing villages, 6 of which are made up of floating houses. The floating villages are also some of the most ethnically diverse in Cambodia. Although Cambodia's richest natural resource, the floating villages are some of the country's poorest communities. The constant seasonal movement is costly to the villagers, who must pay for towing and repairs to their vessels, which together account for a large part of their annual expenditure. The water is filled with floating trash, rotting organic matter, fuel and oil, making it hazardous to its inhabitants.[4]

The floating villages move to the base of Phnom Kraom when the water level is high in the lake. In the dry season, the villages anchor in a small inlet at the edge of the lake, where there is access to fishing grounds and some protection from storms. The wooden houses are built upon mats of bamboo, metal drums or boat hulls, such that the front veranda floats a meter or so above the water. Villages move not only vertically up and down but also laterally several kilometers back and forth as the Tonle Sap Lake contracts and expands (fig. 264-269).[5]

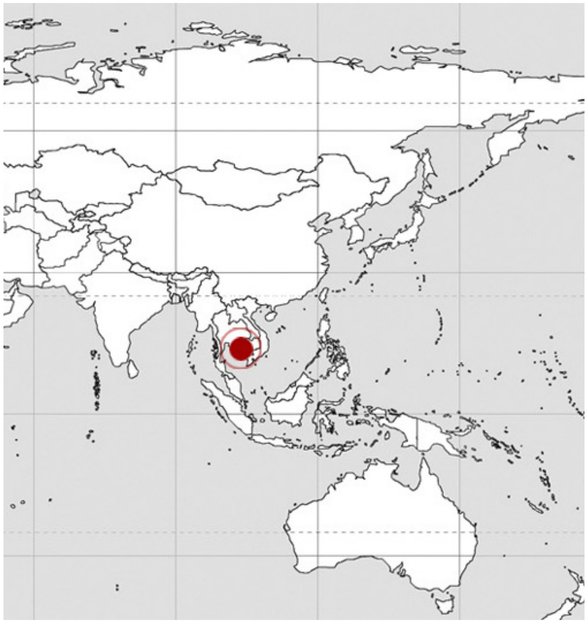


fig. 264: Location Cambodia

fig. 265: Floating Church, Cambodia

fig. 266: Chong Kneas Village, Cambodia

fig. 267: Floating House, Chong Kneas, Cambodia

fig. 268: Floating House, Chong Kneas, Cambodia 2

fig. 269: Floating Village, Chong Kneas, Cambodia 3

fig. 270: Iraqi Marsh Villages, Iraq

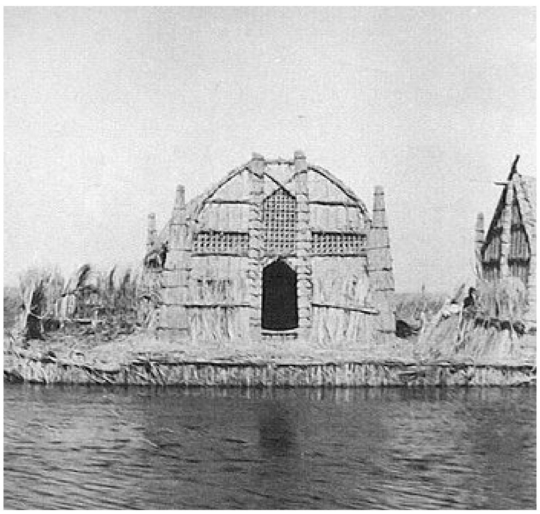


fig. 271: Iraqi Marsh House, Iraq

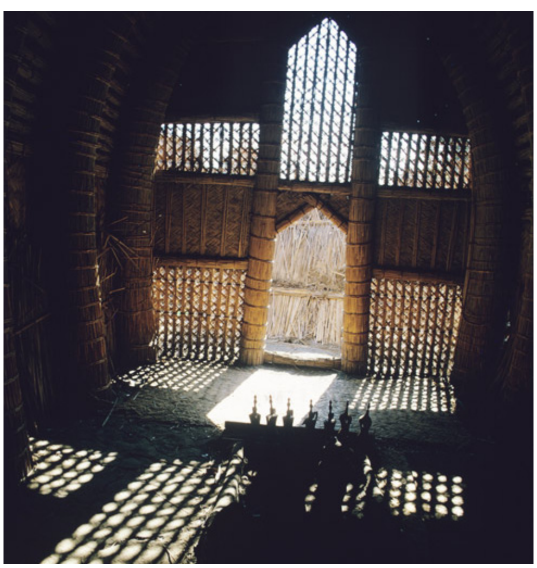


fig. 272: Interior of a Reed Hun Iraq

IRAQI MARSH VILLAGES

The Ma'dān peoples, and the Beni Hassan created the Iraqi Marsh Villages. These are floating villages in the marshes of the Euphrates. These marshes have been disappearing with the various dams built on the Euphrates.[6]

> Reed huts in Euphrates flood plain. View from water. We went up the Euphrates all morning. It is the most curious sight. The whole country is under water, the villages, which are mainly not sedentary, but nomadic, are built on floating piles of reed mats, anchored to palm trees, and locomotion is entirely by boat.[7]

Since 1968, the Government has slowly eradicated these villages though irrigation plans, diversions of water and damming (fig. 270-272).[8]

MI'DAN

Mi'dan villages were sometimes built directly in the marshes on platforms or islands they constructed of alternate layers of reed mats or reeds and silt. Bitumen has always been used as a material. Reeds grew everywhere in the marshes and were considered the cheapest building material. Mud-brick structures were very rarely as they required the services of professional builders and were quite expensive. Family members could build pise (compressed or packed mud) houses without any assistance but still used them as a status symbol. The typical house was usually a little more than 2 meters wide, about 6 meters long, and a little less than 3 meters high.[9]

fig. 273: Beni Hassan

fig. 274: Beni Hassan Interior

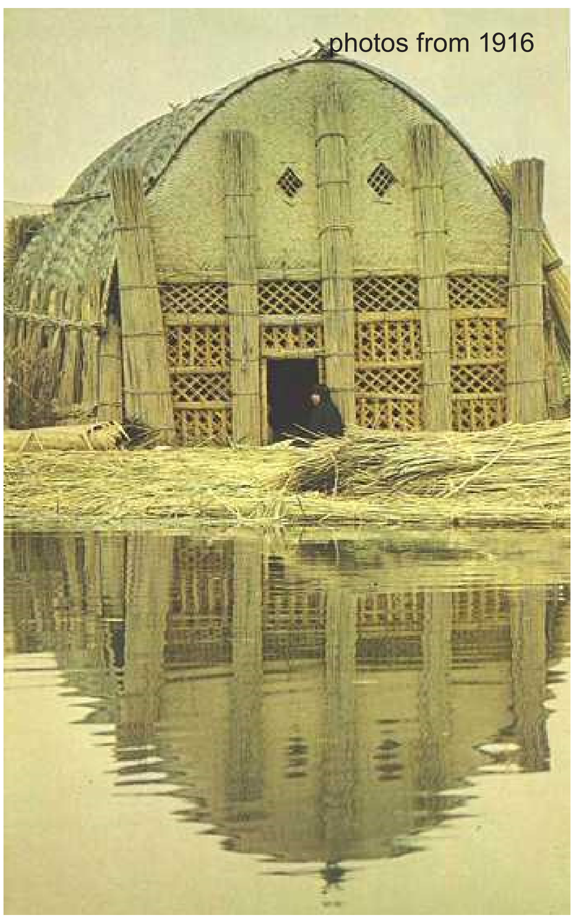


fig. 275: Beni Hassan 2

Houses built of reeds had the additional advantage of being portable. In the spring, if the marsh waters rose too high, a five-arched raba could be taken down, moved to higher ground, and re-erected in less than a day. Reed dwellings could last for well over 25 years, and mud dwellings for two or more generations with proper care and maintenance.[10]

BENI HASSAN

Beni Hassan are dwellings with walls of mud lumps or of pise. When the structure was situated alongside a canal or irrigation channel, it was made of lumps of mud set on edge in herringbone pattern. Each lump consisted of a shovelful of mud, and its plano-convex shape, which resulted from the form of the shovel paddle (fig. 273-275).[11]

fig. 276: Floating Islands, Lake Titicaca, Peru

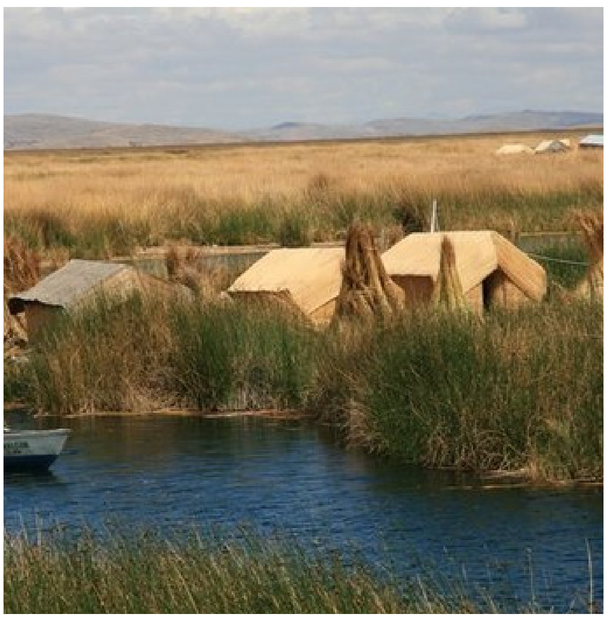


fig. 277: Floating Islands, Lake Titicaca, Peru 2

LAKE TITICACA

The Uros people are a group of pre-Incan people who live on Lake Titicaca in Peru. Floating islands are made from dried totora reeds. The dense roots that the plants develop, interweave to form a natural layer called Khili (about one to two meters thick) that support the islands and are anchored with ropes attached to sticks driven into the bottom of the lake. The reeds at the bottom of the islands rot away fairly quickly, so new reeds are constantly added to the top. After about 30 years, the reeds beneath begin to rot, and the islands must be rebuilt. For sewage treatment residents use 'outhouse' islands near the main islands, and the ground root absorbs the waste. Larger islands house about 10 families, while smaller ones (about 100 feet wide), house only 2 or 3 (fig. 276-277).[12]

Endnotes

1. “Ha Long Bay,” http://www.worldheritagesite.org/sites/halongbay.html (accessed August 1, 2009).

2. “Agusan Marsh Wildlife Sanctuary,” http://www.thailandsworld.com/index.cfm?p=421 (accessed August 1, 2009)

3. “Preparing the Chong Kneas Environmental Improvement Project,” http://www.adb.org/Documents/TACRs/CAM/36176-CAM-TACR.pdf (accessed August 1, 2009).

4. “Flood Forests, Fish, and Fishing Villages - Tonle Sap, Cambodia,” http://www.asiaforestnetwork.org/pub/pub49.pdf (accessed August 1, 2009).

5. ibid.

6. “Life on the Edge of the Marshes,” http://www.laputanlogic.com/articles/2004/04/14-0001.html (accessed August 1, 2009).

7. ibid.

8. ibid.

9. ibid.

10. ibid.

11. ibid.

12. Life in the Fast Lane, http://www.lifeinthefastlane.ca/45-amazing-and-incredible-artificial-islands/weird-science (accessed August 1, 2009).

appendix ii

canadian floating + amphibious architecture

This section was provided by Andre Arsenault as his submission to "ARCH 684-016 Amphibious Architectures: The Buoyant Foundation Project and Alternative Flood Mitigation Strategies in Post-Katrina New Orleans," an elective course held at the University in spring 2009.

INTRODUCTION

The History of human beings living on water goes back to prehistoric times. Their floating or fixed habitations generally took one of three main forms; pile dwellings, rafts, or ships.[13] *- Fleche and Burchard*

The following study is intended to comprehend the amphibious nature of structures found in the contemporary Canadian landscape, and to reflect on the relationship of architecture to the search for a distinctive Canadian identity. Three key regions of Canada (Newfoundland, Ontario and B.C.) have been selected to represent the diverse Canadian answer to the question of how one lives on water. The quotations and photography selected will provide a visual response to the question of what constitutes Canadian Amphibious Architecture.

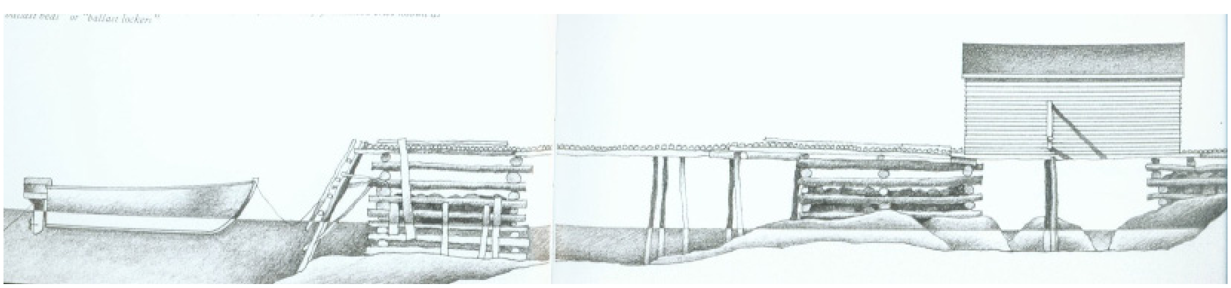


fig. 278: Floating Dwelling Sketch

fig. 279: Floating House, Tilting NFL

fig. 280: Floating Dock, NFL 2

fig. 281: Floating House, Tilting NFL 3

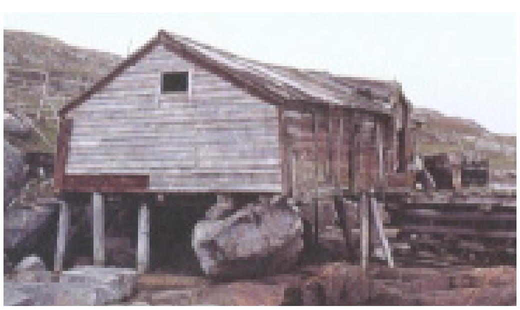


fig. 282: Floating House, Tilting NFL 4

TILTING, NEWFOUNDLAND

Located on a remote island, Tilting has managed to remain close to its fishing origins and keep its connection with water through architecture that is at the same time simple and a clever response to the rugged landscape surrounding it. Originally used as a common shared space, the harbour which houses the village, spawned intricate interwoven boardwalks and fishing stages that upon reviewing; clearly demonstrate a vernacular response to the complicated question of how to bridge land and water for human activities (fig. 278-282).[14]

Robert Mellin states:

> From wherever they caught their fish, Tilting men brought it home to their fishing stages. James Candow aptly describes fishing stages as amphibious structures 'which served as a bridge between land and sea'. He notes their obscure ancestry and their architectural form, characterizing them as enclosed wharves, or hybrids of wharves and ships, similar in structure to the 'North American Iroquoian longhouse and the Beothuk smoking or drying house for fish and game.[15]

Mellin further comments on Tilting's topography in relation to housing form,

> In Tilting the topography does not influence house form. The house has autonomous value and its relation to its site is enigmatic. . . . The immediate site is nearly ignored in the placement of the house, and houses are placed in gardens or on rocks in what appears to be a casual manner. Houses rarely go beyond a tentative acknowledgment of their site, such as fitting a foundation skirt to the rocks, extending a porch with a bridge, or placing an ornamental garden adjacent to the house.[16]

fig. 283: Ontario Place Elevated Walk, Canada

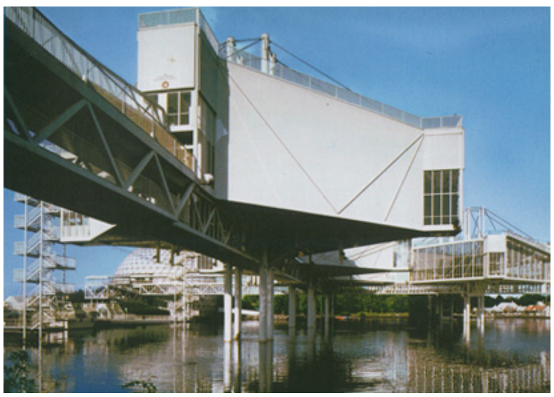


fig. 284: Ontario Place, Canada

fig. 285: Ontario Place, Canada 2

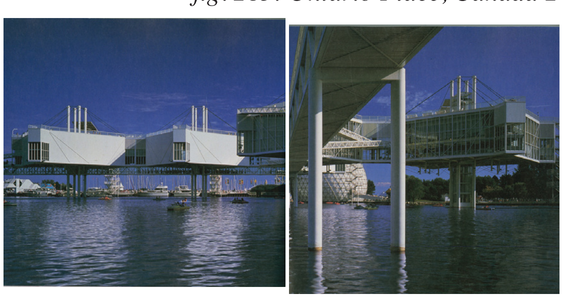


fig. 286: Ontario Place, Canada 3

ONTARIO PLACE

At first glance, Ontario would seem an unlikely location as a landlocked province to enter into this discussion. However, with its great lakes and large population bases along shorelines, two interesting examples of amphibious architecture may be chosen to represent the two interdependent cultural movements of Ontario: the first as a national response to its growing global presence, and the second as a common retreat of summer cottagers on the southern edge of the province (fig. 283-286).

Eberhard Zeidler, architect of Ontario Place comments,

> Ontario Place started as the fulfillment of a promise by the Ontario Government to replace the outdated Ontario Exhibition Building in the Canadian National Exhibition grounds. . . . The result was five pods, or exhibition pavilions amid the 46 acres of manmade islands in the lagoon. These pods are modules that are approximately 750 sqm in area, three storeys high, and can be combined and joined into many forms. The pods are light high-tech steel construction, much like oil derricks, using the minimal amount of material to "float" above the lake.[17]

He further states,

> The three-story pavilions hang from four central pylons, in the manner of a suspension bridge, with wire-hung trusses for structural stability. The facade of white-coated steel and glass conceals a skeleton frame on a cruciform basis with protruding corners and intersections for connecting bridges.[18]

LAKE HURON COTTAGE

Lake Huron Cottage was designed by Michael Meredith and Hilary Sample of MOS architects in 2005 (fig. 287-291). They explain:

> This project intersects a vernacular house typology with the site-specific conditions of this unique place: an island on Lake Huron. The location on the Great Lakes imposed complexities to the house's fabrication and construction, as well as its relationship to site. Annual cyclical changes related to the change of seasons. . . cause Lake Huron's water levels to vary drastically from month-to-month, year-to-year. To adapt to this constant, dynamic change, the house floats atop a structure of steel pontoons, allowing it to fluctuate along with the lake.[19]

They further comment on construction materials and fabrication techniques:

> Lake Huron as a waterway. Construction materials were instead delivered to the contractor's fabrication shop, located on the lake shore. The steel platform structure with incorporated pontoons was built first and towed to the lake outside the workshop. On the frozen lake, near the shore, the fabricators constructed the house. The structure was then towed to the site and anchored. In total, between the various construction stages, the house traveled a total distance of approximately 80 km on the lake.[20]

fig. 287: Lake Huron Cottage, Lake Huron, Ontario

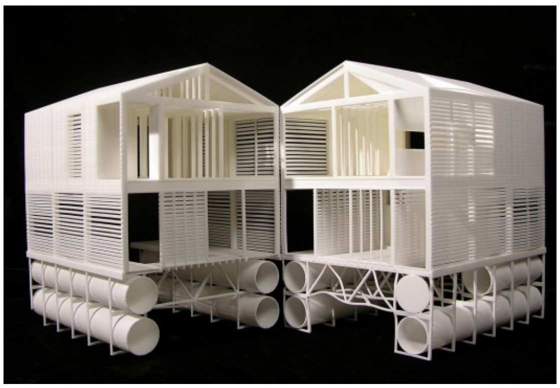


fig. 288: Lake Huron Cottage, Model

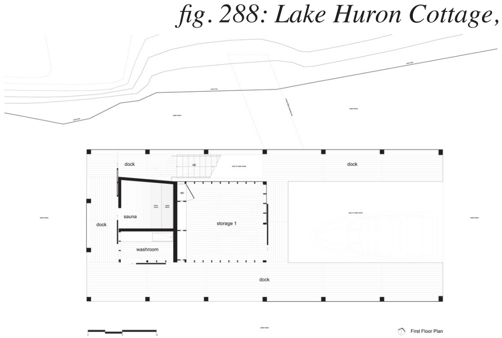


fig. 289: Lake Huron Cottage, Plan

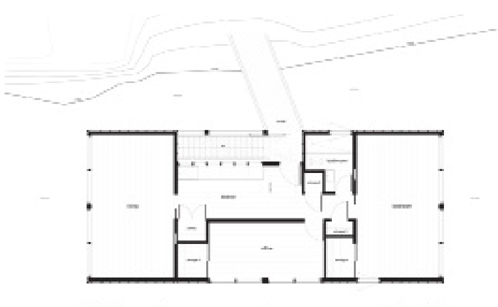


fig. 290: Lake Huron Cottage, Upper Level Plan

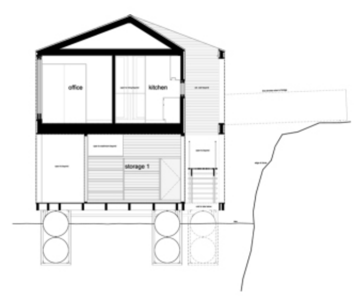


fig. 291: Lake Huron Cottage, Section

fig. 292: British Columbia, Ladner Community

fig. 293: British Columbia, Floating House

fig. 294: British Columbia, Floating House 2

fig. 295: British Columbia, Floating House 3

BRITISH COLUMBIA

Situated at the complete opposite end of the country from Newfoundland, the roots of its architecture speak of a completely different relationship with the landscape and its influence. Originally sought out for its resources, British Columbia has become somewhat of a flagship example of western lifestyle and its environmental approach. As noted in some of the web material found about the floating villages of the Vancouver Delta area, the architecture is an example of lifestyle choices more so than any other sort of reasoning (fig. 292-295).

BRITISH COLUMBIA LADNER COMMUNITY

According to International Floating Homes:

> Founded in 1882, Ladner is the oldest of Delta's communities. Located on rich farmland at the mouth of the Fraser River, its agriculture and fishing industries are a continuing tradition in a diverse community that is now home to 20,000 residents. Ladner Village boasts several turn of the century heritage buildings, still in use. . . . Floating homes on the Fraser River add a distinctive feature to this community.[21]

fig. 296: British Columbia, Log Floats

fig. 297: British Columbia, Log Floats2

fig. 298: British Columbia, Log Floats 3

BRITISH COLUMBIA LOG FLOATS

According to Flesche and Bruchard,

> In Northwestern British Columbia, where the vast forests have made timber a major industry, there have always been floating houses. Log Cabins - built on rafts as camps for the families of the lumberjacks. . . . In former times, these camps consisted of ten to twenty rafts built of thick cedar trunks, with a life expectancy of some twenty-five years, and were moved from one area to the next as the forests were cleared. But with the march of progress. . . people are more willing to travel longer distances to work. As the mobility of these camps is no longer as important as it once was, they grow bigger and more fully equipped. City dwellers in search of rural tranquility have long since discovered the floating weekend home as an alternative to a more land-bound holiday cottage, but now they need not go without such creature comfort as electricity [fig. 296-298].[22]

Clearly there is a relationship with water in Canada that is as diverse as is the population and culture of Canada. Although three very separate and distinct cultures were selected, it is clear that an underlying desire to work with water and land have created a unique Canadian response to the type of site context. In the case of Newfoundland a very temporary and unsure footing speaks of a continual renewal of connection with land and materials used. As political centre of Canada, Ontario sets itself high above the water line and ships in its prefabricated solution to create an almost imposing figure on water. British Columbia seems to have found a semi-permanence with its use of the native materials surrounding it. Ever struggling to define itself, Canadian Amphibious Architecture seems to represent the overall cultural iconic metaphor of a mosaic, instead of a single national identity.

Northrop Frye comments on Canadian identity,

> The famous Canadian problem of identity may seem a rationalized, self-pitying or made-up problem to those who have never had to meet it, or have never understood that it was there to be met. . . . The question of identity is primarily a cultural and imaginative question. . . . Identity is local and regional, rooted in the imagination and in works of culture.[23]

Endnotes

13. Felix Flesche and Christian Burchard, *Water House* (Munich; New York: Prestel. 2005), 13.

14. Robert Mellin, *Tilting; House Launching, Slide Hauling, Potato Trenching, and Other Tales from a Newfoundland Fishing Village* (Princeton Architectural Press, 2003), 162.

15. ibid., 50.

16. ibid.

17. Eberhard Zeidler, “Composition of Oceanic Architecture,” Process Architecture Series 96 (1993): 36.

18. Felix Flesche and Christian Burchard, *Water House* (Munich; New York: Prestel. 2005), 22.

19. Nico Saieh, “Floating House/MOS Architects,” Arch Daily, December 29, 2008, http://www.archdaily.com/10842/floating-house-mos/ (accessed July 23, 2009).

20. ibid.

21. “International Marine Floating Structures,” June 30, 2009, http://www.floatingstructures.com/menu.php?id=1 (accessed July 23, 2009).

22. Felix Flesche and Christian Burchard, *Water House* (Munich; New York: Prestel. 2005), 68.

23. Northrop Frye, *Bush Garden : Essays on the Canadian Imagination* (Toronto: Anansi, 1971), i-iii.

appendix iii

floating structures of recycled materials

fig. 299: Junk Rafts

fig. 300: Junk Rafts 2

fig. 301: Junk Rafts 3

fig. 302: Junk Rafts 4

FLOATING STRUCTURES OF RECYCLED MATERIALS

This section was provided by Maria Alexandrescu as her submission to "ARCH 684-016 Amphibious Architectures: The Buoyant Foundation Project and Alternative Flood Mitigation Strategies in Post-Katrina New Orleans," an elective course held at the University in spring 2009.

It is useful to reference non-architectural floating precedents as means to provide insight into non-traditional floating methods and materials. These boats often re-use everyday objects such as plastic water bottles as flotation devices. Brooklyn-based street artist SWOON is the creator of Junk Rafts, which are crafted from construction site cast-offs and recycled scraps. These eclectic floats are a cross between a stage-ship and art-raft. These 'eco-art' ships are envisioned, by SWOON, as a manifestation of "bits of land broken off and headed to sea." The vessels are the result of the creative efforts of a host of collaborators, including Lisa D'Amour and Chicken John Rinaldi (fig. 299-302).[24]

SWOON's fleets are The Miss Rockaway Armada (2006-2007), which followed the Mississippi, and The Swimming Cities of Switchback Sea (2008), which rode the Hudson and the current Swimming Cities of Serenissima that set sail in the Adriatic Sea from Slovenia to Venice in May 2009. While previous rafts by the vagabond Floating Neutrinos have actually crossed the Atlantic, Swimming Cities will keep its travels to the bends of canals, rivers and seas. Each incarnation of the boat-circus seems to sharpen its aesthetic, so we're excited to see what floats downstream next.[25]

The boats are crafted of foam and plywood, like two coffins filled with scrappy foam. The design is pontoon-based; the water that the pontoon displaces has somewhere to go, and that place is called a displacement hull. The boats resemble a floating dock, and are very sturdy and stable in the water. The bigger the boat, the less the chop affects it. The boats are by design not waterproof; the water fills the pontoons and the foam ensures they float.[26]

fig. 303: Junk Rafts 5

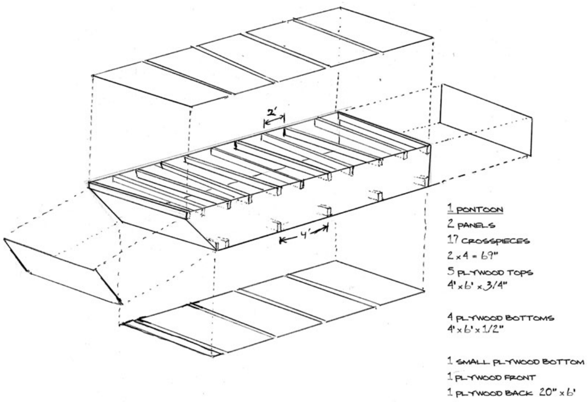


fig. 304: Junk Rafts 6

fig. 305: Junk Rafts 7

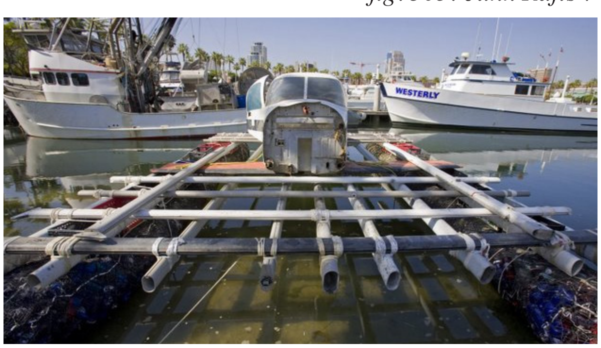


fig. 306: Junk Rafts 8

SWOON comments on the engines used for Junk Rafts,

> For propulsion, I use Mercedez 240 D diesel engines. Four speeds. I pull the engine out of the car but leave the front tires on. The front tires then become the bearing that allows me to pull the propeller out of the water. The engine sits in a cradle called a 5th wheel. It's the thing you see in the back of a pick-up truck for a horse trailer. I just got a few of those and modified them. You literally move the entire engine module to steer the craft. If you look, you can imagine how it works. It's ridiculous, amazing and totally functional. No one has ever done anything quite like it. It's not an out-board or an in-board. I call it: the ON-BOARD.[24]
>
> Two Volkswagen Rabbit diesel engines converted to run on waste vegetable oil will power the propeller. The motors will have an alternator from a police car that will keep our deep cell batteries charged (so we can have things like lights) [fig. 303-304].[27]

Dr. Marcus Eriksen, Joel Paschal and Anna Cummins in the United States are the creators of another type of Junk Raft or 'Eco-Mariner.' In response to the accumulation of plastic trash in the seas, the "raft is 30 feet long, built on six pontoons filled with 15,000 plastic bottles," the "deck is made of salvaged sailboat masts," the "cabin is the fuselage of a Cessna airplane" and "the vessel has four sails and can make 90 degrees headway into the wind." After nearly three months at sea, sailing 2,600 miles from Los Angeles to Hawaii, none of the 15,000 plastic bottles have shown much sign of wear and tear, demonstrating the incredible durability of the plastic that washes into the sea (fig. 305-306).[28]

N55 FLOATING PLATFORM

The Floating Platform by N55 was created in Denmark as a buoyant foundation for the N55 Space Frame, or for other lightweight constructions. The Floating Platform is a modular construction space lattice, composed of small modules made from stainless steel with built-in buoyant tanks. The small modules in the platform can all be assembled by hand. The platform draws approximately 1.2 meters when loaded (fig. 307-309).[29]

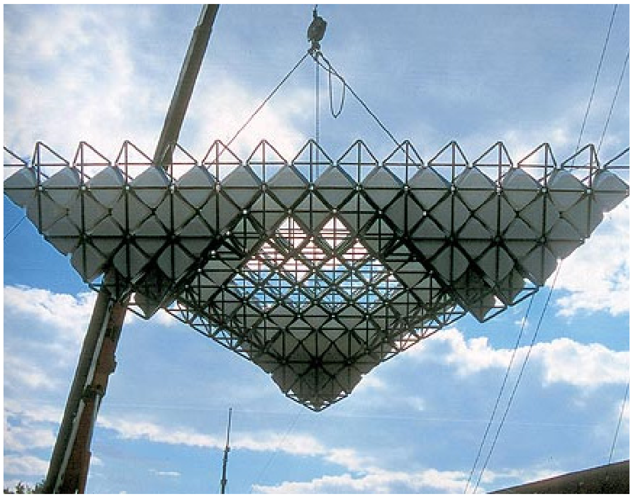


fig. 307: N55 Floating Platform

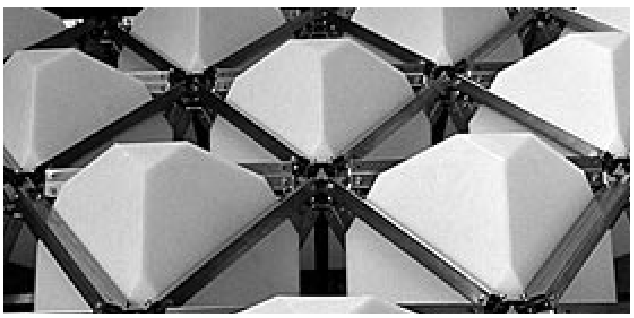


fig. 308: N55 Floating Platform- Detail

fig. 309: N55 Floating Platform 3

TECHNICAL BACKGROUND:

Floating systems that lie still in the water most of the time have other requirements than ships and barges that have to be stable during navigation. For example, stability can be obtained without ballasting, thereby reducing the use of materials. In addition, construction methods that normally are not used on water can be applied. The floating system can also be shaped according to the intended usage. The Floating Platform has comparatively low net buoyancy. This is an economic advantage, but limits the amount of weight that can be added to the platform. However, the modularity of the platform offers the possibility to add more buoyancy when there is a need for it: extra tanks may be connected to the sides of the platform, material may be put into the cavities in the steel truss and extensions can be made from the same building system. Toilets, and tanks for water and wastewater, can be integrated in ways that do not add load to the construction.[30]

CONSTRUCTION AND BUOYANCY:

The platform is constructed as an "octet truss" space lattice and is shaped as an equilateral triangle. A total of 189 polyethylene tanks make the platform buoyant. They are concentrated in the three pontoons situated in each corner of the platform. The pontoons are constructed from three layers of tanks and are shaped as tetrahedra with one vertex pointing downwards and a plane facing upwards. The tanks are made from low-density polyethylene. They are built into tetrahedra of stainless, acid-resistant steel, which are assembled into a coherent "octet truss" space lattice. The buoyancy of the tanks is reduced at low temperatures because they are made of flexible material (there is an approximated 10 percent difference between zero and twenty degrees Celsius).[31]

Due to the stronger buoyancy in the pontoons, leverage creates a strain towards the centre. This is compensated for by reinforcing the platform with a sidepiece consisting of an extra layer of struts. The cavities between the tanks in the steel truss create turbulence, and thus the effect of the waves is reduced when they meet the platform. The triangular shape also adds stability as the platform floats on three "points." Boards are attached to the steel truss and plates of birch plywood are fastened on top of them. The plywood functions both as a deck and a floor. It also contributes to the stabilization of the lattice construction. The top construction is fixed directly onto the wood as well as with bolts through the wood to the platform. The space lattice in the platform is constructed from a steel type that is the most durable in brackish water, on the condition that plants and algae will grow on it. However, galvanic currents will cause sporadic corrosion on the steel unless measures are taken. Zinc blocks are attached to the steel with a maximum distance of one metre. Zinc is a more reactive metal than stainless steel and will therefore provide sacrificial protection. Using this method, one should be able to avoid any corrosion of the steel.[32]

WIND LOAD AND MOORING:

The construction as a whole is stable and safe in heavy weather, including hurricanes, provided that it is well moored. The maximum load on the large sides is 3,000 kilograms horizontally and 300 kilograms vertically in a wind of 33 m/s (i.e. hurricane conditions). To secure the construction under these conditions, it should be moored from each corner with strength of 3.3 tons and an angle of 12 degrees. There are mooring chains fixed around two of the node points in each corner of the platform. Two bruce-anchors hold one of the corners and the other two are moored to bollards on land. The tanks are concentrated in the corners of the platform. In order to increase the buoyancy it is possible to attach extra tanks. The tanks can also be used for wastewater, sewage and other purposes.[33]

MAINTENANCE:

Neither the steel nor the tanks are treated; they need no other maintenance other than regular checking. The construction can be lifted up in order to check thoroughly for corrosion and leaks. The zinc blocks must be exchanged when the zinc is gone. The plywood deck must be checked regularly for damage, and the damp seal on the edges must be maintained. Boards of birch plywood are fixed with bolts to the node points of the construction. The boards are treated against dampness with epoxy and light primer. The top construction is fixed directly onto the wood as well as with bolts through the wood to the platform.[34]

Technical specifications:

Dimensions:
Sides 8.4 m, Area approx. 40 m, Height: 1.5 m.
Buoyancy in platform: 7,500 kg.
Total weight of the construction: 5,500 kg.
Net buoyancy: 2,000 kg.
Tanks: buoyancy / tank at 20°C: 44.8 l. At 0°C: 41.3 l.[35]

fig. 310: Floating Neutrinos

fig. 311: Floating Neutrinos 2

FLOATING NEUTRINOS

A group called The Flying Neutrinos (fig. 310-311) created another version of the Junk Raft in the USA. "A raft, by definition, floats because the materials with which it has been made are all floatable materials. In the case of all the Neutrino rafts, we used mainly recycled wood, logs, Styrofoam and polyurethane foam. Other floatables we have used include empty plastic jugs and bottles, cork and basically anything that floats."[36]

The Son of Town Hall is the name of their raft. It is self-righting because all the weight is in the bottom quarter of the entire raft, including very heavy logs. The top part of the raft is very light, and so it automatically comes back upright if it is tipped.[37]

> All of our rafts conform to the standards of international regulations about discharge of all kinds. The regulations are very specific; for example, no plastic material of any kind can be discharged overboard at any time from any vessel. Toilet facilities are regulated according to distance from shore, and accordingly the rafts are equipped both with holding tanks for shore side pump out, and also for overboard discharge where permitted on the high seas.[38]

Endnotes

24. Moe Beitiks, "ECO ART: SWOON's 'Junk Rafts'," April 4, 2009, http://www.inhabitat.com/2009/04/04/eco-art-swoon-swimming-cities/ (accessed July 29, 2009).

25. "Swimming Cities of Switchback Sea," http://www.switchbacksea.org (accessed July 29, 2009).

26. "Swimming Cities of Serenissima," http://www.swimmingcities.org (accessed July 29, 2009).

27. "Junk Raft," http://junkraft.blogspot.com/ (accessed July 29, 2009).

28. "Junkboat Fleet: The Miss Rockaway Armada," http://blog.makezine.com/archive/2006/07/junkboat_fleet_the_miss_r.html (accessed July 29, 2009).

29. "Manual of Floating Platform", http://www.n55.dk/N55_BOOK_PDF/N55BOOK.pdf (accessed July 30, 2009).

30. ibid.

31. ibid.

32. ibid.

33. ibid.

34. ibid.

35. ibid.

36. "Floating Neutrinos," http://www.floatingneutrinos.com/ (accessed July 30, 2009).

37. ibid.

38. ibid.

appendix iv

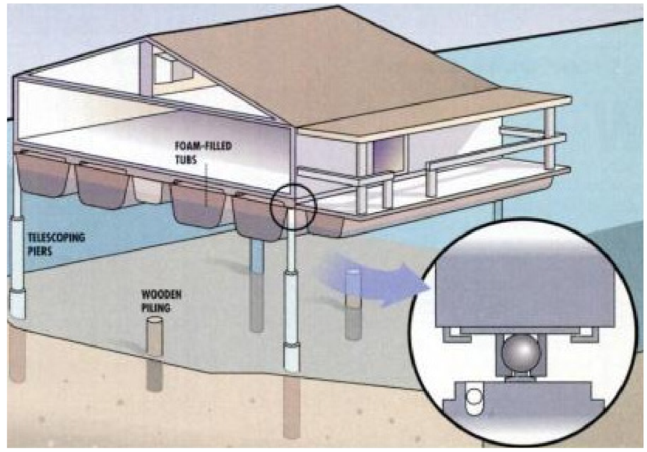
the winston land-locked floating house

THE WINSTON LAND-LOCKED FLOATING HOUSE (WLFH)

Paul Winston, Chief Executive of Winston International, has worked in the house manufacturing field for over 50 years. In the last four decades he has been actively engaged in the development of 'The Winston System' of factory-built housing. This system was designed by architect Ron R. Campbell. Winston International has developed a new concept in modular homes, specifically designed for areas that experience flooding. Winston has patented a new technology for its invention: The Land-Locked Floating House (WLFH). As the flood waters rise, the Land-Locked Floating House is gently and safely lifted up off its pilings. The house is anchored in place, while in the flotation mode. As the flood water recedes, and the danger passes, the new anchoring system also guides the house, as the water lowers it back onto the pilings. This patented technology has been designed by professional architects, marine and structural engineers (fig. 312-318).[39]

Winston summarizes how the WLFH system works:

> The system is composed of telescoping piers set in concrete anchors supporting a catamaran flotation base attached to one, two, or three storey buildings. These structures will rise above any recorded flood, and float back to their original positions as the flood recedes. This technology has been fully tested by accredited testing laboratories using computer testing methods. Test results state that 'any Winston house can be analyzed for any geographical area to withstand floods up to five feet above the recorded 500 year level.'[40]



When flood waters roll in, foam-filled tubes and concrete-anchored telescoping steel piers will keep this modular house dry. After the flood, the house settles back onto the wooden pilings.

fig. 312: Diagram of WLFH

CONSTRUCTION

Winston comments on the construction techniques used for the WLFH:

> The construction techniques employed in the Winston Modular Home are unique in their structural integrity. The foundation system is composed of four vertical laminated beams, blocked and fastened to the floor joist system. The foundation and the joist system are then locked together with steel post tension rods. The steel rods make the foundation and the floor joist system one structural unit. The system is so strong that a finished house can be lifted with a crane from four points on the side of the foundation. The house is then set on nine pressure treated pilings. The wooden piling is nine inches in diameter and eight to ten feet long. It is driven into the ground, to a distance dictated by the soil density. Under dry conditions, the pilings act as a leveling system.[41]

FLOTATION SYSTEM

Winston discusses the flotation system:

> The first flotation device consisting of expanded foam insulation is installed between the floor joists. A three foot thick second flotation member joined directly to the first flotation assembly is attached to the underside of the house. As flood waters reach the bottom of the flotation system the home begins to rise. The house continues to rise as the flood level increases protecting the interior contents from damage.[42]

fig. 313: WLFH in 'Normal' Position

fig. 314: WLFH in 'Floating' Position

HOW IT WORKS

Winston explains how the WLFH flotation system works:

> The home is set on nine pressure treated pilings connected to vertical laminated beams. Under dry conditions the pilings act as a foundation system supporting the house on the ground. In addition to the pressure treated pilings four or more steel piers are located at the outer corners of the house and connected to the vertical laminated beams. The bases of the piers are encased in concrete so the steel piers serve as both anchors and station guides when the house is in the flotation mode. Each pier contains two or more lubricated telescoping sections; a leveling stabilizer assembly has been incorporated into the system. When a flood occurs the tubing segments nestled inside each other allow the house to rise with the water. Electrical, water, sewer and gas lines are manually disconnected from the house. Optional back up systems are designed into the housing unit for emergency use including a septic holding tank. Fresh water is contained in a 'freshwater' tank. A small generator system maintains lights, utilities and appliances. When flood water recedes, the house guided by the telescoping piers, settles back onto the foundation.[43]

FEMA's EVALUATION OF WLFH

Currently, FEMA does not support the efforts of Paul Winston's Land-Locked Floating House. Below are statements from FEMA summarizing their evaluation of the project. FEMA initially viewed the Winston Floating House with hostility. Eventually, after a series of meetings in Washington, DC, it became clear that some within FEMA viewed the Winston House as a threat to the thrust of their new policy direction. Winston comments:

> To date, FEMA has not supported the concept of floating home flood proofing technologies because they do not meet the Congressional intent of the Conference Report of the NIFRA. FEMA believes that the underlying concepts supporting floating home technologies raise serious technical concerns. This report concludes that any floodproofing technology that relies on mechanical processes to provide flood protection, such as WI's floating home system, cannot be as effective as the permanent elevation of a structure. In summary, FEMA has determined that floating home systems are not as effective as a permanently elevated structure built in conformance with the NFIP requirements. The basic tenets of the NFIP call on Federal, State and local governments to ensure that when people choose to develop flood prone areas, that such development occurs in a manner that limits future damages and minimizes risks of deaths and injuries to building occupants and the public at large. This technology is not consistent with these basic tenets of floodplain management nor the requirements of the Act.[44]

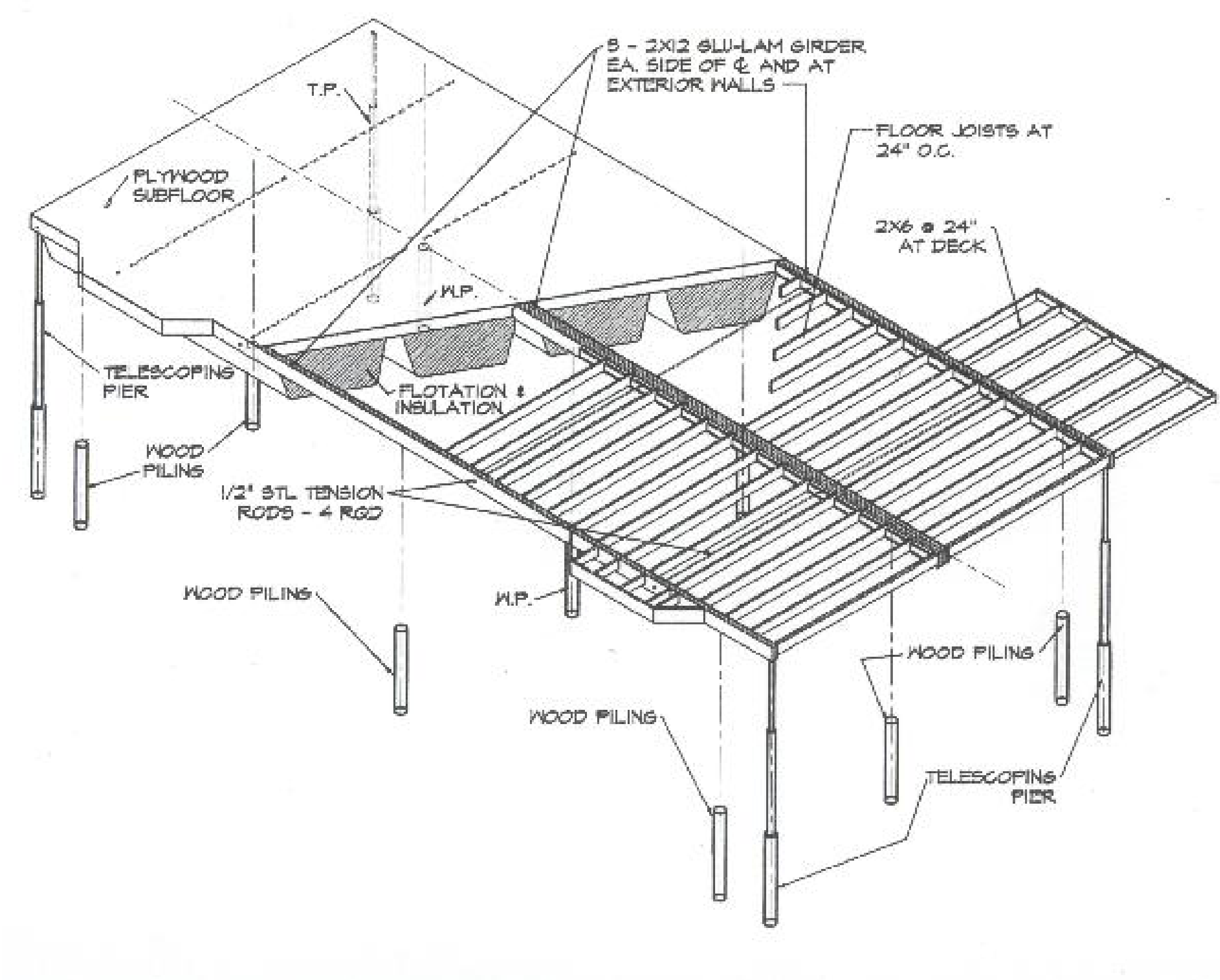


fig. 315: WLFH System, Axonometric

image from: http://www.floodproofhousing.com/howitworks/viewthebasicstructuraldesign.html

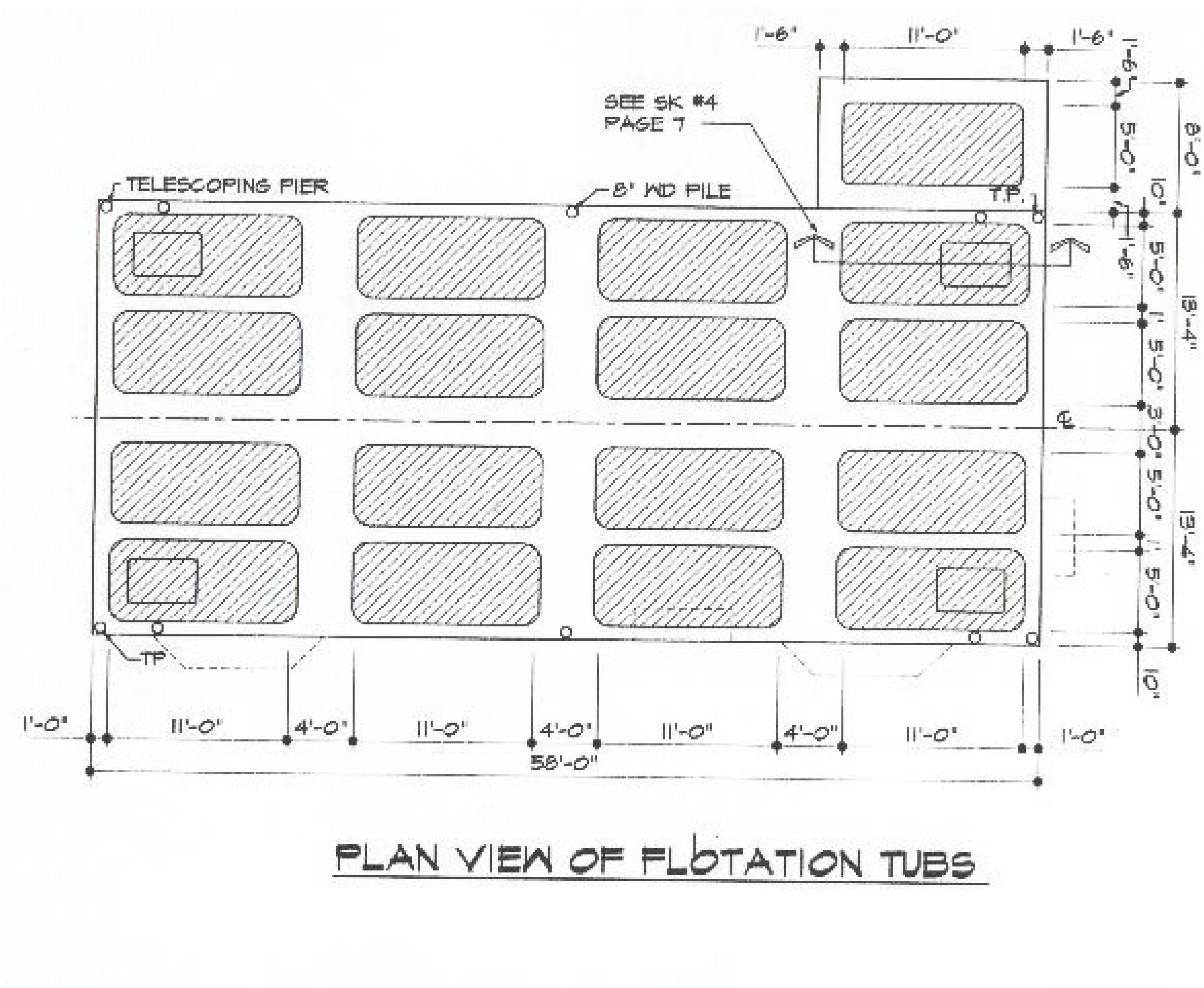


fig. 316: WLFH System, Plan

image from: http://www.floodproofhousing.com/howitworks/viewthebasicstructuraldesign.html

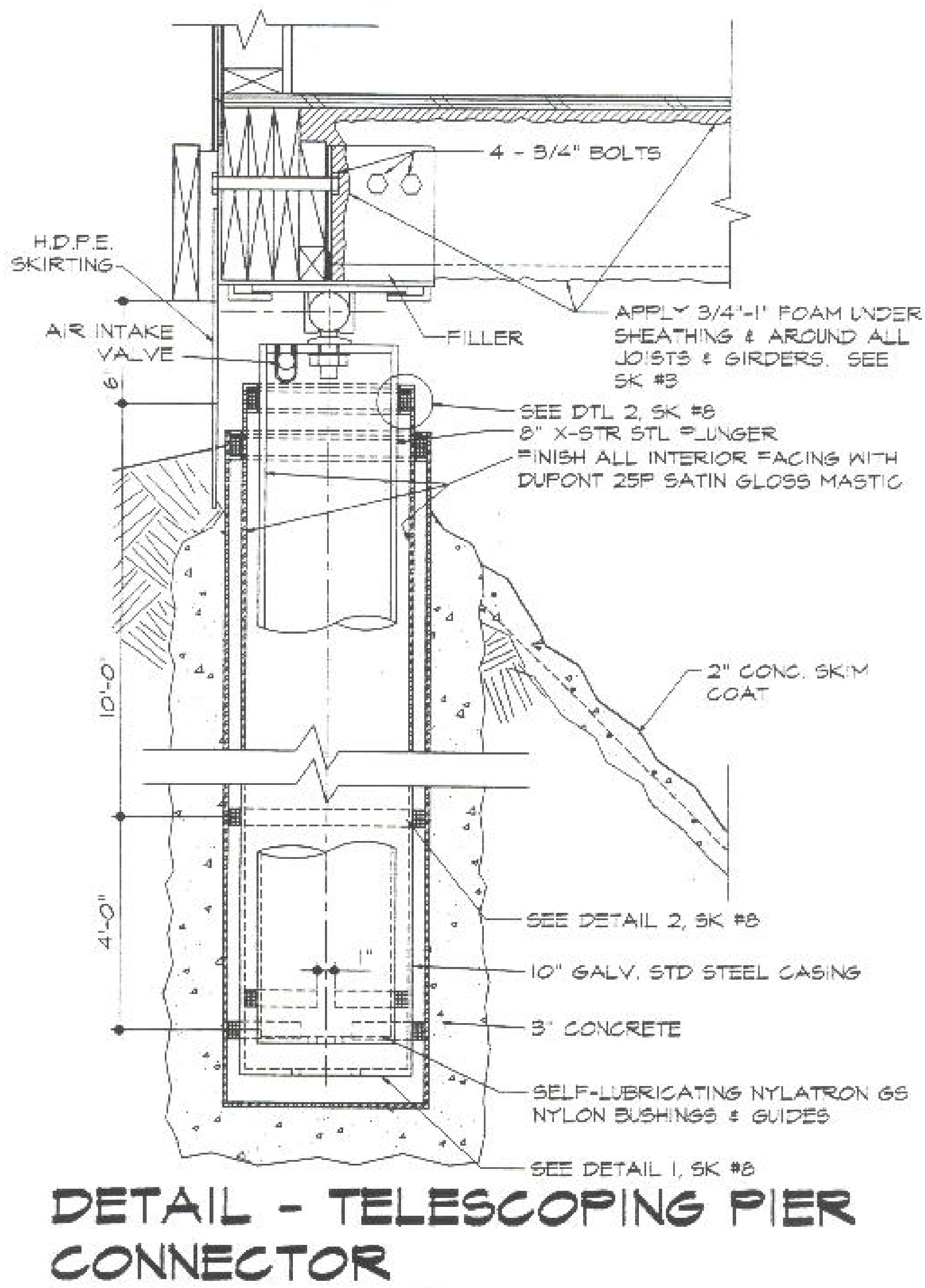


fig. 317: WLFH System, Detail

image from: http://www.floodproofhousing.com/howitworks/viewthebasicstructuraldesign.html

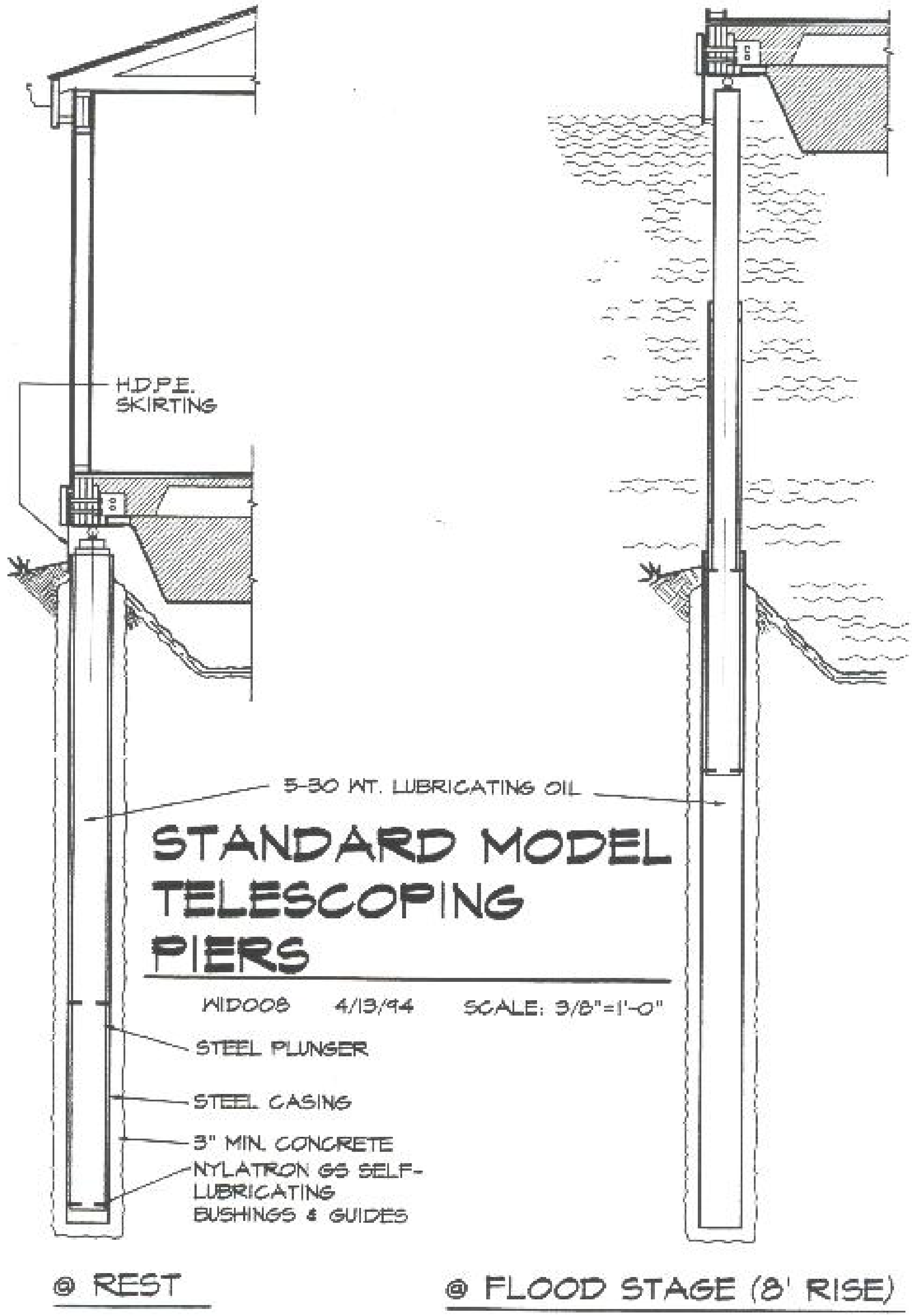


fig. 318: WLFH System, Section

image from: http://www.floodproofhousing.com/howitworks/viewthebasicstructuraldesign.html

Endnotes

39. Winston International, "The Winston Land-Locked Floating House," http://www.floodproofhousing.com/home.html (accessed November 28, 2009).

40. ibid.

41. ibid.

42. ibid.

43. ibid.

44. ibid.

appendix v

articles on the BFP

List of Articles on the Buoyant Foundation Project in Reverse Chronological Order

Fall 2010.
Elizabeth Fenuta, ***"New Orleans: No Easy Buoyancy" - Spacing Magazine,*** 333-334

December 16, 2009.
Brett Schweinberg, ***"Are Floating Homes an Option in Flood-Prone Regions?" - Tri-Parish Times***, 335-336

November 8, 2009.
Nikki Buskey, ***"Could Floating Homes Be On The Way?" - Houma Today,*** 337-339

January 31, 2009.
Matt Walcoff, ***"Floating an idea: Prof goes with the flow to protect homes from floods" - Rex Magazine. Business In Waterloo Region and Guelph,*** 340

February 1, 2008.
University of Waterloo Faculty of Engineering Annual Report, 341

August 29, 2007.
Richard Fausset, ***"New Orleans: Two Years Later: An old city revels in its new spirit of innovation; By accident and by necessity, the Big Easy is awash in ideas -- homes that float, revitalized schools and government reform -- as it struggles to rebuild" - Los Angeles Times,*** 342

August 29, 2007.
Richard Fausset, ***"New Orleans: Two Years Later: Staying afloat; An engineer envisions homes atop blocks of Styrofoam" - Los Angeles Times,*** 343-344

August 29, 2007.
"Two Years After the Storm, the Devastated City Is a Boomtown of Fresh Ideas for Rebirth" - The Daily Green, 345

June 8, 2007.
Maria Guerrero, ***"New Buoyant Foundation System Hopes to Save Homes from Flooding" WAFB 9News,*** 346

June 2, 2007.
Amy Wold, ***"Float This House: Professor Hopes To Save Ambiance of N.O. Homes" - The Advocate, Baton Rouge,*** 347-348

April 28, 2007.
Bruce Alpert, ***"Louisiana Professor Proposes Idea For Making Houses Flood Proof" - The Seattle Times,*** 349-350

April 11, 2007.
Bob Dart, ***"Plan would make homes in New Orleans Floatable" - The Dallas Morning News,*** 351

April 8, 2007.
"Floating Houses May Be Big Easy's Answer To Floods" - COX News Washington Bureau, 352-353

April 7, 2007.
Bruce Alpert, ***"Rising to the Occasion" - The New Orleans Times-Picayune,*** 354-358

November 7, 2006.
Ashley Berthelot, ***"Professor Proposes Buoyant Foundation for New Orleans Homes" - LSU News,*** 359

November 1, 2006.
"LSU Prof Researches Idea of 'Amphibious Homes'" - New Orleans City Business Print, 360

October 18, 2006.
Chris Gautreau, ***"N.O. ideal for Buoyant Houses" - Baton Rouge Advocate,*** 361

August 21, 2006.
Dan Baum, ***"Letter from New Orleans, The Lost Year: Behind the Failure to Rebuild" - The New Yorker,*** 363-375

NEW ORLEANS

No easy buoyancy

BY **LIZ FENUTA** • PHOTO BY **LATOYA PRINCE**

Every night, we gather on my front stoop. We are multiple combinations of jobless, homeless, family-less, and sometimes just plain listless. We sit and some of us drink and some of us smoke and together we solve the problems of the city — since no one in any official capacity seems able or inclined to do so....We are a porch full of people who don't know who's playing in the World Series and don't know what movies opened this week and don't know how many died in Iraq today. We are consumed. We would probably bore you to tears. But it is good therapy and we laugh more than we cry, and that's a start, that's a good thing, that's a sign of winning the war, of getting this damn elephant out of our city — out of our sight.

— from *1 Dead in Attic: After Katrina*, by Chris Rose

→ Five years after evacuation, still-displaced residents of New Orleans have a strong desire to return to their former communities. Pre-Katrina New Orleans was a vibrant community of hard-working residents, and had a dynamic street life of neighbourhood parades that bound communities, creating strong identities and a strong sense of place.

Hurricane Katrina's flood waters inundated 80% of the city on August 29, 2005 as a result of multiple levee failures, particularly around Lake Pontchartrain. Flooding in the aftermath of Hurricane Katrina led to new US Federal regulations and requirements, including recommendations that homes in low-lying areas of New Orleans be rebuilt and raised high off the ground in order to be safe from future flooding. Unfortunately, this is a flood mitigation strategy that disrupts the style of community life in traditional New Orleans neighborhoods.

The front porch is an architectural characteristic of the shotgun-style housing prevalent in southern Louisiana, which relies on its relationship to street level to thrive. This is the threshold of family life, social encounter and community engagement; it provides refuge and sanctuary. But porches simply do not function as spaces of social interaction when they're 12 or 15 feet above the road. Raising homes above street-level disrupts the harmonious relationships among residents, porch-dwellers, next-door neighbours, community passersby, and even foreign pedestrians — a community of social engagement becomes a community of division and solitude.

Mindful of this fundamental relationship between the form of shotgun housing

The BFP supports the local culture and is a catalyst in the restoration of a physical habitat. The shotgun house has been an integral part of shaping the distinctive culture in many parts of New Orleans, creating tight-knit communities and contributing to a sense of place. The BFP recognizes the significance of allowing the house to remain at street level in order to restore this tight-knit community culture.

One of the first widely publicized examples of modern amphibious housing appeared in the Netherlands in 2005 in Maasbommel. This engineered solution that satisfies building codes in the Netherlands has been working reliably and can be easily reproduced. Local examples of amphibious housing can be seen in Lakeview and at the FLOAT House in the Lower Ninth Ward, both in New Orleans. Each of these recently constructed homes is fully functional and, like the BFP, utilizes components that provide buoyancy and vertical guidance.

Through the retrofit of existing structures with buoyant foundations, less waste and energy are consumed when compared to new construction. It is also a more economical form of flood protection than permanent static elevation, as it is more cost effective to implement. As well, the BFP provides a higher level of flood protection than permanent static elevation, as it is able to adapt to changing flood levels. And the BFP is unique in that it offers protection not only from future floods but from cultural annihilation as well — it protects not just the house, but also the street-level life and character of the city's neighbourhoods.

and the way of life it nourishes, Dr. Elizabeth English, Associate Professor at the University of Waterloo's School of Architecture, founded the Buoyant Foundation Project (BFP) in 2006. The BFP aims to provide an alternative form of flood protection, more appropriate for New Orleans than permanent static elevation high above the street.

The BFP is an amphibious foundation system designed for retrofit to existing traditional wooden shotgun-style housing. It enables the house to sit just above ground, retaining the original elevation of a streetscape under normal (dry) conditions, and during flood conditions, allows the house to float up on the water. A structural sub-frame is installed underneath the house. It connects buoyancy blocks to the house and is attached near the corners of the house to the tops of vertical guidance posts that telescope out of the ground as water levels rise. Thus, lifted by the buoyancy blocks, the house can move only straight up and down, as required by the depth of flooding. Utility lines can have either long, coiled "umbilical" lines for water and electrical supply or self-sealing "breakaway" connections that disconnect gas and sewer lines when the house begins to rise.

TRI-PARISH TIMES
& BUSINESSNEWS
Wednesday, December 16, 2009 Terrebonne, Lafourche & St. Mary Parishes Weekly tri-parishtimes.com
www.tri-parishtimes.com Tri-ParishNews 9A
Tri-Parish Times • Wednesday, December 16, 2009

Are floating homes an option in flood-prone regions?

Absolutely, says LSU professor/Buoyant Foundation Project founder

By BRETT SCHWEINBERG
brett@tri-parishtimes.com

In protecting their homes against flooding, residents of low-lying areas have few options: elevate or leave. Former Louisiana State University Hurricane Center Professor Elizabeth English may have a new option in her Buoyant Foundation Project, but the idea has had a hard time getting off the ground due to red tape.

The Buoyant Foundation Project is a new take on the old idea of floating homes. Rather than elevating houses in flood-prone areas, English proposes adding steel guide posts and buoyant blocks under the foundation so they'll float during flooding. The idea has two major benefits in that it allows residents to keep their houses near the ground and is less expensive than elevating.

There's a catch, however. Because the idea is untested, it doesn't fit into the models of the National Flood Insurance Program. As the only option for most owners of flood-prone houses, that poses a major problem.

"The charter of National Flood Insurance Program, as legislated by Congress, says it can't insure anything that floats," said English. "FEMA wants to make sure that everyone has flood insurance. So, anything that floats, they were going to consider out of code."

English and FEMA had reached a stalemate, and for a year and a half, the project stalled. Then, an architectural firm working with Brad Pitt's Make It Right Foundation, contacted English in hopes of building a floating house. The groups were able to strike a deal, as base flood elevation in Orleans Parish is only 3 feet. The Make It Right Foundation's house is elevated to 3 feet, and has an additional 10 feet of protection from a floating foundation.

"They made, basically, a huge Styrofoam block and covered it with fiberglass reinforced concrete," said English, who is currently a professor at the University of Waterloo in Ontario. "Utilities can either have umbilical connections, or umbilical for water supply and electrical and self-sealing breakaway connections for gas and sewage."

English's aim with the project is to give people a safe way to move back into New Orleans without changing the culture of their neighborhoods.

"The whole tradition of the way of life here is close to the ground. You sit on your front porch and talk to the neighbors as they go by," said English."There's this incredible sense of community in these old shotgun communities that isn't going to happen here with people way up on the porch, yelling, 'Hello down there!'"

Extreme elevation is also tough for the elderly and disabled, said English. Some have taken to installing elevators on their elevated homes, at and even greater expense.

According to Earl Armstrong, a public information officer for FEMA, buoyant foundations may face a difficulty beyond flood insurance protection.

"There may be circumstances where a structure that is primarily land-based, but was built on platforms to allow for sporadic flotation, could be ruled eligible for flood insurance. In such cases, however, several entities may share a role in deciding whether such a structure can be covered by flood insurance," said Armstrong in an e-mail to the Tri-Parish Times.

"These include the local community, which may decide that these structures do not meet required building codes or floodplain management requirements to issue a building permit," he said.

Orleans Parish has a large federal levee system that allows them to have such a low base flood elevation. Therefore, a floating foundation serves as a sort of a back up for levee failures, as seen during Hurricane Katrina.

"If you elevate your house to maybe 8 feet, and then there's a 10 foot flood, you're back where you started," said English. "The advantage of amphibious foundation is that they can be made to go up as high as you need."

In lower Terrebonne Parish, which has no federal levee system, base flood elevations can be as high as 16 feet. That makes the deal English struck with FEMA in New Orleans unlikely in this area. In order to be permitted, the floating house idea would require an exemption to those laws, said Patrick Gordon, Director of Planning and Zoning for Terrebonne Parish.

"That might be the camps of the future in Terrebonne parish, homes built on barges instead of elevating camps 16 feet off the ground," said Gordon. " But if you're not recognized by FEMA, it would be hard to get a permit.'

Gordon also expressed concern that floating houses might not elevate fast enough during a very sudden flood, such as a tidal surges or levee failures.

"Where you have areas of shallow flooding and it's caused by rainfall, perhaps a floating house would be an acceptable method for elevation," said Gordon. "If the water comes in too quickly it may not allow the home to float. A wall of water or a huge surge of water within a short period of time may not allow the home to float immediately or flip it over."

For now, the projects prospects in the area remain murky.

"No on has sought out this type of housing in Terrebonne Parish," said Gordon. "Until we receive something from FEMA that this is

Tri-Parish Times
& BusinessNews
Wednesday, December 16, 2009 | Terrebonne, Lafourche & St. Mary Parishes Weekly | tri-parishtimes.com
www.tri-parishtimes.com | Tri-Parish News | 9A
Tri-Parish Times • Wednesday, December 16, 2009

Are floating homes an option in flood-prone regions?

Absolutely, says LSU professor/Buoyant Foundation Project founder

Staff photos by BRETT SCHWEINBERG / Tri-Parish Times

Professor Elizabeth English (right) shows where an amphibious home would separate from its slab. She also consulted on the design for the Make It Right Foundation's amphibious on Tennessee Street in the Lower Ninth Ward (above).

allowable, it would have to be approved by an engineer."

For English, her project represents a way to revitalize the Lower Ninth Ward in a whole new way.

She's already working on another site for an amphibious house, and hopes to bring her idea to much of the area.

"I'm working on a green jobs proposal for bringing a major effort to the Lower Ninth Ward to set up a 5-year project that's going to bring lots of money and 1,500 jobs. It would train people to do sustainable restoration of old shotgun houses and install amphibious foundations on them so that this neighborhood is prepared for the next flood," said English. "Because there will be another flood. It's not a question of if. It's a question of when and how big."

Could floating homes be on the way?

By Nikki Buskey
Staff Writer

Published: Sunday, November 8, 2009 at 6:01 a.m.

Emily Schwarze/Staff
Ronald Buquet works on a wooden toy train underneath his elevated house Friday in Chauvin. Buquet uses part of the space beneath his house as a workshop.

CHAUVIN — What are the options for bayou residents whose houses have flooded three times in the last decade? Do you elevate? Move? Pray?

Or do you build a house that can float?

Groups working in the New Orleans area believe that houses with floating foundations could provide a cheaper, less lifestyle-altering approach to protecting south Louisiana communities from flooding. Homes could rest on the ground until a flood threatens, eliminating climbs that are hard on elderly or disabled residents and preserving neighborhood character.

In bayou communities, where many have been forced to elevate their homes due to repeated flooding, that could be appealing.

Mark Callahan of Chauvin said he was reluctant to elevate his home at first. He eventually paid $45,000 to boost his house 11 feet. Had he been given the choice of keeping it on the ground with new technology, he might have taken it.

“I wasn’t so sure about going up at first,” he said. “But the levees aren’t stopping the water.”

But officials aren’t buying into the new technology just yet. Mike Hunnicutt, deputy section chief of FEMA’s Hazard Mitigation Program, said FEMA doesn’t endorse floating houses as a good strategy for protecting against hurricane flooding. Also, the National Flood Insurance Program, locals’ only option for flood insurance, won’t insure floating houses because they’re not considered anchored to the ground.

He said FEMA officials began investigating floating-home technology when the first such house was built last month in New Orleans. Storm surge and waves can still push water into a floating home.

“And suppose you have a levee break,” Hunnicutt said. “It doesn’t take a rocket scientist to figure out that gush of water is still going to inundate your home before it can float.”

NOT A NEW IDEA

The idea of a floating house is a little revolutionary, but not unprecedented, said Elizabeth English, founder of the Buoyant Foundation Project, which is promoting the technology to protect homes in New Orleans’ 9th Ward.

“It’s an idea that’s catching on around the world,” she said.

English teaches architecture and engineering at the University of Waterloo in Canada. Before that, she worked for the LSU Hurricane Center.

English was a consultant on the lone floating house in the 9th Ward, built by the Brad Pitt-sponsored Make it Right Foundation. The house is still uninhabited. There are also floating houses in the Netherlands, and some floating fishing camps along the Mississippi River, though the camps are not properly permitted by local authorities, English said.

The house works like a floating dock. A steel frame that holds the flotation foundation is attached to the underside of the house. Guidance poles are attached to the frame to allow the house to move up and down. When flooding occurs, the steel frame keeps the home stable while guidance poles keep the house from going anywhere except straight up and down on top of the water.

English said she believes it’s a good solution for communities where small levees might be overtopped, causing slow flooding that inundates ground-level homes. You’ll still have to evacuate — the technology isn’t meant to keep people safe inside, just keep their houses dry. The advantage is that your home can stay on the ground the rest of the time.

“The time for the application of amphibious houses has come. It’s a much, much better solution socially, and in terms of cost,” English said. “People prefer houses on the ground.”

LEGAL QUESTIONS

Permanently elevated homes are vulnerable to wind damage, English said, and elevations are expensive. Retrofitting an existing house with a floating foundation costs up to $25,000 compared with the $40,000 to $60,000 it can cost homeowners to elevate. Adding an elevator for elderly or disabled residents makes it even more expensive.

Pat Gordon, planning and zoning director for Terrebonne Parish government, said he has not been approached with any plans to build a floating house locally.

“It’s not something we’d promote,” he said.

It may not even be legal in some of the most flood-prone areas of Terrebonne. Hunnicutt said that a stop order was issued to prevent construction of a floating house in the Lakeview area of New Orleans because that community is considered a special flood-hazard zone, which means FEMA deems it especially vulnerable to storm surges. Much of Terrebonne and Lafourche lies in such special flood-hazard zones.

A floating home would not meet elevation standards, and you could not purchase flood insurance, Hunnicutt said.

“We promote elevation of homes, or in extreme cases, buyouts of repeatedly flooded properties, and moving north,” Gordon said.

There are grants that the parish can help you to apply for if your home has been repeatedly flooded. Parish grants can provide up to $30,000 for elevating. The parish has helped to elevate 150 homes since Hurricane Lili in 2002.

“Elevating those homes seemed to have had a ripple effect through the community,” Gordon said. “I see many more going up every day.”

SOCIAL SPACES

English said one of the biggest reasons she endorses floating homes is social —

homeowners who elevate can lose the character and social atmosphere of neighborhoods as houses go up higher.

But true to the local community's talent for adaptation, many bayou homeowners that have elevated have turned the area underneath their homes into recreational spaces, Gordon said.

"People put porch swings, deck chairs and barbecue pits down there," Gordon said. "It's very nice."

Callahan said once he elevated his house, he enjoyed having the extra space underneath. Residents in Chauvin have turned the paved spaces beneath their homes into everything from sitting areas to garages for trucks, boats and four-wheelers.

Laverne Charpentier tended to the small garden she's started beneath her Chauvin home Wednesday afternoon. Charpentier said she and her husband have lived in their house for 30 years and elevated 9 feet after Hurricane Ike.

Though she's still not used to all the stair-climbing required to go into and out of her house, she said enjoys their new shaded area, with two porch swings and a picnic table for sitting.

"On a day like today, it's very nice being down here. You get a little breeze and it's almost like being on the beach," Charpentier said.

Nikki Buskey can be reached at 857-2205 or nicole.buskey@houmatoday.com.

QUICK READS

Floating an idea

Prof goes with the flow to protect homes from floods

Elizabeth English loves her job as an architecture professor at the University of Waterloo, but her heart remains in Louisiana. That's where her passion for preserving the culture and character of New Orleans has led her, to challenge the conventional wisdom about how to protect homes from flood damage.

The U.S. government is pushing homeowners in flood-prone areas to elevate their houses, sometimes by more than 10 feet. But that's expensive and separates people from their neighbourhood. English has a simple idea that she says will allow Louisianans to keep their homes at ground level: Instead of fighting floods, go with the flow. Allow homes to float on the water.

The professor designed a home that sits on top of big blocks of styrofoam. When the water rises, so does the house. The building is connected to four metal posts to keep it from floating away. "They work with the water instead of going against the water," English says. "It doesn't matter if it's a four-foot flood or a 14-foot flood."

Students from Louisiana State University built a house frame with a buoyant foundation to test the floating house design. Photo courtesy of Elizabeth English

The idea isn't new. Residents of a rural hamlet on the Mississippi River have built buoyant homes for decades. Floating houses are also popular in the watery Netherlands.

English first heard about buoyant homes at a conference after Hurricane Katrina. In 2006, English, then at Louisiana State University, built a test home with some mechanical design students.

She now splits her time between UW's School of Architecture in Cambridge and Louisiana, where she is trying to raise money to build a full-scale prototype. She hopes to demonstrate to American authorities that buoyant houses should be eligible for flood insurance. The government has been reluctant to go along so far, English says.

"When I started at this, people told me I was nuts," she says. "The idea of a floating house is just too strange."

But nothing less than the unique culture of New Orleans is at stake, she says. "A whole way of life ... in New Orleans is being destroyed," she says. "This is actually something for people to come back to and restart their lives as much as possible as they were before." R

Matt Walcoff

UNIVERSITY OF Waterloo

FACULTY OF ENGINEERING ANNUAL REPORT 2007

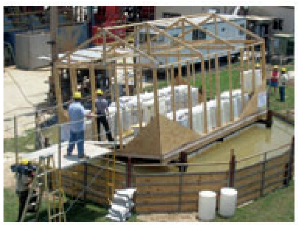
CONTENTS

Dean's Message
Faculty News – Major Developments
Undergraduate Studies
Graduate Studies
Research
Architecture
- A grand house
- A green escape
- Sparking talk downtown

Business, Entrepreneurship and Technology
Chemical Engineering
Civil & Environmental Engineering
Electrical & Computer Engineering
Management Sciences
Mechanical & Mechatronics Engineering
Systems Design Engineering
About the 2007 Report
Past Annual Reports
Engineering Home

ARCHITECTURE

Elizabeth English has designed a foundation that can float a house. She wants to use it to help rebuild New Orleans. ■ It's an unconventional idea: usually, houses in low-lying areas are raised to protect them from floods. But new guidelines call for houses to be raised much higher, which disrupts the character of the street – and doesn't always work. "Even if you do put the house on eight-foot stilts, you might have a 10-foot flood," says English, who came to Waterloo's School of Architecture in 2007 from the Louisiana State University



Hurricane Center. "Trying to fight floodwater is a losing battle. It's better to work with it, let the floodwater keep your house up." ■ English's foundation uses a lightweight steel frame for strength and coated Styrofoam for buoyancy. Steel poles that telescope from the ground like car antennas let the house move up and down but keep it from drifting away. ■ "It's designed to go under an existing house," says English. "It leaves the house looking the same. And it doesn't ruin the character of the neighbourhood by destroying the relation of the houses to the street. New Orleans has whole neighbourhoods of perfectly recoverable houses where this system could be used." ■ Saving these neighbourhoods, English says, is vital: the historically poor, still-ruined areas of New Orleans are its cultural heart. "The culture of New Orleans is like an endangered species. It doesn't exist anywhere else. If it gets wiped out there, it will become extinct." ■ The buoyant foundation is the sort of solution you might expect from English, who has a background in both civil engineering and architecture. At Waterloo, one of her priorities is to increase connections between the School of Architecture and the Department of Civil and Environmental Engineering.

back to top

FACTS AND HIGHLIGHTS

- **Jeff Lederer**, the general manager of the School of Architecture, was one of two winners of the inaugural Faculty of Engineering Outstanding Staff Award.
- Architecture faculty member **Terri Meyer Boake** was one of the winners of the 2007 Faculty of Engineering Teaching Excellence Award.
- **Michaela MacLeod** (MArch '06) is the latest architecture graduate to win the Prix de Rome, a top honour for emerging architecture practitioners. MacLeod will investigate how natural, ecological processes can reclaim neglected and contaminated industrial sites.
- **Sara Navrady** and **Erica Moore**, both fourth-year students, won the Berkeley prize for architectural essay writing. Their essay described a proposed centre – part school, part hospital, part ritual and community space – for rescued child-soldiers in Uganda.
- The work of architecture professor **Philip Beesley** was showcased in a major installation at the Musée des beaux-arts de Montréal. Electrical and computer engineering professor Robert Gorbet collaborated on the work.

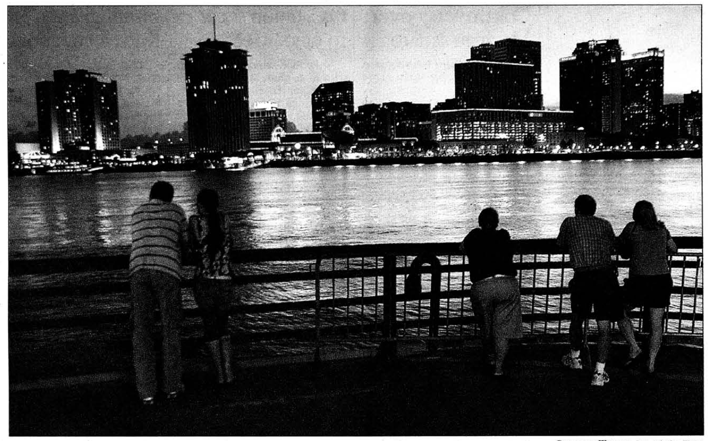
NEW FACULTY

- Anne Bordeleau
- Elizabeth English
- Kathy Velikov

Los Angeles Times

COPYRIGHT 2007 92 PAGES OC | Wednesday, August 29, 2007 : Orange County | DESIGNATED AREAS HIGHER 50¢

NEW ORLEANS : TWO YEARS LATER



SPENCER WEINER *Los Angeles Times*

BEACONS OF HOPE: *As lights flicker across the Mississippi River, tourists and commuters on the deck of the Canal Street ferry watch the sun set over New Orleans. This city, some experts say, has an opportunity few get: to rebuild from the ground up.*

An old city revels in its new spirit of innovation

By accident and by necessity, the Big Easy is awash in ideas — homes that float, revitalized schools and government reform — as it struggles to rebuild.

By RICHARD FAUSSET
Times Staff Writer

New Orleans

IT'S difficult to nail down the last time this antique city was considered cutting edge.

Was it the 1850s, when a coffeehouse owner created the Sazerac cocktail? Or perhaps the 1940s, when a teenager named J.M. Lapeyre invented the automatic shrimp peeler?

Whatever the answer, New Orleans was not defined by its spirit of innovation in the decades preceding Hurricane Katrina. But the flood that changed everything two years ago has changed that too: Today, by accident and by necessity, this city is awash in ideas: the new and the ambitious, the au courant and avant-garde, the idealistic and the slightly nutty.

The New Orleans public education system, long considered one of most ineffective in the nation, has been revitalized with a grand experiment in charter schools; more than half of the city's public campuses are charters, the highest percentage of any major metropolis.

The city housing authority hopes to transform the shuttered St. Bernard Projects, once one of its most notoriously violent properties, into something akin to a public-housing country club with two 18-hole championship golf courses and a 45,000-square-foot YMCA.

Environmental groups have swept into New Orleans, preaching a gospel of green building, solar power and other ideas familiar in Santa Cruz or Santa Monica but rather exotic here.

Local reformers have pushed for important changes to archaic government entities like the public defender's office (each defendant is now assigned to one lawyer, not just to the office in general) and the tax assessor's office (voters in November decided that the city needs one assessor, not seven).

Then there are the inventions. Elizabeth English, a Harvard-educated engineer and architect, is perfecting a method to retrofit shotgun houses with Styrofoam

[*See Ideas, Page A16*]

Income up, but there's a catch

Data show households are earning more by working longer. Also, 5% more people lack health insurance.

By PETER G. GOSSELIN and RICARDO ALONSO-ZALDIVAR
Times Staff Writers

WASHINGTON — The U.S. economy produced slight improvement in income and poverty levels last year, but failed to bring widespread benefits as the number of people without health insurance climbed to 47 million, according to a major report released Tuesday that reflects the nation's underlying economic anxieties.

In its annual report on poverty, income and health insurance, the Census Bureau said that median household income rose slightly to $48,201, but mainly because people were working longer hours, not because they were being paid more.

The nation's official poverty rate inched down to 12.3%. Again, the improvement was not broad-based, but the result of gains among a single segment of the population: older people.

The number of people without health insurance jumped by 2.2 million, or about 5%, the biggest increase since 2002. And a trend of steady progress in reducing the number of uninsured children seemingly lurched into reverse, as more than 600,000 youths were added to the rolls of the uninsured, an increase of nearly 8%.

The bleak statistic on children is released at a time when President Bush is threatening to veto legislation that would expand a health insurance program for children of the working poor, and that seemed certain to galvanize opposition to the administration's stand.

[*See Census, Page A8*]

An old city awash in new ideas

[*Ideas, from Page A1*]

foundations. There will be fewer flooding problems, she figures, if the houses of New Orleans can float. "The old ways of doing things clearly haven't worked," said English, a professor at Louisiana State University.

English's floating house concept lacks funding and the blessing of government. But hers is not the only long shot. No one guarantees that amateur inventor John Knost will ever see the groundbreaking for the flood wall he designed in his French Quarter apartment. Nor are city officials knocking down the doors of the San Francisco architectural firm that has proposed lining New Orleans' shores with huge "sponge combs" — caterpillar-like things filled with baby-diaper lining that would expand when wet to block surging floodwaters.

For some locals, however, it's enough that the city is reveling in a new spirit of innovation.

Sean Cummings is a New Orleans native who is directing one of the most plausible big ideas for New Orleans — a riverfront revitalization project sponsored by the city agency he heads, the New Orleans Building Corp. If Cummings has his way, the project could include a number of modern buildings that would soar beyond the city's old architectural traditions.

Cummings believes that post-Katrina New Orleans has a chance to reconnect with the spirit of experimentation that defined it in the early 20th century, when Louis Armstrong and others were redefining music, and a Tulane-educated engineer named A. Baldwin Wood was inventing the pumps that would revolutionize modern flood control.

Back then, Cummings said, New Orleans "was an early adapter, a creator, a first."

"Then, about 80 years ago, it became this very insular community," he said. "And post-catastrophe, there's a temptation, even a natural reaction, to recoil and fear the new. Well, quite honestly, that's the medicine that this patient needs."

Many of the people pushing for change here acknowledge that New Orleans — with its economic problems, dysfunctional bureaucracies and recent reluctance to embrace change — has a long way to go before it is seen as a reliable incubator of the new.

They also acknowledge that the most crucial innovation — that is, guaranteed protection from a Category 5 hurricane with sustained winds of more than 155 mph — has not been dreamed up, and perhaps never will be, despite renewed federal efforts to improve the city's flood control system.

But they can also sound giddy that they have a shot to rethink a major American city from the ground up.

"Those of us working in bigger-pic ture stuff feel like we're making the mod el not only for the country, but for al most the entire world," said Elizabet Teel Galante, local director for Globa Green USA, a nonprofit that is buildin an environment-friendly affordable housing project in the Lower 9th Ward.

"Sure, we could be wiped off the fac of the Earth this fall," she said. But i the meantime, she said, "We are focuse on adapting."

A sampling of some of the bold ideas that might define post-Katrina New Orleans appears on these two pages.

richard.fausset@latimes.com

On latimes.com

See photo galleries and complete coverage of the second anniversary of Hurricane Katrina in New Orleans at **latimes.com/katrina**

ELEVATION; NEW ORLEANS : TWO YEARS LATER; Staying afloat; An engineer envisions homes atop blocks of Styrofoam

[HOME EDITION]

Los Angeles Times - Los Angeles, Calif.

Subjects:	Flotation, Hurricanes, Disaster recovery, Housing
Date:	Aug 29, 2007
Start Page:	A.16
Section:	Main News; Part A; National Desk
Text Word Count:	268

Document Text

Since katrina, many New Orleans residents have begun elevating their old houses on tall foundations to comply with new federal flood guidelines -- and to be clear of the water when the next big flood comes.

But that solution seems inadequate to Elizabeth English, an engineering professor at Louisiana State University's Hurricane Center in Baton Rouge. She worries that those elevated houses will destroy the front-stoop culture that long defined the city's neighborhoods. She also worries that they might not be high enough to escape the next deluge.

So English developed an alternative: Propping a house on steel beams with big blocks of Styrofoam attached underneath. The beams are attached to steel collars that run up and down tall guideposts planted in the ground. When the water rises, the house floats up, but not away. (A more sophisticated version, she said, could use beams that telescope like a car antenna.) "It's an idea that works with the water, instead of fighting the water," English said.

Earlier this year, English's students built a successful prototype. Today, her nonprofit Buoyant Foundation is hoping to raise $150,000 to retrofit a house. Then she'll need to lobby for changes in the Federal Emergency Management Assn.'s National Flood Insurance Program, which denies coverage to houses that aren't affixed to a permanent site.

Though some have called her crazy, English noted that homes were built on similar principles in the Netherlands. She also said South Louisianans had for decades tricked out riverside fishing camps with Styrofoam

"This is a hugely innovative concept," English said. "On the other hand, it's really not new at all."

thedailygreen

Click to Print Close

Two Years After the Storm, the Devastated City Is a Boomtown of Fresh Ideas for Rebirth

As these pictures make clear, much of New Orleans continues to lie abandoned and destroyed, even a full two years after Hurricane Katrina swept through the region with a vengeance. The Louisiana city still struggles with severe economic problems, dysfunctional government and the toxic residue left in place after the storm waters receded. But, as the Los Angeles Times makes clear, the Big Easy is also an incubator of exciting change.

Authorities are certainly in no position to guarantee the protection of New Orleans from a future Category 5 hurricane. Particularly with many scientists warning that the frequency and severity of great storms is likely to increase with global warming, the danger is very real. But designers and engineers are rushing to the challenge with ideas to mitigate potential damage.

One of the most original schemes is being put forth by a Harvard-educated, Louisiana State University professor named Elizabeth English, who suggests retrofitting houses with Styrofoam foundations. If high waters roll in, the houses can float. An amateur inventor has envisioned a special flood wall for his French Quarter apartment. A San Francisco architectural firm has proposed lining New Orleans' shores with giant "sponge combs" filled with baby diapers. They would expand when wet to block surging floodwaters.

None of these ideas have received widespread or government support to date, but they illustrate how the rebuilding of the Gulf Coast represents an historic opportunity to do things differently. Clearly, our built environment poses many challenges, from safety to susceptibility to natural disasters to the enormous environmental footprint. Our buildings use up more energy, and thus fossil fuels, than any other sector, including industry and transportation. That's why so many are looking at New Orleans as a chance to shine, instead of going back to business as usual and old bad habits.

Environmental groups have ridden into town, touting the opportunity to try out the latest in affordable green housing, which will provide substantial energy and resource savings, save residents money on bills, and make for cleaner, safer living spaces. For instance, a wave of builders are repurposing salvageable materials from the destruction, which is a win-win in terms of reducing costs and cleaning up the enormous mess. Brad Pitt is lending his star power to Global Green USA, which is working on an affordable green building project in New Orleans that will hopefully be able to generate all of its own energy. It will have solar roofs, recycled carpeting, cisterns to catch rainwater, and geothermal heat pumps. Funding support has been provided by the Home Depot Foundation.

New Buoyant Foundation System Hopes to Save Homes from Flooding

Updated: June 8, 2007 07:16 PM

One of the biggest losses to the people along the Gulf Coast during Hurricane Katrina was their homes. Now, LSU has unveiled its prototype of an invention to protect homes from floodwaters. You could call them 'floaties' for your home.

Flooding is the most destructive and the deadliest aspect of a hurricane, creating an all too familiar scene like the ones during Hurricane Katrina. Now, wood-framed houses may be equipped with what homeowners can use to avoid those scenes again. A shot-gun style house has been equipped with a buoyant foundation, designed to protect a home from a flood by literally floating the house up above floodwaters. The founder of the Buoyant Foundation Project says it's not a question of if the levee will break again, but when. Elizabeth English says, "And when the levees overtop, if there is a category four or category five storm surge, the levees will not be designed to be able to keep from overtopping in those situations."

A team of engineering students and their professor built what they say can also protect homes in flood-prone areas. Big blocks of polystyrene make the house float, and to avoid the house from floating away, poles are installed in the ground with sleeves that move up and down. Project officials admit this floating foundation won't protect homes from all floodwaters. English says, "This can't deal with a house right on the coastline that is subject to storm surge coming right off the Gulf, but a couple miles inland where the water isn't moving so fast, it could help with that."

However, it's not cheap. It can cost you $20,000 to have the buoyant foundation installed or about $10,000 if you do it yourself. Still, English says it's a better alternative than elevating your home on pylons. She says, "If you elevate your house to eight feet, you could still have a 10-foot flood and your possessions would be destroyed."

Stuart Broussard, one of the LSU students who worked on the project, says, "I think the advantage is having a house that's still only about three feet off the ground instead of 10 to 12. I think you know climbing those stairs everyday is going to get old." Using a new system to help an age old problem. The project's founder wants to install this system on a house in New Orleans to show how it works.

Reporter: ***Maria Guerrero, WAFB 9NEWS***

SATURDAY
JUNE 2, 2007
BATON ROUGE
2theadvocate.com
50 cents

THE ADVOCATE

THE INDEPENDENT VOICE OF SOUTH LOUISIANA

TODAY'S WEATHER
A stray shower?
High: 88. Low: 68.
DETAILS: 8B

GOOD MORNING, LOUISIANA

SPORTS

ULL beats Ohio State in College Station Regional
➤ PAGE 1C

RELIGION
Bikers motor en masse to church service
➤ PAGE 1E

Bush demands Iran free 4 Americans

WASHINGTON — President Bush demanded Friday that Iran "immediately and unconditionally" release four Iranian Americans held on suspicion of espionage, escalating their detention into a standoff between the two countries.

In a statement released by the White House, Bush said he strongly condemned the detention of the four, and he insisted that their presence in Iran "poses no threat."

"These individuals have dedicated themselves to building bridges between the American and Iranian people, a goal the Iranian regime claims to support," he said.

➤ Secretary of State Rice says Vice President Cheney supports Bush policy against using military force in Iran. 3A

Kevorkian walks out of Mich. prison

CHICAGO — Jack Kevorkian — the infamous "Dr. Death" considered a remorseless murderer by some and a compassionate physician by others — was released on parole Friday from a Michigan prison after serving eight years.

Kevorkian

The frail 79-year-old, wearing his familiar light-blue cardigan and a tie over a button-down shirt and dress slacks, walked slowly out of the Lakeland Correctional Facility in Coldwater, Mich., and grinned cheerfully.

Telling a crowd of reporters outside the detention center that leaving prison was one of the "high points of life," the retired pathologist waved goodbye as he and attorney Mayer Morganroth stepped into a white van and drove away.

INDEX

Business	1D	Movies	7E
Classified	1F	Notices	15F
Comics	9E	Opinion	6B
Commentary	7B	People	1E
Deaths	11A	Puzzles	8E

82nd Year, No. 337, 96 Pages
7 17673 00100 4

Budget fight breaks out

BY MICHELLE MILLHOLLON
Capitol news bureau

One of Gov. Kathleen Blanco's legislative leaders is calling for Republican lawmakers to name their price on a key bill they are holding hostage in the House.

"Where's the ransom note? Let's identify what they want," Rep. Gil Pinac said Friday.

Republicans say they simply want the governor to rein in the spending in her $29.6 billion state budget proposal.

"We are doing all we can to restore some budgetary sanity to this process," House Republican leader Jim Tucker of Terrytown said Friday.

On Thursday, Republicans tried to amend House Bill 1, the governor's budget proposal, to reduce spending and to free up room for tax breaks.

A push also was made to carve out money for a shortfall in the "Road Home" program that could be as much as $5 billion.

Republicans argued that Blanco's budget threatens to saddle state government with $1.5 billion in recurring expenses that will not be sustainable when the hurricane recovery slows down.

Democrats thwarted their efforts to purge millions of dollars in spending from HB1 and moved the legislation to the Senate.

Republicans retaliated by blocking House Bill 3, which authorizes the borrowing for state construction projects.

HB3 is vital to implementing the $6.5 billion construction budget.

Blanco on Friday characterized the Republicans' maneuver

➤See BUDGET, page 5A

Tobacco sale splits Blanco, Kennedy

BY WILL SENTELL
Capitol news bureau

Gov. Kathleen Blanco said Friday that State Treasurer John Kennedy should "cease and desist" in his opposition to her plan to sell the remaining 40 percent of Louisiana's tobacco settlement.

Kennedy's criticism of the sale could endanger Louisiana's new master plan to restore its coastline, Blanco said.

"We have games being played right now," the governor told reporters. She said later that Kennedy is the chief culprit.

Kennedy disputed the criticism in an interview later.

"I can't cease and desist from doing my job," he said. "I am not going to cease and desist from telling the truth.

"The sale is a bad deal for the people of Louisiana," Kennedy said.

The dispute centers on what the state does with the remainder of the money it got from a 1998 settlement that included 46 states over health-care costs related to smoking.

Louisiana sold 60 percent of its future settlement in 2001. It got $1.1 billion.

Blanco wants to sell the remaining 40 percent, which would raise about $1 billion in cash for the state, and pave the way for $350 million for coastal restoration dollars.

That $350 million, she said, could then be leveraged into about $1 billion.

"We know we have a 10-year window of opportunity to save our wetlands," Blanco said. "It is very important that we act now."

Kennedy countered that, if the sale goes through, the state will be settling for $1 billion now rather than $3.5 billion over two decades.

He also disputed comments from backers of the sale that it is a smart hedge against the possibility tobacco firms will have financial problems in the future, and endanger what they owe Louisiana and other states.

"Any analyst's report you read will tell you that the tobacco industry has never been stronger," Kennedy said.

Blanco disagreed.

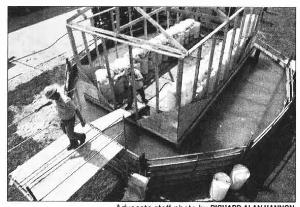
"If we can get up-front cash right now, we should do so," she said.

The proposed sale won approval from the State Bond Commission on May 7 over the objections of Kennedy, who is chairman of the panel. It cleared the Joint Legislative Committee on the Budget on May 18, again over Kennedy's criticism.

The sale next faces action in the House and Senate.

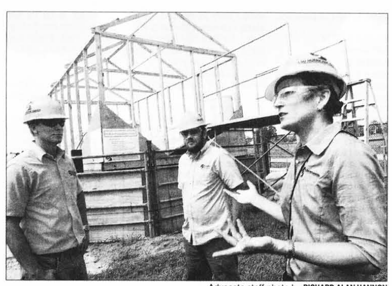
State budget officials contend that selling the final 40 percent of the settlement and refinancing what it has already collected would generate $3 billion. Blanco has also asked the Legislature to set aside $200 million of state surplus dollars for coastal restoration.

➤See TOBACCO, page 5A



Advocate staff photo by RICHARD ALAN HANNON
Stewart Broussard, left, and Ezra Boyd, graduate students working with Elizabeth English, an associate professor at LSU, on Friday demonstrate how buoyant foundations could help keep homes from flooding. The replica home is supported by a floating foundation.

Float this house



Advocate staff photo by RICHARD ALAN HANNON
Elizabeth English, right, an associate professor-research at the LSU Hurricane Center, explains Friday how The Buoyant Foundation project designed a home that can survive above the flood waters. Standing next to English are students Stewart Broussard, left, and Ezra Boyd.

Professor hopes to save ambiance of N.O. homes

BY AMY WOLD
Advocate staff writer

➤ Agencies assess readiness for hurricanes. 4A
➤ Tropical Storm Barry forms in Gulf. 4A

A team of students and professors from LSU have come up with a new twist on an old technology to keep homes high and dry during flooding.

For 18 months, Elizabeth English, associate professor-research with the LSU Hurricane Center, has been working on creating floating houses.

Unlike homes built in the Netherlands, which are designed to float during flood conditions and settle on the ground during dry periods, English is focusing on how to retrofit old homes to do the same thing.

"Every single one of those other installations (in The Netherlands and elsewhere) are for new construction," she explained during a demonstration of the floating home Friday at LSU.

English said she wanted to find a way to

➤See FLOAT, page 4A

Tembec to close paper facility

St. Francisville mill employs 540

BY GARY PERILLOUX
Advocate business writer

Tembec Inc., a Canadian paper maker that paid $185 million for a struggling St. Francisville mill in 2001, decided Friday to close the facility and eliminate 540 high-paying jobs.

Management informed employees in a 3 p.m. meeting, and by 4:30 p.m. state Rep. Thomas McVea, R-St. Francisville, fielded a call from Tembec executive Dan Alexander with the crushing news: A $50 million payroll (including benefits) — roughly a quarter of what the ThyssenKrupp steel mill would have brought to Louisiana in a recent deal lost to Alabama — will disappear from the economy.

"That guy that works at the paper mill spends money at the local stores and in the community and buys cars — the trickle-down effect of this is going to be devastating to our area," McVea said. "That's 540 of our taxpayers — and significant taxpayers."

Still unclear is whether the July 31 shutdown is permanent. The company issued a news release from its Ontario headquarters late Friday that made no bones about the fact that the 50-year-old mill continues to lose money — as has the overall Tembec company in recent years.

Tembec President James Lopez said a recovery plan issued by the company last year requires that sites improve their financial performance or necessary action would be taken where no long-term solutions exist.

Despite changes that lowered operating costs and improved Tembec's mix of coated paper primarily used in magazines and catalogues, "this facility continues to be hampered by high energy costs, low machine productivity and difficult market conditions," Lopez said in the release.

Alexander, executive vice president of Tembec's paper group, has headed a team trying to turn around the St. Francisville plant's fortunes for the past 15 months.

In the past year, the team has undertaken 47 projects to reduce energy costs and succeeded in reducing natural gas consumption by 15 percent. During the same period, natural gas costs rose 17 percent.

Closing the St. Francisville mill is a consequence of energy costs climbing and the coated paper market softening, meaning Tembec can't command the volume of business and prices it needs to make a profit.

After returning the plant to the black for six months in 2006,

➤See MILL, page 4A

FLOAT

Continued from page 1A

keep the character of New Orleans neighborhoods by allowing them to rest just a few feet off the ground during normal conditions.

However when floods occur, the homes would float up secured pilings because of the blocks of flotation material under the home.

Unlike homes built on pilings, the flotation homes would look much like they do today and aren't limited to water levels.

For example, she said, if a home is built to a height of 8 feet and a flood of 10 feet occurs, the house still floods.

However, a buoyant home can rise as high as the pilings will allow, she said.

A similar thing has been done for fishing and hunting camps in Pointe Coupee Parish for 30 years, she said.

"They go up and down with the Mississippi River every year, sometimes several times a year," English said. "Basically, it works like a floating dock."

These floating camps are retrofitted without having to adhere to building codes or other recommendations for about $5,000, she said.

Doing similar work in New Orleans with building codes, permits and much worse soil conditions will increase that cost to about $20,000, she said. That price could fall to $10,000 if the homeowner was willing to do some of the work, she said.

English said she got interested in the project after hearing a presentation by representatives from The Netherlands.

"And I thought, if they could do it, why can't we do it here," she said.

In addition, English said "I'm very distressed about what happens to the character of a neighborhood when some houses are elevated and others aren't.

"The subtext to this is 'save the shotgun,' " she said.

The next step for English and the team of engineering students is to design guide poles that will only extend 3 feet from the ground during dry weather. But, if flooding occurs, the action of the house floating upward will extend guide poles as well.

This design will help better fit neighborhood character by being relatively hidden most of the time.

To help generate money for the research project, English created The Buoyant Foundation nonprofit group. More information about the group is available at http://www.buoyantfoundation.org.

The Seattle Times

Saturday, April 28, 2007 - Page updated at 02:00 AM

Louisiana professor proposes idea for making houses floodproof

By Bruce Alpert
Newhouse News Service

/ NNS

This house in a flood-prone community in the Netherlands has a 'buoyant foundation' to reduce flood damage. This system works like a floating dock. When flooding occurs, the house is lifted above the water by flotation blocks beneath the home.

/ NNS

This home in Pointe Coupee Parish, La., is a less-sophisticated version of the floating house idea being promoted by a Louisiana State University engineering professor.

WASHINGTON — A Louisiana State University engineering professor is lobbying congressional staff and Bush administration officials to push a system she says could protect many homes from the kind of disastrous flooding that occurred in Hurricane Katrina.

Elizabeth English, who is affiliated with the Louisiana State University Hurricane Center, hopes to borrow an idea from the Dutch, who use "buoyant foundations" in some flood-prone communities to reduce flood damage.

In effect, the system works like a floating dock. When flooding occurs, the house is lifted above the water by flotation blocks beneath the home. The house settles to ground level when the flooding recedes. The concept, English said, is designed especially for wood-frame homes, such as the so-called "shotguns" — houses consisting of three to five rooms in a row with no hallways — common in New Orleans. It would not work, at least as now conceived, for brick or concrete-slab homes.

English said she heard about the idea last year during a symposium with counterparts from the Netherlands.

"I thought this could work in New Orleans," English said. "If the Dutch can do it, we should be able to do it in Louisiana."

The concept is relatively simple.

The flotation blocks, made of expanded polystyrene, commonly known as Styrofoam, are held together by steel frames and attached to the underside of a house, according to a description of her proposal. Four vertical guidance poles are attached not far from the corners of the house.

When flooding occurs, the flotation blocks lift the house.

Collars are attached around the poles to ensure that the house doesn't go anywhere but up when the water rises and down when it falls, English said. The homes would be strengthened with steel channels attached to the bottom beams to ensure they are strong enough to withstand being lifted and dropped.

Hilary Inyang, director of the Global Institute for Energy and Environmental Systems at the University of North Carolina at Charlotte, said English's proposal is a "more sophisticated version" of what flood-prone communities in many countries have used for decades — attaching homes to stilts.

"There are some practical difficulties with that concept, such as what you do about utilities that are generally tied in one place," Inyang said. "You'd have to make them more flexible. And you'd have to make sure that with these new foundations, you don't make these buildings more vulnerable to other environmental stresses, such as wind.

"So you'd want this done experimentally at first before you do it wholesale."

In her proposal, English talks about using "self-sealing breakaway connections" for utility lines, or long, coiled umbilical lines that would allow electrical and telephone lines to move away from a home when it rises during a flood. Plumbing and sewage lines also can be designed to break away as needed, she said.

She estimated that building and installing the foundation would cost about $20,000. She stressed that the figure is "very preliminary" based on estimates for the cost of materials and installation and experience building floating foundations along some Louisiana bayous.

The floating foundation has some clear advantages over the preferred flood-mitigation solution of elevating homes on a permanent foundation or piers, English said.

Raising homes make access difficult, particularly for the elderly, she said. Higher houses also are more vulnerable to strong winds.

Moreover, English said, setting homes at street level makes them fit in better with neighboring structures, helping to preserve a neighborhood's culture and facilitate conversations between porch-sitters and passers-by.

"A buoyant foundation home would remain at street level when it's dry, ready to rise with the floodwater," English said.

English said she was excited to hear Federal Emergency Management Agency Administrator David Paulison at a hurricane conference in New Orleans talk about how his agency is committed to change and not trying the same old techniques it has relied on in the past.

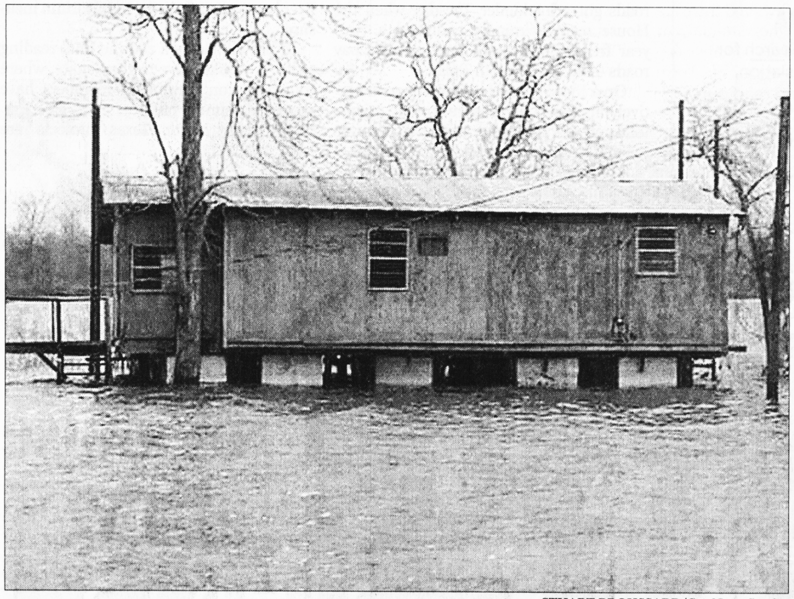
"I hope that's true," said English, who said she handed Paulison a copy of her proposal after his speech. FEMA approval would be needed to include buoyant foundations as flood mitigation.

FEMA spokesman Aaron Walker said English's information would be evaluated by agency staffers.

English said it would take about $200,000 to build a prototype and test it by releasing floodwater to see if it could keep the home dry during a significant flood.

What the technology won't do, at least now, is provide protection from a strong storm surge like the one that inundated homes near failed levees and in St. Bernard Parish and New Orleans' Lower 9th Ward.

English said she is looking for a financial "angel" to help pay for a thorough test. If buoyant foundations were in place before Katrina, she said she thinks the number of destroyed and severely damaged homes would have been substantially reduced.



STUART BROUSSARD/Cox News Service

Many hunting and fishing lodges in Louisiana bayous are on foundations that float when rivers rise. Changing an existing house to a floatable one would cost $20,000 to $30,000.

Plan would make homes in New Orleans floatable

'Buoyant foundations' more feasible than stilts, researchers say

From Wire Reports

WASHINGTON — The next time a hurricane floods New Orleans, whole neighborhoods might just bob up like corks as the water rises.

Under a proposal by Louisiana State University engineering students, traditional shotgun houses would be attached to "buoyant foundations" — essentially big blocks of plastic foam — and "telescoped" pilings that grow longer as the water gets deeper.

Once in wide-scale production, it would cost $20,000 to $30,000 to change an existing frame house in, say, the Ninth Ward into a floatable one.

Buoyant houses have already been built in the Netherlands, and hunting and fishing lodges that float when rivers rise are already occupied in Louisiana bayous, said Elizabeth English, a research professor at the LSU Hurricane Center who is overseeing the project by six students.

The plan is considerably more feasible than proposals to raise existing houses atop stilts, Ms. English said during a promotional trip to Washington last week.

"Sitting on the front porches and talking to folks who pass by on the sidewalk is an important part of the culture of these places," she explained. "You lose that with permanent static elevation," the technical term for placing the houses atop poles around 10 feet high.

A floating house "is also a better solution for withstanding hurricane winds" than stilts that would raise the building into the wind stream, she said.

The LSU engineering team has formed the nonprofit Buoyant Foundation and is seeking grants to continue its research. Contractors and construction companies are being solicited for the $150,000 or so that the students think it would cost to build a prototype and flood tank to test it.

Thousands of homeowners in low-lying areas of southern Louisiana are already being required to elevate their houses, usually by about 3 feet. In New Orleans, some homeowners are considering raising their houses even higher — to as much as 12 to 15 feet — because they fear the city's levees will not be improved enough to prevent future flooding.

The LSU solution would, in effect, turn the houses into floating docks or stationary houseboats. The houses would be raised to the required elevation atop the buoyant foundations, with steel frames to distribute the structure's weight to the outside walls. In a flood, the telescoping pilings would let the house and foundation rise, and then gently settle back into place as the water recedes.

Bob Dart,
Cox News Service

CORRECTIONS & (

The Dallas Morning News welcom information that may require corre mit your comments by visiting Dal 214-977-8352.

■ In the March 30 Metro section, spelled in a photo caption accompan the Garland Opry.

COX Newspapers Washington Bureau

Floating Houses May Be Big Easy's Answer To Floods

By BOB DART
Cox News Service
Sunday, April 08, 2007

WASHINGTON — The next time a hurricane floods New Orleans, whole neighborhoods might just bob up like corks as the water rises.

Under a proposal by Louisiana State University engineering students, traditional shotgun houses would be attached to "buoyant foundations" — essentially big blocks of plastic foam — and "telescoped" pilings that grow longer as the water gets deeper.

Once in wide-scale production, it would cost $20,000 to $30,000 to change an existing frame house in, say, the Ninth Ward into a floatable one.

Sound far-fetched? Buoyant houses have already been built in the Netherlands, and hunting and fishing lodges that float when rivers rise are already occupied in the bayous of Louisiana itself, said Elizabeth English, a research professor at the LSU Hurricane Center who is overseeing project by six students.

The plan is considerably more feasible than proposals to raise existing houses atop stilts, English said during a promotional trip to the nation's capital last week.

"Sitting on the front porches and talking to folks who pass by on the sidewalk is an important part of the culture of these places," she explained. "You lose that with permanent static elevation," the technical term for placing the houses atop poles around 10 feet high.

A floating house "is also a better solution for withstanding hurricane winds" than stilts that would raise the building into the wind stream, said English.

A classic shotgun house in New Orleans is a long, narrow one-story dwelling. The name comes from a saying that a shotgun blast through the front door would pass through all the lined-up rooms and out the back door.

Shotgun houses have long been popular in historic New Orleans neighborhoods, where dry land is limited and lots are narrow.

The LSU engineering team has formed the nonprofit Buoyant Foundation and is seeking grants to continue its research. Contractors and construction companies are being solicited for the $150,000 or so that the students and professor think it would cost to build a prototype and flood tank to test it.

Their motive is academic rather than financial, but "I would be thrilled" if builders took the donated technology and began retrofitting houses behind the infamous levees of New Orleans, said English.

Thousands of homeowners in low-lying areas of southern Louisiana are already being required to elevate their houses, usually by about three feet. In New Orleans, some homeowners are considering raising their houses even higher — to as much as 12 to 15 feet — because they fear the city's levees will not be improved enough to prevent future flooding by hurricanes.

The LSU solution would, in effect, turn the houses into floating docks or stationary houseboats. The houses would be raised to the required elevation atop the buoyant foundations, with steel frames to distribute the structure's weight to the outside walls.

In a flood, the telescoping pilings would let the house and foundation rise, and then gently settle back into place as the water recedes.

While buoyant foundations are not new, the LSU student engineers have come up with "retrofitting" designs that permit the conversion of existing houses.

The LSU designs include "breakaway" connections that "will allow utility lines to move with the house and break off at specified heights and forces," explained Scott Schroth, 21, a team member who will graduate in May with a degree in mechanical engineering. "Breakaway valves for plumbing are already in wide use," he added.

The appearance of a retrofitted house would not change — an important consideration in a city where historic preservation is a passion.

"The project can be practical for certain areas of New Orleans, where shotgun-type houses are still appraised for quite a bit," said Schroth, a native of the Big Easy. In other areas, he said, "these houses were too badly damaged and the cost of the retrofit would be just as much as the house is worth."

Where they are financially feasible, houses that float make a lot of sense because the next flood is more a question of "when" than "if," English said. Instead of relying exclusively on the levees, this system provides another layer of protection, she explained.

"If people knew more about this, they would have more confidence in moving back to New Orleans," said English. "It's a well-tested system."

On the Web:

Buoyant Foundation: www.buoyantfoundation.org

The Times-Picayune

50 CENTS 171st year No. 76 | SATURDAY, APRIL 7, 2007 | METRO EDITION

Jeff decision stuns loser, winner

Traffic-camera bids produce drama

By Richard Rainey
East Jefferson bureau

As the Jefferson Parish Council weighed his company's proposal for a contract, Adam Tuton waited in his Scottsdale, Ariz., office with confidence.

His business is installing cameras at intersections to catch drivers running stoplights. His company, American Traffic Solutions Inc., says it has won three out of every four government contracts when competing against its chief rival, Redflex Traffic Systems. And in Jefferson, American Traffic had the support of an advisory committee that recommended the council award it the contract over Redflex.

But when the news finally came, Tuton was flabbergasted. The council awarded the contract to Redflex.

"Everyone's jaw dropped on the floor," he said in a recent interview.

Tuton's reaction was not remarkable for the vice president of a company that loses a spirited competition with a rival. What is noteworthy is that Redflex, too, seems to have been

See CONTRACT, A-4

Climate forecast grim for N.O.

New report predicts flooding, disease

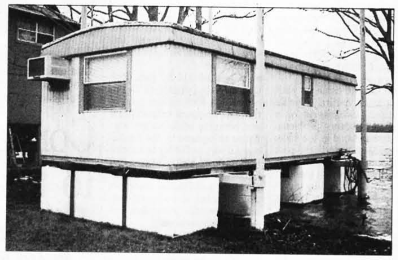
By Mark Schleifstein
Staff writer

A new international report on the potential effects of global warming uses Hurricane Katrina's devastation of New Orleans and its surrounding natural environment as an example of what coastal communities around the world may be facing during the next 100 years.

For Louisiana, the report promises major changes in weather patterns that could result in increased periods of drought interspersed with intense rainfall events that could

See CLIMATE, A-6

Buoyant foundations would allow homes to float out of harm's way during floods, LSU engineer says



RISING TO THE OCCASION

By Bruce Alpert
Washington bureau

WASHINGTON — A Louisiana State University engineering professor made the rounds of congressional staff and Bush administration officials this week to push a system she says could protect many homes from the kind of disastrous flooding that occurred in Hurricane Katrina.

Elizabeth English, who is affiliated with the Louisiana State University Hurricane Center, hopes to borrow an idea from the Dutch, who use "buoyant foundations" in some flood-prone communities to reduce flood damage.

In effect, the system works like a floating dock. When flooding occurs, the house is lifted above the water by flotation blocks beneath the home. The house settles to ground level when the flooding recedes. The concept, she said, is designed especially for wood-frame homes, such as the shotguns common in New Orleans. It would not work, at least as now conceived, for brick or concrete slab homes.

English said she heard about the idea last year during a symposium with counterparts from the Netherlands.

"I thought this could work in New Orleans," English said. "If the Dutch can do it, we should be able to do it in Louisiana."

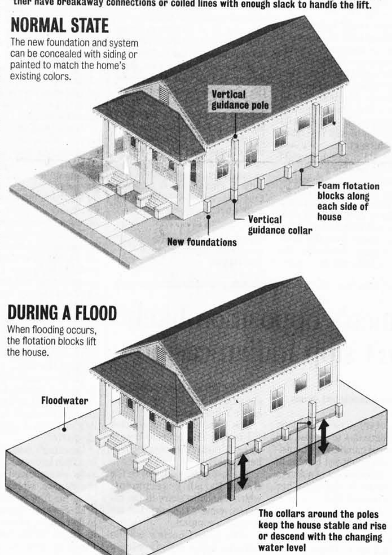
A less sophisticated version has been used for years along some waterways in South Louisiana, she said.

The concept is relatively simple.

The flotation blocks, made of expanded polystyrene, commonly known as Styrofoam, are held together by steel frames and attached

See FLOAT, A-5

A LOOK AT THE SYSTEM: A system proposed by an LSU engineering professor would turn existing New Orleans-style homes into floating docks, enabling them to rise above floodwaters and return to the ground as the water recedes. Utility lines would either have breakaway connections or coiled lines with enough slack to handle the lift.



Sources: LSU Hurricane Center STAFF GRAPHIC BY DAN SWENSON

FEMA jumps the gun, Landrieu charges

She wanted hearing before Miss. got grant

By Bruce Alpert
Washington bureau

WASHINGTON — Sen. Mary Landrieu, D-La., said the Federal Emergency Management Agency plans to begin releasing $281.3 million to Mississippi for an alternative housing program Monday, despite her request that the distribution be delayed pending a hearing on whether the distribution discriminated against Louisiana.

Sen. Mary Landrieu
Considers timing of announcement a 'calculated pattern'

Mississippi's award was nearly four times as much as the $74.5 million awarded Louisiana — even though Louisiana lost more than 205,000 homes during Hurricanes Katrina and Rita, compared with 61,000 in Mississippi.

The money was approved by Congress to test alternatives — such as "Katrina cottages" — to provide more permanent and comfortable housing after a disaster than the 101,000 travel trailers and mobile homes used for Katrina and Rita.

FEMA said that the alternative housing financing wasn't determined based on need but on the quality of the proposals, and that Mississippi's proposals were superior. According to scoring summaries obtained by The Times-Picayune, Mississippi's Green Mobile project and its Park Model-Mississippi Cottage project garnered scores of 184 and 182, respectively, compared with a score of 176 for Louisiana's Cypress

See HOUSING, A-5

FAITHFUL CUSTOM

James Smith portrays Jesus Christ during the Evergreen Baptist Church's re-enactment of the Crucifixion Friday in Paulina. The event included a march along the levee to the spot where, on three crosses, the crucifixion of Jesus and two thieves was depicted.
More pictures, A-7

STAFF PHOTO BY BRETT DUKE

British captives say confessions coerced

Iran isolated sailors, vowed years of jail

By Kim Murphy
Los Angeles Times

LONDON — For two weeks, their televised confessions were seen by many in Britain as a humiliating case of "surrender first and apologize after" by the British Navy. But on Friday, the sailors who spent 13 days in an Iranian jail disclosed that they were blindfolded and threatened into fabricating their confessions.

Their dramatic account, given only a day after leaving Tehran with gift bags of sweets and pistachios, appeared to turn Iran's carefully crafted public relations script on its head. The sailors told of being locked in isolation for days and said they were threatened with seven years' imprisonment if they did not admit to entering Iranian waters.

See BRITISH, A-10

nola.com READ THE LATEST NEWS ONLINE
In alliance with The Times-Picayune

Classified	E	Editorials	B-6	People	A-16	Sports	D		
Comics	C-10	Living	C	Puzzles	C-4	Television	C-7		
Deaths	B-5	National	A-12	Religion	C-8	World	A-13		

BREEZY AND COLDER
HIGH 56 LOW 39
Weather, B-8

7 12393 11111 8

CONTINUED

"A buoyant foundation home would remain at street level when it's dry, ready to rise with the flood water."
ELIZABETH ENGLISH, LSU Hurricane Center professor

This home in Pointe Coupee Parish is a less sophisticated version of the floating house idea being promoted by a Louisiana State University engineering professor. If buoyant foundations were in place before Katrina, the LSU professor said she is convinced the number of destroyed and severely damaged homes would have been substantially reduced.

This house in a flood-prone community in the Netherlands has a 'buoyant foundation' to reduce flood damage. The system works like a floating dock.

Professor seeks financing for prototype

FLOAT, *from A-1*

to the underside of a house, according to a description of her proposal. Four vertical guidance poles are attached not far from the corners of the house.

When flooding occurs, the flotation blocks lift the house.

Collars are attached around the poles to ensure that the house doesn't go anywhere but up when the water rises and down when it falls, English said. The homes would be strengthened with steel channels attached to the bottom beams to ensure they are strong enough to withstand being lifted and dropped.

Utility obstacles

Hilary Inyang, director of the Global Institute for Energy and Environmental Systems at the University of North Carolina at Charlotte, said English's proposal is a "more sophisticated version" of what many countries in flood-prone communities have used for decades.

"There are some practical difficulties with that concept, such as what you do about utilities that are generally tied in one place," Inyang said. "You'd have to make them more flexible. And you'd have to make sure that with these new foundations that you don't make these buildings more vulnerable to other environmental stresses, such as wind.

"So you'd want this done experimentally at first before you do it wholesale."

In her proposal, English talks about using "self-sealing breakaway connections for utility lines, or long, coiled umbilical lines that would allow electrical and telephone lines to move away from a home when it rises during a flood. Plumbing and sewage lines also can be designed to break away as needed, she said.

She estimated that building and installing the foundation would cost about $20,000. She conceded the figure is "very preliminary" based on estimates for the cost of materials and installation and experience building floating foundations along some Louisiana bayous.

Ground-level advantages

The floating foundation has some clear advantages over the current preferred flood-mitigation solution of elevating homes on a permanent foundation or piers, English said.

Raising homes make access difficult, particularly for the elderly, she said. Higher houses also are more vulnerable to strong winds. Moreover, English said, setting homes at street level makes them fit in easier with neighboring structures, helping to preserve a neighborhood's culture and facilitate conversations between those sitting on their porches and passers-by.

"A buoyant foundation home would remain at street level when it's dry, ready to rise with the flood water," English said. How high a house rises would depend on the length of the vertical guidance poles; the bigger the flood risk, the higher the pole.

English talked to Rep. Charlie Melancon, D-Napoleonville, by phone and met with his staff this week. Melancon thinks the concept is worth looking into, spokeswoman Robin Winchell said.

"It's being used in some areas, and maybe we should be looking to expand it into South Louisiana," she said.

English said she was excited to hear Federal Emergency Management Agency Administrator David Paulison at a hurricane conference in New Orleans talk about how his agency is committed to change and not simply trying the same old techniques it has relied on in the past.

"I hope that's true," said English, who said she handed Paulison a copy of her proposal after his speech. FEMA approval would be needed to include buoyant foundations as an acceptable form of mitigation.

FEMA spokesman Aaron Walker confirmed that Paulison received a packet of information from English, and said it would be evaluated by agency staffers.

No surge protection

English said that it would take about $200,000 to build a prototype and test it by releasing flood water to see if it could keep the home dry during a significant flood. It wouldn't take long, perhaps a few months to build the prototype and a few more months of testing, before she thinks it would be ready for deployment in New Orleans, English said.

What the technology won't do, at least now, is provide protection from a strong storm surge like the one that inundated homes near failed levees and in St. Bernard Parish and the Lower 9th Ward. English said she's convinced the idea will work and is looking for a financial "angel" to help pay for a thorough test. If buoyant foundations were in place before Katrina, she said she believes the number of destroyed and severely damaged homes would have been substantially reduced.

English's students have drawn up a small model and plan to begin testing it in the next few weeks. Ultimately, though, English said, it will take a full-size prototype that can be tested in a variety of flood situations, and that's "where money is a major obstacle."

••••••

Photos, models and other information about the flood-mitigation concept are available at www.buoyantfoundation.org

Bruce Alpert can be reached at bruce.alpert@newhouse.com or (202) 383-7861.

nola.COM
Everything New Orleans

The Times-Picayune

RISING TO THE OCCASION

Buoyant foundations would allow homes to float out of harm's way during floods, LSU engineer says

Saturday, April 07, 2007

By Bruce Alpert
Washington bureau

WASHINGTON -- A Louisiana State University engineering professor made the rounds of congressional staff and Bush administration officials this week to push a system she says could protect many homes from the kind of disastrous flooding that occurred in Hurricane Katrina.

CONTINUE STORY

Elizabeth English, who is affiliated with the Louisiana State University Hurricane Center, hopes to borrow an idea from the Dutch, who use "buoyant foundations" in some flood-prone communities to reduce flood damage.

In effect, the system works like a floating dock. When flooding occurs, the house is lifted above the water by flotation blocks beneath the home. The house settles to ground level when the flooding recedes. The concept, she said, is designed especially for wood-frame homes, such as the shotguns common in New Orleans. It would not work, at least as now conceived, for brick or concrete slab homes.

English said she heard about the idea last year during a symposium with counterparts from the Netherlands.

"I thought this could work in New Orleans," English said. "If the Dutch can do it, we should be able to do it in Louisiana."

A less sophisticated version has been used for years along some waterways in South Louisiana, she said.

The concept is relatively simple.

The flotation blocks, made of expanded polystyrene, commonly known as Styrofoam, are held together by steel frames and attached to the underside of a house, according to a description of her proposal. Four vertical guidance poles are attached not far from the corners of the house.

When flooding occurs, the flotation blocks lift the house.

Collars are attached around the poles to ensure that the house doesn't go anywhere but up when the water rises and down when it falls, English said. The homes would be strengthened with steel channels attached to the bottom beams to ensure they are strong enough to withstand being lifted and dropped.

Utility obstacles

Hilary Inyang, director of the Global Institute for Energy and Environmental Systems at the University of North Carolina at Charlotte, said English's proposal is a "more sophisticated version" of what many countries in flood-prone communities have used for decades.

"There are some practical difficulties with that concept, such as what you do about utilities that are generally tied in one place," Inyang said. "You'd have to make them more flexible. And you'd have to make sure that with these new foundations that you don't make these buildings more vulnerable to other environmental stresses, such as wind.

"So you'd want this done experimentally at first before you do it wholesale."

In her proposal, English talks about using "self-sealing breakaway connections for utility lines, or long, coiled umbilical lines that would allow electrical and telephone lines to move away from a home when it rises during a flood. Plumbing and sewage lines also can be designed to break away as needed, she said.

She estimated that building and installing the foundation would cost about $20,000. She conceded the figure is "very preliminary" based on estimates for the cost of materials and installation and experience building floating foundations along some Louisiana bayous.

Ground-level advantages

The floating foundation has some clear advantages over the current preferred flood-mitigation solution of elevating homes on a permanent foundation or piers, English said.

Raising homes make access difficult, particularly for the elderly, she said. Higher houses also are more vulnerable to strong winds. Moreover, English said, setting homes at street level makes them fit in easier with neighboring structures, helping to preserve a neighborhood's culture and facilitate conversations between those sitting on their porches and passers-by.

"A buoyant foundation home would remain at street level when it's dry, ready to rise with the flood water," English said. How high a house rises would depend on the length of the vertical guidance poles; the bigger the flood risk, the higher the pole.

English talked to Rep. Charlie Melancon, D-Napoleonville, by phone and met with his staff this week. Melancon thinks the concept is worth looking into, spokeswoman Robin Winchell said.

"It's being used in some areas, and maybe we should be looking to expand it into South Louisiana," she said.

English said she was excited to hear Federal Emergency Management Agency Administrator David Paulison at a hurricane conference in New Orleans talk about how his agency is committed to change and not simply trying the same old techniques it has relied on in the past.

"I hope that's true," said English, who said she handed Paulison a copy of her proposal after his speech. FEMA approval would be needed to include buoyant foundations as an acceptable form of mitigation.

FEMA spokesman Aaron Walker confirmed that Paulison received a packet of information from English, and said it would be evaluated by agency staffers.

No surge protection

English said that it would take about $200,000 to build a prototype and test it by releasing flood water to see if it could keep the home dry during a significant flood. It wouldn't take long, perhaps a few months to build the prototype and a few more months of testing, before she thinks it would be ready for deployment in New Orleans, English said.

What the technology won't do, at least now, is provide protection from a strong storm surge like the one that inundated homes near failed levees and in St. Bernard Parish and the Lower 9th Ward. English said she's convinced the idea will work and is looking for a financial "angel" to help pay for a thorough test. If buoyant foundations were in place before Katrina, she said she believes the number of destroyed and severely damaged homes would have been substantially reduced.

English's students have drawn up a small model and plan to begin testing it in the next few weeks. Ultimately, though, English said, it will take a full-size prototype that can be tested in a variety of flood situations, and that's "where money is a major obstacle."

. . . .

Photos, models and other information about the flood-mitigation concept are available at www.buoyantfoundation.org

Bruce Alpert can be reached at bruce.alpert@newhouse.com or (202) 383-7861.

General Information, Research, Science & Technology

Professor Proposes Buoyant Foundations for New Orleans Homes

11/07/2006 04:30 PM

Elizabeth English, associate professor at the LSU Hurricane Center, has found a simple and surprisingly affordable way for people to protect their homes against the dangers of flooding in New Orleans. It's based on a concept called buoyant foundations, an idea as simple as making a house float.

English, working with a team of senior mechanical engineering students, is devising a way to retrofit houses with a flotation system that will keep them above water in a flood. Similar devices are already in use along the banks of the Raccourci Old River right here in Louisiana and as far away as the Netherlands and southeast Asia.

But English's "amphibious" foundation system is unique. It is designed to be used for retrofitting existing houses, such as the "shotgun" style homes that are so plentiful in New Orleans. The design will be engineered to satisfy new building codes. It avoids many of the disadvantages that come with the more traditional method of elevating a house by lifting it high above the ground.

"There are so many issues, both obvious and not so apparent, that come with permanently elevating homes," said English. Among them are significant expense and increased risk of wind damage, and such social issues as lack of convenience and accessibility, the loss of neighborhood character and the appearance of the structure if it were to be raised on stilts.

A home equipped with a buoyant foundation will remain low to the ground unless a flood occurs, in which case the house will rise as high as necessary to stay dry. Special flexible utility lines accommodate the change in elevation. Then, the house simply floats until the water recedes, with a vertical guidance system keeping it in place. And, when there is no flooding, the house looks essentially the same as it did before being retrofitted with a buoyant foundation.

English's team hopes to secure enough funding to develop and begin testing a prototype as early as December of this year. They've recently received a donation of $2,500 from Innovative Technologies Group, or ITG, from West Virginia, but they're in need of approximately $150,000 to support the project through completion.For more information about buoyant foundations, visit http://www.buoyantfoundation.org/ or contact Elizabeth English at english@hurricane.lsu.edu or 225-578-6019.

-30-

Ashley Berthelot
LSU Media Relations
225-578-1870
aberth4@lsu.edu

Ashley Berthelot
LSU Media Relations
225-578-3870

New Orleans CityBusiness

LSU prof researches idea of 'amphibious homes'

BATON ROUGE – Elizabeth English, associate professor at the Louisiana State niversity Hurricane Center, wants to protect homes against flooding in New Orleans with "buoyant foundations."

English, working with a team of senior mechanical engineering students, is devising a way to retrofit houses with a flotation system to keep them above water in a flood. Similar devices are already in use along the banks of the Raccourci Old River in Louisiana and in the Netherlands and southeast Asia.

English's unique "amphibious" foundation system is designed to retrofit

existing houses such as the "shotgun" style homes in New Orleans. The design will be engineeered to satisfy new building codes and avoids many disadvantages tof more traditional methods of elevating a house.

"There are so many issues, both obvious and not so apparent, that come with permanently elevating homes," said English. Among them are significant expense and increased risk of wind damage, and lack of convenience and accessibility, possible loss of neighborhood character and appearance of a structure raised on stilts.

A home equipped with a buoyant foundation will remain low to the ground unless a flood occurs, when the house would rise as high as necessary to stay dry. Special flexible utility lines accommodate the change in elevation. The house simply floats until the water recedes with a vertical guidance system keeping it in place.

Sans flooding, the house looks essentially the same as it did before being retrofitted with a buoyant foundation.

English's team hopes to secure enough funding to develop and begin testing a prototype as early as December of this year. A $2,500 donation from Innovative Technologies Group from West Virginia helped fund the project, which still needs about $150,000 to complete.

For more information about buoyant foundations, visit www.buoyantfoundation.org/ or contact English at english@hurricane.lsu.edu or (504) 717-5098.

2theadvocate.com
Produced by The Advocate and WBRZ News 2 Louisiana

NEWS

N.O. ideal for buoyant houses

By CHRIS GAUTREAU

Advocate business writer

Published: Oct 18, 2006

CLICK TO ENLARGE IMAGE

Associated Press photo by PETER DEJONG
Metal pylons, right, stand between the foundations of amphibian houses under construction in the central Dutch village of Maasbommel, Netherlands, southeast of Amsterdam. The houses, attached to pylons, stand on solid ground, but float if water levels rise.

If you can't hold back the flood, make the house float.

Armed with that idea, an LSU professor and several engineering students are developing a buoyant foundation system that would enable homes to float atop floodwaters.

Elizabeth English, associate professor for research at the LSU Hurricane Center, says that, when perfected, the system could help south Louisiana avoid massive devastation in the event of another catastrophic flood.

"It seemed to me that this is an idea that would apply beautifully to the situation in New Orleans," English said. "You can't rebuild the city if you can't get people to come back. And you can't get people to come back if they can't rebuild their homes."

Buoyant foundations, typically made from big foam blocks, are nothing new. In fact, several can be found in flood-prone parts of south Louisiana. They're also standard fare in the Netherlands, whose flood-protecting infrastructure is world renowned.

But English's version has a twist: It could be retrofitted to shotgun-style houses built on piers — the design of countless New Orleans homes destroyed in last year's hurricanes.

If floodwaters top the city's levees again, the system, which includes "breakaway" utility connections, would allow houses to float until the water recedes.

English and the five students on her team are still in the early stages of development and there are lots of challenges, but they hope to test a prototype by next summer.

For now, they're pitching the idea to builders and contractors, trying to attract corporate sponsors to cover the cost of the research project — about $150,000.

A PowerPoint presentation they've prepared touts several advantages of buoyant foundations:

- They avoid the need for elevating homes. Lower homes also are less susceptible to hurricane wind damage.
- They alleviate the problem of subsidence.

- Retrofitted homes look essentially the same. Homes' original architecture is retained, and neighborhoods keep their original character.

Scott Schroth, a senior mechanical engineering student on the team, also said retrofitting homes would be comparable to another flood-prevention scheme under consideration — raising houses between 10 and 30 feet off the ground.

A commercially produced buoyant foundation could be installed on a 1,200-square-foot home for about $30,000, Schroth said, compared to estimates of $25,000 to $29,000 for elevating a similar sized home.

English said the flexibility of a buoyant foundation gives it superior flood protection.

"It moves up and down," she said. "You could build a house so it's 8 feet above ground, but you might have a 10-foot flood."

Moreover, she said, elevated houses could create other problems, especially for older residents who may not be able to move around easily.

English said buoyant foundation technology already is proven, and she is confident it can be adapted to a retrofit design.

But she acknowledged team members have several hurdles.

They must figure out, for example, how much foam is needed and a way to keep the blocks protected. They also must figure out a way to maneuver equipment in between closely built homes and a design that keeps homes upright while they're afloat.

Though some individuals have built homemade buoyant foundations, she said, her project design must address government building codes and permitting, as well.

She conceded the idea has its limits. It might not work in levee breaches in which the power of rushing water is too great. And it won't be adaptable — at least until later versions — to homes with concrete foundations.

But English said that, if embraced by builders and planners, buoyant foundations could provide cost-effective protection against flooding on the scale after Hurricane Katrina.

Her inspiration came in January after she sat in on a symposium and talked to members of the LSU Hurricane Center who had visited the Netherlands. The center, along with other Louisiana agencies, has turned to that country for building techniques that could withstand a repeat of last year's hurricanes.

This past spring, LSU hosted Dutch engineering students who developed a retrofit design for a shotgun-style house.

"They came up with very good design ideas," English said. "But the project was basically two students working for six weeks."

Now, she is working to perfect the design with Schroth and four other engineering students, who have turned it into a class project.

Schroth said the project is generating interest among several state and corporate officials in Louisiana. He said the team has received pledges for materials, services and expertise.

"There are a lot of construction companies and homebuilders that see this as a good solution," she said. "It solves construction issues, but it also alleviates the social issues created by elevating a house."

So far, the team has received one donation — Innovative Technologies Group, a West Virginia company, wrote a check for $2,500.

ITG is seeking government approval to use a steel foundation it developed on homes in hurricane-ravaged parts of the Gulf Coast.

"It wasn't until we met with Dr. English that we understood the impact of elevating houses," said Rick Romeo of ITG. "We believe that would destroy the character of all these neighborhoods."

http://www.newyorker.com/archive/2006/08/21/060821fa_fact2?printable=true

Letter from New Orleans

The Lost Year:

Behind the failure to rebuild.

by Dan Baum August 21, 2006

The downriver side of New Orleans has always evoked strong emotions. The French avoided it, settling the high ground of a Mississippi River oxbow that would become the heart of the city. The Americans, who took over in 1803, reviled it as a pestilential swamp. “A land hung in mourning,” the novelist George Washington Cable later wrote. “Darkened by gigantic cypresses, submerged; a land of reptiles, silence, shadow, decay.” Free blacks and European immigrants too poor to crowd into the upriver districts felled the cypresses to build clever, elongated houses that ventilated well, and assembled a rural neighborhood that was pencilled onto city maps as the Ninth Ward. Without much in the way of schools, hospitals, or transportation, the people of the Ninth Ward depended on each other, organizing mutual-aid and benevolent societies to care for the sick and the indigent. At the turn of the century, when New Orleans’s civic leaders began developing plans for a so-called Industrial Canal, connecting Lake Pontchartrain with the river, they routed it through the Ninth, cutting off the area that came to be known as the Lower Ninth Ward. Three bridges eventually joined the Lower Nine, as it is called, to the city, but the district remained isolated.

Only fourteen thousand people lived in the Lower Ninth Ward at the time of Katrina—fewer than three per cent of the city’s population—but the neighborhood instantly assumed an importance out of all proportion to its size. Depending on who was talking, the two sodden square miles represented either the indolence, poverty, and crime that Katrina had given the city a chance to expunge or the irreplaceable taproot of African-American New Orleans. The Lower Ninth Ward became, in the aftermath of Katrina, a vortex of overwrought emotion and intemperate r hetoric, a stand-in for conflicting visions of the city’s future.

New Orleans had a tradition of intermarriage going back to the French period, and the blacks living upriver of the canal tended to be light-skinned. The Lower Nine came to be known simultaneously as the dark-skinned side of town and as an area that was exceptionally integrated. Cane cutters from surrounding sugar plantations poured into the city after the First World War, in search of good dockside jobs, and the housing lots in the Lower Nine were cheap enough for them to buy yet big enough to keep gardens, chickens, even hogs. Schools, of course, were segregated, but Frank Minyard, who has been the Orleans Parish coroner for more than thirty years, grew up in the Lower Nine in a white family so loyal to the neighborhood that his mother forbade him to swim in the Audubon Park pool, in the city’s tony Audubon Park section. “My mother used to say, ‘They don’t like us poor whites uptown,’ ” he told me. “I didn’t get to swim in the pool until I was out of the Navy.”

The neighborhood’s racial weave began to unravel on November 14, 1960, after Brown v. Board of Education, when federal marshals escorted a six-year-old black child named Ruby Bridges through a jeering crowd and into the William Frantz Public School, on North Galvez Street. Leander Perez, the political boss of adjoining St. Bernard Parish, which was almost entirely white, urged white New Orleanians to resist. “Don’t wait until the burr-heads are forced into your schools,” he said. “Do something about it now!” Whites gradually fled New Orleans. By the time Hurricane Katrina struck, the city had lost about a quarter of its people, and more than sixty-five per cent of those who remained were black; in the Lower Nine, the figure was more than ninety-eight per cent. A quarter of New Orleanians were poor, double the national average; in the Lower Nine, most households were getting by on less than thirty thousand dollars a year (the national average is fifty-seven thousand), much of it from public assistance. For years, the city has been one of the most violent in America. Ruby Bridges’s brother was killed in 1990 at the housing project where he lived; last July, her oldest son, Craig, was shot dead on a New Orleans street while on a brief break from his job on a cruise ship. The Lower Nine was particularly dangerous. By the eve of Katrina, it had become, in the words of a local criminologist, “the murder capital of the murder capital.”

The Lower Ninth Ward does not lie particularly low. Large portions of New Orleans—including some wealthy areas near Lake Pontchartrain—sit four or more feet below sea level, while almost all the Lower Nine sits within a foot and a half of sea level, and parts of it are a couple of feet above. What doomed it during Katrina was its position near the junction of the Industrial Canal and another canal, the Mississippi River Gulf Outlet, or Mr. Go, which extends eastward from the city. The two waterways funnelled Katrina's surge into a wedge that burst the Industrial Canal's levee with a sound like cannon fire early on the morning of August 29th. The violence was tremendous. A huge wave scraped half a square mile of houses off their foundations and ground them to rubble. A red iron barge the size of an airplane hangar rode through the breach and landed on top of a school bus. Not a house in the Lower Nine was spared; most of those which didn't collapse or slide off their foundations flooded to their rooflines. Their residents—among the least able to evacuate, for want of cars and money—drowned in the oily brown floodwaters or hacked holes through attic ceilings and sat on scalding tar-paper roofs for days, waiting to be rescued. The most famous, Fats Domino, was carried from the roof of his house—an incongruously grand white mansion in a particularly bleak part of the Lower Nine—by Coast Guard helicopter in the middle of the night.

Televised images of desperate people wading out of the Lower Nine shocked the American people—the obesity and missing teeth, the raggedness and strange English. Commentators of all persuasions were astonished and outraged that these citizens' plight had been ignored by the government and the national media for decades. "A Third World country had suddenly appeared on the Gulf Coast," a *Times* article said. Shepard Smith, on Fox News, declared that the country would be "forever scarred by Third World horrors unthinkable in this nation until now."

Even as the city remained underwater, prominent politicians and businessmen began speaking of Katrina as a quick fix for generations of mistakes and neglect, a deus ex machina that would finally eliminate poverty in New Orleans. Some of the best-publicized early rhetoric seemed to confuse eliminating poverty with eliminating the poor. Twelve days after the storm, the *Wall Street Journal's* Washington Wire column generated a furor when it reported that Richard Baker, a Republican congressman from Baton Rouge, had been overheard telling lobbyists, "We finally cleaned up public housing in New Orleans. We couldn't do it, but God did." (Baker claimed that he had been misquoted.) A former maker of shipboard electronics and a wealthy private investor named James Reiss told the *Journal* that, in rebuilding, he wanted to see the city transformed "demographically." A number of people I encountered—often barricaded in their homes and heavily armed—explained the distinction between the "good blacks" they'd welcome back and other blacks, or passed along a bit of back-fence etymology, saying that the root of the word "Katrina" is "cleansing."

From the earliest days of the crisis, the Lower Ninth Ward seemed to be in a special category. No other neighborhood, for example, was cordoned off by troops. When outside help arrived in force, six days after the storm, the National Guard roadblocked the bridges leading into the Lower Nine. Of all those people who were toughing it out in attics across the flooded city, only those of the Lower Nine were forbidden to return if they waded out for supplies. Though eighty per cent of New Orleans was inundated, the city's homelandsecurity director, Terry Ebbert, appeared to single out the Lower Nine when he told a reporter that "nothing out there can be saved at all," and Mayor Clarence Ray Nagin, Jr., said, inaccurately, "I don't think it can ever be what it was, because it's the lowest-lying area." Ebbert and Nagin were exhausted, stunned by the vastness of the destruction, and lacking solid information. But nobody seriously proposed ditching Lakeview, an upscale white neighborhood that had borne the force of another breach, that of the Seventeenth Street Canal, and lay under even deeper water. Some bluntly welcomed an opportunity to abandon the Lower Ninth Ward. "I don't want those people from the Lower Ninth Ward back," Robby Robinson, the owner of French Quarter Candles, said. "I don't think any businessperson does. They didn't contribute anything to this city."

Because of its history of black home-ownership, the Lower Ninth Ward is a neighborhood of deep roots. Many black New Orleanians either have lived there at some point or grew up visiting relatives there. Suggestions that it be forsaken sounded to many like a pretext for getting rid of the city's black majority. Three days after the levees ruptured, I met a man named Michael Johnson on an uptown street that was covered with smashed oak boughs. He and a friend, David Bell, and Bell's two small daughters had just escaped from the Lower Nine by lashing three refrigerators into a makeshift raft. "We put the babies in. David and I got in the water and pushed," Johnson said. He is short and sturdy; in his muddy, tattered clothes, he looked like an escaped convict. (He is actually a dialysis technician.) He and I found some plastic buckets and took them to the banks of the Mississippi, a few blocks away, so the family could bathe. His voice cracked as he described their ordeal, which included a terrifying night on the hot tarmac of an Interstate 10 overpass with hundreds of restless and angry refugees. Johnson had food and drinking water for only a couple of days, and no means of leaving the city, but his mind was already leaping to the bigger picture. "I'm not saying they planned this as a way to empty New Orleans of poor black people," he said as he dipped buckets of khaki-colored water from the river. "But it's sure going to work out that way." Already, the city seemed to be cleaving along a black-white line.

When President Bush addressed the nation from Jackson Square on the evening of September 15th, the French Quarter was dark and silent. Crews from the White House had set up generators and lit the gleaming-white façade of St. Louis Cathedral as a backdrop. In his speech, which lasted twenty-six minutes, the President eloquently praised the victims' "core of strength that survives all hurt, a faith in God no storm can take away, and a powerful American determination to clear the ruins." Then he vowed, "We will do what it takes, we will stay as long as it takes, to help citizens rebuild their communities and their lives." He announced that more than sixty billion dollars would be spent on "the first stages of the relief effort." He also pointed out that, "in the work of rebuilding, as many jobs as possible should go to the men and women who live in Louisiana, Mississippi, and Alabama."

Mayor Nagin initially believed that Bush's promise would amount to a hundred billion dollars, spread over ten years—enough not only to recover from Katrina but also to cure many of the old city's pathologies. Nagin spent his early childhood in Treme ("Tre-*may*"), the heart of Creole New Orleans. His father worked three menial jobs, and his mother tended a lunch counter in a K mart. He was the sec-ond in his family to go to college—a historically black college, the Tuskegee Institute, in Alabama—but his rise to prominence, unlike that of most Southern black politicians, was through the corporate world rather than the pulpit. By the time he was forty-six, Nagin was earning four hundred thousand dollars a year managing Cox Communications' cable-television operation in New Orleans. His mayoral campaign in 2002 was predicated on "running the city like a business," and his victory is usually credited to white voters. His first three years in office were remarkably scandal-free for New Orleans, but his relationship with the black majority has always been strained; the preacher of the city's biggest black congregation has called him a "white man in black skin."

Bush's pledge was contingent on the city's having a recovery plan, so Nagin announced, on September 30th, that he was forming the Bring New Orleans Back Commission to develop one. As he explained to me later, what seemed most important at the time was maintaining good relations with the White House, and he appointed several people who, if necessary, could get President Bush on the phone. The co-chairs were Mel Lagarde, a white health-care executive, and Barbara Major, a black community activist and the director of St. Thomas Health Services, a clinic. In some circles, the group came to be known as the Canizaro Commission, because its most influential member was a real-estate developer named Joseph Canizaro, a friend of Bush's and one of his biggest fund-raisers. Although Nagin was careful to appoint eight blacks, eight whites, and one Hispanic, Barbara Major, the only figure on the commission who is from what poor blacks call "the community," told the *Times*, "Some people don't understand that an equal number of black and white isn't the same as equity."

By early October, most of the people gutting houses and clearing fallen trees from New Orleans's streets weren't locals but Hispanics from elsewhere. Some fifteen thousand Hispanics had lived in New Orleans before Katrina, but they'd never had a high profile—no Spanish radio station, identifiable Hispanic neighborhood, or fashionable cuisine. (The restaurant Nacho Mama's, in the Garden District, was owned by a man named Shane Finkelstein.) Eduardo Ramirez, a twenty-five-year-old construction worker from Mexico City who was standing in line one afternoon for a cup of stew at a Salvation Army wagon, told me that, before the storm, hanging Sheetrock paid twelve dollars an hour. "It pays twenty now," he said. "And the cops don't bother us anymore, asking for papers." Ramirez and several friends commuted two hours each way from Baton Rouge. Other Mexicans he knew were sleeping in tents. On October 4th, representatives from a number of organizations, including the A.F.L.-C.I.O. and the N.A.A.C.P., held a joint press conference to denounce the business owners who were hiring non-union workers from out of state, even when locals were available and ready to work. The electricians' union said that one contractor had dismissed its union employees "in favor of workers from Texas."

On October 6th, Mayor Nagin held a "Back to Business" meeting in the downtown Sheraton hotel, and in the opening words of a twenty-minute speech managed to alienate almost everybody. Several hundred rumpled, frightened, grief-stricken business owners had crowded into the Armstrong Ballroom to hear the Mayor and other officials talk about reviving New Orleans's economy. Nagin, who walks with the stylish lope of a jazz singer, appeared confident as he took the microphone. "I know you want to know how do I make sure that New Orleans is not overrun by Mexican workers?" he said, without preamble, in his easygoing homeboy drawl. He was addressing television cameras at the back of the room, and, by extension, his increasingly resentful black constituents scattered around the South. But the business owners, far from being concerned about Mexicans, were grateful for the pliant and low-cost workforce digging them out of the muck. Judging by the response on a twenty-four-hour call-in radio show that was the only broadcast airing in New Orleans, blacks, too, found Nagin's baldly racial comments on their behalf insulting. The Mayor backpedalled for days.

Over breakfast one morning, the city's best-known pollster, Silas Lee—a large bald man of fifty-one with an air of perpetual amusement—analyzed Nagin's mistakes, starting with appointing the Canizaro Commission before reaching out to the people of New Orleans. The Mayor, Lee said, needed to "disperse teams right away, and organize discussion panels at places in the community." He should have advertised a 1-800 number in the Houston *Chronicle*, for instance, encouraging evacuees to call in. Taking measures like these would send the message that ordinary New Orleanians—and not just a small group of élites—were included in the planning. "In a volatile time, you have one chance to get your message out," Lee said. "You hit the bull's-eye or that's it." Lee makes a lot of his money coaching experts on how to testify in court—how to convey complicated information to jurors, frequently of limited education, without patronizing them. Nagin's commission would need that skill, he said. Painful decisions about what to keep and what to change would be based on such arcana as floodplains, actuarial tables, population density, and city budgets. The "jury"—the population of New Orleans, mostly black and poorly educated, affected by generations of poverty and discrimination, traumatized by the storm, and scattered all over the country—would be hard to win over. Discussions involving the Lower Nine would be especially sensitive. The area, Lee said, "represents African-Americans' cultural and historical significance, and their financial stability. They're not going to let anybody take that away."

Nagin stumbled immediately when it came to the Lower Ninth Ward. He began allowing residents to "look and leave" on October 12th, so they could spend a few daylight hours plucking possessions from the wreckage. Some travelled great distances from their temporary shelters. To get into the neighborhood, they tried to cross one of the bridges over the Industrial Canal or to circle around to the east and enter through St. Bernard Parish, where the Lower Nine's border was fortified by a wall of flood-wrecked cars stacked three high. National Guard troops protected all the approaches, and, for reasons that varied from soldier to soldier, they refused to let many people in. The residents were furious, and their frustration nourished a whole new crop of conspiracy theories: the city wanted to turn the Lower Nine into an industrial park; developers wanted the Lower Nine, with its riverfront and view of downtown, for condominiums; somebody's cousin's cousin saw Donald Trump drive through in a limousine. The rumors became so widespread that Nagin felt compelled, the following week, to issue a statement: "Read my lips: We will rebuild the Lower Ninth Ward."

Seven weeks after the storm, Richard Baker—the Louisiana congressman who had reportedly celebrated God's "cleanup" of public housing—introduced a bill to finance reconstruction throughout the state. In local mythology, the proposal quickly became known as an eighty-billion-dollar buyout, even though the bill stated that federal spending would be capped at less than half that amount. Under the bill, the government would buy, at sixty per cent of the pre-Katrina value, any flood-damaged house or small business in Louisiana that an owner wanted to sell. The government would consolidate the properties and sell them for planned development. Baker's proposal was big enough to save New Orleans. It would put money and options in the hands of homeowners. And it was tailored to appeal to Bush's sensibilities—government involvement would be temporary, and about half of the initial public outlay would be recovered when redeveloped properties were sold. The bill made New Orleans the greatest urban-revival opportunity in recent American history, and planners and architects from around the world gathered to help. More than just New Orleans was at stake. A third of the world's population lives in coastal zones, many of them in delta cities that may flood as the climate changes and seas rise. The Netherlands' complex of levees, fortified after a hurricane killed hundreds in 1953, is a respected flood-control model; done right, planners said, New Orleans could serve as another example of how to rebuild, smarter and better, a city flooded on an unprecedented scale. "That is the silver lining in this whole disaster," a prominent local architect named Ray Manning told the *Times-Picayune*. "We have this incredible, once-in-a-lifetime opportunity to reëngage and recalibrate this city in a way that, politically, you might never have been able to get to." Joseph Canizaro called the city a "clean sheet."

In their enthusiasm to create a new city, though, the planners were up against New Orleanians' uncommon fondness for the old one. A Gallup poll conducted a few weeks before Katrina found that more than half of the city's residents, regardless of age, race, or wealth, were "extremely satisfied" with their personal lives—a higher percentage than in any of the twenty-one major American cities in the survey. I had glimpsed that stubborn affection in October, when the first secondline since Katrina wound its way through the debris-strewn streets of Treme. The secondline is the quintessential trafficdisrupting New Orleans art form; in this case, the Black Men of Labor, a social aid and pleasure club, marched in matching yellow print shirts, with matching hat bands and parasols, while the Hot 8 Brass Band followed behind them, blasting music into the mostly vacant neighborhood. As the procession moved along St. Bernard and Dorgenois Streets, people materialized from the shadows. They ran laughing down the steps of houses blessedly elevated, or emerged gloved and masked, carrying buckets, from the gloom of moldy interiors. More than a hundred people fell in with the band, shimmying their shoulders and twitching their hips—tentatively at first, as though remembering how to celebrate, and then bursting into full-on, high-stepping, arm-waving street jive. Fred Johnson, a non-profit housing consultant who was shading himself with a yellow-and-green parasol, nodded appreciatively and remarked, "You can't plan this in, you can't plan this out. You can't legislate this in, you can't legislate this out."

Governor Kathleen Babineaux Blanco created a commission of her own. The Louisiana Recovery Authority was established with twenty-three members, who were to advise her on rebuilding and later to oversee the distribution of the federal dollars that were expected to begin flowing any day. The only person named to both Nagin's commission and Blanco's was Donald (Boysie) Bollinger, who personified the impatience for a "new" New Orleans which was the driving ethic of both the city and the state commissions. Bollinger is broad-chested and jowly, with a big mane of gray hair, bushy expressive eyebrows, and the carriage of a viceroy. A Cajun from Lockport, about thirty miles west of New Orleans, he owns seven shipyards in and around the city, where, before the storm, he employed about a thousand people. He has been a friend of George W. Bush for a quarter century. Bollinger invited me one day to follow his silver Mercedes to a shipyard on the other side of the Mississippi. As we crossed over the sweeping white Crescent City Connection bridge, the creepy stillness of New Orleans receded, and it was striking to see the bustling activity at Bollinger's Destrehan Avenue shipyard. Every berth was occupied by a storm-damaged ferry or barge. Great geysers of welding sparks rained down upon the docks, and the racket was intense. All that was holding things up, Bollinger said, was a shortage of manpower. "Ever since the storm, I've been trying to get my workforce back," he shouted over the din. "My H.R. people went to every shelter in Texas, Louisiana, Arkansas, and Mississippi, offering jobs at twelve to eighteen dollars an hour. I didn't get one worker." Bollinger held the view that the Federal Emergency Management Agency was pampering evacuees, by handing families two thousand dollars in emergency help. "I said to the President, 'You're empowering people not to come back to work.' The President said, 'I don't think two thousand dollars will do that.' I said, 'Mr. President, these people haven't had two thousand dollars in their lives.' " Rather than wait, Bollinger was hiring as many Mexicans as he could find. "I'm hoping the people of New Orleans come back and take a different attitude toward employment," he said, pulling open the door to a small office building. "But until they do . . ."

We entered what had once been a reception area but was now a "kitchen"—a row of brand-new microwave ovens and some folding tables and chairs. Down a hall, small panelled offices had been converted to dormitories; four double bunk beds filled each one, their mattresses wrapped in plastic. Bollinger has devoted decades to improving New Orleans incrementally, as a chairman of the National World War II Museum and the president of the New Orleans Region of the Boy Scouts of America, and as a member of various committees to improve transportation, housing, and public schools—which he called "a failure." Now he was a believer in Katrina-as-opportunity. "One storm, we have a whole new playing field," he said as we examined a row of narrow fibreglass shower stalls. Bollinger believed that Nagin's commission should deal with the city's blighted neighborhoods by engineer-ing them off the map. "We do ourselves a disservice if we end with the concentrated poverty as it was," he said. He supported a radical plan that the commissioners were discussing, which would sprinkle the poor throughout the middle class, in the hope that, among other things, they would absorb a work ethic. "If both my neighbors get up and go to work, *I'm* more likely to get up and go to work," Bollinger said.

The chief promoter of mixed-income neighborhoods in New Orleans is Pres Kabacoff, whose company, HRI Associates, specializes in transforming disused industrial areas into trendy residential neighborhoods. Kabacoff, a handsome and soft-spoken man of sixty, has for years been pushing Operation Rebirth, a four-billion-dollar mega-plan that would, among other things, con-vert one of the city's oldest housing projects, just outside the French Quarter, to a mixed-income development. Op-eration Rebirth would scramble the poor and the middle class in new housing throughout Treme and the lower Garden District, and pro-vide the city with a light-rail system. Kabacoff described the project, which would be funded by the Baker bill, as New Orleans's best shot at greatness. His office, on the thirty-first floor of a building in the Central Business District, has a vast window overlooking the area in question, and, as we unrolled an artist's rendering of the project, he swept a hand across the view. "New Orleans could be an Afro-Caribbean Paris," he said.

The era of social engineering by wrecking ball began in 1954, when the U.S. Supreme Court allowed Washington, D.C., to raze and redevelop a section of the run-down Southwest neighborhood. Whatever good such urban-renewal projects as this may have done, they traumatized residents of the minority neighborhoods they obliterated. This was especially true when the projects incorporated interstate highways. After I-94 displaced hundreds of people in St. Paul, Minnesota, during the nineteen-sixties, one observer wrote, “Very few blacks lived in Minnesota, but the road builders found them.” Black New Orleans had suffered its share of urban renewal, which carried echoes of the 1923 splitting of the Ninth Ward by the Industrial Canal. In the nineteen-sixties, city-council members chose to run Interstate 10 through the center of Treme. The city cut down the large oaks shading Claiborne Avenue—a graceful boulevard where blacks celebrated a parallel-universe Mardi Gras—and overhung it with a gigantic concrete roadway. Planners also razed eight square blocks of homes and businesses to build a cultural center and amusement park inspired by the Tivoli Gardens, in Copenhagen. The project never materialized, but urban renewal wiped out half of Treme. Likewise, though it wasn’t called urban renewal anymore, the city got a federal grant in the nineteennineties to raze the St. Thomas housing project, which occupied a prime spot near the Mississippi River, and replace it with mixed-income housing and resident-owned shops. Pres Kabacoff eventually got the contract, and the result, River Garden, is a collection of simple, attractive attached houses that stood up well to Katrina. Somewhere along the way, though, the number of subsidized units fell by more than two thirds; the idea of resident management disappeared; and the small resident-owned stores became a two-hundred-thousand-square-foot Wal-Mart.

Even before Katrina, public-housing residents were fighting a city plan to replace more projects with mixed-income developments. Some argue that the projects, as grim as they are, are the wellspring of New Orleans’s unique “bounce” style of hip-hop: the artists Juvenile, Master P, Turk, Baby Williams, and Soulja Slim all spent their childhoods in and around New Orleans public housing. In general, when New Orleanians describe what they love about the city, the first thing they mention is neither the food nor the music but the intimacy of the neighborhoods—knowing everybody on the block where you were born, and never leaving. “This is our neighborhood,” Paula Taylor, a public-housing resident, told the *Gambit*, a local newspaper, in April. She added, “Do I want to see it better? Yes. Safe? Yes. Clean and decent? Yes. But this is home.” It would be hard to imagine an idea less suited to New Orleans culture than breaking up the neighborhoods. When I asked Kabacoff about objections to his mixed-income plans, he waved them away. “You get it from both sides,” he said. “I’ve also gotten e-mails saying, ‘You’re contributing to the niggerization of New Orleans.’ ”

For residents of the Lower Nine, the most frightening proposal before the Bring New Orleans Back Commission was to “shrink the footprint” of New Orleans. The idea, in many ways, made sense: the city’s present size and scale were appropriate for the 1960 population of more than six hundred thousand. After the exodus following school integration, many buildings, and some whole blocks, were abandoned. Planners estimated that the post-Katrina population would reach only a quarter of a million—about half of what it was before the storm. Life among thousands of deserted buildings would be bleak, and a city shorn of much of its tax base would be hard-pressed to provide services to sparsely inhabited, far-flung settlements. In early January, the commission published a map of the proposed shrunken city. Huge areas indicated by round green blotches would be converted to parks and green space. All of the blotches covered areas instantaneously recognizable to New Orlea-nians as primarily black areas. Oliver Thomas, the lumbering, emotional president of the city council and a native of the Lower Nine, led the opposition to a geographically smaller city. “To say you’re not going to fix this community or that community—you’re not honoring the dead!” he told a crowded council chamber on the evening of Janu-ary 6th. The room erupted in applause. Before Katrina, sixty per cent of homes in the Lower Nine were owned by the people who lived in them—a higher percentage than in the city as a whole—and Thomas was eager to help his constituents protect the one thing of which they were sure: that property rights are sacred, and that they owned a city lot.

Those who wanted a smaller footprint waited all fall and winter for the federal government to relieve them of the burden of fighting for it. FEMA was set to release, for the first time since 1984, new guidelines for maps that would show what parts of the city the federal government would insure against floods. The maps were expected to rule out certain areas and thus cut through the racial politics. Proponents talked excitedly about the “discipline” they hoped the maps would impose—the city-planning equivalent of “Wait till your father gets home!”

Sean Reilly, a member of Governor Blanco’s statewide recovery authority, told me that New Orleans’s obsession with neighborhoods was dangerous in the context of the bigger hurricanes predicted by atmospheric scientists. “When you say ‘neighborhood,’ it’s become politically and racially charged,” he said, the day we met in the office of his family's national billboard-advertising company, in Baton Rouge. The White House had just approved $6.2 billion for housing, and Reilly wanted the state to withhold it from any place that was too low-lying. "We should talk about blocks and elevations, not neighborhoods, so we can talk about people rebuilding out of harm's way." Reilly, a red-haired man in his forties who likes to call himself "Mr. Tough Love," showed me a poster-size satellite photograph of New Orleans at the height of the flood, color-coded according to water depth. He ran his hand over the darkest areas, which included a sliver of the Lower Nine. "We're not going to allow rebuilding where it's unsafe. We know what the FEMA maps are going to say. They will make some decisions. Certain places are obviously unsafe to build."

Neither Nagin's nor Blanco's commission had any real authority, except to make recommendations. But, in a city desperate for direction and leadership, the media reported every notion that the commissions discussed. Ideas poured forth in a dizzying torrent: scramble the neighborhoods; ban building in the hardest-hit areas; make the city smaller; impose a three-year moratorium on building; no, three months; no, one month; no, forget the moratorium and let neighborhoods organize themselves, but, if too few return after a year, pull the plug on services. The debates were hard to follow, especially for citizens evacuated to Houston or Atlanta. The process paralyzed those trying to make decisions about damaged homes, and exacerbated their sense of exclusion. "It's like someone coming to totally redecorate your home, and they don't talk to you. You feel raped, violated," the pollster Silas Lee said. "First, nature violated them, then the bureaucracy and planning process. If the commissions had understood that you're not just physically rebuilding but emotionally rebuilding, they'd be achieving something now instead of deadlocked."
If ever a city needed a voice of brotherhood, it was New Orleans after Katrina. No one could find the right words, including the city's powerful clergymen. When I visited the First Baptist Church on Canal Boulevard, which has about a thousand congregants, mostly white, its blue-eyed and flinty pastor, the Reverend David Crosby, told me, "There is nothing left in the Lower Ninth Ward but dirt! A woman who has a house down there, what's she got? A piece of dirt worth two or three thousand dollars." During a Sunday service at Watson Memorial Teaching Ministries, on St. Charles Avenue, the Reverend Tom Watson, a scholarly-looking African-American who subsequently challenged Nagin in this year's race for mayor, alternately scolded his congregants for their mistrust ("You have to ask yourself, am I involved in something that would be divisive in my community?") and stoked it ("I believe there is a systematic conspiracy to keep people out so they can make this city the way they want it").
The planning process so alienated the black majority that even ideas that showed promise were not acknowledged. Making the city smaller, for example, didn't have to mean annihilating the Lower Nine. Janet Howard runs a nonprofit group called the Bureau of Government Research, which issues critiques of New Orleans's waste and inefficiency. A former Wall Street lawyer with a vinegary, patrician disdain for pomposity, she often criticized the Bring New Orleans Back Commission, but she was a strong proponent of shrinking the footprint. In a borrowed downtown computer-company office that she'd been using since her own office flooded, she explained to me how the city could contract without destroying neighborhood integrity, through land swaps. She sketched it for me on a legal pad, showing how those in, say, the utterly destroyed parts of the Lower Nine who wanted to return could swap with people who owned lots in the less damaged part and didn't want to return. The result: a smaller, but intact, Lower Nine neighborhood.

On Martin Luther King's birthday, as Nagin's reëlection campaign geared up, the Mayor reached out to his black constituents. "It's time for us to rebuild a New Orleans, the one that should be a chocolate New Orleans," he said. A bit later, he added, "This city will be a majority African-American city. It's the way God wants it to be. You can't have it no other way." Quoting from an old George Clinton song was a ham-fisted attempt at reassurance from a mayor whose diction, if not his sense of audience, was usually more precise. Jack Cafferty scolded him on CNN, and conservative bloggers were in high dudgeon—"Where is the liberal outrage?" a Web site called Rhymes with Right demanded. Nor did Nagin's pandering do him much good with black constituents. "Everybody's jaw is dropping right now," the council president, Oliver Thomas, told the *Times-Picayune*. "Even if you believe some of that crazy stuff, that is not the type of image we need to present to the nation."

New Orleanians both at home and in exile seemed to take it for granted that once the President signed on to some version of the big buyout plan proposed by Representative Baker, the Bring New Orleans Back Commission would hand down solutions like beads from a Mardi Gras float. The expectation had induced a torpor. "People have been asking, 'What's going to happen to our property?,' instead of asking, 'What can we do to save our property?' " Greta Gladney, a fourth-generation Lower Nine resident, told me in New Orleans. "Instead of coming back and getting to work, they've been asking, 'When will we get permission to come back?' " Gladney, who is forty-two, short, and caramel-colored, had her first child when she was fourteen, and went on to earn bachelor's degrees in chemistry and philosophy and a master's in business administration from Baruch College, in New York. She'd long since started rebuilding her own two-story house, on Jourdan Street, tearing off sodden plaster to let the cypress lath dry. She was impatient for her neighbors to shake off their lethargy and set about rebuilding. "People will depend on the kindness of strangers," she said, echoing Blanche Dubois. "That's not good public policy, but that's what there is in poor neighborhoods."

On January 24th, New Orleans suffered what Congressman Baker called a "death blow." Donald Powell, a former F.D.I.C. chief, who was overseeing Gulf Coast recovery for the White House, announced that President Bush would not support the Baker bill. The President didn't want the government in the "real-estate business," Powell said. Of the more than two hundred thousand Louisiana homes that Katrina had destroyed, the federal government would pay to rebuild only a tenth, he said: those which lacked flood insurance, were owner-occupied, and were outside established floodplains. Officials at all levels of state and local government appeared to be taken completely by surprise; on the streets of New Orleans, people were visibly stunned.

An official involved in the negotiations with the White House told me that responsibility for handling the bill within the Administration had shifted, from the coöperative Treasury Department to the office of Allan Hubbard, the President's chief economic adviser. "Hubbard just looked at it as 'We don't want to set up another bureaucracy,' " the official said. "I'm a conservative ideologue myself, but I think it's ideological." Three weeks later, Bush announced that he would ask Congress for an additional $4.2 billion for housing in New Orleans, bringing the total to a little more than ten billion dollars—far from the ten billion dollars a year over ten years that Nagin initially had expected.

The Bring New Orleans Back Commission continued meeting into March, but its grandiose plans for social engineering now seemed pointless. The failure of Bush to "do what it takes" to rebuild New Orleans was only part of it. Much of what could have been done to improve New Orleanians' lives, such as land swaps to preserve a smaller Lower Nine, wouldn't have required a lot of money. It would, however, have required trust and coöperation. But, as the weather grew warm, the vision of a planned recovery slipped away, and an every-man-for-himself ethic replaced it. People began piling rotten wallboard on their front lawns and lining up on the eighth floor of City Hall for building permits.

Ronald W. Lewis's family left the Cedar Grove sugar plantation, in Thibodaux, Louisiana, in the nineteen-forties, and ended up at 1911 Deslonde Street, a block from the eastern bank of the Industrial Canal. After Katrina, Lewis went to stay with relatives in Thibodaux, and I met him on a warm late-January day in the parking lot of an Applebee's restaurant in Met-airie, a mostly white suburb west of New Orleans. His 1986 Cadillac was leaking coolant onto the pavement as he arrived, and the driver's door was badly dented; he slid across the front seat to get out on the passenger side. "Isn't this just the most beautiful day!" he said exuberantly. Lewis is broad-shouldered and very dark, with one gold incisor, a white pencil-line mustache, and tiny diamond studs in each earlobe. He's fifty-four, but he seemed much older as he walked, hunched and stiff-legged, to my rental car. "Just wear and tear," he said, from a third of a century swinging sledgehammers and wrenching pry bars as a streetcartrack repairman. Metairie, which was lightly damaged in the storm, was in a frenzy of rebuilding, like Reconstruction Atlanta in "Gone with the Wind." The streets were jammed with high-riding contractors' pickups and glaziers' trucks that reflected the sun crazily in every direction. The farther into the city we drove, the thinner the traffic became. Along Napoleon Avenue, the grassy median—"neutral ground," in New Orleans parlance—was covered with cars encrusted to their roofs with mud, parked there before the storm in the belief that five extra inches of elevation would keep them dry. By the time we reached Almonaster Boulevard, in the upper Ninth Ward, there was little sign of life. As we drove, Lewis told me about his childhood in the days when New Orleans was booming and his parents' two-bedroom house on Deslonde Street was often filled with friends and relatives from the countryside. In those days, the rural blacks of the Lower Nine didn't go in for what they considered the parading-in-the-street foolishness of the Creoles in Treme. "You worked and you went to church and you played music," Lewis said. "You didn't parade." Lewis helped change that in the nineteen-eighties, when he formed the Lower Nine's first social-aid and pleasure club, the Big Nine, which combined the mutual-aid functions of the old Ninth Ward neighborhood organizations with what he called "flash and dash: a two-hundred-dollar hat, nine-hundred-dollar shoes." We crossed the Claiborne Avenue Bridge, glancing to our left at the spot where the Deslonde Street home had stood before it vanished. Under a crust of dried flood slime, storefronts testified to generations of hard times: cinder-block liquor marts, tire-repair shops with hand-lettered signs, a Popeye's Chicken. The Lower Nine didn't have a supermarket or a bank branch. For produce or credit, residents crossed into St. Bernard Parish, where they shopped on Judge Perez Drive—originally named for the same Leander Perez who had called blacks "burr-heads." Lewis's effusive cheer waned as we ventured deeper into the neighborhood. By the time we passed Fats Domino's vast white house, on Caffin Avenue, he'd grown quiet. But when we turned onto Tupelo Street, where in several yards small mountains of stained Sheetrock, lumber, and sodden mattresses rose, his face lit up. "That's progress!" he said, clapping his big hands and laughing. "That means people are coming back!"

We stopped at No. 1317, a small tan bungalow that Lewis had bought in 1978, the year after he helped organize the city's streetcar-track repairmen into the International Brotherhood of Electrical Workers. An orange "X" and "9/16" had been spray-painted on the door, meaning that rescuers hadn't reached the house until more than two weeks after the flood. He stood on the dead grass, pointing to house after silent house: "Miss Catherine there, she's in Atlanta. They found Christine's body in that one two weeks ago. Her son walked in and there she was. Those people there are in McComb, Mississippi." We peered through the back door of Lewis's house; the interior had been stripped to the studs by a team of University of Montana students. "Isn't that something?" Lewis said. "Came down here on their Christmas break just to help." Until Katrina, a small, freestanding garage in Lewis's back yard had contained the House of Dance and Feathers, a homemade museum dedicated to the Mardi Gras Indians and the social-aid and pleasure clubs of the Lower Nine. The museum, a ten-by-twelve room, had been officially recognized with tax-exempt status shortly before Katrina. All that remained was a muddy strip of Indian beadwork, drying on a kitchen stool. Lewis's voice took on a dreamy quality as he spoke of neighborhood crayfish boils and fish fries, of bringing meals to Miss Catherine, and of the kinship ties among neighbors who looked out for each other's children—life in the Lower Nine as painted by Norman Rockwell. When I suggested that perhaps grief was buffing his memories, Lewis insisted that the Lower Nine was never as bad as the crime and the poverty statistics suggested. "People weren't as poor as all that. At least, it didn't feel like that," he said. "People got by. Everybody knew everybody. The criming wasn't everywhere; it was, like, this corner was bad, or that parking lot." He winked. "We're able to hold more than one thought in our heads."

As planning for a new New Orleans stalled, growing numbers of students and professors arrived to see what might be salvaged of the old one. One February morning, Jeffrey Chusid was taking a break and eating a praline at Loretta's Too, a coffee shop in a run-down, arty part of the city near Elysian Fields Avenue. Chusid, a heavy-lidded man with a gray-and-white beard, teaches historic preservation at Cornell. Three graduate students sat at the table with him, studying an inventory they had made of public assets in the Ninth Ward—businesses, public buildings, parks. They were particularly excited about the Meat People, a gaudily painted market at Derbigny and Mazant, which had the look of an important neighborhood fixture. Chusid said, "The need is for everybody to be planning, so the people can say, 'This building is important; we remember the people who lived here.' Or 'You know what we liked about this street? The curbs were the right height, and the kids would sit here.' " He finished his praline, and we piled into a white minivan to continue the inventory, moving slowly along Urquhart Street. A blue van coming the other way rolled down the windows and stopped, and the occupants, another group of students, exchanged intelligence about some oak trees on Poland Street; the students were making a list of every viable tree in New Orleans, and their best estimate was that forty thousand had been lost in the storm and flood.

While Chusid cruised the neighborhoods, Kenneth Reardon, the chairman of the Department of City and Regional Planning at Cornell, was helping to coördinate data on the condition of New Orleans which had been gathered by teams from seventeen universities. "It's absolutely criminal—people looking out a downtown hotel window, making statements about neighborhoods they never visited much to begin with, saying nothing can be done and nobody wants to come back," Reardon said, when I reached him by phone at Cornell later that month. He couldn't imagine making plans for a city whose precise physical condition was unknown. "The first rule is: Survey before plan. The whole process should be driven by data, and people's preferences, and the reality."

Elizabeth English studies the effects of hurricanes on buildings, at the Hurricane Center of Louisiana State University, in Baton Rouge. "You need to think about how architecture helps shape culture," she said, when I met her at a back-yard dinner party in Baton Rouge. English, who is fifty-two and slight, has the intensity of someone whose career has met its most significant challenge. She is trying to save an architectural feature that is as emblematic of New Orleans as crayfish étouffée: the shotgun house. The shotgun—sometimes four to six times as long as it is wide—catches stray breezes and allows them to pass through every room. The house is too narrow to have a hall, so the rooms are lined up one behind the other. The original plantations in the Mississippi River oxbow that later cradled New Orleans were long, thin strips, starting at the river and running north, toward the lake. "People grow accustomed to the geometry in which they live," English said.

When it came to laying out lots in New Orleans, they naturally laid them out long and narrow. That led to the long and narrow shotguns." The shotguns, in turn, helped develop the close-knit neighborhoods that New Orleanians love. A shotgun's salient feature is its lack of privacy. Getting from the front room to the kitchen, which is usually in the back, means walking through everybody else's room or around the outside. On the narrow lots, shotguns sit close together, so neighbors are also on top of each other. "That communal culture everybody talks about in New Orleans, that warmth, all that life on the street, you could say that originates with the need for every plantation to have a little piece of riverfront," English said. The shotguns are built of old-growth swamp cypress that resists mold, termites, and rot. "And they were built to flood." The homes were designed to drain water and dry quickly. From English's informal survey of the Lower Nine, it looked as though at least half of the houses on many blocks were shotguns. Most were in good structural shape, even those which had floated away. They needed new Sheetrock and wiring but little else, and it wouldn't cost much, she said, to jack them up in anticipation of future floods. "You just put more cinder blocks under them." A do-it-yourself owner could restore a shotgun for not much more than the amount—twenty-six thousand dollars—in reconstruction assistance that FEMA was promising to homeowners who lacked insurance. "There was this message coming out of the commission that you'd be foolish to invest in your flooded home," English said. "But that's just not true."

When I visited Mayor Nagin in his office, in February, he was awkwardly straddling the issue of the Lower Ninth Ward. His Department of Safety and Permits was handing out as many as five hundred building permits a week, regardless of location in the city. Those who could cajole city inspectors into believing that their houses were less than fifty per cent damaged got a permit to accomplish repairs. Nearly ninety per cent of applicants were able to make that case. Even as his administration was authorizing the permits in the Lower Ninth Ward, Nagin said that he thought building there was a bad idea. "I wouldn't put money in the Lower Nine," he told me. "Nowhere." Maps were the post-Katrina currency of communication, and Nagin, sitting beneath a vast abstract canvas, unfolded one of his own. He traced a finger along the path of the storm surge. The Lower Nine would remain vulnerable even if the Army Corps of Engineers closed Mr. Go, he said. "I'm comfortable with rebuilding everywhere but the Lower Nine. Yes, the Lower Nine carries that emotional charge. I have relatives who live in the Lower Nine. But I'd rather be honest and tell them exactly what the danger is."

I asked Nagin if, given the black community's hostility toward the Bring New Orleans Back Commission, he now thought that including James Reiss—who'd spoken of changing the city "demographically"—on the commission had been a mistake.

"I've known Jimmy Reiss for a long time," Nagin said. "I'm not one to throw people off because they're controversial. You need some edginess, especially in this town." Black resentment, he said, was part of "the nature of New Orleans, the negativity and self-pity." He folded his hands and bowed his head for a moment, sighing loudly. "Look," he said. "What you see in the Lower Nine—the hurt, the resentment—has been there for years. Anytime you talk about revitalization, urban planning, you're going to have people who say it's a racial thing."
As Nagin walked me to the door and shook hands, I asked him how he saw his prospects for reëlection. A few dozen candidates had entered the race, and a couple of especially formidable ones were about to declare. Polling a city blown apart was nearly impossible, but, given the bungled rescue, the failed Baker bill, and the woebegone state of the city six months after the storm, things did not look good for Nagin.

"Twenty-four candidates—most of them white?" he said. "You've got to be kidding. Of course I'm going to win!"
Mardi Gras fell on a sunny, cool, and dry day this year. Nagin, dressed in the desert-tan camouflage of a four-star Army general, rode a big horse at the head of the parade. Zulu, the oldest of the black Mardi Gras krewes still parading, had brought twenty-four Zulu warriors from South Africa, who danced down Jackson Street in the crisp morning sun. The Muses handed out their signature hand-strung glass beads from floats that depicted Nagin playing the "race card" in a Cajun variant of poker called bourré, and FEMA as a barrel of monkeys.

Governor Blanco, a Democrat, offered me a ride in her black S.U.V. from her downtown hotel to the main reviewing stand, a quarter of a mile away. She had lost the haggard look she'd worn during the crisis, when she was feuding with President Bush over control of the rescue, and was fresh and relaxed in a red silk jacket. "My surprise is how slow things are at every level," she said. As of that morning, not a penny of either the original six billion dollars or Bush's additional four billion had arrived in the state. (It didn't begin arriving until May.) I asked her if she thought that Louisiana's reputation for corruption was preventing Congress from acting. For months, the state treasurer, John Neely Kennedy, had been pushing Blanco to remove any whiff of impropriety by banning state officials and their families from securing reconstruction contracts. Blanco told me that she didn't like the idea. "The legislature is not a full-time job," she said. "These people have to make a living, too." I asked whether a Republican Congress and White House might be deliberately slowing the release of funds for a city that is essentially a big blue dot on an otherwise red state map. She closed her eyes. "I can't let myself go there," she said.

Interstate 10 casts a deep gray shadow over Claiborne Avenue, but that has never stopped black New Orleans from celebrating Mardi Gras along its noisy, smoggy, gritty length. Music thumped and blared from dozens of overamplified car radios and boom boxes, sirens wailed, and horns honked. In exchange for a twenty-dollar bill, a fat woman handed me a plastic plate holding a turkey neck, a crab, a sausage, and a pig's foot, all fished out of a waist-high pot of spicy broth. A big man approached, dressed in a black shirt and pants with white skeleton bones painted on them. His face shone with a white skull that had been daubed on. His arms were thrown wide. "I'm a bones man!" he yelled, engulfing me in a hug. It was Ronald Lewis, the streetcar-track repairman whose Mardi Gras museum had been destroyed in the flood. Masking skull-and-bones, a traditional Mardi Gras reminder of mortality, seemed appropriate, as bodies were still being discovered in ruined houses. (One was found in a house in the center of the city on May 27th, nine months after the storm. The Louisiana death toll so far is fourteen hundred and sixty-four; about eighty per cent of the victims have been found in New Orleans.)

Lewis was deliriously happy that Mardi Gras day was a sparkling one, and that so many people were back for it. Now that the Baker bill was dead, the era of waiting for that illusionary eighty billion dollars was over, and the rebuilding could finally begin. "All that waiting around hurt us." Sweat beaded on his face. "They dangle resources, and everybody waits to get them instead of just starting in." Nobody else from his block had yet returned, but Lewis was going ahead with his remodelling. "I don't care if I'm the only person on my block," he said. "I'm going to live in my house." Only in the bizarre world of the first post-Katrina Mardi Gras could the withholding of federal aid be considered good news and the prospect of living in an abandoned neighborhood victory.

In late February, about a hundred homeowners from the Lower Ninth Ward met in a church building, many of them wearing red T-shirts that said "I'm from Dat Nine and You Ain't Takin' Mine!" Along the walls, boxes of diapers, sanitary napkins, hand sanitizer, and plastic cutlery stood open for the taking. Ceiling fans barely stirred the stifling air. The crowd was angry; six months after Katrina, the Lower Nine was the only neighborhood without electricity. A man from the Small Business Administration offered loans, and a middle-aged FEMA employee stretched her smile to the breaking point as she explained the intricacies of something called "excess flood coverage." Joe Ringo, a sturdy man in his fifties with a big fuzzy beard, stood in overalls and rubber boots, leveling a finger at the FEMA official's face. "I don't know why you're down here talking to us about flood insurance," he said. "This wasn't a flood. A flood is an act of God. This was the government—the government!—doing a bad job of building levees and destroying our homes." The crowd murmured; several people yelled, "That's right!" Ringo swivelled and pointed at the S.B.A. official. "And don't you be talking about no S.B.A. loans," he said. "I don't need no loan. The government's the one needs that loan, because the government's going to pay for my house!" People cheered for this vain hope; though levees built by the Army Corps of Engineers failed, the government has never accepted liability for all the damage that ensued.

The decision to rebuild was now in the hands of residents, who, for the time being, wanted only to put things back the way they were. A few weeks after Nagin told me that he was uncomfortable rebuilding in the neighborhood, he attended a similar homeowners' meeting and announced, "We're going to rebuild all sections of New Orleans, including the Lower Ninth Ward!"

The last hope for a planned recovery ended a little more than a month later, on April 12th, when FEMA released its long-awaited floodplain guidelines. Instead of ruling out redevelopment in low-lying areas, the agency had essentially left floodplain elevations unchanged. The only new rule was that some builders would have to raise new houses three feet off the ground. Sean Reilly, of the state planning authority—who had hoped that the FEMA guidelines would make rebuilding decisions a matter of safety rather than of racial politics—was incredulous. The three-feet requirement seemed both arbitrary and pointless in an area where water had run over rooftops. He told me that the agency had "simply abdicated" its responsibility. "They took away our moral authority to tell people what to do," he said. "We staked our authority to move people to higher ground on the maps." Instead, authority had devolved to homeowners. The latest plan from Blanco's commission was to give homeowners the pre-Katrina value of their homes—up to a hundred and fifty thousand dollars—minus any insurance settlements or FEMA assistance they'd already received. The pre-Katrina value of many New Orleans homes, particularly in the Lower Ninth Ward, was far less than a hundred and fifty thousand dollars—too little to buy a house elsewhere in the city. So, instead of encouraging people to move to higher ground, Blanco's commission ended up doing the opposite: encouraging people, especially those in the lowest-lying and poorest neighborhoods, to stay put and fix up their houses. The state expects to start handing out checks this month. "There isn't much to be done now," Reilly said, morosely.

The mayoral primary election, on April 22nd, whittled the vast field of candidates down to two, Nagin and the state's mild-mannered lieutenant governor, Mitch Landrieu, but the contest gained little substance. Landrieu, whose family—his father, Moon, was the city's last white mayor, and his sister, Mary, is a United States senator—has long been notable for its efforts to reach across the color line, banked on a clash of styles: a staid hard worker against a charismatic loose cannon. As Ron Forman, who came in third, put it when he endorsed Landrieu, "It's not the plan now; it's the man." On Election Night, May 20th, the man, of course, turned out to be Nagin, by fifty-two percentage points to forty-eight. The blacker and more flooded a precinct was, the more likely its majority had voted for Nagin. But the results showed a lot of crossover, too. New Orleans is full of conservatives who would never vote for a Landrieu, and of blacks furious that Nagin left them sitting on their roofs, or sweltering in the Superdome.

At his victory celebration at the Marriott, Nagin breezed up to the microphone and lavished thanks upon President Bush for what will, if it ever arrives, amount to between ten and twenty per cent of what the city originally believed would be coming. "You and I have been the most vilified politicians in this country," he said to Bush, directing his comments over the heads of his cheering supporters and toward the TV cameras. "But I want to thank you for moving that promise you made in Jackson Square forward."

The morning after the election, before a small group of reporters in the community room of a Treme church, Nagin did not address the question of whether some parts of the city might have to be abandoned. "People are starting to say, 'Well, maybe there are parts of town that can't come back,' " he said. But he wasn't going to force it. Invoking eminent domain would be political suicide. Withholding services would be certain to prompt civil-rights lawsuits. "We're not going to choke people out of city services," Nagin said. "Everything that's getting city services now will continue to get them." He didn't specify how the devastated city would extend schools, garbage pickup, buses, and other services to homes widely dispersed amid acres of wreckage. Three new committees, which included a couple of Republicans who had run against him, would take up those details. This was a day to celebrate, he said; President Bush had just called and was "pretty excited" about the election results. "I think the opportunity has presented itself for me to kind of go down in history as the mayor that guided the city of New Orleans through an incredible rebuild cycle, and really eliminated a lot of the pre-Katrina problems that we had with blight, with crime, with the public-school system."

That evening, I drove east from the French Quarter, downriver, along St. Claude Avenue and into the Ninth Ward. St. Claude was busy, but when I turned north onto Alvar Street, into the area that flooded, I found myself in a ghost town. As I crossed the Claiborne Avenue Bridge into the Lower Nine. I could see, from the peak of the bridge, the freshly repaired breach in the Industrial Canal. The Army Corps of Engineers had mounded the levee there higher than before, and built along its top a white concrete floodwall that from above looked as thin as paper. Three recent studies of New Orleans's flood-protection system make grim reading. A University of California at Berkeley study found that the Army Corps of Engineers—pressed by the contrary demands of "better, faster, and cheaper"—had over the years done such a bad job of building and managing New Orleans's levees and floodwalls that, even with post-Katrina repairs, the city remained in as much peril as before. The corps itself, in a report of more than six thousand pages, acknowledged that it had built a hurricane-protection system "in name only," and that it had done almost everything wrong, from assessing risk to choosing technologies. An article in the journal *Nature* found that the city and its levees are sinking into the Mississippi Delta mud much faster than anyone thought. In some places, the authors wrote, New Orleans is sinking by an inch a year, and some parts of the levee system are now three feet lower than their builders intended. In the following months, there was more bad news. Street violence grew so alarming—five teen-agers were shot dead in a single incident one night—that Mayor Nagin had to call in the National Guard to help patrol the streets. As much as two billion dollars in federal disaster relief was discovered to have been wasted or stolen, and last week a survey found that little more than a third of the pre-Katrina population had returned. The fate of the Lower Ninth Ward and the rest of the city remains anyone's guess. New Orleanians tend to talk about the prospects of another devastating flood in the fatalistic way that people in the fifties talked about nuclear war. They know that they are living under the ever-present threat of annihilation. They want the people in power to do all they can to prevent it. But, in the meantime, there's nothing to do but soldier on. A few days ago, Ronald Lewis left a cheerful message on my answering machine: "Dan, we have rededicated the House of Dance and Feathers!"

On my last night in New Orleans, I crisscrossed eastward, away from the breach. Most of the wrecked houses that had blocked the street had been removed; on only a few blocks did I have to back up to detour around a bungalow listing across the pavement. Debris crunched under my tires. Street lights were on, but no lights shone from windows. Doors stood open to dark interiors. On Lizardi Street, a half dozen young black men sat in the gloom on the front steps of a ruined house. They wore brilliant-white T-shirts as big as muumuus and heavy jewelry that sparkled in the dim light. Two doors down, on an unlit porch, a seventy-three-year-old homeowner named Ernest Penns sat slumped in an old kitchen chair. He wore glasses and had a full head of spiky gray hair, and the gold in his crooked brown teeth looked as if it had been applied with a garden trowel. He said that he didn't need anything, and patted a heavy leather-bound Bible in his lap. "I got everything I need right here." He led me inside. The single-story bungalow was lit by a battery-powered camping lantern. It smelled heavily of mildew and chlorine. "I washed the walls down with bleach," he said, gesturing at the panelling.

I asked if he worried about the mold that was blooming inside the walls.
"This is not the worst thing that's ever happened to me," he said. He pulled up his T-shirt to reveal a boiling purple scar. "In 1972, I was stabbed with a screwdriver. Drove myself to the hospital." The incident had made him stop drinking and become a Christian, he said. Twelve years later, he had saved enough to buy this house, for thirty-six thousand dollars. Now, with many more years of payments on it, he was getting by on Social Security. He had water service but no electricity or gas, so he drove across the Industrial Canal a couple of times a day to get something to eat at a Wendy's or a Subway.

We walked back onto the porch, and he kicked aside a can of TAT Roach & Ant Killer so that I could sit down. The street light on the corner flickered. A gold Lexus with complicated free-moving hubcaps, its subwoofers booming like a giant heart, screeched to a halt at the house two doors up. Penns and I listened to the young men laughing and shouting to each other. "They're plying their trade," he said. "They're not what we need around here, but they're part of this community, and it's something we can't control." A police car rolled by once in a while, he said. I asked him how often. "About every five days." I felt my way down the steps and said goodbye. Penns raised a hand and waved, barely visible in the gloom. ♦

appendix vi

interview by charlotte garson with dr. elizabeth english

E. ENGLISH INTERVIEW IN BREAUX BRIDGE, AUGUST 2008 (TRANSCRIBED FROM CD)

I [Charlotte Garson, French public radio reporter] (French introduction)

E [Elizabeth English] I didn't understand all of that, most of it.

I Yeah, so you originated this project that could potentially change/revolutionize the whole way the 'habitat' is being built?

E I think that this is the right solution for New Orleans in combination with some other revolutionary ways of planning. My project, I call it the Buoyant Foundation Project, it's for retrofitting existing wooden houses, the old wooden houses, pre-world war two, with amphibious foundations that work like a floating dock, except that they sit on the ground like a normal house most of the time and they only float when there's a flood. But if these were used in combination with a cascading levee system, it would be revolutionary for NO and would be a very, very safe solution for the redevelopment of NO and make it much more comfortable in terms of safety and confidence of survival for the displaced residents that I hope will return to NO.

I How did you get the idea for this project, and maybe does it come from the Netherlands?

E The idea definitely comes from the Netherlands. I heard that they were doing amphibious housing in the Netherlands and two of my students and I were invited to the Netherlands in the summer of 2007. We spent a month there, which is where I learned about cascading levee systems, which are being developed by a German professor by the name of Erik Pasche in Hamburg.

I Can you explain what that is?

E What it is, it's saying that rather than having one big huge levee, which is only as strong as its weakest part, you have a series of levees. So, we could leave the existing levees in NO, not make them any bigger, just get them all to the point where they are really category 3 resistant. Then behind the levees have other smaller levees, for example there could be a secondary levee, behind the primary levee along Lake Ponchartrain, that went around City Park in NO so that if it went to the south of City Park - if the new secondary levee was parallel to the primary levee but included an area that wouldn't be disastrous, absolutely disastrous if it flooded, then you can let the primary levee overtop and the park would fill up with water but the land behind the secondary levee wouldn't fill until that very large reservoir was full. And when that reservoir filled up, then that levee could overtop and there could be a tertiary levee system. It would be so easy to make cascading levees of this sort in NO because we already have the boulevards with what in NO is called the 'neutral ground', which is the strip of grass between the streets going in opposite directions on either side, a boulevard. But the neutral ground is always raised, it's always mounded and in fact there is a great tradition in NO of whenever there is a relatively small flood, people drive their cars up onto the neutral ground so that the cars are safe and don't get flooded in the streets. Well, the neutral grounds, by putting a mound where the streets are as well as where the grass is, could be turned into a secondary or tertiary levee system. There are people who talk about using the old railroad tracks as part of a multiple layer levee system. So if you had a set of cascading levees, you could put houses that are appropriate for that environment in those places. So you wouldn't have to put every house in NO onto buoyant foundations, you could put the houses between the primary and secondary levees on buoyant foundations. If that area flooded, those houses would float, so it wouldn't be so bad.

I (French) So, the first question, I guess I reversed it, maybe I should ask it again… (French)

E I think I understood. The pre-world war 2 houses are built like wooden shoe boxes sitting on piers so that they're off the ground. After ww2 they constructed what we call 'slab on grade' houses where they just level the land and pour the slab on the level land and build the house up from that. Well that's fine where you don't have any floods. You can put a house like that in a location like NO because the ground never freezes here. Obviously in other parts of the country you have to have real foundations that go down below the frost line so that you don't have problems with the foundations in the winter, but that's not an issue here. Slab on grade works, as long as the levee works. But slab on grade is a really bad type of housing for an area that floods, because it's right smack on the ground. Traditional houses in Louisiana have always been built a few feet off the ground on piers, originally on stone piers, then brick, now masonry block, just something that lifts the house 2, or 3 or 4 feet off the ground. This house here is elevated on masonry piers. And so the concept is that with an existing house that's already elevated off the ground, if you elevate it just maybe a few more inches, maybe not at all, to 3 ft, then you can put buoyancy blocks underneath the house that will allow the house to float. These are basically expanded polystyrene, EPS blocks, that you can put underneath the house and they just sit there. The house hardly looks any different at all from what it looked like originally but if a flood comes the house will float. There have to be what I call, 'vertical guidance posts', which are posts that keep the house from going anywhere except straight up and down. In order to attach the styrofoam blocks safely to the bottom of the house you have to put a metal frame underneath the house, but that can be made of lightweight pieces of steel angle, angle iron, and bolted to the house and bolted together so that it can, for someone who is handy, be a do-it-yourself project to put the steel frame and the buoyancy blocks underneath the house. And then, in four places near the corners of the house, the steel frame extends beyond the perimeter of the house and attaches to the vertical guidance posts. My first idea for trying to develop amphibious houses for NO or an 'amphibious solution' is to make the existing houses safer without having to raise them many feet off the ground. The original idea came from the Netherlands. But when I started working with students at LSU, I learned that right under our noses, almost in our own backyards, there are people who have been making amphibious foundations for their vacation homes in a place called Raccourci Old River, in Point Coupee Parish in Louisiana. Old River is a vestigial piece of the Mississippi River. It used to be part of the Mississippi River but now it's a horseshoe shaped lake that attaches to the Mississippi at one end. So, when the Mississippi rises and falls with the spring floods, the water level at Old River goes up and down. Well, people were tired of having to mop out their little cabins every time they came back in the spring or in the summer to go fishing, and it was very expensive and inconvenient and ugly to put the houses 25 ft up in the air in order to keep them above the flood water. So, about 30 yrs ago a very enterprising fellow figured it out. He put a metal frame and EPS blocks under his house and he put four posts that looked like telephone poles near the corners, and from the steel frame there were loops that went around the posts, and when the flooding came every year the buoyancy blocks would lift up his little house and the metal loops would slide up and down on the poles, and the house would go straight up and come straight back down. This little house is still there, it has been operating reliably for 30 years now, and many of the neighbors have followed suit so there are dozens of these there now, but very few people know about them. I had been working on this project for 6 or 8 months already and never heard of them and they were only 40 miles away from where I was working. But one of my students had built one of these with his family for their summer place and so he showed me photographs. That's basically the prototype for our design, except that for aesthetic reasons and also for stability reasons and resisting the wind, which they're not so concerned about at Old River, what we find works better is to have the poles telescope out of the ground, kind of like a car antenna. So the metal tabs that extend from underneath the house attach to the tops of the posts and when the EPS blocks lift the house, the tabs pull the posts up out of the sleeves, out of the ground, but the poles are very rigid and they don't let the house go anywhere except straight up and straight down. Then people always ask about the utilities, well in Old River they did it a very simple way. They watched what the Mississippi River was doing and if the Mississippi River was going to flood then they went and disconnected the utilities so that the house could go up and down. But obviously we need to have a system where the house takes care of itself completely passively so that you can be on vacation in France and your house will take care of itself. So, we would put the water supply and the electricity on umbilical connections, which is basically a very long coiled cord, like an umbilical cord, and gas and sewer would be on self-sealing breakaway connections. The technology for these devices is already very, very well developed so we don't have to invent those ourselves. They are already available and can be installed on these houses as well.

I (French)

E Entirely after Katrina. I started on this project in January or February of 2006 so it's been about 2 and half years. The reason I got involved, the reason I got interested in doing this, is that I'm very, very concerned about the authentic culture in New Orleans.

NO is famous for its food and its music, but the food and music that you consume in the French quarter were not generated in the French quarter, they come from the neighborhoods like the Lower Ninth Ward, or Mid City or New Orleans East. These are neighborhoods that are largely lower income; largely black and that have evolved a unique culture in those neighborhoods. Part of it, I believe, is related to the nature of the New Orleans shotgun house. Now the shotgun house developed for a number of reasons. The plots of land are long and skinny because what was critical in NO originally was access to the river, and then as streets were made, leading to the river, access to those streets. So, you would have a very narrow strip along the street or the river but your property would extend way, way back. So, when the city was laid out and property was developed, that was the pattern that it took. So the houses that were built on these narrows strips of land tended to be long and skinny. Also when you have a house where the rooms are 'en filade', one room is straight after the other with no corridors and just a door leading from one room into the next room, you get very good cross ventilation, so you can open the windows and get cross ventilation and in a climate like South Louisiana, that's very, very important, prior to A/C. Everything changed after ww2 when they started putting in air-conditioning and modern building materials and thinking that humans could control nature, and that's a big mistake.

I (French)

E I have more to say about the nature of the shotgun house. I think this is an important part of the story. The other reason that the houses were made long and skinny with just a very small façade on the street is because taxes were levied according to the square footage of the front façade of the house. So by having a very small area where their front door is, and the house extending way back, your taxes would be a lot less. That's also why the camel back shotgun house developed in NO. A camel back shotgun is a house that is one story for the first two rooms of the house and then for the back two or three rooms of the house, it's two storeys. You get two storeys in the back but you're only taxed on the one storey façade in the front. So that's a camel back shotgun. One of the fundamentally important aspects about NO and the shotgun houses and the culture that developed in these neighborhoods is that in a shotgun house there's no privacy. Every room is connected to one another, no corridors, you have to go through one room to get to the next. So you have to go through someone else's bedroom to get to your bedroom perhaps, so there's no secrets in a house like that and everybody knows everybody else's business. Also in these neighborhoods with long skinny plots of land where it's hot and the windows are open for ventilation and your next door neighbors also have their windows open, and your window might be only 3-4 ft away from your next door neighbor's window, it means that your neighbors know what's going on too, so everybody knows everybody's business. And what happens, what developed in these neighborhoods was a very, very, very strong sense of community. The neighbors on the block became like a little village, raised each other's children, and went to each other's house for food all the time. I hear about the kids growing up, and whosever house they were, wherever they were at dinnertime, that's where they ate dinner, because it was all like one big family. When these neighborhoods were first settled, the people who built the houses usually gave the houses to their children and then if they had more than one child who wanted to live nearby, then they would buy a house that became available on the block. There would be whole families that lived very close to one another. So, there is a very, very strong sense of community that developed that I think is related to the form of the shotgun house, and that that's why the vernacular architecture and the culture that evolved there is unique. The products of that culture, the music, the food, the art, the way of living, are unlike any place else in the world, truly unlike any place else in the world. What happened with Katrina is that these people were displaced, sent all over the country, it's a diaspora! Scattered all over, they no longer have the support system, they no longer have their community, and the culture is fragmented as well. So without community it's very, very difficult to keep the traditions and the way of life continuing. For many of the families, because they lived in a house that was built by their grandparents or their great-grandparents, their whole family history is in this place as well. So, this is what were dealing with, we're thinking, how can NO recover and be authentic. Not be the Disney World version of NO, living in Katrina cottages. They need their homes; they need their real shotgun houses elevated on piers, made of cypress. Cypress is a particular native growth wood that is not available anymore. The wood is mold resistant, rot resistant, and termite resistant, it's perfect for Louisiana and the houses were made so that they could get wet and the water would drain out. The walls were plaster, plaster doesn’t mold so they were basically drip-dry houses. But they didn’t flood that much because they were elevated above the ground. So this is what’s appropriate for Louisiana, and to me, personally, having lived in NO for four years and having experienced NO’s uniqueness and how it is completely different from any other city in the United States, it's really much more of a Mediterranean, or Caribbean or European or French-seeming city compared to the rest of Anglo-protestant North America. NO is catholic and Louisiana has French law, it's different than the rest of the United States, and you can feel that here, if you take the time to slow down enough to experience it. And it devastates me to think of all that being lost. So here I am, an architect, engineer, wind-engineer, hurricane-engineer, working at LSU, and Katrina and Rita happen. What can I do? If there’s anything I can do to take my skills to help the culture recover, then how can I do that? Well, because, trained as an architect, I see a very strong relation between the housing form and the culture there, that led me to think of what can I do to save the shotgun houses, if we could save the shotgun houses then people will come back to their houses. There is an incredibly strong homing instinct in Louisiana, they go other places in the world and realize there is no place like home, there is no place else in the world like Louisiana, and it’s not perfect, it has its problems, but it’s a really special place. They go make much of their adult lives in other places and come back if they can or come back sooner than that. I know many people who left Louisiana for a few years or even more than a few years and found a way to come back. So I think if people have their houses and they think that their houses are safe to live in, then they will come back. So how can we take these houses and save the existing old pre-ww2 shotgun houses that are made the way houses in Louisiana ought to be made, and make them safe, so that they are really safe? Because FEMA says elevate your house to the BFE, the base flood elevation or elevate it higher, but the BFE is only 3 ft in a lot of places. In a lot of places that flooded to 12 or 15 ft, the BFE is 3 ft. You know if you elevate your house to 3 ft, that will satisfy the law but if won't keep you safe. So you put your house up on stilts and now your house is 8 ft in the air, and you have to go up and down all those stairs, your grandmother is in a wheelchair, how are you going to get your grandmother up and down all those stairs, you go up and down those stairs all day, everyday, for years and years in order to protect your house from a flood that may or may or not come, and then when it comes, the flood, let's say it's 14 ft, and your house is ruined anyway. So, that strategy, what I call permanent static elevation, is a fundamentally flawed strategy. It's so inconvenient, it doesn't accommodate disabled people and you live in an inconvenient way for a great amount of time in order to try to be safe from a short duration event that happens very infrequently. That doesn't seem like a good solution to me. Not only that, but permanent static elevation destroys the neighborhoods because it elevates the houses off the street and there's no longer that close relationship between the front porch and the street, where everybody in these neighborhoods sits on the front porch and talks to their neighbors as they go by on the street. Without that front porch, that sense of community in the house is lost. And then there's the aesthetic aspect of it as well. I mean, some of the houses are up 3 ft, some of the houses are up 6 ft, some of the houses are up 10 ft, it's like you know, the teeth in a jack-o-lantern, and who wants to see a neighborhood like that, much less live in one? So, what if we can come up with a solution that preserves the original character of the neighborhood, keeps the houses close to the street, so that the neighbors continue to have that relationship to the street that fosters community and for historic preservation reasons keeps it looking the same? And keeps it safer, because the solution I'm proposing is one that accommodates whatever level of water you find, you just have to make sure the poles are long enough. You can tailor the poles to your neighborhood, there are very good predictive methods for looking at what the maximum likely storm surge would be for a category 5 depending on your location, depending on where you're living. You can put in the length of poles that are necessary to accommodate that environment. So the buoyant foundation is a solution that preserves the neighborhood's character, it is convenient, you don't have to go up and down all those stairs, and it provides a much, much better level of safety because it goes up as much as you need, not just as much as you were able to afford at the time you elevated your house. The other thing is that it works with the water, it's not fighting the water. It takes things like global warming, and subsidence of the soil, the gradual lowering of the soil, sinking of the soil, it takes those environmental aspects in stride, because it just means that it has to elevate itself a little bit higher. We should know by now, if there's going to be fight between human kind and the forces of nature, eventually the forces of nature are going to win, particularly a force of nature as strong as moving water. So, work with the water; work with Mother Nature instead of trying to fight it or trying to beat it.

I (French)

E That's pretty much the whole story, the other thing is that this is actually a lot cheaper than permanent static elevation, the only real disadvantage is that it hasn't been done before and that FEMA doesn't allow it. So, there's a problem with regulations and national flood insurance and that sort of thing, having to do with FEMA not being willing to approve of anything that moves.

I (French)

E There are some parts of NO that had very little damage and are in good shape and recovering well and all of that. There are other parts of NO that suffered from the levee breaches after Hurricane Katrina, but the inhabitants of those neighborhoods have had the resources to bring back the neighborhoods relatively expediently. But then there are other neighborhoods in NO that suffered greatly, where the inhabitants of those neighborhoods don't have the resources to be able to afford to live somewhere else while they're fixing up their house. And the combination of policies of the city and the utilities and FEMA have been kind of a vicious cycle and worked against the possibility of people coming back. So that's one of the neighborhoods that I've been looking at in the Lower 9th Ward. I'm specifically focused on the area between North Claiborne Avenue and St. Claude Avenue in the L9W because it's a sort of in-between neighborhood, between the neighborhood north of North Claiborne where Brad Pitt's Make It Right is working, and south of St Claude, the Holy Cross neighborhood that the preservationists are looking after. It's an in-between neighborhood where people think the houses were destroyed but most of them were not and are recoverable. I call it the "neglected neighborhood". So my work on the buoyant foundation is directed at starting there to help that particular neighborhood recover. If it expands beyond that, that would be fabulous. It's a solution that could be used all over the world actually, any place that would have substantial flooding without a great deal of water flowing, so an area that is behind a levee is what this is good for, or a body of water where the water rises gradually, without a wave of water, or water action that would push a house off of its foundations. That’s an incredibly powerful force and this system is not designed to resist that. I’m optimistic that NO will recover, but some parts of NO are having an easier time recovering than others. I’m very, very sad about the difficulty that the residents of this area of the L9W are having in coming back to their homes. If you have another minute I can explain this policy that has had such a negative effect on this neighborhood. What happened is that after Katrina, FEMA said, ok, you can apply for a trailer so you can live in it while you fix up your house. Ok, but we can only put a trailer where there are utility hookups. And Entergy, the energy company, said, there’s no people in the L9W, so we're not going to hook up the energy to the L9W. Well if there are no people there, then there’s no energy; if there’s no energy then there’s no trailers; if there’s no trailers then there are no people because these people had no other options, they couldn’t afford to be there except in a trailer. So it was months and months before Entergy even put the power back on in this neighborhood. It was a catch 22, people couldn’t come back no matter how much they wanted to, unless they tried to live illegally in the house while they were fixing it up and that had to be miserable. There were people who were doing that. It was such a long time before it was possible for the residents of this neighborhood between North Claiborne and St Claude, before they could even get trailers, that many of the people were so discouraged, and in the meantime their houses had deteriorated further because there was no air-conditioning and they couldn’t get in there to clean them out. They couldn’t even get in there to go clean them out. They weren’t even allowed to go see their houses for months, they were prohibited from entering that part of the city! I was able to get in because I was a researcher with the LSU Hurricane Center, so I could get a pass to go in. It’s appalling to me, that I could go in and see these houses, and the people who owned them, whose possessions were there, weren’t even allowed to go into the neighborhoods and retrieve their possessions, even see their houses, even know how much damage was there, know if their pets were alive!

I That really helps us understand.

E I'm actually working on a particular block. The city of NO does what it calls a tax sale. Which is that it takes houses where people haven't been able to pay their taxes and offers them up for auction, where the price of these houses is the amount of back taxes that are owed. They didn't really publicize this. I found out that there was going to be a tax sale last November. I found out the night before because a friend of mine in Opelousas saw a public notice in the Opelousas paper that there was going to be a tax sale on the internet, an internet tax sale, the next morning. She told me this around 8pm on Sunday night. What I saw happening, which is I think what's happened to most of these properties, is developers pay the back taxes, then you have to wait for 3 years to allow the owners of these house the opportunity to pay you back, to redeem their house and regain title. In the mean time the person who paid the taxes is responsible for upkeep and all of this. Well, if you don't really want the house to survive, if you would rather have the people go away and not come back, so that you get a plot of land that is someday going to be worth quite a lot for cheap, well then you just let the house fall down. So you pay the taxes and you let the house fall down and then the people have no place to come back to so they're not going to redeem it. So then you get a nice cheap plot of land if you are willing to wait for 3 years. So I ended up staying up all night and getting google earth maps and locating shotgun houses, through the combination of the research that I had done in the area, because I had done quite a bit of fieldwork there, looking at the damage to the houses. So with the combination of fieldwork that I had done and looking at google maps, I picked out a few shotgun houses that looked like they might be in reasonable shape and decided that I was going to try to save them. Well I was going to do that for one house, then two houses, and I ended up doing it for 5 houses. Two of the owners have come back and already bought the houses back, which is great. The other 3 owners I haven't been able to locate, but all three of the houses are on the same block. Now the city is trying to tear those houses down. I've blocked the demolition of one of them already, and I'm in the process of blocking the demolition of the two others. If these three houses were torn down that would have a huge impact on that block. But I'm able to keep those houses there. I went myself and cleaned out the yards. I found a youth group that went in and took out all the trash that had been there for almost 3 years, all the dead furniture and the overturned refrigerators and inches of muck that had all been there for three years. One of the houses is a camel back, and the kids found two dog skeletons. If three years later they're still discovering things --- but those were dogs who could get upstairs, they didn't drown but their owners weren't allowed to come back and nobody found them and they perished. So what I'm hoping is that we can find the owners, or relatives of the owners and they'll come back and help revive this block. I would say about a third of the residents are back on the block but that leaves an awful lot of empty houses and a few houses have been torn down. One of these houses might be appropriate for the installation of a buoyant foundation, but I need to raise some money before I can do that. With the lack of cooperation from FEMA in terms of regulations and the fact that I don't have any powerful backers, I'm waiting for someone to give me $150,000 so I can do the prototype of the buoyant foundation on this little house in the L9W and demonstrate to the world that it works. My students at LSU did a mock up of part of a shotgun house and we tested the buoyant foundation on the LSU campus in that way, but we need to put it on a real shotgun house to show everyone that it will work and that it's the right solution.

I I hope you will update me on that. So when it airs we actually have progress.

E Ok, well let me know. Here I've told you the whole story.

appendix vii

the BFP powerpoint presentation

Building Flood Resilience with Amphibious Architecture

ChaRisMa:

1st Waterloo Conference on the Characteristics, Risk and Management of Natural Hazards

2 December 2010

buoyant foundation project

FLOAT WHEN IT FLOODS

Elizabeth C. English, PhD
Associate Professor
University of Waterloo
Ontario, Canada

WATERLOO ARCHITECTURE

UNIVERSITY OF WATERLOO - SCHOOL OF ARCHITECTURE

What is amphibious architecture?

- Amphibious architecture refers to buildings that sit on dry land like ordinary buildings, except when there is a flood, in which case they are capable of rising and floating on the surface until the floodwater recedes. This is a strategy that has already been applied successfully in the Netherlands and in back-woods Louisiana.

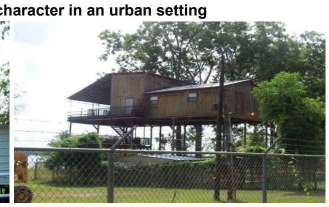
- My students and I are exploring amphibious housing as a superior flood mitigation strategy for New Orleans (The Buoyant Foundation Project; the Rising House; TILT House) and Bangladesh (The LIFT House). These are all deltaic regions where occasional flooding is anticipated to worsen with the rise in sea level that is expected to accompany global climate change.

- There is increasing awareness that traditional flood-mitigation strategies that alter the environment and create concentrations of risk, such as levee- and dike-building, only increase the probability of catastrophic consequences to failure in the long run. Amphibious architecture is a strategy that can reduce the hazard vulnerability of flood-prone regions and increase their long-term disaster resilience.

New Orleans after Hurricane Katrina

Problems with Elevated Homes

- Difficult access – especially for the elderly & disabled
- Expensive
- Insufficient protection in extreme flooding
- Greater risk of wind damage in a hurricane
- Creates gap-toothed effect in a neighborhood
- Homes lose close relationship to the street
- Loss of neighborhood character in an urban setting



Elevated homes at Raccourci Old River, Pointe Coupee Parish, LA photos by D. D. Ewing

New Orleans: There must be a better way!

New amphibious homes in the Netherlands

Maasbommel, Netherlands photo by Hans van Beek

The first development of amphibious housing in the Netherlands was in Maasbommel, along the Maas River, designed and built by Factor Architecten and Dura Vermeer.

BUOYANT FOUNDATIONS
Create homes that float in a flood

Mission

The mission of the BFP, founded in 2006, is to support the recovery of New Orleans' unique and endangered traditional cultures by providing a strategy for the safe and sustainable restoration of traditional housing.

Flood-proofing the city's traditional elevated wooden shotgun houses by retrofitting them with buoyant (amphibious) foundations avoids the destruction of neighborhood character that results from permanent static elevation high off the ground.

Buoyant Foundations provide increased safety and resilience in cases of extreme flooding and support the restoration of both the physical and the social structures of pre-Katrina New Orleans neighborhoods.

In rural Louisiana --

Amphibious homes at Raccourci Old River, Pointe Coupee Parish, LA   photos by D. D. Ewing

When the Mississippi River rises in the spring, it floods Old River -- this happens almost every year, sometimes more than once.

Dry in September   Floating in February

For over 30 years, amphibious houses at Raccourci Old River have been rising and falling reliably with the level of flooding of the Mississippi River.

Dry in September ... the same house ... Floating in February

Average cost of buoyancy system is around $5,000.

Dry in September ... the same house ... Floating in February

Amphibious foundations are not new!

Dry in September ... the same house ... Floating in February

So why fight floodwater when you can float on it?

BUOYANT FOUNDATIONS
Create homes that float in a flood

Advantages

- House normally remains close to the ground
- Elevates house to exactly what is required to stay above water, even if high above BFE
- Less susceptible to hurricane wind damage
- Alleviates problems of soil subsidence and elevated sea level due to global warming
- Looks essentially the same as before Katrina
- Original traditional architecture is preserved
- Neighborhood retains original character

How a Buoyant Foundation works

It basically works like a floating dock. A structural frame that holds the flotation blocks is attached to the underside of the house. There are four "vertical guidance" posts not far from the corners of the house. The tops of the posts are attached to the structural frame. The posts telescope out of the ground, allowing the house to move up and down. Utility lines have either self-sealing "breakaway" connections or long, coiled "umbilical" lines. When flooding occurs, the flotation blocks lift the house, with the structural frame transferring the forces between the house and the blocks. The vertical guidance posts keep the house from going anywhere except straight up and down on top of the water.

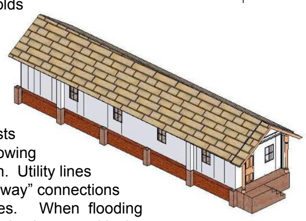


Figure Created by Ben Morvant

How it works

Section drawing of a shotgun house with a buoyant foundation installed, showing buoyancy blocks under the house and vertical guidance posts that telescope out of the ground

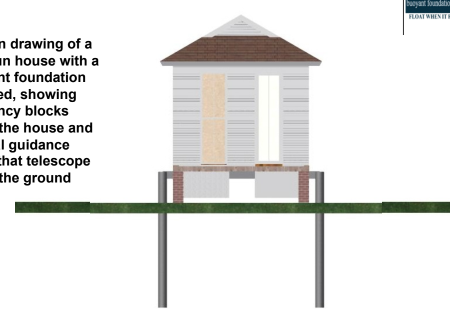
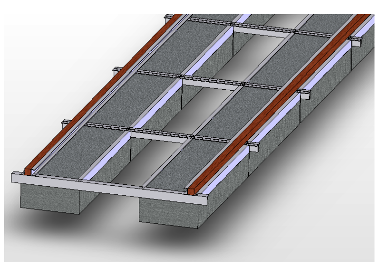


Figure Created by Stuart Broussard

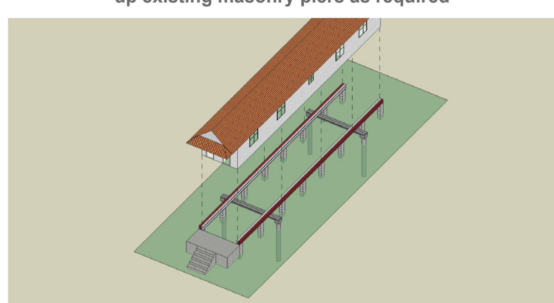
How it works

A steel frame attaches to the underside of the house and holds the buoyancy blocks off the ground. The house remains sitting on its original masonry piers after the buoyant foundation has been installed.



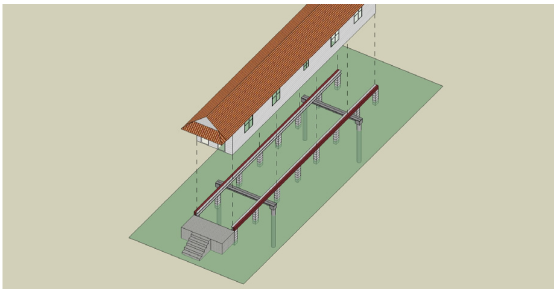
Construction Process:

1. Jack up house to BFE (3 feet) and build up existing masonry piers as required



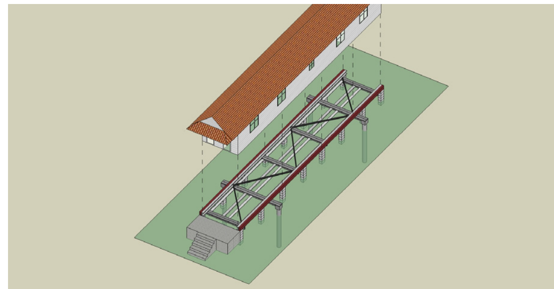
Construction Process:

2. Put in vertical guidance posts and attach channels to inside surfaces of sill beams



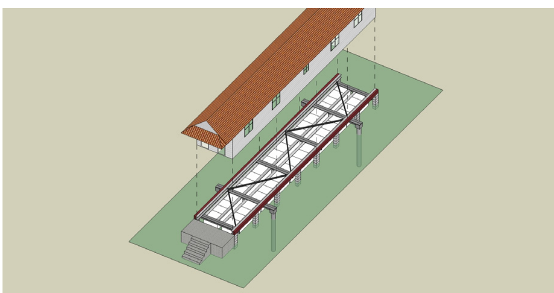
Construction Process:

3. Add T-beams and secondary angles to support buoyancy blocks



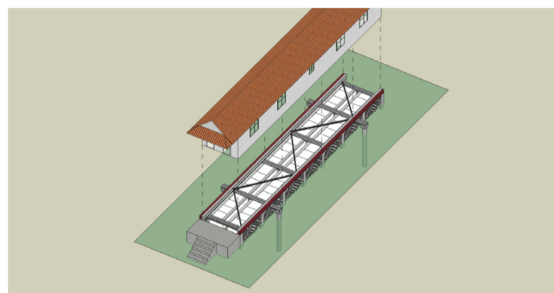
Construction Process:

4. Add foam buoyancy blocks



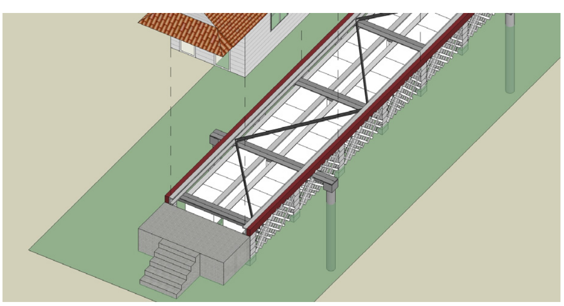
Construction Process:

5. Add protective screen to keep waterborne debris from settling underneath the house



Construction Process:

Detailed view



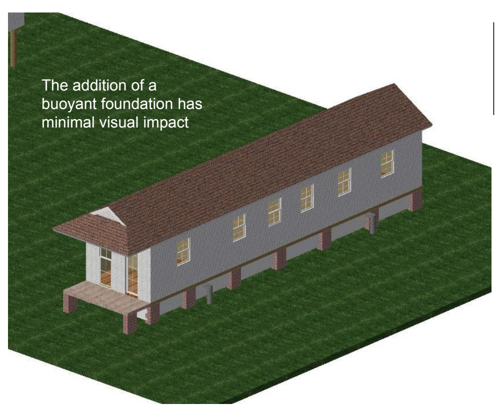
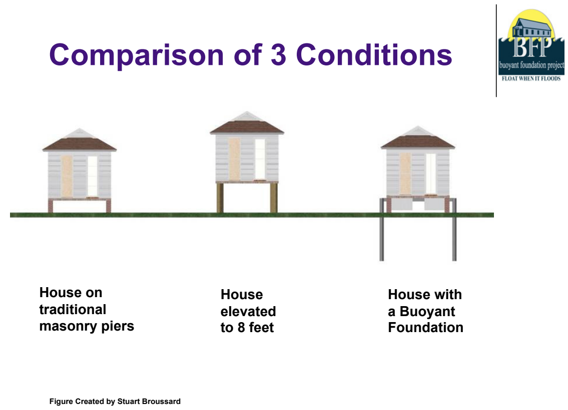
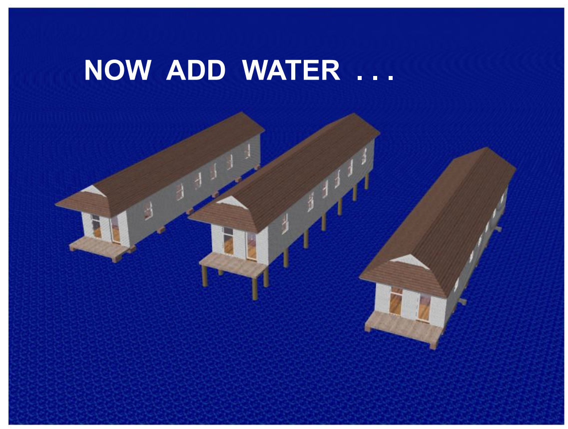


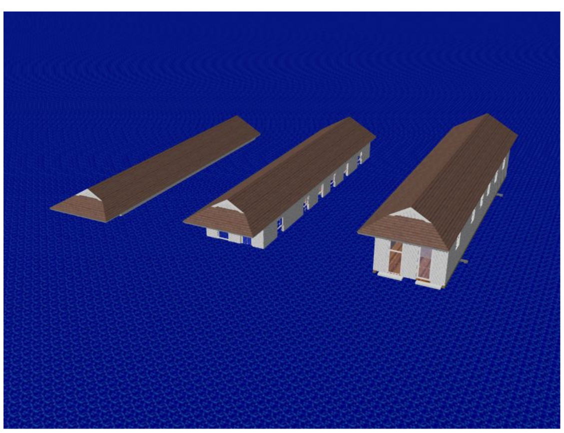
Figure Created by Stuart Broussard

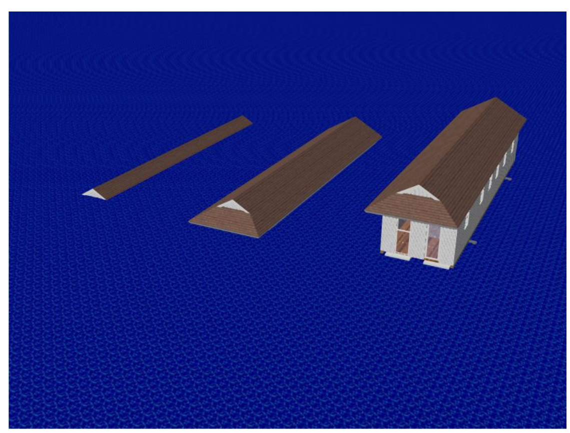

The addition of a
buoyant foundation has
minimal visual impact
Even less if you
add bushes!
Figure Created by Stuart Broussard

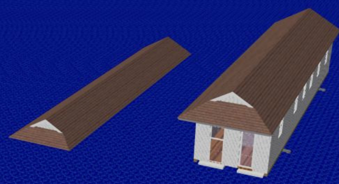

Comparison of 3 Conditions
House on
traditional
masonry piers
House
elevated
to 8 feet
House with
a Buoyant
Foundation
Figure Created by Stuart Broussard


NOW ADD WATER . . .
Existing
Shotgun
House
Shotgun House
Elevated to 6 ft
Shotgun House on a
Buoyant Foundation
Figure Created by Stuart Broussard


NOW ADD WATER . . .







WHICH WOULD YOU CHOOSE?

SPRING - SUMMER 2007

Five LSU Mechanical Engineering students built a platform with a buoyant foundation to test the design for flotation and stability:

Scott Schroth	Matt Guidry
Dustin Husser	Ben Morvant
Dustin Ewing	

Students from the LSU Hurricane Center added a house frame and built the flood tank to run the tests:

Stuart Broussard
Ezra Boyd

Construction of prototype: Setting the piers

Adding the platform

Setting the vertical guidance posts

(Note post design has since been changed to telescoping posts)

House frame almost complete

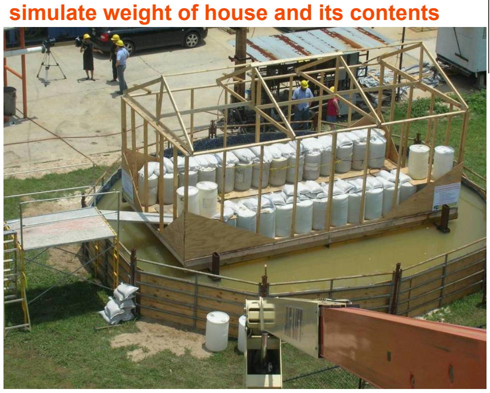
A layer of sand holds down the liner

Now add water . . .

LIFT-OFF!

Buoyant foundation at rest on the water

Water barrels and sandbags are added to simulate weight of house and its contents



Moving the sandbags to tilt the house

Testing complete!

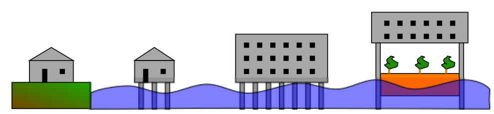
Buoyant Foundations Save Shotgun Houses

Future Considerations: Using Sustainable Materials

The use of recapped, recycled empty water bottles in place of EPS (styrofoam) flotation blocks:
Bundles of air-filled, sealed plastic bottles can provide both buoyancy and redundancy.

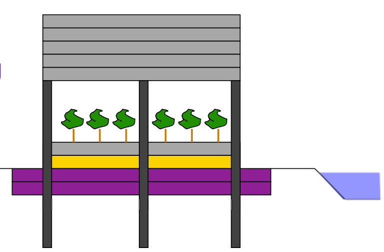
Stuart Broussard & Scott Schroth
Project for
UNESCO Urban Flood Mitigation Workshop
Delft, Netherlands, July 2007

Hybrid Flood Resilient Building



Concept

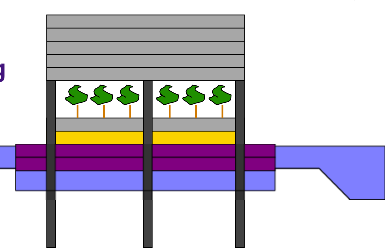
- Housing
- Shops
- Parking
- Water



Only the 2 lowest levels will float,
<u>not the whole structure</u>

Concept

- Housing
- Shops
- Parking
- Water



Parking garage provides buoyancy when flooding occurs

New Community Core Facility

- Can house critical facilities in coastal communities
- Hurricane shelter for local community
- Police and emergency services
- Hospital / health clinic
- Municipal offices
- Library and elementary school
- Community services
- Shops and offices on ground floor
- After a hurricane, if homes do not survive, core facility provides support for rebuilding community

"Noah's Ark" House in Lakeview, New Orleans Spatz Construction

This house in the Lakeview neighborhood of New Orleans was built by a contractor as a commercial spec house. It was completed in the fall of 2007, but to date it has not been occupied. The house was constructed with a legal building permit, but was denied a Certificate of Occupancy . . . but that may soon change.

"Noah's Ark" House in Lakeview, New Orleans Spatz Construction

To the best of my knowledge, it is the first modern engineered amphibious house constructed in the United States, and second in the world only to the amphibious houses in Maasbommel.

"FLOAT House" Make It Right Foundation, New Orleans

Actor Brad Pitt launched the Make It Right (MIR) Foundation in 2007, promis-ing to give to former residents of the Lower Ninth Ward in New Orleans 150 affordable, sustainable and storm-resistant new homes.

"FLOAT House" Make It Right Foundation, New Orleans

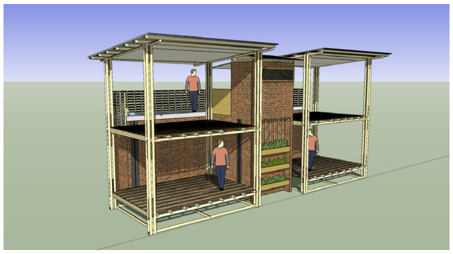
We believe the FLOAT House by Morphosis Architects to be the first fully-engineered amphibious house in the United States to achieve occupancy.

LIFT House, Dhaka, Bangladesh

This prototype of a low-cost, sustainable amphibious house for urban slum-dwellers broke ground in November 2009 in Dhaka, Bangladesh. Initiated and designed by Prithula Prosun, currently a Master of Architecture student at the University of Waterloo School of Architecture, each unit consists of two to eight floatable bamboo dwellings clustered around a shared courtyard.

The stationary brick base structure contains plumbing, utilities and rainwater storage cisterns. Each two-room amphibious bamboo dwelling unit is living and sleeping quarters for a single family.

lift
low income
floodproof
technology



DHAKA: November 2009 – Soils testing before the start of construction

Day 1 – Start of excavation, November 12, 2009

Concrete foundation for the service core

Starting the brick walls for the composting latrines and rainwater storage cisterns

Bamboo for the amphibious housing units

Day 10 – Brick foundation walls are started for water cisterns and composting latrine storage

Buoyancy blocks made of recapped empty plastic bottles

Day 11 – Sample buoyant foundation is tested with live load

Building up the water storage cistern walls

Prithula Prosun supervising construction

Day 15 – Bamboo poles are submerged in chemical for treatment

Day 32 – water cistern top slab and brick walls with concrete beams are finished

Day 33 – Ferrocement frame prepared for one of the buoyant foundations

Day 40 – Empty used water bottles are prepared for second buoyant foundation

Day 46 – Brick work is finished and bamboo frame for one dwelling is started

Day 50 – Pre-fabricated bamboo columns for second dwelling are erected

Day 55 – Bamboo frames are erected for both dwellings

Day 66 – "You will notice in Photo25...the house on the right is higher than the left.. its floating!" (this has the recapped plastic bottle buoyancy blocks)

Day 68 – Photo of bamboo entrance door and brick vertical garden

Day 69 – The lift house from across the pond

lift
low income
floodproof
technology

www.lifthouse.org

BFP
buoyant foundation project
FLOAT WHEN IT FLOODS
www.buoyantfoundation.org

appendix viii

paper for the urban flood management conference in paris

AMPHIBIOUS FOUNDATIONS AND THE BUOYANT FOUNDATION PROJECT: INNOVATIVE STRATEGIES FOR FLOOD-RESILIENT HOUSING

English[1] *E.*

[1] Associate Professor, University of Waterloo School of Architecture, Canada

Abstract

Amphibious foundations are a cost-effective, resident-friendly alternative to permanent static elevation for housing in areas where rising flood waters are not accompanied by high flow speeds. There is growing awareness that homeowners in established neighborhoods are resistant to permanent static elevation, a strategy that disrupts a neighborhood's appearance and causes daily inconvenience, with no assurance of providing sufficient protection in an extreme flood event. Amphibious foundation systems retain a home's close proximity to the earth and relationship to the street by supporting the house at a slightly raised elevation under normal circumstances. When flooding occurs, the house floats to as high a level as is necessary to remain safely above water, then settles back into place as the water recedes. Successful amphibious foundation systems are functioning in Maasbommel, Netherlands, and at Raccourci Old River, Louisiana, where they provide flood protection that is both more reliable and more convenient than can be obtained from permanent static elevation. Two new amphibious houses have recently been completed in New Orleans, and a prototype amphibious house for slum dwellers has begun construction in Dhaka, Bangladesh.

In urban areas, amphibious foundations help encourage the preservation of established neighborhoods and existing architectural character. Homeowners in South Louisiana in general and New Orleans in particular are facing difficult decisions about how to comply with new flood protection regulations that privilege permanent static elevation at the expense of accessibility and neighborhood character. The absence of substantial improvements to the levees means that in most neighborhoods the risk of flooding above typical permanent static elevation levels remains significant. The Buoyant Foundation Project is developing an amphibious foundation system for retrofitting traditional New Orleans elevated wooden "shotgun" houses, so that displaced residents will feel safe in returning home to rebuild their communities. Amphibious foundations are a proven, low-cost, low-impact flood protection strategy that gives a community or a region enhanced flood resilience and improves its ability to recover from disaster.

Introduction

In the aftermath of Hurricanes Katrina and Rita, many homeowners in southern Louisiana are required to comply with new government regulations in order to retain their eligibility for flood insurance. For most, this means elevating their houses to comply with the new Base Flood Elevation (BFE) requirements issued by FEMA (the US Federal Emergency Management Agency). Furthermore, in the absence of significantly improved levees, many New Orleanians who do not face official requirements to elevate their houses remain concerned about their safety and wish to improve their protection from flooding.

Permanently elevating houses, in some areas by as much as 12-15 feet, may be FEMA's solution to the problem of flooding but it creates new problems, such as difficult access to living areas, loss of neighborhood character and increased vulnerability of the structure to wind damage. With permanent static elevation, even if a house is raised to the BFE or higher, it can still flood in an extreme event. In the meantime, residents must live with daily inconvenience and a reduced quality of life in the hope of avoiding flooding in a future event that is statistically very rare indeed. A look at floating docks and houseboats suggests that there may be an alternative approach, one that would allow a house to remain close to the ground under normal conditions but rise as much as necessary, even if far above the BFE, when flooding occurs.

Figure 1: Permanent static elevation of homes in south Louisiana. This is the flood mitigation strategy currently promoted by US government agencies.

Background

In February 2006, six months after Hurricane Katrina, I found myself questioning how I, in my position of Associate Professor - Research at the Louisiana State University (LSU) Hurricane Center, could help New Orleanians scattered across the country feel that it was safe to return home, to reverse the diaspora that had siphoned away the people who were New Orleans' heart and soul, the city's authentic cultural source and creative force. For me this meant, could I direct my work in a way that might serve to mitigate the dissolution of New Orleans' core culture? It became for me a mission to devise a way to make the shotgun houses in the old New Orleans neighborhoods truly protected from flooding, so that the people who used to live in them would feel that it was safe to return and that restoring them was not an exercise in futility; so that the old neighborhoods could be reestablished, so that New Orleans' unique culture, currently displaced, fragmented and endangered, would not become extinct. Endangered plants and animals are protected by the federal government, but who protects endangered human cultures? What could an academic researcher in a technical field do to counteract a set of social and political forces that had compounded into what appeared to be nothing short of a cultural genocide?

Might not restoration of the physical habitat encourage restoration of the culture? Demolition and rebuilding would not reestablish the pre-Katrina neighborhoods, community culture, and culture of community that had flourished there; we would do better if we could "save the shotgun". In fact, the shotgun houses themselves are critical players in this project, because the uniqueness of New Orleans culture is, I believe, in no small part due to shotgun house typology. The strong sense of community at the heart of New Orleans cultural life is a direct response to an absence of privacy in a shotgun house that serves to foster social interaction, both within the house and among the houses in a neighborhood of shotguns.

Shotgun houses need a flood-proofing strategy that does not compromise the relationship of the house to the street or to the other houses in the neighborhood. What they do not need is permanent static elevation, which is occupant-unfriendly, neighborhood-disruptive and unable to provide sufficient protection in an extreme flood, but which is the only elevation strategy approved by the US National Flood Insurance Program (NFIP) and thus the only one FEMA has allowed. A buoyant foundation is a relatively inexpensive, unobtrusive retrofit to a shotgun house that provides it with buoyancy blocks and a vertical guidance system interconnected by a light structural frame, so that the house rises to float on the water when flooding occurs and settles back into its original place when the water recedes. Unlike such risk-concentrating, traditional flood mitigation strategies as levees and floodgates, buoyant foundations diffuse risk and increase a community's resilience. In action, buoyant foundations work with flood water rather than trying to fight it.

Amphibious Housing in Louisiana

Figure 2: Amphibious houses in rural Louisiana, dry in September, floating in February.

There is a growing number of cost-effective amphibious houses around the world. Best known are the amphibious houses designed and built earlier this decade by Factor Architecten and DuraVermeer at Maasbommel in the Netherlands. In rural areas of south Louisiana, there have been clusters of amphibious housing functioning reliably for over thirty years. Raccourci Old River in Point Coupee Parish is one such location. The lake that is called Old River was once a part of the Mississippi River, and remains connected to the Mississippi at one end; thus the water level in Old River rises and falls with the Mississippi's spring floods. Unhampered by building codes in these rural areas, local residents and vacationing fishermen devised an amphibious foundation system that has been keeping their homes and fishing camps dry for over three decades. Large blocks of EPS (expanded polystyrene, or styrofoam) are secured underneath the home which has been raised to an elevation 3 - 4 ft above the ground. Long poles or pipes are sunk into the ground near the corners of the house. When flooding occurs, the EPS blocks raise the house. Sleeves that have been placed around the poles and attached to the structural frame of the home are able to slide up and down, allowing the home to rise and fall with the level of flooding.

Figure 3: An amphibious house in rural Louisiana, the same house in September and in February.

Make It Right FLOAT House in New Orleans

Figure 4: The FLOAT House, New Orleans. Elevation, interior guide post and sleeve detail.

Actor Brad Pitt launched the Make It Right (MIR) Foundation in 2007, promising to give to former residents of the Lower Ninth Ward in New Orleans 150 affordable, sustainable and storm-resistant new homes. Morphosis Architects designed the amphibious FLOAT House for MIR. It was completed just a few weeks ago in October 2009. The base of the house is a "chassis" formed of EPS encased in fiberglass-reinforced concrete. It acts as a raft, allowing the house to rise vertically by sliding on two guide posts that pass through sleeves in the chassis, one at each end, inside the house. The house can float up to twelve feet as water levels rise.

Lakeview Amphibious House in New Orleans

Figure 5: Lakeview House, New Orleans. Elevation and detail of connection to post.

This house in the Lakeview neighborhood of New Orleans was built by a contractor as a commercial spec house. It was completed more than a year ago, but to date it has not been occupied. Due to difficulties with the permitting process, the contractor has been unable to obtain a Certificate of Occupancy. The house appears to be supported on a hollow steel box that provides its buoyancy. The box rests on a concrete slab-on-grade. Four wood vertical guidance posts are set near the corners of the house. Each post is attached to the house by two steel sleeves welded to the steel box. The sleeves are capable of sliding up and down on the posts.

LIFT House in Dhaka, Bangladesh

Figure 6: The LIFT House in Dhaka, Bangladesh. Eight-unit and two-unit clusters.

This prototype of a low-cost, sustainable amphibious house for urban slum-dwellers broke ground in November of this year in Dhaka, Bangladesh. Initiated and designed by Prithula Prosun, currently a Master of Architecture student at the University of Waterloo School of Architecture, each independent structure consists of two to eight floatable bamboo dwellings clustered around a shared courtyard. A stationary brick base supporting the dwellings contains plumbing, utilities and rainwater storage cisterns. Each two-room amphibious bamboo dwelling unit provides living and sleeping quarters for a single family.

Figure 7: The LIFT House in Dhaka, Bangladesh. Concrete and brick base structure under construction; buoyancy block made of recapped, recycled plastic bottles.

The Buoyant Foundation Project

The Buoyant Foundation Project (BFP) is a non-profit research initiative founded in 2006 at the LSU Hurricane Center with the goal of designing and implementing retrofittable buoyant foundations for New Orleans "shotgun" houses.

What is a Buoyant Foundation?

A buoyant foundation is a type of amphibious foundation that is specially designed to be retrofitted to an existing south Louisiana shotgun house. It allows the house to sit just above the ground like a normal elevated house under normal conditions, but to rise up and float safely on the water when there is a flood. It has a structural subframe that attaches to the underside of the house and supports the flotation elements, or buoyancy blocks. Extensions of the structural subframe attach to the tops of vertical guidance poles near the corners of the house that telescope out of the ground to provide resistance to lateral forces from wind and flowing water. When flooding occurs, the flotation blocks lift the house, with the structural subframe transferring the forces between the house, blocks and poles. The vertical guidance poles keep the house from going anywhere except straight up and down on top of the water.

The elements of the structural subframe are inserted underneath the house in pieces. Most of the pieces are small and light enough to be installed by two persons without machinery. After the buoyant foundation is in place, the house remains supported on its original piers except when flooding occurs. Utility lines have either long, coiled "umbilical" lines or self-sealing "breakaway" connections that disconnect gas and sewer lines when the house begins to rise.

Figure 8: Schematic diagrams of the buoyant foundation system.

In 2007 our team of LSU Hurricane Center faculty and students successfully constructed and tested a full-scale prototype buoyant foundation system installed on a platform structure representing the full width (13 ft) and 40% (24 ft) of the full length (approx. 60 ft) of a typical shotgun house.

Figure 9: Full-scale testing of prototype buoyant foundation system. Constuction of prototype; stability test showing floating platform tilted due to unevenly distributed sandbags representing imbalanced live load.

Preservation and Sustainability Considerations

Buoyant foundations preserve traditional shotgun houses. They are considerably less expensive ($20-25k US) than permanent static elevation ($40-60k US). They alleviate any long-term deterioration of protection resulting from soil subsidence and elevated sea level from global warming, something that permanent static elevation cannot avoid. The house is not permanently elevated and it is therefore less vulnerable to hurricane wind damage.

A house when retrofitted with a buoyant foundation looks essentially the same as it did before, unlike a house with permanent static elevation. The original traditional architecture and the relationship of the house to the street are preserved. New Orleans neighborhoods retain their original, unique character.

The use of buoyant foundations is an approach to flood mitigation that disperses risk rather than concentrating it. They are a low impact solution that improves community resilience. They promote restoration rather than demolition, which is a much more sustainable response to local housing needs. They preserve a form of traditional vernacular housing that is particularly appropiate for the local climate and made of a particularly appropriate local material (native cypress is termite-, mold- and rot-resistant) that is no longer available and thus irreplaceable.

Future directions

We are currently exploring the use of Thermoplastic Timber, a new structural material made of recycled plastic bottles, reinforced with fiberglass from recycled automobile bumpers, to replace the steel in the structural subframe and telescoping vertical guidance poles. We are also exploring the use of containers filled with recapped recycled plastic waterbottles to replace the styrofoam in the buoyancy blocks. Our goal, with proper funding, is to install buoyant foundations on 300 shotgun houses in New Orleans' Lower 9th Ward in the next eight to ten years.

Conclusions

Amphibious foundations are a proven, low-cost, low-impact flood protection strategy that can increase a flood-prone community's resilience in the face of disaster.

Why fight floodwater when you can float on it?

Figure 10: Rendering of a shotgun house retrofitted with buoyant foundation system.

appendix ix

richard campanella at the building resilience workshop

Richard Campanella, Flood Resilience Conference, February 25-27, 2010

I realize this is the regional panel; however, I'm gonna start on an empirical, urban scale, and then cast a water net toward the end and pass it on to my colleagues. What I'd like to do is trace the movement of the population here in New Orleans with respect to topography. You're all familiar with the underlying topography of the delta plain, the natural levy and ridge system, and the establishment of the original city, which we're on the brink of here. At the cusp of that natural levy, if you look at the population centroid, and that is the center of balance, around which the human population is evenly distributed, roughly around the same Peter Royal intersection is where the colonial era population was. Now, with American emigration as well as foreign immigration and the growth of the city, in the mid 1800s, that centroid moved to the present day central business district. Throughout this era, in as late as the 1890s, almost the entire deltaic plain remained at or above sea level. We were not anywhere near below sea level. Now, this is developed from contours that were mapped as part of the Drainage Advisory Board's initial research in 1893. These are roughly the corollaries of people in this room a hundred and fifteen years ago. Top notch engineers and surveyors and planners are preparing for the municipal drainage system, that would be built from this data. And as you can see—I've interpolated it here—but with the small exception of that [inaudible] ward area on the right there, the entire city remains above sea level. Right after this, (about) 20 years, with the installation of the municipal drainage system, the removal of the water component from the sand, silt and clay, the drying out of organic matters, those minute particles settle into those cavities, we start of see the drying out and the subsidence of those areas as the populations starts to move toward the lake. This is 1910. Census stayed at the enumeration level, and you can see the centroid is now for the first time moving away from the river toward the lake. 1930s, this is 1939, WPA data, moving even more toward the lake, as you see, lake view. And Gentilly developing. 1960s, still in that northward direction, even as these areas (are) subsiding. By 2000 and the development of New Orleans East, we now see this eastward movement over here. By this time we start to have modern-day LIDAR measurements as well as GPS, and when we overlay the topography now, after 100 years of subsidence, all those red areas have dropped in some cases 2-3 meters below sea level. So when you neutralize for the changing vertical datums and mapping technologies and basically subtract that 1895 map from the LIDAR map, (it) comes as no surprise that the lion's share of that subsidence has happened in those five particle areas. Now, what about pre- and post-Katrina? We have to shift gears here, we don't have census data yet. If you look at households receiving mail, and their centroid, this is the pre-Katrina one, and for the first time now, in New Orleans' history, it's shifting back towards the river. So, here is the progression up until Katrina and for the first time we're seeing that curlicue. I'm going to skip over this in the interest of time and conclude by revisiting some of Elizabeth's guiding questions here. What innovations have occurred in response to catastrophic events? We can reverse that, and wonder what catastrophic events came off what we thought were innovations. Innovative solutions have too often spawned future hazards. What about the physical and cultural implications of redesigning cities? As Larry Buss alluded to earlier, unless you can swiftly and fairly compensate those inconvenienced by the redesigning, expect resistance. And this is one of the lessons you can take away from the post-Katrina era: that the more vicious and radical the plan, the more likely it was, to fail. We (are) negotiating the footprint, water storage, house relocation, house floating, and so the challenge for us then, exactly what we need, is ambitious and radical plan(s). So I'll leave that on the table. Thank you.

appendix x

the people's plan

THE PEOPLE'S PLAN

for overcoming the **hurricane katrina blues**

a comprehensive strategy for building a more vibrant, sustainable, and equitable 9th Ward

ACORN Housing University Partnership

ACORN HOUSING

ACORN

CORNELL UNIVERSITY FOUNDED A.D. 1865

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

NSF

CONTENTS

forward
03

physical description
04
- "The Ninth Ward" – Districts 7 and 8
- Bywater, Desire, Desire Development, Florida, Florida Development, Lower Ninth Ward, Marigny, St. Claude, St. Roch

barriers to return
05
- lack of schools, hospitals, seniors centers, daycare centers
- poor policing
- inadequate public transportation

land use
07
- existing land use and settlement patterns
- human scale neighborhoods served by small business
- everybody has a right to return

housing
09

09 housing damage
10 housing actions
11 house rebuilding
13 building recovery
14 re-occupancy
15 possible housing choices
17 delery housing development

economic development
19
- business corridors survey
- modular housing factory and YouthBuild grant
- commercial corridors development

01

parks and playgrounds
21
- parks and playgrounds survey
- desire park
- railway park

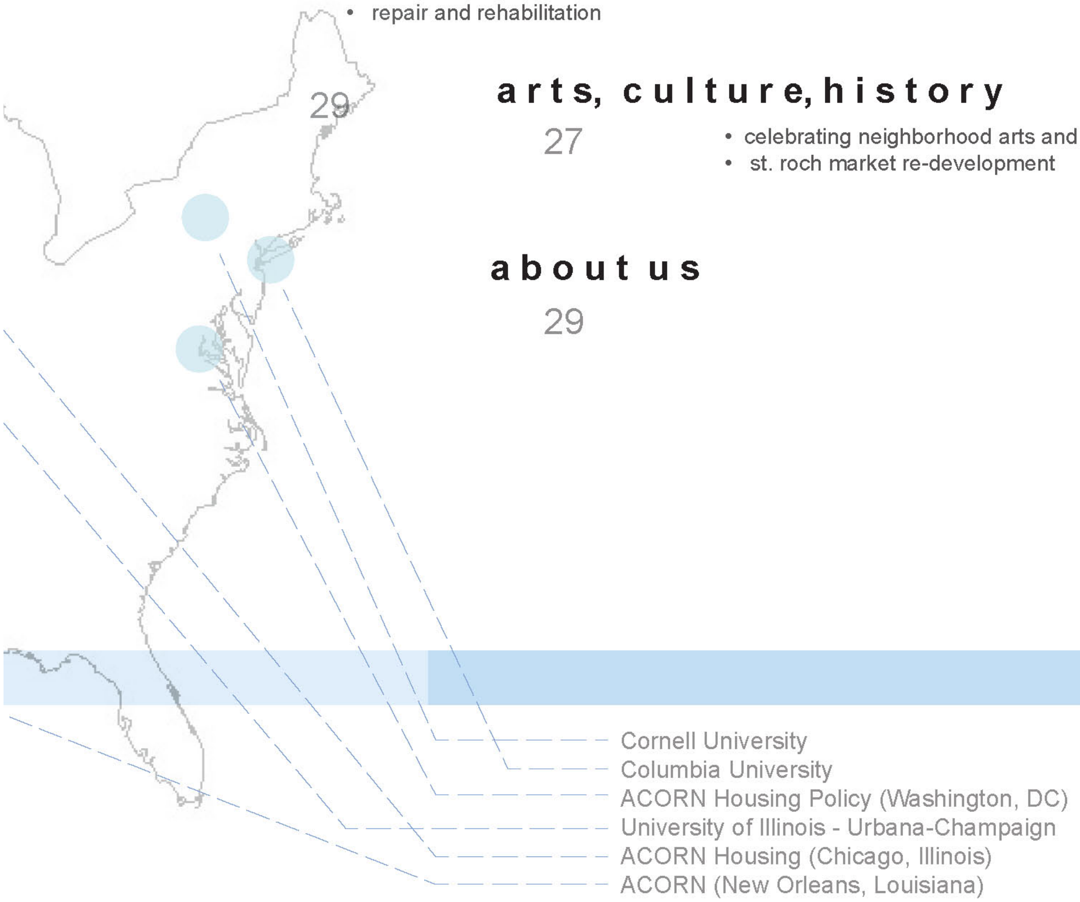
education
23
- education challenges
- immediate and short term opportunities

infrastructure
25
- street conditions
- street and traffic signage
- repair and rehabilitation

arts, culture, history
27
- celebrating neighborhood arts and history
- st. roch market re-development

about us
29

02



forward

Overall Development Goal and Objectives:

Create a more vibrant, sustainable and equitable 9th Ward that offers former and current residents, business owners, and institutional leaders a higher quality of life and attracts new residents and investors eager to participate in an unprecedented revitalization of one of America's most historically, culturally, and socially significant urban communities.

The Peoples' Plan is a strategic action plan for the recovery of the 9th Ward. We've created it based on conversations with residents – some struggling to return home, others intent on remaining in a neighborhood that has always been there own. The Peoples' Plan provides a thorough assessment of what must be done to provide recovery in one of the hardest hit areas of the City, and provides a recovery model for all badly flooded areas.

Our Plan seeks to transform the 9th Ward as it is rebuilt. The proposed transformation will be resident-driven and will provide improved employment opportunities, better education programs as well as greater access to healthcare, childcare and numerous other community services.

Research informing the People's Plan:

- Evaluated more than 3,500 individual parcels and buildings to determine their structural integrity and rehabilitation potential.
- Interviewed representatives of more than 230 households to determine the highest-priority redevelopment needs of the neighborhood.
- Surveyed five of the 9th Ward's most important commercial corridors to determine the current level of business activity.
- Reviewed 29 public plans examining past and future conditions within the 9th Ward.
- Studied and compared recent economic, population, employment, income, and housing trends within the 9th Ward.
- Inspected 15 of the 9th Ward's most important educational, cultural, civic, and health-related facilities to determine their structural integrity and potential for reuse.
- Evaluated 28 city-owned open spaces to establish their current facilities, maintenance levels, and use.
- Surveyed more than 12 civic organizations located in the 9th Ward regarding their preferred redevelopment strategies and recommended revitalization projects.

03

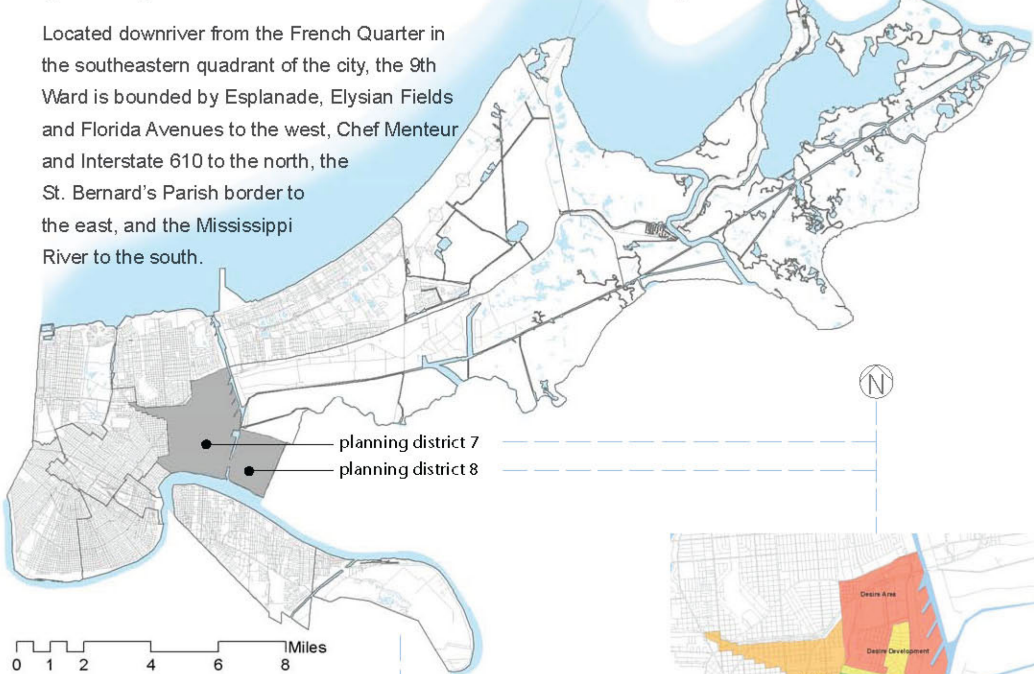
"Let the neighborhood decide what they want."

"This is the family! Everybody helps everybody else, all you gotta do is ask."

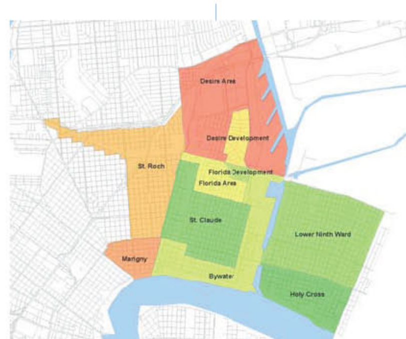
9th Ward Residents

physical description

Located downriver from the French Quarter in the southeastern quadrant of the city, the 9th Ward is bounded by Esplanade, Elysian Fields and Florida Avenues to the west, Chef Menteur and Interstate 610 to the north, the St. Bernard's Parish border to the east, and the Mississippi River to the south.



Our planning work covers the 7th and 8th planning districts, which approximates the historic boundaries of the Upper and Lower 9th Ward. Since few residents recognize the planning district boundaries as meaningful areas, we decided to use the term "9th Ward" to describe our focus area even though it is not geographically exact.



neighborhoods

elevation

Contrary to popular belief, a significant portion of the 9th Ward is located on the alluvial plain of the Mississippi river, which is well above sea level.

katrina flood extent

Levee failure and flood damage resulted from heavy rainfall and winds as New Orleans was brushed by an arm of the hurricane. In the 9th Ward, flooding extended to St. Claude Avenue and engulfed lower neighborhoods. Only blocks immediately adjacent to the Mississippi levee were spared.

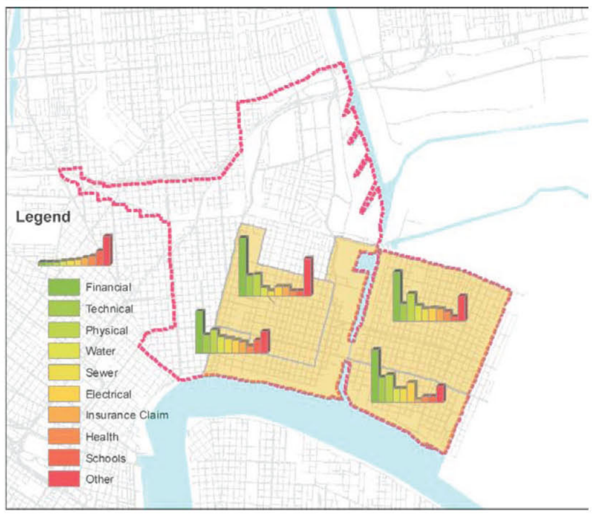
04

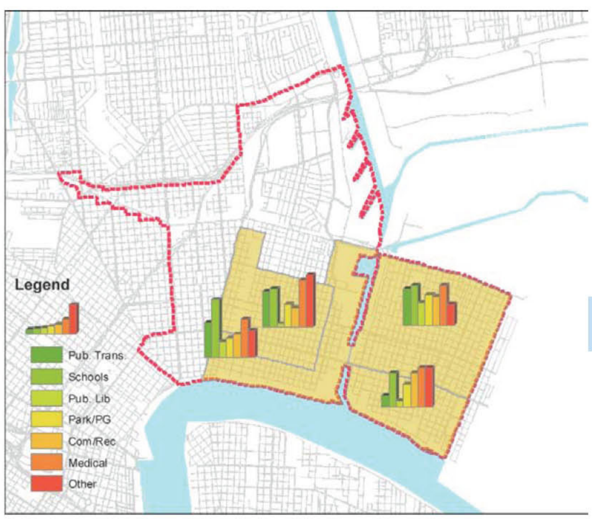
barriers to return

resident survey

When queried about the types of services residents needed to return to their neighborhood, survey results indicate that residents placed a high priority on the need for schools, medical facilities, public transportation, community and recreational facilities, parks and playgrounds, affordable housing and grocery stores.

What do you feel you need to have before you can return?





What things or services does the neighborhood need before you can return to it?

public transit

Public transportation services in New Orleans before Katrina were fairly good, with buses and light rail cars spanning most of the city. Currently, only 49% of all public transportation routes, and only 17% of bus routes are operational.

education

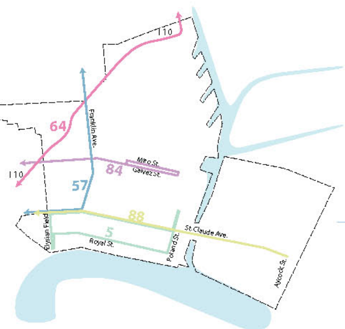
In December 2006, only 49% of New Orleans former public schools were open (as opposed to 74% at the regional level). In the 9th Ward, only three public schools reopened.

safety

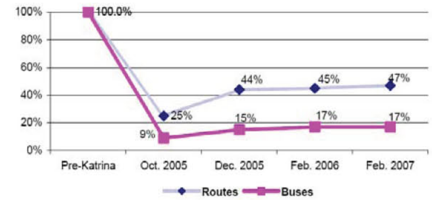
Only one police sub-station sits in the Upper 9th Ward, none in the Lower 9th Ward. While members of the New Orleans Police Department and the National Guard regularly drive through the neighborhood, residents believe they made little effort to develop the kind of relationships with local residents needed to form an effective community-based crime prevention program. Fire stations appear to be appropriately located throughout the neighborhood in order to assure reasonable emergency response times.

05

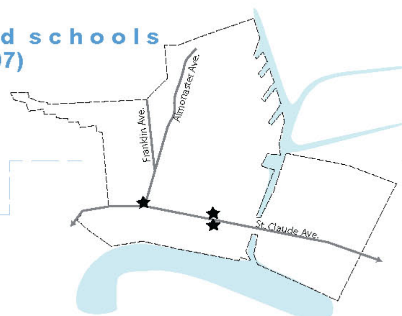
operational bus routes (march '07)



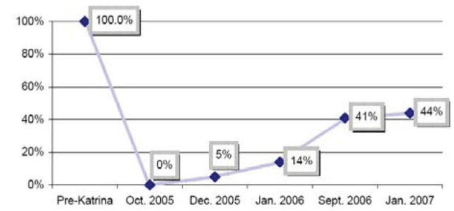
new orleans operational public transit:
the brookings institution (feb. '07)



opened schools (march '07)

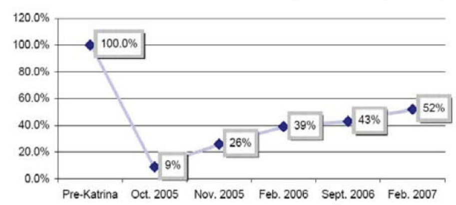


new orleans schools in operation:
the brookings institution (feb. '07)



police and fire stations

new orleans hospitals in operation:
the brookings institution (feb. '07)



There was only one operational hospital in the Ninth Ward, pre-Katrina – the Bywater Hospital. This facility is scheduled to be converted into a senior center once it will be renovated.

By May 2006, water and electrical services were restored throughout New Orleans with the exception of a few select areas of the Lower Ninth Ward and Lakeview District that were targeted for demolition by City Hall. The percentage of former customers that were using gas and electrical services in November 2006 was 41% and 60% respectively – the same percentages registered in April 2006.

06

"People who can't get back are stressed, worn out and worrying about money."

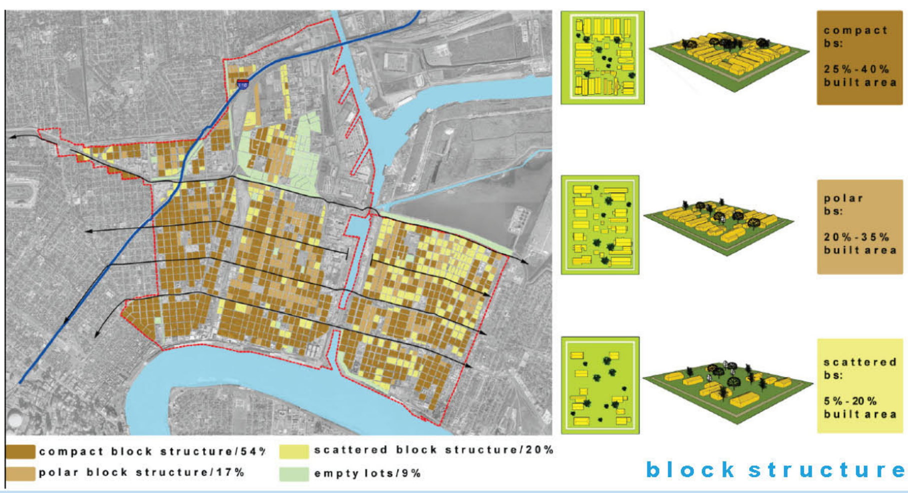
"Get all of the older people back, they are the rock of the neighborhood.... They are giving up because no one is helping."

9th Ward Residents

land use

Land uses vary significantly within neighborhoods comprising the 9th Ward. Residential uses, primarily single and small multi-family buildings (less than 5-unit buildings) dominate, followed by neighborhood-oriented retail, community and public facilities, industrial and warehousing facilities, and shipping and port facility uses. The neighborhood also contains two public housing facilities: Florida and Desire. In the past, these projects provided critical housing for families with extremely low incomes.

pre-katrina land use



block structure

07

Four distinct block types constitute the study site: compact, polar, scattered, and empty. As one moves from the city center towards the outskirts of the Lower 9th, the progression from a solid, compact block structure in the Western part, to a dominantly polar type in the middle, and a predominantly scattered type in the East becomes evident. We progress from a compact block typology along the banks of the Mississippi to a looser one in the Northern areas.

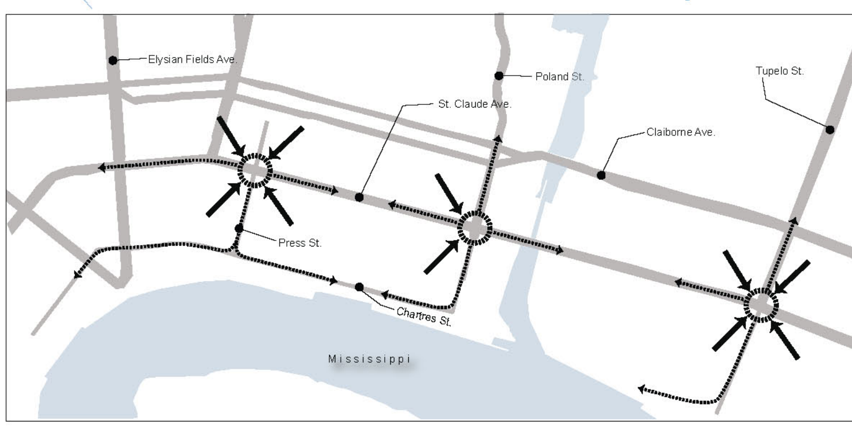
land use proposal

A new land-use plan for the Ninth Ward, with accurate flood plain maps and new building standards and designs could restore confidence in people to return and be used as a guide for ecologically responsible rebuilding in certain areas of the Ninth Ward. Maps that overlay topography, soil types, depth-to-water table zones, pollution zones, and main drainage areas ought to be compared to new building standard overlays after which local land use pattern options can be considered with the community.

A survey done by university students and faculty in October 2006 showed that residents were mostly concerned about the undesirable appearance of the neighborhood, rent inflation and lack of funds to rehabilitate homes, shortage of local jobs and retail opportunities, poor educational facilities, endemic crime, and lack of alternative occupational/recreational opportunities for youth. Redeveloping the neighborhood's major arteries and creating a series of strategic nodes and condensers could respond to these problems by attracting people and businesses and by creating a vibrant and dynamic community.

nodes of activity and flow

We propose public investments in three nodes of activity: at the intersection of Press St. and St. Claude Ave., around the St. Claude bridge between the Lower Ninth and the Upper Ninth, and at the intersection of Tupelo St. and St. Claude Ave. These nodes should be landscaped and developed to include institutional and private uses that serve a large clientele. They could serve as points of socio-economic activity and as general meeting points for people.



08

"We want our lives back. We must have hope, we're not going to give up. Can nolonger borrow a ladder from one another.... We need our community back again."

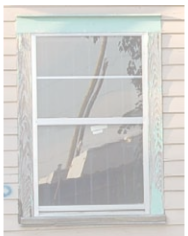
9th Ward Resident

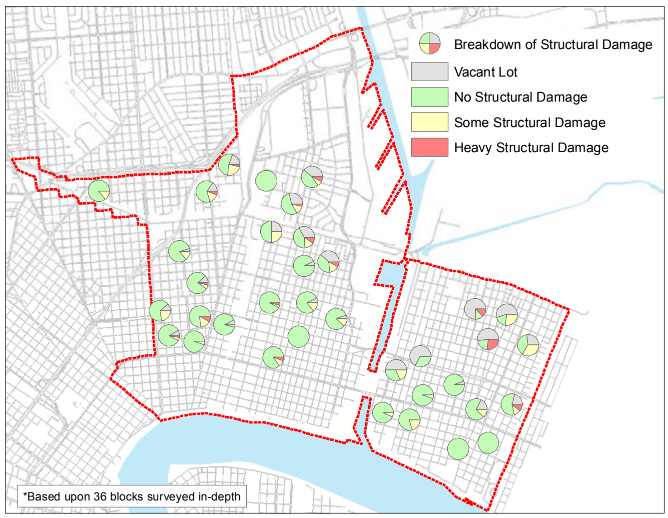
housing damage

Over 80% of housing had **no structural damage.**

Fifteen teams of university students conducted a survey of the residential housing on 165 blocks in Planning Districts 7 and 8. The survey covered 12% of the building stock in these districts. The teams captured information on the types of residential structures and the recovery activity evident at the time of the survey.

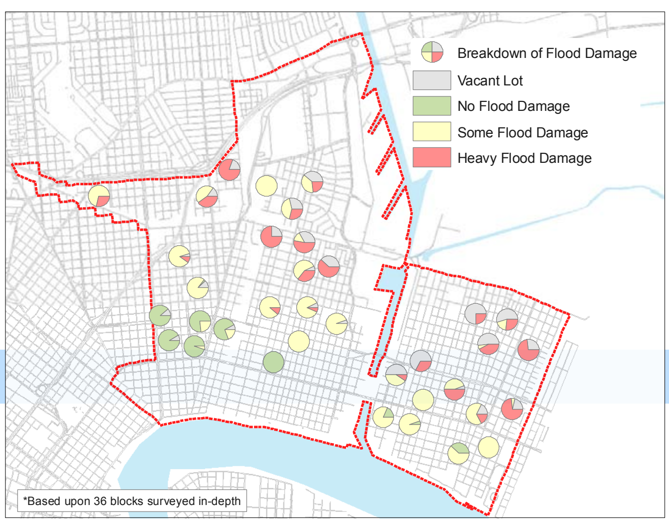
Over 90% of the approximately 3,000 parcels surveyed were residential lots. Of the lots with buildings on them, 85% had a main structure that was single story, 14% had a structure with two stories, and 1% had a structure over two stories.





Structural damage – collapsed walls, caved in roofs, or houses that have moved off of their foundation - is limited across Planning Districts 7 and 8. Over 80% of the remaining homes had no structural damage when surveyed in October 2006. While this housing may have been heavily flooded, much of it is potentially cost-effective to repair.


heavy structural damage



flood damage

Flooding was extensive throughout Planning Districts 7 and 8. Homes with some flood damage will typically cost $35,000-$50,000 to repair. Homes with heavy flood damage will be more expensive. More importantly, these heavily flooded homes will likely need to be elevated to new FEMA guidelines. This procedure will add an additional $20,000-$30,000 in repair cost to the 75% of the homes on pier foundations and will be too costly to perform for 25% of homes on slab foundations.


heavy flood damage

09

housing actions

"We want our lives back. We must have hope, we're not going to give up. We can no longer borrow a ladder from one another…we need our community back again."

immediate

temporary/workforce housing

Aggressive steps must be taken to secure FEMA trailers and identify lots for these trailers and to expand the rental housing stock. As rebuilding drags on, the wealth of the community and families diminishes.

design and development rebuilding…

- will require residents to weigh the importance of the character and culture of neighborhoods against safe design.
- in this area will focus on rehabbing existing housing since much of the housing can be saved.
- in the most severely damaged areas may require higher densities to make it affordable for residents to return.

short term

signature housing development

A mixed-income, mixed-use housing development, which respects the existing pattern of ownership, encourages municipal reinvestment in the community, allows residents to return, and encourages the establishment of much needed community businesses and services.

community planning and design center

Provides a centralized resource of information about housing design, community development projects, zoning, permit process, building codes and regulations, resources for rehabilitation, materials, and financial assistance.

"There is still a need to help people clean their houses out. People need help with renovating."

9th Ward Resident

housing trust fund

Provides a local source of funding for affordable housing. Nonprofit organizations and eligible for-profit developers can use HTF funds to build affordable housing.

community land trust

Strengthens communities and makes housing permanently affordable. Community land trusts create an additional subsidy by removing the value of land from the cost of housing, promote community-minded response to redevelopment, enhance resident input, and leverage public resources for maximum benefit and efficient results.

rent stabilization

Protects tenants from excessive rent increases by landlords.

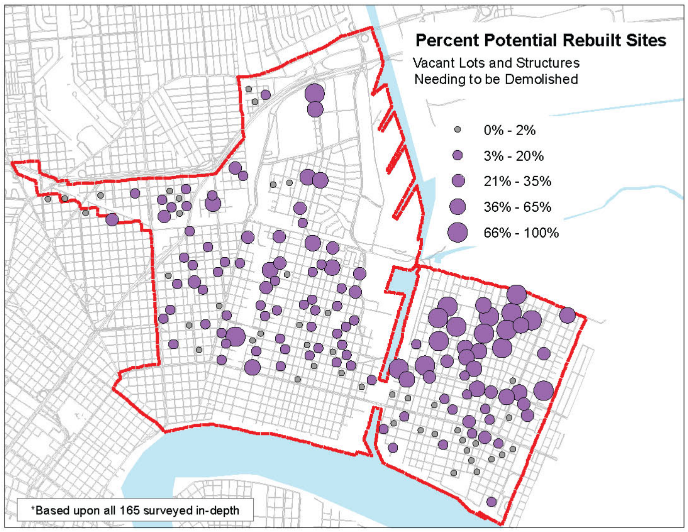
open public housing

Gives community members who were elderly, disabled, or working, but poor the same opportunity to return to the city.

house rebuilding

The heaviest structural damage was in the northern section of the Lower Ninth. Here 10% of the existing homes had heavy structural damage. Another 43% of the lots were vacant. Much of this vacancy is due to post-storm demolition. Areas like this have the highest percentage of lots that will need to be rebuilt from the ground up.

potential rebuild sites



The northern section of the Lower 9th has a high percentage of vacant lots, heavily damaged structures and structures with slab foundations. These lots are potential sites for future rebuilding. As such, this area is a potential site for extensive infill development and new large-scale development.

In the southern section of the Lower 9th, Holy Cross, and St. Claude and St. Roch neighborhoods, potential rebuild lots were a much smaller percentage of the building stock. These areas are more suitable to limited infill development and refurbishing of existing housing stock surveyed.

heavy structural damage

house on slab foundation

house on pier foundation

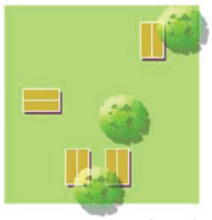
11

"I want to come home, but I have no where to come home to."

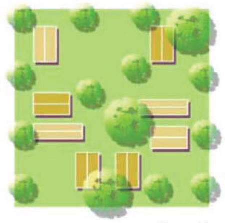
"People need to get out of the trailer!"

9th Ward Residents

new housing developments

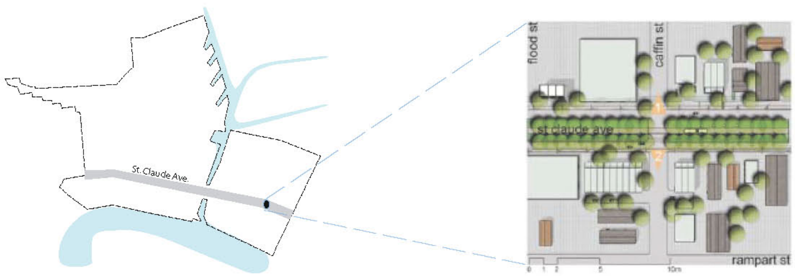


phase 1
post-katrina undamaged and repaired homes on existing lots



phase 2
infill of salvaged homes from dismantled 9th Ward blocks and newly planted street trees

phase 3
infill of newly constructed homes and maturation of street trees



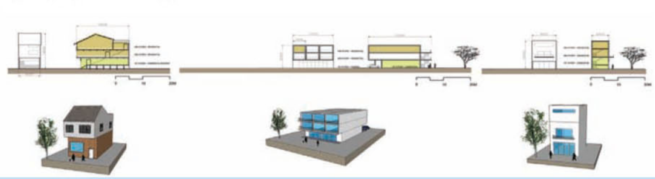
mixed-use infill development along st.claude

Areas that were severly affected by the floods (such as the northern section of the Lower 9th), as well as areas that are underutilized (e.g. the St. Claude commercial/retail/institutional corridor) present potential sites for new development, and mixed-use infill development. A Cornell urban design team made specific recommendations for how commercial/retail/institutional arteries, like St. Claude, could be developed, and it proposed a series of building designs that would be both affordable and respond to the specific requirements of the site (ground elevation, flood resilience, potential buyers, and already existent uses).

street elevation 1

Structures that have a commercial/retail use on the first floor and housing on the second floor create a mixture aimed at satisfying both housing and amenities needs. These structures will largely provide infill alternatives for parcels of land that are currently undeveloped or are occupied by decrepit or abandoned structures.

street elevation 2



revitalised streetscape

new public light rail in the widened 'neutral ground'

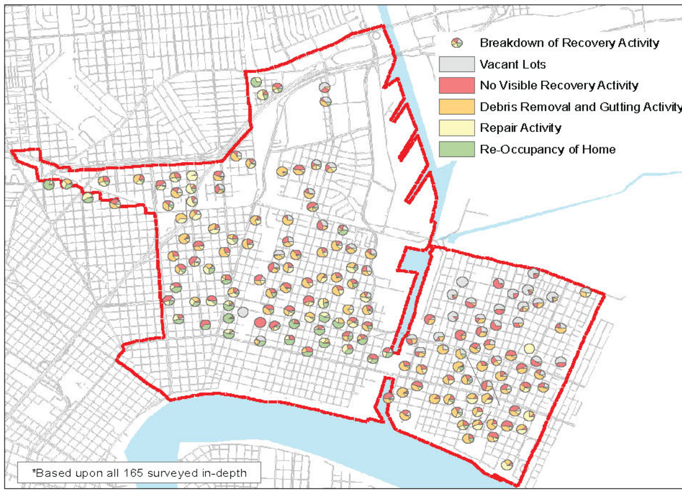
12

"People are dying to get back to this city... there ain't no other city like it!"

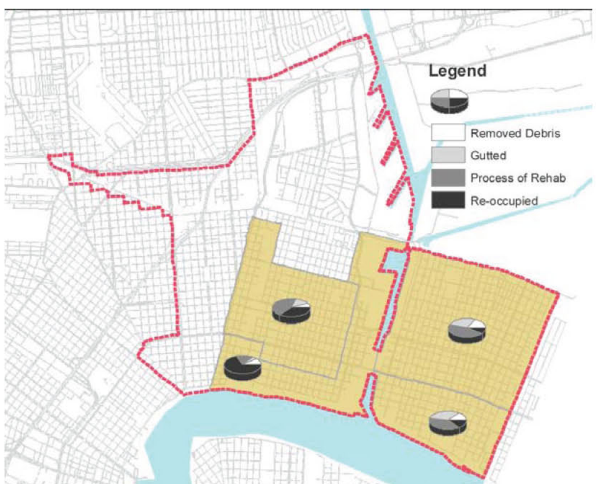
9th Ward Resident

b u i l d i n g   r e c o v e r y

building recovery



The October 2006 survey indicated significant recovery activity in the flooded neighborhoods of Planning District 7 and 8. Approximately 70% of the homes had been gutted or debris had been removed. In a third of all homes – many in the southern sections of St. Roch, St. Claude and Holy Cross - repairs had be started or completed. Recovery activity was more limited in the heavily damaged northern section of the Lower Ninth. There, 40% of the homes surveyed showed some sign of recovery, typically gutting.



resident survey

What condition is your home/apartment in New orleans now?

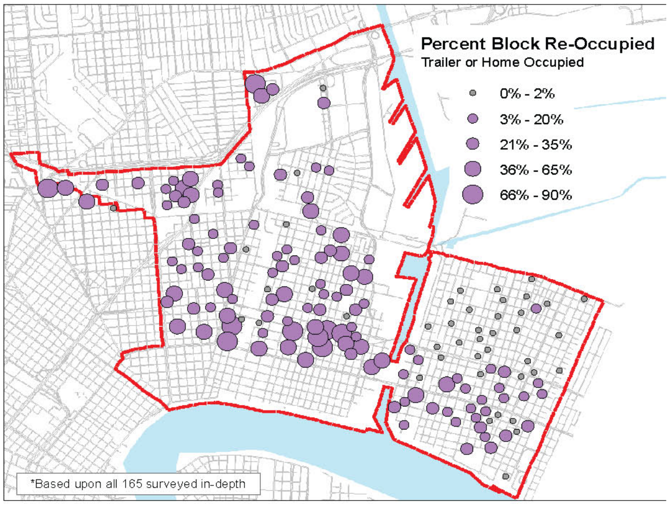
While doing resident surveys we were struck by the resilience of residents in each of the four quadrants represented - - not only in their overwhelming desire to move back to New Orleans (94% Lower Ninth, 100% Holy Cross, 88% St. Claude and 85% Bywater, but also in their commitment to rebuilding and returning to their pre-Katrina homes.

13

"I am not waiting on no people to help me. I give up no hope."

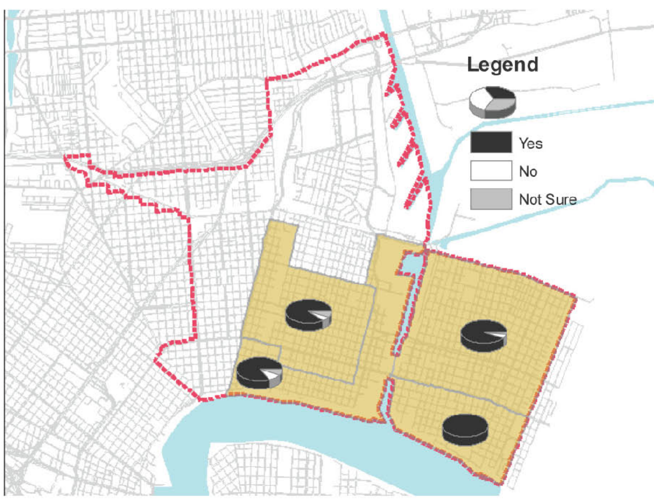
9th Ward Resident

b l o c k r e - o c c u p a n c y



r e - o c c u p a n c y

Residents had returned to live in their homes or in FEMA trailers on their lots all across Planning District 7 and 8. In October 2006, residents had returned to live on over 25% of their lots in the flooded neighborhoods of Planning District 7. There were also residents on 15% of the lots in the Holy Cross neighborhood and 12% in the southern section of the Lower Ninth neighborhood. Only 1% of the residents had been able to return to their lots in the northern section of this neighborhood.



r e s i d e n t s u r v e y

Do you want to move back and stay in New Orleans?

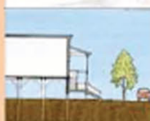
In St. Claude, resident reoccupation was at 38%, rehab was at 43%, debris removal was at 6%, and 13% had gutted their houses. Resident recovery and rebuilding efforts in the 8th district were not as far along. Only 8% and 12% of residents surveyed in the Lower Ninth and Holy Cross, respectively, reported reoccupation of their homes. Close to 80% were in the process of rehabbing or gutting.

14

"This neighborhood isn't known for its schools or education, but the residents of the lower ninth are hard working people. We have always worked hard and we will always work hard. We aren't going anywhere."

9th Ward Resident

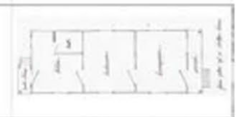
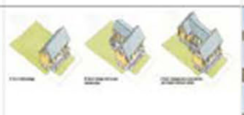
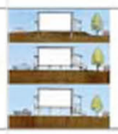
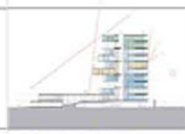
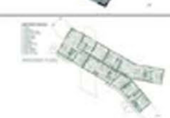
possible housing choices

		Type	Cost	Area	Individual vs Planned Construction
rehab		Shotgun	$15,000 - $100,000	600-1400 sq ft 3 bedroom	?
		Creole	$15,000- $100,000	600-1400 sq ft 3 bedroom	?
temp		FEMA trailer	Free for 18 mths $75,000 deliver and install	30-40 ft travel trailers	 Mass Produced Prefab Trailers
		Katrina Cottage	$25,000 - $50,000 above	300 - 1200 sq ft 1-2 bedroom	 DIY Easy+fast to build. Materials at Lowes
permanent		LIFT House by MIT	Material Cost Sweat Labor - Volunteer	Flexible	Unskilled and semi-skilled volunteers
		St. Bernard Parish Charette	$80,000 - $100,000	?	Resolution to the State of LA to have the Katrina Cottage as an alternate standard for FEMA trailers
		Biloxi Home Program	Up to $110,000	12 Designs max 1600 sq ft size: 50' x 170'	Individual
		High Density on Hight Ground Competition	?		Pre-fabricated unites 160 units
		Sustainable Design Competition New Orleans	Low can DIY	?	1.6 acres. 18 unit (12 multi-family and 6 single family) and a community center

15

"Let the neighborhood decide what they want."

9th Ward Resident

Sustainable Design Features	Potential for Future Extension	Flood Resistance	Hurricane Resistance	Repairibility	Typical Floor Plan
×	×			Pending	
×	×			Pending	
×	Temp Housing only Max 18 months	×	×	Repair Centre	
×		×	Withstand at least 140 mph winds (meet most hurricane codes.)	?	
×	×	8' - 10' above ground	×	?	Generic Concept
×		 Raised land or house 6-8 ft above ground	×	?	×
Depends on individual proposal	✔	6' - 12' above ground	×	?	Oriented on an east-west axis in the longer direction
Filters rainwater for plants	×		×	?	
Rain water collection and recycle - no electric bill	×	Raised building Use lower level for garden	×	?	

16

“I think you can hear the anger in my voice... this city can be up in five years if people stopped sitting on the money”

9th Ward Resident

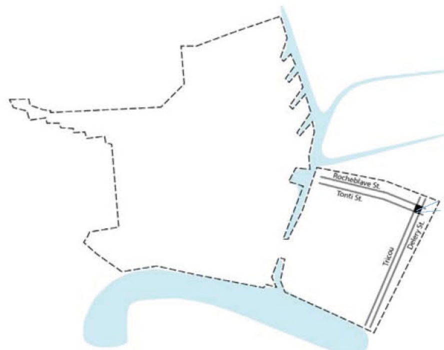
delery housing

ACORN housing developments

"Raising the two houses on Delery St. is just one of many more steps in bringing back New Orleans. Our next step is to work […] to repair or rebuild 150 more homes in the 9th Ward."

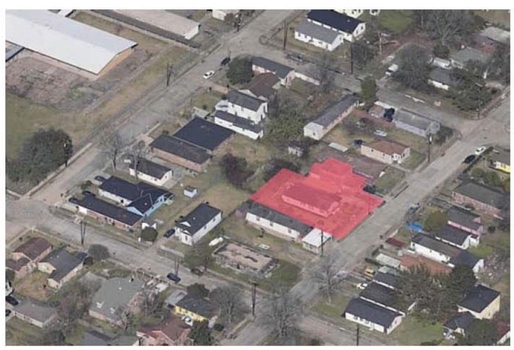
(Tanya Harris, ACORN Organizer)

On February 2007, ACORN Housing inaugurated the first two new developments to be raised in the Lower 9th since Hurricane Katrina hit in August 2005.



location of new developments

sanborn map



site: pre-katrina

site: post-katrina

the site-pre-construction

The Delery houses were built in one of the hardest hit areas of New Orleans. The images above show how the site looked before, and after the storm.

17

delery houses and their owners
courtesy New York Times (Feb 23, 2007)

With the assistance of ACORN Housing, Louisiana State University, HUD, and Countrywide Bank, former next-door neighbors – Gwendolyn Guice and Josephine Butler – received keys to their new houses on Delery St. on February 22, 2007.

construction phase

inauguration

"The destruction of the Lower Ninth Ward, which was working-class and black before the hurricane, and its subsequent failure to begin recovering, have become symbols for what some see as inequities in the city's halting revival."

Adam Nossiter, The New York Times – Feb. 23, 2007

18

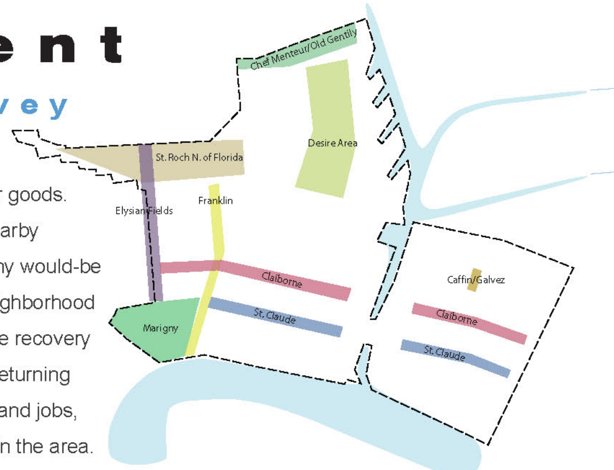
"We aren't crying for money, we are crying to get back into our houses."

9th Ward Resident

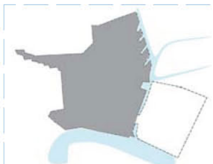
economic development

business survey

Healthy residential areas require convenient access to basic consumer goods. The stability of a residential area's nearby commercial corridor is viewed by many would-be investors as a leading indicator of neighborhood stability. In a post-disaster context, the recovery of local commercial corridors offers returning residents access to goods, services, and jobs, and encourages further investments in the area.



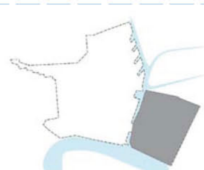
business clusters



A total of 364 businesses were surveyed in the **7th district**. About 54% of these businesses have reopened, 5% are in the process of being renovated, and 38% are closed, while the status of 3% of the businesses is unknown. Three-fourths of the district's businesses have intact facades, and 81% have signage that is functional.

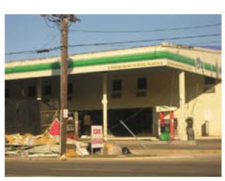
Restaurants and bars are by far the most common business type throughout the district. Almost 25 % of the total businesses surveyed — and of the open businesses — are restaurants or bars. Other local businesses include several grocery stores, salons and beauty shops, auto repair shops, and offices throughout the district. However, many of these businesses remain closed.

Whereas 80% of the businesses in the Marigny neighborhood appear to have successfully re-opened, fewer than half of the businesses located along the St. Claude and Claiborne corridors and in the Desire and St. Roch (north of Florida Avenue) areas have done so. In fact, only eight of the neighborhood's existing businesses were back in operation in the Desire area.



Businesses have been slowly returning to the **8th district**. In October of 2006, only seven (11.9%) of the district's fifty-nine previously-operating business establishments were open, and 3 (5.1%) appeared to be under active renovation, while 49 (83%) remained shuttered.

19



In mid-October of 2006, nearly 60% of the commercial buildings within the district appeared to have sustained significant damage to their facades, while 39% of the establishments formerly operating from these buildings had severely damaged or missing signage. Approximately 30% of the district's vacant commercial buildings appeared to have experienced minimal structural damage and may be ready for immediate occupancy if the demand for this space should develop.

economic opportunities

Apart from developing a series of commercial corridors (such as St. Claude and Claiborne), there are opportunities to bank on the available work-force in the 9th Ward, as well as on existing needs. In particular, we propose the development of a modular housing industry, in tandem with a YouthBuild program, and the development of a flea market.

A **modular housing factory** in the Ninth ward would offer well-paid employment opportunities in close proximity to an available workforce. This local industry would accelerate the neighborhood reconstruction process, generating infill housing that could be easily adapted for sites near the factory.

The adjacent figure maps the areas with industrial zoning in the Ninth Ward. Also, the neighborhood's proximity to the Mississippi River and a nearby harbor, as well as an extensive railway system, could revive this underutilized industrial area into an important regional and national export zone. A modular housing factory couldserve its immediate area, and potentially act as a catalyst for housing production in the entire Gulf Coast.

modular housing factory

commercial arteries

Fostering a series of institutional/commercial/retail arteries throughout the neighborhood will offer much needed amenities to residents, will create jobs, and will create a vibrant and dynamic community.

These arteries would serve local, city-wide, and regional retail shopping needs (food store, drug store, barber/ hair salon, sporting goods store, video rental outlets, credit union, etc.). St. Claude could cater to a larger audience (e.g. through a senior center, cinema, or a large supermarket), Claiborne would serve a city-wide and local audience (e.g. through local restaurants, rental stores, grocery stores, or local banks), while Galvez would serve neighborhood needs (laundromats, corner stores, or a day care center).

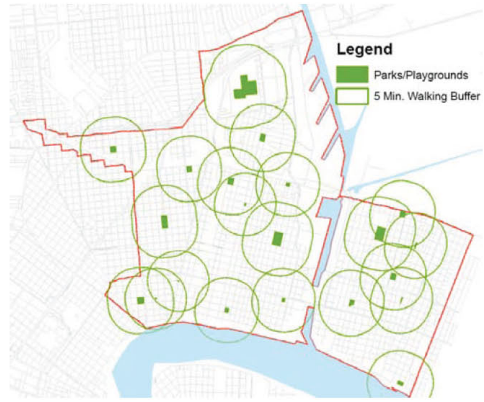
20

YouthBuild grant

The physical rebuilding process in the Ninth Ward stimulates economic and workforce development, and an emphasis must be placed on developing local skills in the building trades. Community empowerment and swift redevelopment depend on programs that connect residents to careers in the building trades, which they can focus on the recovery of housing and business in their own communities. Such programs should, if possible, be developed around the sites of existing or proposed housing development facilities.

parks + playgrounds

One team conducted a two-day survey of the 22 local parks and playgrounds in the 9th Ward. They documented whether the parks had been damaged, their current status and use. While neutral ground on many New Orleans Avenues provide areas for recreation, we did not survey these green spaces.



parks, playgrounds, and open space

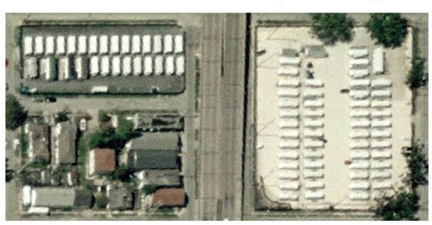
The adjacent map shows that the parks and playgrounds surveyed are within a five minute walking distance from many neighborhoods. Residents in Holy Cross and between N. Claiborne and St. Claude Avenues in the St. Claude neighborhood, however, did not have easy access to parks and playgrounds even before Hurricane Katrina.

District	No. Parks	Storm Damaged	Closed	Used As Park	Status of Closed Parks/Playgrounds
7	7	6	4	2	Three overgrown or unkempt, one used as construction staging area.
8	15	13	11	4	Four used as FEMA trailer parks, one used as a parking lot, six overgrown or unkempt.
9^{th} Ward	22	19	15	6	

parks, playgrounds, and open space conditions (oct. '06)

Over three-quarters of 9th Wards 22 parks showed signs of damage from Hurricane Katrina in October 2006. A third of the parks were open and used as parks. The remaining two-thirds of the parks were un-maintained or used for post-storm recovery. Five were used as FEMA trailer parks, another as a construction staging area, and a seventh as a gated parking lot.

converted parking lot



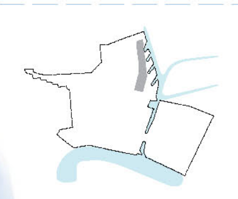
21

"We want more action, the government is moving too slowly and not serving our needs "

9th Ward Resident

open space proposals

The need for open space, as well as the need to bridge the transition between neighborhoods, and between neighborhoods and working areas prompted the proposal of two parks: one along the Desire industrial area, and one along the railway-line separating the Upper 9th from the rest of the city.



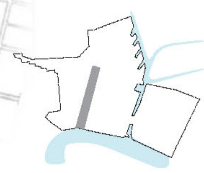
1. long view towards downtown

3. view of the wetland looking south

2. view from france rd. looking roads

desire park would become an extensive natural system that weaves together the neighborhood's industrial past, new park spaces, and rebounding native habitats while providing links to the greater New Orleans park system through dedicated bike routes, nodes, and improved roadway connections.

railway park would protect the neighborhood from the railway lines. A vegetative berm would serve as a noise and flood buffer. The park would connect the Bywater, St. Roch and Florida Area neighborhoods. Existing bridges would be improved with separate pedestrian/bike lanes, and a new pedestrian bridge is proposed for the northern part of the site. The bridge would connect with a new community park built on the vegetative berm.



new play-grounds and tot-lots

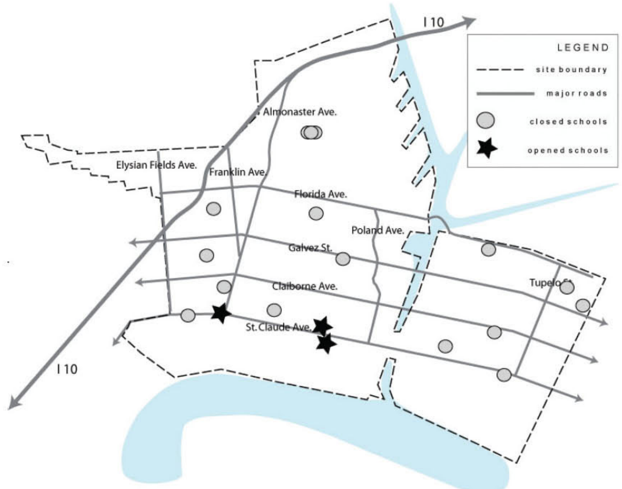
Residents cite the lack of safe spaces for their children as one of their top concerns: several respondents to our surveys cited playgrounds for kids as the most important thing they would like to see incorporated in a recovery plan. A comprehensive system of playgrounds, often physically linked to community institutions like schools can help prevent criminal activity from taking control of single, unregulated playgrounds. Neighborhood participation in both the design and construction of these playgrounds increase both the quality of community stewardship over these new public spaces.

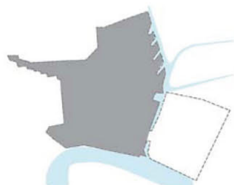
education

school system

Prior to hurricane Katrina, the public school system in Orleans Parish was not providing high quality education. As cited by the Recovery School District Legislatively Required Plan, the public school system in New Orleans was persistently plagued by poor academic performance, wide achievement gaps, low graduation rates, racial and class inequities, high levels of illiteracy and poverty, building neglect, financial woes, and increasing turnover in administrative leadership. Given the current state of the school system, it is not surprising that in "2004–2005, 63 percent of schools in the New Orleans Public School system (NOPS) were deemed academically unacceptable."

schools



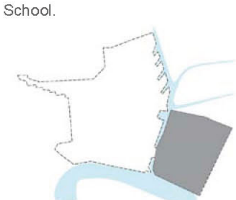


Before hurricane Katrina struck New Orleans there were 15 public schools in Planning District 7. Currently, only three public schools have reopened: Reed PreK-8, Frederick A. Douglass Sr. High School, and Dr. Charles Richard Drew Elementary School.

public school conditions in planning district 7

School Name	Address	Neighborhood	Current Status (Sept. 2006)	% Damaged (Sept. 2006)
Carver, George W. Jr. High	3019 Higgins Blvd.	Desire Area	Closed	49%
Carver, George W. Sr. High	3059 Higgins Blvd.	Desire Area	Closed	49%
Colton, Charles J. Jr. High	2300 St. Claude Ave.	St. Roch	Closed	21%
Douglass, Frederick A. Sr. High	3820 St. Claude Ave.	St. Claude	Open	21%
Drew, Dr. Charles Richard Elem.	3819 St. Claude Ave.	St. Claude	Closed [now Open]	29%
Edwards, Helen S. Elem.	3039 Higgins Blvd.	Desire Area	Closed	57%
Frantz, William Elem.	3811 N. Galvez St.	St. Claude	Closed	54%
Haley, Oretha C. Elem.	2515 N. Robertson St.	St. Roch	Closed	45%
Hansberry, Lorraine Elem.	1339 Clouet St.	St. Claude	Closed	12%
Lockett, Johnson C. Elem.	3240 Law St.	Florida Area	Closed	39%
Morton, Robert R. Elem.	3000 Abundance St.	Desire Area	Closed	18%
NOCEA	1815 St. Claude Ave.	Marigny	Closed	15%
Reed Pre K – 5	2521 Marais St.	St. Roch	Open	Not Included in Report
Shaw, John A. Elem.	2518 Arts St.	St. Roch	Closed	24%
Truancy Center	Unknown	St. Roch	Closed	Not Included in Report

Source: New Orleans Public Schools Informational Planning Package. Sept. 2006. Draft Report



public school conditions in planning district 8

School Name	Address	Current Status (Sept. 2006)	% Damaged (Sept. 2006)
Armstrong, Louis D. Elem.	5909 St. Claude Ave.	Closed	70%
Edison, Thomas Alva Elem.	1339 Farstall St.	Closed	39%
Hardin, Joseph A. Elem.	2401 St. Maurice Ave.	Closed	100%
King, Martin Luther Jr. Elem.	1617 Caffin Ave.	Closed	21%
Lawless, Alfred Sr. High	5300 Law St.	Closed	84%
Noble, J.B. Special School	2201 Dubreuil St.	Closed	Not Included in Report

Source: New Orleans Public Schools Informational Planning Package. Sept. 2006. Draft Report.

23

The post-Katrina educational environment calls for greater innovation and exploration of alternative and community-based models of education. Partnerships should be created between schools and local organizations, businesses and foundations to provide financial and volunteer assistance when available.

opportunities

immediate

school exploration committees

Comprised of residents and experts on youth and education, should be formed to explore options for opening more area schools. This group could encourage new schools that are responsive to educational need within the community.

summer youth employment program

That offers teenagers stipends for work focused on revitalizing the Ninth Ward would foster personal growth and empowerment and it would move the community forward.

short term

Schools were very segregated

and "not really beautiful."

9th Ward Resident

community schools

... are community centers that integrate education, social services, and recreation, promote contact between neighbors, and connect residents with services. A middle/high school with a hands-on community development curriculum would compliment services such as dental care and job placement and all ages recreational space.

non-traditional high school and vocational programs

Vocational schools that give residents skills in living wage construction industry jobs would serve to enhance the lives of previously under-employed residents, add desperately needed construction labor to the New Orleans workforce, and increase money being spent in the local economy.

cultural arts school

... could celebrate what is great about the Ninth Ward and New Orleans – Jazz, traditional cuisine, architecture, and the visual arts.

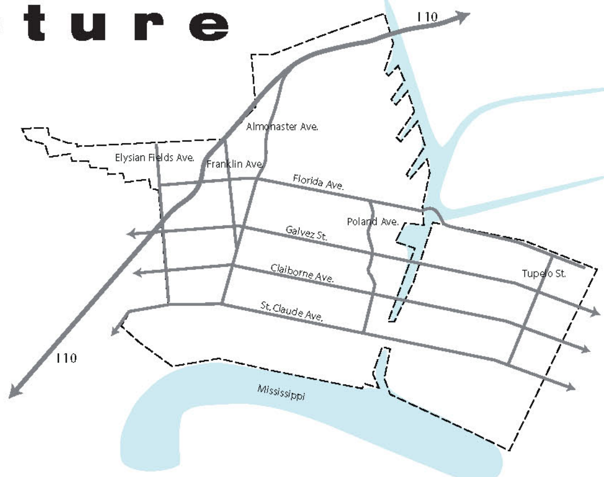
"If you live in New Orleans and you have any money, even to pinch by, you don't send your kids to public schools. I don't think they could be any worse"

9th Ward Resident

infrastructure

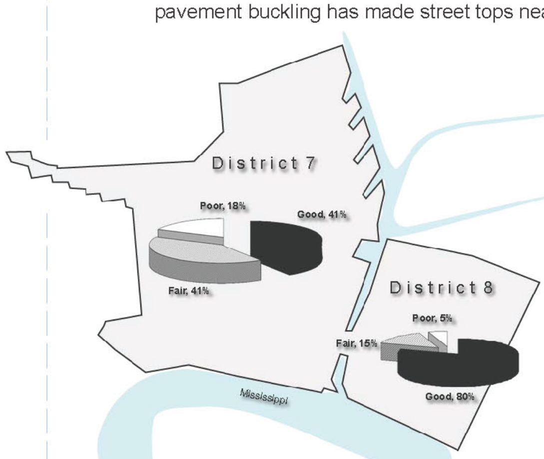
existing conditions

In order to determine key areas for investment in public infrastructure that will foster swift recovery, ACORN Housing – University Partnership team investigated current conditions of street-level infrastructure. We surveyed 42 sample blocks throughout the districts to assess the conditions of street infrastructure, including pavement conditions, street signs, fire hydrants, and storm drains.



main roads

Streets, even in severely flooded areas, remain at generally "fair" or better condition. Streets conditions were "fair" where the pavement allowed easy passage by car or bicycle but the presence of scrapes, cracks, or missing pavement require repairs. However, along several streets that rarely entered our sample, ground subsidence and pavement buckling has made street tops nearly impassable.



pavement conditions (oct. '06)

ad-hoc street signs

25

9th Ward Infrastructure Survey

(October 2006)

	PD 7	PD 8
Stop Signage		
Standing	72%	71%
Not Standing but in Ground	22%	5%
Missing	6%	24%
Street Signage		
Standing	53%	30%
Not Standing but in Ground	0%	1%
Missing	47%	69%

Most traffic lights surveyed were not functioning. Missing street signs announcing street names were more frequent than missing stop signs, but both pose a dangerous problem. In the Lower 9th, many unlabeled streets have been replaced by unofficial, hand-painted signs created by non-governmental organizations.

debris removal
courtesy FEMA 2005

Systematic, block-by-block disposal of road debris by a conglomeration of residents from the area can prove more efficient and economical. The following steps will lead to a more rapid recovery:

- Initiate disaster debris pickup.
- Create a director's board.
- Award local contracts and encourage local hirings.
- Repair houses and streets systematically and holistically.
- Identify types of debris and designate locations for disposal.
- Consolidate similar materials to increase recycling possibility.

median improvement

Street medians can become more functional and pleasing with some pruning, a series of targeted projects (e.g. the adopt-a-neutral-ground program from Parkway Partners), and a series of design projects:

- Accomodate St. Claude for proposed street car line and walking-paths for pedestrians.
- Bike paths can run along a center aisle of the neutral ground for recreational and commuter use.
- Implement heightened curbs and pedestrian-protecting treatments (like curb 'skirts').
- Support continued tree planting efforts.
- Add street furniture along neutral grounds to set the tone of these avenues as civil, public spaces to be used recreationally and economically.

infrastructure repair
courtesy FEMA 2005

In an effort to encourage residents to return home, infrastructure repairs (water, electric, gas, sewer, drainage systems) should be made to the major arteries, collector streets, and service streets. Drains need to be cleaned, lines restored, and streets repaved. Doing so without incurring future costs will depend upon thoughtful critique of existing systems, guidance of land use maps, and updating current infrastructure in conjunction with other city departments and the quality of life goals of residents.

26

"Poor sidewalks - they are not maintained ... they have gaps. My daughter is in a wheelchair and the unevenness of the pavement makes it very difficult for her to get around."

9th Ward Resident

art, culture, history

The 9th Ward has a wealth of resources in the arts, architecture, and **music**, resources that should be preserved and protected for future generations.

The Lower 9th Ward is home to the Doullet Steamboat Houses, Jackson Barracks, **Fats Domino's** recording studio, and a host of musicians and artists. **Holy Cross** is renowned for its rich architectural tradition, including shotgun and Creole cottage homes and the St. Maurice Catholic Church.

The "streetcar named Desire" ran through the St. Claude neighborhood. In 1960 Ruby Bridges, a 6-year-old African American child, made civil rights history by attending an all-white school in the Florida neighborhood

A mural arts program in the 9th Ward would hire local artists to work with children and adults on **public mural projects**. Through commissions, grants, or donations, the mural program would beautify businesses, schools, and eyesores in the neighborhoods

27

"It's very important for me to come back, because it keeps the culture going."

"I'm not Ray Charles, I'm not Stevie Wonder, but I know what love is"

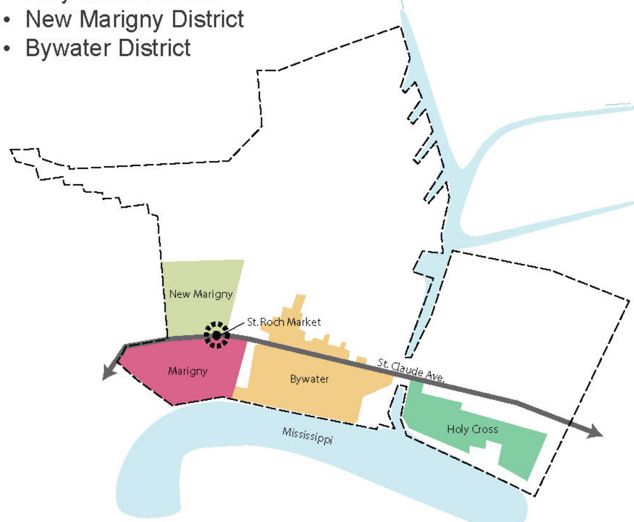
9th Ward Residents

historic preservation

The rich social history, unique architectural features, protected open spaces and scenic views of the 9th Ward represent a significant resource, which, when guided by the local residents, institutional leaders, elected officials, and their regional and national allies, such as the National Trust for Historic Preservation, can support the long-term recovery of the 9th Ward.

The 9th Ward contains **Four Historic Districts**, which appear on the National Registry of Historic Places:

- Faubourg Marigny District
- Holy Cross District
- New Marigny District
- Bywater District



St. Roch Market represents a historical structure and cultural landmark of great importance to the history, character, and identity of these neighborhoods. Bringing the market back could serve as a catalytic economic development project for the area and would offer an inspiration for other development and redevelopment projects.

28

Recognizing that deeply engaged citizens were involved with the market and its future, a group of 36 students, 3 alumni, and 4 faculty from Cornell undertook a study trip in the Spring of 2006, assessing the market's post-Katrina condition and possibilities for rehab and redevelopment.

about us

Contact Us

Stephen Bradberry
Lead Organizer
New Orleans ACORN
1024 Elysian Fields Avenue
New Orleans, LA 70117
504-943-0044
laacornnoho@acorn.org

Richard Hayes
Director of Special Projects
ACORN Housing
739 8th Street SE
Washington, DC 20003
rhayes@acornhousing.org
202-547-7500

Ken Reardon
Department Chair
Department of City &
Regional Planning
106B West Sibley Hall
Cornell University
Ithaca, NY 14853
607-254-5378
kmr22@cornell.edu

ACORN Housing/University Partnership students, faculty and staff wish to acknowledge the inspiration of Cleveland's long-term Planning Director Norm Krumholz, who's pioneering equity planning activities have set the standards for professionals seeking to promote social justice in our field.

Please go to our website **www.rebuildingtheninth.org** to download addition copies of the plan and for updates on planning activities.

background

The ACORN Housing – University Partnership begun, in effect, shortly afterthe flooding of August, 2005. Faculty and students responded to requests from ACORN leadership to show solidarity and give support to its recoveryand rebuilding efforts. What began with student volunteers gutting homes blossomed into a formal partnership to truly serve the needs of New Orleans'residents in their struggle to recover their city and their lives

history

From the immediate aftermath to today, ACORN and ACORN Housing Corporation (AHC), in cooperation with their university partners, have conducted community-based planning and recovery activities.

highlights

November 2005
First community forum on rebuilding New Orleans

January 2006
Community planning initiative with university partners begins

March, 2006
Planning forum to gather input with 250 resident participants

May, 2006
Cornell & Pratt complete plans & designs based on residents' needs

June-August, 2006
Cornell & Pratt students intern with ACORN Housing

August, 2006
AHC awarded adjudicated properties for affordable redevelopment

August, 2006
AHC selected to serve 9th Ward under Unified New Orleans Plan

October, 2006
AHC-University Partnership continue community planning effort despite retracted UNOP contract

January, 2007
AHC-University Partnership completes 9th Ward plan & presents to residents, community and city leadership, prospective investors and funders

appendix xi

the buoyant foundation project movie

This appendix is a movie file of The Buoyant Foundation Project.
The file name of this movie file is “The Buoyant Foundation Project Movie.mp4”.

If you accessed this thesis from a source other than the University of Waterloo, you may not have access to this file. You may access it by searching for this thesis at http://uwspace.uwaterloo.ca.